Appendix K

Comments Received on the Draft EIR

COMMENT LETTER # GOV1

From: Meng Heu <Meng.Heu@OPR.CA.GOV>
Sent: Monday, June 15, 2020 3:21 PM
To: Taryn Vanderpan <TVanderpan@co.tuolumne.ca.us>
Subject: SCH Number 2019110286

Your project is published and the review period will begin on 6/16/2020. Please use the "navigation" and select "published document" to view your project with attachments on CEQAnet.

Closing Letters: The State Clearinghouse (SCH) would like to inform you that our office will transition from providing close of review period acknowledgement on your CEQA environmental document, at this time. During the phase of not receiving notice on the close of review period, comments submitted by State Agencies at the close of review period (and after) are available on CEQAnet.
Please visit: https://ceqanet.opr.ca.gov/Search/Advanced

- Filter for the SCH# of your project **OR** your "Lead Agency"
    - If filtering by "Lead Agency"
        - Select the correct project
    - Only State Agency comments will be available in the "attachments" section: **bold and highlighted**

Thank you for using CEQA Submit.

GOV1-01

Meng Heu
Office of Planning and Research (OPR)
State Clearing House

To view your submission, use the following link.
https://ceqasubmit.opr.ca.gov/Document/Index/257123/3

From: Pete Kampa <pkampa@gcsd.org>
Sent: Friday, July 17, 2020 8:18:50 PM
To: Quincy Yaley <QYaley@co.tuolumne.ca.us>; Maureen Frank <MFRANK@co.tuolumne.ca.us>
Subject: Extention of comment deadline

Quincy,
The Groveland CSD respectfully requests that the county extend the DEIR comment deadline for the Under Canvas and Terra Vi projects for 30 days each to allow the district and county to work out the details of an agreement to fund the cost of fire and emergency response services to the respective projects. We firmly believe that a Community Facilities District or other similar funding mechanism can be required as a condition of development of the projects and provide funding to mitigate the impacts of the development on GCSD fire. Please let me know at your earliest convenience as we have a special meeting on this matter at 10 am Monday July 20.
Thank you,

GOV2-01

Peter J. Kampa
General Manager

COMMENT LETTER # GOV3

STATE OF CALIFORNIA—CALIFORNIA STATE TRANSPORTATION AGENCY GAVIN NEWSOM, Governor

DEPARTMENT OF TRANSPORTATION
DISTRICT 10
P.O. BOX 2048, STOCKTON, CA 95201
(1976 E. DR. MARTIN LUTHER KING JR. BLVD. 95205)
PHONE (209) 948-7325
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www.dot.ca.gov

Making Conservation a California Way of Life.

July 30, 2020

Ms. Quincy Yaley, Planning Director
County of Tuolumne
Community Resources Agency
2 South Green Street
Sonora, CA 95370-4618

TUO-120-PM 50.082
Terra Vi Lodge
Draft Environmental Impact Report
SCH # 2019110286

Dear Ms. Yaley,

The California Department of Transportation (Caltrans) appreciates the opportunity to review and comment on the Draft Environmental Impact Report (DEIR) for the development of Terra Vi Lodge, a master planned lodge located at 11262 Sawmill Mountain Road, Groveland, CA 95321. The Terra Vi Lodge will include one hundred (100) guest rooms, seven cabins with 26 guestrooms and five employee housing units, a market, a lodge, event space, emergency landing zone for a helicopter, and other support buildings. The project site consists of two parcels totaling 63.38± acres. The parcels are zoned Commercial Recreation (C-K) and Open Space (O) under Title 17 of the Tuolumne County Ordinance Code. The project site is located at the northeast corner of the intersection of Sawmill Mountain Road and State Route (SR) 120.

Caltrans has responded to the previous routing of this project on December 27, 2018, May 20, 2019, October 28, 2019, and December 12, 2019. Caltrans has the following comments based on our previous letters and the current Draft Environmental Impact Report (DEIR): GOV3-01

Traffic Operations:

- The proposed site plan shows only access on Sawmill Mountain Road, however, on page 386 of the DEIR the document states a third driveway along SR 120 will be constructed for emergency vehicles. Please describe how the traveling public will be prevented from using this exclusive emergency vehicle access? GOV3-02

- The proposed public driveway access will need to be placed furthest away from the intersection of SR 120/ Sawmill Mountain Road to avoid queueing onto the State Route. Please provided measurements and location of the driveway in relation to the intersection in the site plan. GOV3-03

- The Traffic Impact Study (TIS) used to determine mitigations in the DEIR needs to be submitted to Caltrans for review along with the electronic files used for the analysis. In addition, please define the Hardin Flat Road intersection location as it relates to the project location. GOV3-04

- Page 379 of the DEIR shows truck traffic may deteriorate Sawmill Mountain Road if used for traffic handling. How will the project mitigate for the truck traffic detour causing this deterioration? GOV3-05

- Page 383-385 of the DEIR states there will be widening at SR 120 and the proponent will pay fair share. The left turn and acceleration lane are day of opening direct impacts, therefore these improvements should be in place prior to opening day. GOV3-06

- The DEIR on page 384 indicates the sight distance to the west from Sawmill Mountain at SR 120 is only 400 ft and does not meet the sight distance of 500 ft for speeds of 55 mph. Page 384 also indicates that the construction of the left turn lane will make the sight distance acceptable. Once the design for the left turn is determined, the sight distance with left turn lane design should be submitted to Caltrans for review. GOV3-07

- The development will also include a landing zone for emergency response helicopters and states in the DEIR that it will be easily accessible from SR 120. Where will be the access, in relation to SR 120? Please provide access location on the site plan. GOV3-08

- The project proposes installing a new Public Transit YART bus stop to Yosemite. Where will this bus stop be relevant to SR 120? Please provide bus stop location on the site plan. GOV3-09

- Please provide a copy of the Temporary construction and lane closures to Caltrans Traffic Management for review. GOV3-10

Outdoor Advertising:

Any proposed directional signs need to be installed by the applicant outside of the state highway right of way and in accordance with State Outdoor Advertising Program regulations and Federal laws. It is important to note that any advertising structure visible to the National Highway System (NHS), which in this case includes SR 49/108, is subject to the provisions of the California Outdoor Advertising Act outlined in Business and Professions Code Section 5200 et seq. Any advertising structure that displays off-premise commercial copy visible from the NHS will require a permit from the Office of Outdoor Advertising (ODA). Any advertising structure that only advertises goods and services available on-premise will not require a permit from ODA, provided it adheres to the provisions of Business and Professions Code Section 5272 and 5274 and California Code of Regulations 2243 and 2246. Each of the proposed advertising structures should refrain from operating in any of the conditions outlined in Business and Professions Code Section 5403. For questions related to the ODA permit application process please contact Kenneth Parmelee at (916) 651-9327. **GOV3-11**

Hydrology:

Please provide a copy of the hydrology and hydraulic report to Caltrans for review so we can determine if grading would divert drainage from this proposed project and cause an increase in runoff to existing State facilities. The report must include hydraulic calculations for both existing and proposed conditions, using 25-year storm events and 100-year storm events at the project site location. The calculations should identify the affected drainage inlets, the amount of flow being intercepted and spread width calculations. **GOV3-12**

Encroachment Permit:

For project construction activities which will encroach into Caltrans right of way, the project proponent must submit an application for an Encroachment Permit to the Caltrans Permit Office. Appropriate environmental studies must be submitted with this application. These studies will include an analysis of potential impacts to any cultural sites, biological resources, hazardous waste locations, and/or other resources within Caltrans right of way at the project site. Please include California Environmental Quality Act (CEQA) documentation with supporting technical **GOV3-13**

studies when submitting the Encroachment Permit. For more information please visit the Caltrans Website.
https://dot.ca.gov/programs/traffic-operations/ep/applications **GOV3-13**

SB 743 is changing CEQA analysis of transportation impacts. It requires local land use projects to provide safe transportation systems, reduce per capita Vehicle Miles Traveled (VMT), increase accessibility by mode share of bicycle, pedestrian, and transit travel, and reduce GHG emissions. VMT reduction is necessary to meet the statewide greenhouse gas (GHG) emissions regulations. Caltrans recommends VMT per capita thresholds are 15% below existing regional VMT per capita. Caltrans also recommends establishment of programs or methods to reduce VMT and support appropriate bicycle, pedestrian, and transit infrastructure. **GOV3-14**

If you have any question or would like to discuss these comments, please contact Michael Casas at (209) 986-9830 michael.casas@dot.ca.gov or me at Kevin Schroder (209)Kevin.Schroder@dot.ca.gov

Sincerely,

Kevin Schroder

Kevin Schroder, Interim Office Chief
Office of Rural Planning

Cc: Quincy Yaley, Planning Director, Tuolumne County Planning Department
State Clearinghouse

Groveland Community Services District

G.C.S.D. Services - 209 / 962-7161
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water • fire protection • parks • wastewater collection & treatment

18966 Ferretti Road P.O. Box 350 Groveland, CA 95321-0350

July 30, 2020

Quincy Yaley
Community Development Director
Tuolumne County
2 S. Green Street
Sonora, CA 95370

VIA EMAIL ONLY: qyaley@co.tuolumne.ca.us

Re: Terra Vi Lodge Yosemite - Draft EIR/SCH# 2019110286

Groveland Community Services District (GCSD) thanks you for the opportunity to comment on this project. GCSD requested an extension on the comment period to resolve the fire protection and emergency medical services matter with the County, which request was denied. Given that denial, GCSD provides the following comments. **GOV4-01**

GCSD is one of the local fire agencies identified in the Terra Vi Lodge Yosemite Draft Environmental Impact Report (DEIR) as providing fire protection and emergency services to the project pursuant to a mutual aid agreement between GCSD and the Tuolumne County Fire Departments (TCFD). In recognition of a doubling of Groveland Fire Department call volume over the past decade, and in preparation to better understand the impacts to the department by continuing to provide an increased level of service outside the GCSD boundaries, the District commissioned a Fire Department Master Plan update in 2019, which was completed and approved in March 2020. The Fire Master Plan identified increasing demand on GCSD Fire services, with an average of 11.8% of calls occurring outside the District boundaries, but due to the remote location of those calls, 37% of all GCSD Fire Department response time was spent on emergency response outside the District boundaries. **GOV4-02**

This means that an average of 37% of the time, the capacity of GCSD Fire to maintain adequate staffing and equipment for fire protection and emergency response services inside the GCSD boundaries was impaired. Time on out-of-district responses, existing lower than optimal staffing levels and funding shortfalls are identified as the most significant concerns in the 2020 GCSD Fire Master Plan.

Our December 21, 2018 response to the project Advisory Notice requested that the EIR evaluate the impacts of the project on the fire services provided by the District in a Fire Services Impact Study. The Fire Impact Analysis contained in the project DEIR incorrectly assumes that all fire department time and resources needed to respond to all calls are equal regardless of whether they are in downtown Groveland or 45 minutes travel time to Evergreen Lodge; and that any impact on GCSD **GOV4-03**

Fire services is based solely on the number of potential emergency calls generated by the project. GOV4-03 cont.

The Impact Analysis also incorrectly assumes that the only factor affecting the need for additional staffing and equipment within the GCSD Fire Department is call volume. While call volume is one factor that drives staffing, the most critical factor affecting staff and equipment availability are the types and locations of calls. The more time the engine is out of the station, the more costly and quickly GCSD must add an additional full compliment of staff and equipment. The Fire Impact Analysis does not adequately or accurately evaluate the impact on or of fire department response times on any type of emergency call, nor does it address the impact to GCSD Fire Department's ability to protect life and property inside the District statutory and Automatic Aid/Mutual Aid boundaries, when on calls at the project site. Due to the flaws in the evaluation of impact on fire department staff and equipment availability, the financial impact analysis is also flawed and incorrect. GOV4-04

Section 4.14-3 of the Draft Environmental Impact Report identifies fire protection services for the project will be provided through a multi-jurisdictional effort by the GCSD, Tuolumne County Fire Department (TCFD), CAL FIRE, and the United States Forest Service. The closest staffed fire station to the proposed project site is the GCSD Station 78. While GCSD and TCFD have entered into an Automatic Aid/Mutual Aid Agreement, dated April 2016, the Terra Vi Lodge Yosemite Project is located outside the boundaries of both the GCSD and the response boundaries agreed upon in the Automatic Aid/Mutual Aid Agreement. Therefore, GCSD Fire is not the appropriate entity to identify as the first responding agency to the project site. The FEIR should include analysis and identification of necessary resources so GSCD is able to provide the fire protection and emergency medical services otherwise identified in the DEIR. This analysis must be provided in the FEIR to be considered adequate. GOV4-05

The project is also located in an area deemed a "High Fire Hazard Severity Zone" and is susceptible to wildfire risks with minimal to no fire protection or emergency medical services available. This means that if GCSD Fire is called to respond to an evolving fire emergency related to the project facility and is unable to respond for whatever reason, the result could be small fires becoming large, uncontrolled fire incidents while waiting on response from remote stations. GCSD is agreeable to a condition on the project which would address the facilities, infrastructure and funds necessary to provide adequate fire protection and emergency medical services to the project. We request the revisions and corrections identified above be addressed in the Final EIR. GOV4-06

Very truly yours,

Peter Kampa

Peter Kampa
General Manager

CC: GCSD Board of Directors
Terra Vi Lodge Project File

COMMENT LETTER # GOV5

From: Pete Kampa <pkampa@gcsd.org>
Sent: Thursday, July 30, 2020 4:51 PM
To: Tracie Riggs <TRiggs@co.tuolumne.ca.us>
Cc: Eric Erhardt <EErhardt@co.tuolumne.ca.us>; Maureen Frank <MFRANK@co.tuolumne.ca.us>; Quincy Yaley <QYaley@co.tuolumne.ca.us>; Murphy, Andy@CALFIRE <Andy.Murphy@fire.ca.gov>; Jennifer Flores <jflores@gcsd.org>; Rachel Pearlman <rpearlman@gcsd.org>
Subject: Our meeting re Terra Vi and Under Canvas Impacts and Solutions

GOV5-01

Tracie,
As you are aware, the Terra Vi and Under Canvas projects both fall outside of the service area obligations(Area of Obligation) of the Groveland Community Services District (GCSD) and the 2016 Automatic Aid/Mutual Aid Agreement (Agreement). Currently, the nearest emergency services available to seve the area is located in Jamestown over an hour away. While in the past the GCSD has assisted the County by responding to a few calls to areas outside its Area of Obligation, GCSD simply cannot and will not continue to do so and bear the financial burden associated with doing so. Though GCSD is willing to explore entering into an agreement whereby it would receive reimbursement for providing services to those areas, we fully understand the fiscal constraints that the County is undergoing, especially in this time of pandemic. As I promised during our recent meeting, I have reached out to our special tax consultant, SCI, and GCSD legal counsel regarding possible funding options available for the County to consider. One which is typically used in development situations like these is to have the projects fund the ongoing cost of providing fire and emergency response services to them by creating a Community Facilities District (CFD). It can be made a condition of the approval of their projects. That would provide the County the necessary funding to provide emergency services to the projects without depleting existing limited county funding.

Following our conversation, I have confirmed that a CFD is a common taxation mechanism used by districts, cities and counties throughout the state to efficiently fund public services provided to projects. To form a CFD, one step is to prepare Financial Impact Study to demonstrate the nexus between the purpose and amount of the CFD tax and the services received. All of this work would be at the expense of the developers for both projects. But to do so, the County would need to make it a condition of the approval of both projects. The funds obtained through the annual CFD taxes could be used to reimburse GCSD for the costs of providing emergency services to those projects should it chose to contract with GCSD. In addition, the County could explore including the Rush Creek and Evergreen lodges as part of the CFD since doing so would be in their interests as well. In addition, once created, future developments projects would also be subject to annexation into the CFD thus addressing emergency service needs of those projects.

Considering the above opportunities for funding essential services to be provided to the projects, we feel that it is in the County's best interest to require the formation of a Community Facilities District or similar assessment district as a condition of approval of the Terra Vi and Under Canvas projects to fund the perpetual cost of fire and emergency response services. That way the County would have the funds to contract with GCSD (or other vendor) to provide those services on behalf of the County. It is very important that the County understand that absent an agreement, GCSD will not be providing fire and emergency response services beyond the boundaries of the Response Plan of the Automatic/Mutual Aid Agreement; leaving both projects and the existing lodges with hour-long plus response times provided out of the remote TCFD stations in Jamestown or Sonora. If the county decides to condition both projects on the formation of a CFD or similar assessment area, GCSD is ready to assist the County in working with the project developers in creating it.

GCSD believes that the County should seriously consider conditioning the approval of both projects on the creation of a CFD or other assessment area. That, together with a successful regional Fire Special Tax being considered, would go a long way to solidifying emergency services on the highway 120 corridor. As time is of the essence, we would be happy to meet at your earliest convenience to share thoughts on how the County can take advantage of this development tool.

GOV5-01 cont.

Sincerely,

Peter J. Kampa

General Manager
(209) 591-7100 cell
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Groveland, CA 95321
W: gcsd.org
pkampa@gcsd.org
Groveland Community Services District

COMMENT LETTER # GOV6

CALIFORNIA Water Boards

Gavin Newsom
Governor

Jared Blumenfeld
Secretary for Environmental Protection

Central Valley Regional Water Quality Control Board

30 July 2020

Quincy Yaley
Tuolumne County
Community Development Department
2 South Green Street
Sonora, CA 05370

COMMENTS TO REQUEST FOR REVIEW FOR THE DRAFT ENVIRONMENTAL IMPACT REPORT, TERRA VI LODGE YOSEMITE SDP18-003 PROJECT, SCH#2019110286, TUOLUMNE COUNTY

Pursuant to the State Clearinghouse's 15 June 2020 request, the Central Valley Regional Water Quality Control Board (Central Valley Water Board) has reviewed the *Request for Review for the Draft Environmental Impact Report* for the Terra Vi Lodge Yosemite SDP18-003 Project, located in Tuolumne County. **GOV6-01**

Our agency is delegated with the responsibility of protecting the quality of surface and groundwaters of the state; therefore our comments will address concerns surrounding those issues.

I. Regulatory Setting

Basin Plan

The Central Valley Water Board is required to formulate and adopt Basin Plans for all areas within the Central Valley region under Section 13240 of the Porter-Cologne Water Quality Control Act. Each Basin Plan must contain water quality objectives to ensure the reasonable protection of beneficial uses, as well as a program of implementation for achieving water quality objectives with the Basin Plans. Federal regulations require each state to adopt water quality standards to protect the public health or welfare, enhance the quality of water and serve the purposes of the Clean Water Act. In California, the beneficial uses, water quality objectives, and the Antidegradation Policy are the State's water quality standards. Water quality standards are also contained in the National Toxics Rule, 40 CFR Section 131.36, and the California Toxics Rule, 40 CFR Section 131.38. **GOV6-02**

The Basin Plan is subject to modification as necessary, considering applicable laws, policies, technologies, water quality conditions and priorities. The original Basin Plans were adopted in 1975, and have been updated and revised periodically as required, using Basin Plan amendments. Once the Central Valley Water Board has adopted a Basin Plan amendment in noticed public hearings, it must be approved by the State Water Resources Control Board (State Water Board), Office of

Administrative Law (OAL) and in some cases, the United States Environmental Protection Agency (USEPA). Basin Plan amendments only become effective after they have been approved by the OAL and in some cases, the USEPA. Every three (3) years, a review of the Basin Plan is completed that assesses the appropriateness of existing standards and evaluates and prioritizes Basin Planning issues. For more information on the *Water Quality Control Plan for the Sacramento and San Joaquin River Basins*, please visit our website: http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/

Antidegradation Considerations

All wastewater discharges must comply with the Antidegradation Policy (State Water Board Resolution 68-16) and the Antidegradation Implementation Policy contained in the Basin Plan. The Antidegradation Implementation Policy is available on page 74 at: https://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/sacsjr_201805.pdf **GOV6-02 cont.**

In part it states:

Any discharge of waste to high quality waters must apply best practicable treatment or control not only to prevent a condition of pollution or nuisance from occurring, but also to maintain the highest water quality possible consistent with the maximum benefit to the people of the State.

This information must be presented as an analysis of the impacts and potential impacts of the discharge on water quality, as measured by background concentrations and applicable water quality objectives.

The antidegradation analysis is a mandatory element in the National Pollutant Discharge Elimination System and land discharge Waste Discharge Requirements (WDRs) permitting processes. The environmental review document should evaluate potential impacts to both surface and groundwater quality.

II. Permitting Requirements

Construction Storm Water General Permit

Dischargers whose project disturb one or more acres of soil or where projects disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres, are required to obtain coverage under the General Permit for Storm Water Discharges Associated with Construction Activities (Construction General Permit), Construction General Permit Order No. 2009-009-DWQ. Construction activity subject to this permit includes clearing, grading, grubbing, disturbances to the ground, such as stockpiling, or excavation, but does not include regular maintenance activities performed to restore the original line, grade, or capacity of the facility. The Construction General Permit requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP). For more information on the Construction General Permit, visit the State Water Resources Control Board website at: **GOV6-03** http://www.waterboards.ca.gov/water_issues/programs/stormwater/constpermits.shtml

Phase I and II Municipal Separate Storm Sewer System (MS4) Permits[1]
The Phase I and II MS4 permits require the Permittees reduce pollutants and runoff flows from new development and redevelopment using Best Management Practices (BMPs) to the maximum extent practicable (MEP). MS4 Permittees have their own development standards, also known as Low Impact Development (LID)/post-construction standards that include a hydromodification component. The MS4 permits also require specific design concepts for LID/post-construction BMPs in the early stages of a project during the entitlement and CEQA process and the development plan review process.

For more information on which Phase I MS4 Permit this project applies to, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/water_issues/storm_water/municipal_permits/

For more information on the Phase II MS4 permit and who it applies to, visit the State Water Resources Control Board at:
http://www.waterboards.ca.gov/water_issues/programs/stormwater/phase_ii_municipal.shtml **GOV6-03 cont.**

Industrial Storm Water General Permit
Storm water discharges associated with industrial sites must comply with the regulations contained in the Industrial Storm Water General Permit Order No. 2014-0057-DWQ. For more information on the Industrial Storm Water General Permit, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/water_issues/storm_water/industrial_general_permits/index.shtml

Clean Water Act Section 404 Permit
If the project will involve the discharge of dredged or fill material in navigable waters or wetlands, a permit pursuant to Section 404 of the Clean Water Act may be needed from the United States Army Corps of Engineers (USACE). If a Section 404 permit is required by the USACE, the Central Valley Water Board will review the permit application to ensure that discharge will not violate water quality standards. If the project requires surface water drainage realignment, the applicant is advised to contact the Department of Fish and Game for information on Streambed Alteration Permit requirements. If you have any questions regarding the Clean Water Act

[1] Municipal Permits = The Phase I Municipal Separate Storm Water System (MS4) Permit covers medium sized Municipalities (serving between 100,000 and 250,000 people) and large sized municipalities (serving over 250,000 people). The Phase II MS4 provides coverage for small municipalities, including non-traditional Small MS4s, which include military bases, public campuses, prisons and hospitals.

Section 404 permits, please contact the Regulatory Division of the Sacramento District of USACE at (916) 557-5250.

Clean Water Act Section 401 Permit – Water Quality Certification
If an USACE permit (e.g., Non-Reporting Nationwide Permit, Nationwide Permit, Letter of Permission, Individual Permit, Regional General Permit, Programmatic General Permit), or any other federal permit (e.g., Section 10 of the Rivers and Harbors Act or Section 9 from the United States Coast Guard), is required for this project due to the disturbance of waters of the United States (such as streams and wetlands), then a Water Quality Certification must be obtained from the Central Valley Water Board prior to initiation of project activities. There are no waivers for 401 Water Quality Certifications. For more information on the Water Quality Certification, visit the Central Valley Water Board website at: https://www.waterboards.ca.gov/centralvalley/water_issues/water_quality_certification/

Waste Discharge Requirements – Discharges to Waters of the State
If USACE determines that only non-jurisdictional waters of the State (i.e., "non-federal" waters of the State) are present in the proposed project area, the proposed project may require a Waste Discharge Requirement (WDR) permit to be issued by Central Valley Water Board. Under the California Porter-Cologne Water Quality Control Act, discharges to all waters of the State, including all wetlands and other waters of the State including, but not limited to, isolated wetlands, are subject to State regulation. For more information on the Waste Discharges to Surface Water NPDES Program and WDR processes, visit the Central Valley Water Board website at:https://www.waterboards.ca.gov/centralvalley/water_issues/waste_to_surface_water/

GOV6-03 cont.

Projects involving excavation or fill activities impacting less than 0.2 acre or 400 linear feet of non-jurisdictional waters of the state and projects involving dredging activities impacting less than 50 cubic yards of non-jurisdictional waters of the state may be eligible for coverage under the State Water Resources Control Board Water Quality Order No. 2004-0004-DWQ (General Order 2004-0004). For more information on the General Order 2004-0004, visit the State Water Resources Control Board website at: https://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2004/wqo/wqo2004-0004.pdf

Waste Discharge Requirements – Discharges to Land
Pursuant to the State Board's Onsite Wastewater Treatment Systems Policy, the regulation of the septic system may be regulated under the local agency's management program.

Please note that only domestic wastewater coming from bathrooms and kitchens should be discharged to septic systems. Cannabis cultivation can generate other wastewaters such as irrigation runoff, water treatment effluent, cleaning agents, and wash waters. Discharges of these wastewaters to an on-site wastewater system such as a septic tank and leach field must obtain separate regulatory authorization, such as waste discharge requirements (WDRs), a conditional waiver of WDRs, or other permit mechanism, prior to discharge. The application to obtain WDRs or a conditional waiver of WDRs can take over a year to process and requires that you characterize the wastewater chemistry and volume. In lieu of discharging to a septic system, Water Board staff recommends that wastewaters from cannabis cultivation activities be discharged to a holding tank and then hauled by a servicing company to a community wastewater treatment plant for disposal.

For more information on waste discharges to land, visit the Central Valley Water Board website at: http://www.waterboards.ca.gov/centralvalley/water_issues/waste_to_land/index.shtml

Dewatering Permit

If the proposed project includes construction or groundwater dewatering to be discharged to land, the proponent may apply for coverage under State Water Board General Water Quality Order (Low Threat General Order) 2003-0003 or the Central Valley Water Board's Waiver of Report of Waste Discharge and Waste Discharge Requirements (Low Threat Waiver) R5-2018-0085. Small temporary construction dewatering projects are projects that discharge groundwater to land from excavation activities or dewatering of underground utility vaults. Dischargers seeking coverage under the General Order or Waiver must file a Notice of Intent with the Central Valley Water Board prior to beginning discharge.

For more information regarding the Low Threat General Order and the application process, visit the Central Valley Water Board website at: http://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2003/wqo/wqo2003-0003.pdf

GOV6-03 cont.

For more information regarding the Low Threat Waiver and the application process, visit the Central Valley Water Board website at: https://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/waivers/r5-2018-0085.pdf

Limited Threat General NPDES Permit

If the proposed project includes construction dewatering and it is necessary to discharge the groundwater to waters of the United States, the proposed project will require coverage under a National Pollutant Discharge Elimination System (NPDES) permit. Dewatering discharges are typically considered a low or limited threat to water quality and may be covered under the General Order for *Limited Threat Discharges to Surface Water* (Limited Threat General Order). A complete Notice of Intent must be submitted to the Central Valley Water Board to obtain coverage under the Limited Threat General Order. For more information regarding the Limited Threat General Order and the application process, visit the Central Valley Water Board website at: https://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/general_orders/r5-2016-0076-01.pdf

NPDES Permit

If the proposed project discharges waste that could affect the quality of surface waters of the State, other than into a community sewer system, the proposed project will require coverage under a National Pollutant Discharge Elimination System (NPDES) permit. A complete Report of Waste Discharge must be submitted with the Central Valley Water Board to obtain a NPDES Permit. For more information regarding the NPDES Permit and the application process, visit the Central Valley Water Board website at: https://www.waterboards.ca.gov/centralvalley/help/permit/

GOV6-03 cont.

If you have questions regarding these comments, please contact me at (916) 464-4856 or Nicholas.White@waterboards.ca.gov.

Nic White

Nicholas White
Water Resource Control Engineer

cc: State Clearinghouse unit, Governor’s Office of Planning and Research, Sacramento

COMMENT LETTER # GOV7

From: Casas, Michael@DOT <Michael.Casas@dot.ca.gov>
Sent: Friday, July 31, 2020 1:28 PM
To: Quincy Yaley <QYaley@co.tuolumne.ca.us>
Cc: Schroder, Kevin@DOT <Kevin.Schroder@dot.ca.gov>; Roberts, Alan S@DOT <alan.roberts@dot.ca.gov>
Subject: FW: Terra Vi Draft Environmental Impact Report SCH#2019110286 Caltrans comment letter

Hello Ms. Yaley,

I wanted to share with you some new information regarding the Terra Vi DEIR comment letter that we emailed. One of our Encroachment Permit staff Aland Roberts has the following statement regarding NEPA documentation. Did the EIR include any NEPA consideration for Highway 120 Right of Way impacts? Please see email from Alan Roberts. GOV7-01

If you have questions or comments please email me or call me.

Thanks you,

Michael Casas
Caltrans District 10
Office of Rural Planning
Division of Planning, Local Assistance, and Environmental
1976 E. Dr. Martin Luther King Jr Blvd.
Stockton CA 95205
Telework # 1-209-986-9830
https://dot.ca.gov/caltrans-near-me/district-10

From: Roberts, Alan S@DOT <alan.roberts@dot.ca.gov>
Sent: Friday, July 31, 2020 8:08 AM
To: Casas, Michael@DOT <Michael.Casas@dot.ca.gov>
Cc: Schroder, Kevin@DOT <Kevin.Schroder@dot.ca.gov>
Subject: Terra Vi Draft Environmental Impact Report SCH#2019110286 Caltrans comment letter

Michael,

I can't tell from the letter that was sent to the County if they will be accomplishing a NEPA clearance on the project's impacts in the Highway 120 right-of-way. I did see the original APE and I do not believe any portion of Highway 120 was included. The letter does mention access improvements in the GOV7-02 state Highway 120 right-of-way, with regard to traffic analysis and safety concerns.

Our department is currently requiring that the Environmental Clearance be provided with the applications for commercial developments. If the area is not covered acceptably in the County's environmental clearance determination then the Developer will need to open a Cooperative Agreement with the County and Caltrans to fund environmental study at a future date.

Please notify the County if they are not aware of this matter.

GOV7-02 cont.

Alan Roberts
Caltrans District 10 Encroachment Permits
(209) 736-0253

From: Roberts, Alan S@DOT <alan.roberts@dot.ca.gov>
Sent: Friday, July 31, 2020 7:55 AM
To: Rodriguez, Francisco J@DOT <francisco.j.rodriguez@dot.ca.gov>
Cc: Schroder, Kevin@DOT <Kevin.Schroder@dot.ca.gov>; Casas, Michael@DOT <Michael.Casas@dot.ca.gov>
Subject: RE: Terra Vi Draft Environmental Impact Report SCH#2019110286 Caltrans comment letter

Francisco,

It is good that you saved the attachments as you will need them in the future when PG&E submits an application for the highway crossing, when I am retired.

The projects initial study and the area of potential impact was limited to the private property and I do not believe they studied the power line crossing or limits of the site access improvements on Highway 120, (left turn lane and right deceleration turn lane). The County doesn't like to do environmental reviews/studies of project impacts within the state highway right-of-way especially when it requires NEPA review.

This will need to be accomplished before the related project impacts on State Highway 120 are allowed in the State Highway 120 right-of-way.

I believe both the proposed aerial power line crossing, and Highway access improvements will require environmental clearance CEQA and NEPA as Federal Highway money was used to obtain the access controlled right-of-way at this location in fee title.

The Rush Creek Lodge access was constructed near this projects location and it took a couple years as you recall to get through the environmental reviews. There was no FHWA exception required for utility service on Rush Creek as power was provided from the adjacent county roadways.

Alan Roberts
Caltrans District 10 Encroachment Permits
(209) 736-0253

Caltrans
CALIFORNIA DEPARTMENT OF TRANSPORTATION

STATE OF CALIFORNIA—CALIFORNIA STATE TRANSPORTATION AGENCY GAVIN NEWSOM, Governor

DEPARTMENT OF TRANSPORTATION
DISTRICT 10
P.O. BOX 2048, STOCKTON, CA 95201
(1976 E. DR. MARTIN LUTHER KING JR. BLVD. 95205)
PHONE (209) 948-7325
FAX (209) 948-7164
TTY 711
www.dot.ca.gov

Making Conservation a California Way of Life.

August 26, 2020

Ms. Quincy Yaley, Planning Director
County of Tuolumne
Community Resources Agency
2 South Green Street
Sonora, CA 95370-4618

TUO-120-PM 50.082
Terra Vi Lodge
Draft Environmental Impact Report (Addendum)
SCH # 2019110286

Dear Ms. Yaley,

The California Department of Transportation (Caltrans) appreciates the opportunity to review and comment on the Draft Environmental Impact Report (DEIR) for the development of Terra Vi Lodge, a master planned lodge located at 11262 Sawmill Mountain Road, Groveland, CA 95321. The Terra Vi Lodge will include one hundred (100) guest rooms, seven cabins with 26 guestrooms and five employee housing units, a market, a lodge, event space, emergency landing zone for a helicopter, and other support buildings. The project site consists of two parcels totaling 63.38± acres, APN 068-120-060 and 068-120-061. The parcels are zoned Commercial Recreation (C-K) and Open Space (O) under Title 17 of the Tuolumne County Ordinance Code. The project site is located at the northeast corner of the intersection of Sawmill Mountain Road and State Route (SR) 120. GOV8-01

Caltrans has responded to the previous routing of this project on December 27, 2018, May 20, 2019, October 28, 2019, December 12, 2019, and July 30, 2020. Caltrans has the following comments based on our previous letters and proposal for sight improvements at Sawmill Mountain Road for acceleration and deceleration lanes, including turning lanes on SR 120. GOV8-02

Right of Way:

- In reviewing the location TUO-120 PM 50.82 at Sawmill Mountain Road through TUO-120-PM 50.3, Caltrans has fee of ownership at the location where the break of access lies within an access-controlled right of way (ROW). At Sawmill Mountain Road TUO-120-PM 50.82, the request for highway improvements prompts a Decertification Process and would require the Private or Public requestor to submit a deposit with a GOV8-03

Decertification application.

- Caltrans rights are by easement only through U.S. Forest Service (USFS) lands within the proposed development post mile range. Our easement is limited to the operation and maintenance of SR 120 within 66' left and right of the centerline, together with any and all man-made features including drainages adjacent to and appurtenant to the existing SR 120. **GOV8-03 cont.**

Caltrans Right of Way Manual Section for Decertification

16.05.12.0 Requests to Decertify and Purchase

An adjoining owner or public agency may request the Caltrans to decertify a portion of operating right of way, sell, or otherwise convey access or other property rights not considered as excess land. Excess Land shall not initiate any action until the requesting party has deposited, as a minimum amount, the estimated costs of processing the request, including appropriate overhead assessments. Accounting for the overhead should be done pursuant to procedures set forth in the Accounting Manual. Project Development reviews requests for decertification and obtains approval from Federal Highway Administration (FHWA) where necessary. If the Private or Public requestor is requesting access within National Forest Service (NFS) lands, Caltrans does not have fee rights. Caltrans has only easement rights within NFS lands. **GOV8-04**

Since Federal funding was involved in the development of SR 120, then the improvements, commercial approach, left turn lane, acceleration, deceleration lanes, and utility crossing improvements would need to meet the design standards for the facility. Any design exception will require FHWA approval of sign-off and they would request National Environmental Policy Act (NEPA) clearance documentation in their evaluation.

8.18.18.00 Environmental Clearance

Requests for a federal land transfer may need an environmental document that assures compliance with NEPA of 1969 (42 USC 4332, et seq.), the Historic Preservation Act [16 USC 470(f)], and Preservation of Parklands Act [49 USC 1653(f)]. Under the Caltrans' NEPA assignment from the FHWA, Caltrans is the lead agency and author of the NEPA document for Federal-aid highway projects. **GOV8-05**

- For additional information regarding 16.05.12.0 Requests to Decertify and Purchase and 8.18.18.00 Environmental Clearance, please view the Caltrans website: https://dot.ca.gov/programs/right-of-way/right-of-way-manual GOV8-06

Environmental:

- Prior to Caltrans approval for work in our ROW, Caltrans needs to see approval from USFS for work in their ROW. Please note a NEPA document will be required from the USFS. GOV8-07
- Caltrans will need to see resolutions to all comments made in the draft EIR including the May 29, 2019 Calfire comment regarding the California Forest Improvement Program (CFIP) and public comments regarding pedestrian crosswalk across SR 120. GOV8-08

Encroachment Permit:

- The permit applicant needs to provide a copy of the easement they have to Sawmill Mountain Road that is given to them from the property owner. The Permit Office grants permits only to abutting property owners to the state highway or a third party in case they have a legal easement to that property and the easement is defined. GOV8-09
- Caltrans comments that will be incorporated into the final conditions of approval are not approval of design plans for traffic mitigation improvements inside SR 120. Those design plans will be submitted at a future date.

For project construction activities which will encroach into Caltrans ROW, the project proponent must submit an application for an Encroachment Permit to the Caltrans Permit Office. The NEPA and California Environmental Quality Act (CEQA) clearances must be submitted with the application for encroachment permit which address all improvements and soil disturbance activities within the SR 120 ROW. Copies of all appropriate environmental studies must be submitted with this application. These studies shall include analysis of potential impacts to any cultural sites, biological resources, hazardous waste locations, and/or other resources within Caltrans ROW at the project site. The permit package submittal must have a complete engineered set of plans that meets all Caltrans standards. For more information please visit the Caltrans Website. GOV8-10
https://dot.ca.gov/programs/traffic-operations/ep/applications

If you have any question or would like to discuss these comments, please contact Michael Casas at (209) 986-9830 michael.casas@dot.ca.gov or me at Kevin Schroder (209) 986-9635 Kevin.Schroder@dot.ca.gov GOV8-11

Sincerely,

Kevin Schroder

Kevin Schroder, Acting Branch Office Chief
Office of Rural Planning

Cc: State Clearinghouse

From: John Buckley <johnb@cserc.org>
Sent: Friday, July 10, 2020 9:51 AM
To: Quincy Yaley <QYaley@co.tuolumne.ca.us>; jgray@tuolumne.ca.gov; Sherri Brennan <SBrennan@co.tuolumne.ca.us>; Anaiah Kirk <AKirk@co.tuolumne.ca.us>; Ryan Campbell <RCampbell@co.tuolumne.ca.us>; Karl Rodefer <KRodefer@co.tuolumne.ca.us>
Subject: John at CSERC respectfully asks for extension of the comment period for the two massive DEIRs

July 10, 2020

Quincy and County Supervisors:

ORG1-01

Please read the attached formal request for an extension of time for all of us who are struggling to wade through 3,000+ pages in the two massive draft EIRs for the Yosemite Under Canvas and the Terra Vi Lodge projects.

Both are the largest EIR documents for a project that have ever been presented to the public for comments. Because they are directly adjacent, in order to understand what one EIR claims it is essential to consider what the other EIR claims. In addition, as you know the COVID-19 situation adds additional stress, reduced ability to meet and dialogue, etc.

I respectfully ask that you skim over the attached extension request and then grant the requested extension of the comment period. I know all of you want informed comments.

John
CSERC

Central Sierra Environmental Resource Center
Box 396, Twain Harte, CA 95383 • (209) 586-7440 • fax (209) 586-4986
Visit our website at: www.cserc.org or contact us at: johnb@cserc.org

June 24, 2020

Quincy Yaley
Community Development Department
2 S. Green Street
Sonora, CA 95370

cc: Tuolumne County Board of Supervisors

Request for Additional Time for public comment on Under Canvas DEIR

To Quincy and the Board of Supervisors:

On behalf of our Center (as well as numerous private citizens who have contacted me over the past week as they struggle to wade through the incredibly lengthy DEIR for the "Yosemite Under Canvas" project)**, I am formally asking the County for an extension of the deadline for public comments.**

Because our staff values the State requirement for CEQA analysis and because (as you know) we take the time to actually carefully read planning documents, I respectfully point out that this DEIR is truly overwhelming in size and technical content. Whether the information and judgments within it are accurate, consistent with CEQA, etc. is not the focus of this letter.

But what matters is that after I have personally invested roughly 50 hours in an intensive review of the 272 pages of the key Under Canvas EIR analysis and an additional review of the next 300+ pages of the overall document, I am still struggling to read through the remainder of the 1,263 total pages. THIS IS THE SINGLE LARGEST EIR DOCUMENT PRODUCED FOR A TUOLUMNE COUNTY PROJECT THAT OUR CENTER HAS EVER REVIEWED. Property owners and concerned citizens who are attempting to dig into this intensely detailed document must be struggling even more. 45 days is simply not enough time. ORG1-01 CONT.

In addition, **the COVID-19 pandemic situation already adds considerable stress and challenges** because state mandates restrict gatherings for face-to-face discussions with project neighbors, with other local conservation activists, etc. The pandemic situation adds to the already difficult challenge of not only reading the 1,263 pages of the Under Canvas DEIR, but to simultaneously work to develop well-informed responses and comments.

An additional compelling reason for an extension of the comment period is that for some reason the County chose to release the EVEN MORE MASSIVE DEIR for Terra Vi Lodge at the same

time that county residents are being asked to review the massive Yosemite Under Canvas DEIR. What one EIR claims or asserts for transportation, wildfire, water, biological resources, etc. matters to the other project because they are directly adjacent and because the projects are openly acknowledged to produce combined cumulative impacts. Our staff has seen that Vol. I and Vol. II of the Terra Vi Lodge DEIR total **1,866 pages** that also need to be read through in order to be informed.

THERE IS NO CONCEIVABLE WAY THAT COUNTY PLANNING COMMISSIONERS OR COUNTY SUPERVISORS WILL HONESTLY BE ABLE TO CAREFULLY REVIEW THE YOSEMITE UNDER CANVAS DEIR BY JULY 2OTH OR TO POSSIBLY READ AND PROCESS THE INFORMATION IN THE ADDITIONAL TERRA VI LODGE DEIR BY JULY 30TH. There is no way for our staff or concerned county residents to complete a review of either or both documents by the current deadlines.

ORG1-01 CONT.

FORMAL REQUEST:

Because the County obviously desires well-informed citizen involvement and desires that comments on projects will be accurate and appropriate, then it is essential to allow adequate time for the review of both the Yosemite Under Canvas DEIR and the Terra Vi Lodge DEIR.

CSERC respectfully requests an extension of 30 days for each DEIR since they are interconnected and together require the review of more than 3,000 pages of dry reading, data, Timber Harvest Plans, well reports, site plans, etc. If 30 days is not somehow acceptable, our Center asks for at least an extension of 20 days for each, but 30 days for each is our clear request.

ORG1-01 CONT.

Please respond back to this request for an extension as soon as reasonably feasible. Thank you. Stay healthy.

John Buckley

Executive Director, CSERC

From: Kevin Rice <kjrice@ucdavis.edu>
Sent: Monday, July 13, 2020 11:57 AM
To: Quincy Yaley <QYaley@co.tuolumne.ca.us>
Subject: Request for 30 day extension for review of Under Canvas and Terra Vi DEIRs

Hi Quincy,

The Tuolumne Group of the Sierra Club is respectfully requesting a 30 day extension to the review periods for both the Under Canvas DEIR and the Terra Vi DEIR. The almost simultaneous release of both these DEIRs when coupled with the enormous size of each, makes it very difficult to adequately review either under the current time constraint.

ORG2-01

Thank you for considering our request and please let us know your response as soon as possible. I've sent a similar request to the Board of Supervisors.

Dr. Kevin Rice, PhD
Conservation Chair
Tuolumne Group of the Sierra Club

COMMENT LETTER # ORG3

From: John Buckley <johnb@cserc.org>
Sent: Wednesday, July 15, 2020 7:58 AM
To: Quincy Yaley <QYaley@co.tuolumne.ca.us>
Cc: Natalie Rizzi <NRizzi@co.tuolumne.ca.us>
Subject: John checking for response to request for extension

Quincy and Natalie:

I am checking as to what the County has decided in response to our Center's July 10th request for a meaningful extension of the public comment deadline for the Yosemite Under Canvas DEIR and the Terra Vi Lodge DEIR comment periods.

ORG3-01

Could you confirm that you received my formal request (attached again below) and give me a response as soon as possible?

Thank you.

John
CSERC

Central Sierra Environmental Resource Center

Box 396, Twain Harte, CA 95383 • (209) 586-7440 • fax (209) 586-4986

Visit our website at: www.cserc.org or contact us at: johnb@cserc.org

June 24, 2020

Quincy Yaley
Community Development Department
2 S. Green Street
Sonora, CA 95370

cc: Tuolumne County Board of Supervisors

Request for Additional Time for public comment on Under Canvas DEIR

To Quincy and the Board of Supervisors:

On behalf of our Center (as well as numerous private citizens who have contacted me over the past week as they struggle to wade through the incredibly lengthy DEIR for the "Yosemite Under Canvas" project)**, I am formally asking the County for an extension of the deadline for public comments.** ORG3-02

Because our staff values the State requirement for CEQA analysis and because (as you know) we take the time to actually carefully read planning documents, I respectfully point out that this DEIR is truly overwhelming in size and technical content. Whether the information and judgments within it are accurate, consistent with CEQA, etc. is not the focus of this letter.

But what matters is that after I have personally invested roughly 50 hours in an intensive review of the 272 pages of the key Under Canvas EIR analysis and an additional review of the next 300+ pages of the overall document, I am still struggling to read through the remainder of the 1,263 total pages. THIS IS THE SINGLE LARGEST EIR DOCUMENT PRODUCED FOR A TUOLUMNE COUNTY PROJECT THAT OUR CENTER HAS EVER REVIEWED. Property owners and concerned citizens who are attempting to dig into this intensely detailed document must be struggling even more. 45 days is simply not enough time.

In addition, **the COVID-19 pandemic situation already adds considerable stress and challenges** because state mandates restrict gatherings for face-to-face discussions with project neighbors, with other local conservation activists, etc. The pandemic situation adds to the already difficult challenge of not only reading the 1,263 pages of the Under Canvas DEIR, but to simultaneously work to develop well-informed responses and comments.

An additional compelling reason for an extension of the comment period is that for some reason the County chose to release the EVEN MORE MASSIVE DEIR for Terra Vi Lodge at the same

time that county residents are being asked to review the massive Yosemite Under Canvas DEIR. What one EIR claims or asserts for transportation, wildfire, water, biological resources, etc. matters to the other project because they are directly adjacent and because the projects are openly acknowledged to produce combined cumulative impacts. Our staff has seen that Vol. I and Vol. II of the Terra Vi Lodge DEIR total **1,866 pages** that also need to be read through in order to be informed.

THERE IS NO CONCEIVABLE WAY THAT COUNTY PLANNING COMMISSIONERS OR COUNTY SUPERVISORS WILL HONESTLY BE ABLE TO CAREFULLY REVIEW THE YOSEMITE UNDER CANVAS DEIR BY JULY 2OTH OR TO POSSIBLY READ AND PROCESS THE INFORMATION IN THE ADDITIONAL TERRA VI LODGE DEIR BY JULY 30TH. There is no way for our staff or concerned county residents to complete a review of either or both documents by the current deadlines. ORG3-02 cont.

FORMAL REQUEST:

Because the County obviously desires well-informed citizen involvement and desires that comments on projects will be accurate and appropriate, then it is essential to allow adequate time for the review of both the Yosemite Under Canvas DEIR and the Terra Vi Lodge DEIR.

CSERC respectfully requests an extension of 30 days for each DEIR since they are interconnected and together require the review of more than 3,000 pages of dry reading, data, Timber Harvest Plans, well reports, site plans, etc. If 30 days is not somehow acceptable, our Center asks for at least an extension of 20 days for each, but 30 days for each is our clear request.

Please respond back to this request for an extension as soon as reasonably feasible. Thank you. Stay healthy.

John Buckley

Executive Director, CSERC

SHUTE, MIHALY & WEINBERGER LLP

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ELLISON FOLK
Attorney
Folk@smwlaw.com

July 20, 2020

Via E-Mail

Quincy Yaley
Director, Community Development Dept.
County of Tuolumne
2 South Green Street, Second Floor
Sonora, CA 95370
qyaley@co.tuolumne.ca.us

Re: Request for Additional Time for Public Comment on Draft Environmental Impact Report for the Terra Vi Lodge Project

Dear Ms. Yaley:

On behalf of Save Sawmill Mountain, we write to request additional time for public comment on the Draft Environmental Impact Report ("DEIR") for the proposed Terra Vi Lodge Yosemite Project ("Project") in Tuolumne County ("County"). Like all concerned members of the public, Save Sawmill Mountain relies on the DEIR required by the California Environmental Quality Act ("CEQA") to obtain a thorough assessment of the environmental impacts of the Project, and we are in the process of carefully reviewing the document. However, in light of the DEIR's unusually voluminous length, the concurrent review period for the DEIR for the neighboring Yosemite Under Canvas Project, and extenuating circumstances caused by the COVID-19 pandemic, there has not been sufficient time for public review of the DEIR. We therefore request that the County extend the deadline for the public comment period from July 30, 2020 to August 30, 2020. **ORG4-01**

Save Sawmill Mountain is carefully and expeditiously reviewing the DEIR for the Project in order to gain a clear understanding of the Project's environmental impacts. We intend to comment on the document's adequacy and consistency with CEQA in a forthcoming letter once our review is complete. However, the existing public comment period is too short to allow meaningful public review in light of the document's overwhelming length and technical complexity. The main volume of the DEIR (Volume I) is nearly 500 pages long, while the technical appendices (Volume II) are over 1,300 pages long. The DEIR was made available for public comment on June 16, 2020, and the deadline for public comments is July 30, 2020, a period of only 45 days. This period does not provide enough time for Save Sawmill Mountain or members of the public to conduct a thorough review of the many complex issues raised by the DEIR. Informed decision-making and informed public participation are fundamental purposes of the CEQA process. *See Union of Med. Marijuana Patients, Inc. v City of San Diego* (2019) 7 C5th 1171, 1184-1185; *California Bldg. Indus. Ass'n v Bay Area Air Quality Mgmt. Dist*. (2015) 62 C4th 369, 381; *Laurel Heights Improvement Assn. v. Regents of University of California* (1988) 47 Cal.3d 376, 404. The public must have a meaningful opportunity to comment on a draft EIR. *See Laurel Heights Improvement Assn. v. Regents of University of California* (1993) 6 Cal.4th 1112, 1120, 1129. Here, in light of the length and complexity of the Project DEIR, the review period should be extended to allow adequate time for informed public participation.

The inadequacy of the public comment period for the Project's DEIR is compounded by the concurrent public review period for the DEIR for the neighboring Yosemite Under Canvas Project. The public review period for that project runs from June 5, 2020 to July 20, 2020, significantly overlapping with the review period for the Terra Vi Project. The main volume of the DEIR for the Under Canvas project is over 270 pages long, while the technical appendices are almost 1000 additional pages. Because the two projects would be located directly adjacent to each other across SR-120, they will produce combined cumulative impacts on transportation, wildfire risk, emergency response, water supply, biological resources, and other issues. Thus, in order for members of the public to fully understand the cumulative impacts of the Terra Vi Project, they must also review the Under Canvas DEIR, an even more difficult task in light of the limited time for public review and the combined length of the two documents.

ORG4-01 cont.

Finally, the COVID-19 pandemic has made it more difficult for Save Sawmill Mountain to complete its review of the Project DEIR within the allotted public comment period. State mandates restrict gatherings for face-to-face discussions with Project neighbors and with other local concerned citizens, and the ongoing public health emergency complicates efforts to consult with experts better equipped to evaluate the DEIR's many technical aspects. The pandemic situation adds to the already difficult challenge of reviewing two unusually lengthy DEIRs while working to develop well-informed responses and comments.

In light of the DEIR's length, the need for simultaneous review of the Under Canvas DEIR, and the COVID-19 emergency, the current public comment deadline of July 30 does not allow sufficient time for Save Sawmill Mountain to complete its review of the Project DEIR. In order to enable meaningful public review of the Project DEIR, we therefore respectfully request that the County extend the deadline for the public comment period for the Terra Vi DEIR from July 30, 2020 to August 30, 2020. For the same reason, we also request that the County extend the public comment deadline for the Under Canvas DEIR to the same date. We request your response to this extension request as soon as reasonably feasible. Thank you for your consideration.

Very truly yours,

SHUTE, MIHALY & WEINBERGER LLP

Ellison Folk

EF:PW

cc: Save Sawmill Mountain

1266593.2

From: Kevin Rice <kjrice@ucdavis.edu>
Sent: Sunday, July 26, 2020 2:55 PM
To: Natalie Rizzi <NRizzi@co.tuolumne.ca.us>
Subject: Sierra Club Tuolumne Group comments in response to the Terra Vi Lodge DEIR

Hi Natalie,

Please find attached our comments (Word and PDF) on the Terra Vi Lodge DEIR. Unfortunately we found that the DEIR did not adequately address many of the concerns that we had when we reviewed the IS-MND for this project last year. In particular, we were very disappointed that the developer did not appear to seriously consider building this on the suggested alternate "Scar" site. We think most of the current problems with this project in terms of wildfire risk, water supply, and wastewater disposal issues would be solved if it was built at the alternate site. ORG5-01

Best regards,

Dr. Kevin Rice, Ph.D.
Conservation Chair
Tuolumne Group of the Sierra Club

Tuolumne Group
P.O. Box 4440
Sonora, CA 95370

July 26, 2020

Tuolumne County Community Development Department
2 S. Green Street
Sonora, CA 95370

Comments in response to Terra Vi Lodge DEIR

To Natalie Rizzi, Quincy Yaley, County Planning Commissioners, and the Board of Supervisors:

Thank you for the opportunity to comment on the **Terra Vi Lodge** DEIR. This DEIR is even bigger than the associated Under Canvas Yosemite DEIR, but it also fails to adequately address the many previously identified problems associated with this project. In particular, the fears and concerns expressed previously by local Tuolumne County citizens about this project are clearly not addressed in any real way by this DEIR. The DEIR consistently uses unrealistic estimates of potential impacts of different aspects of the project to minimize the overall impact. This consistent "minimization of impact game" then allows the developer to conveniently dismiss the potential use of a very viable alternate site (The Scar site). Using the concerns of the local residents as a guide, we will focus our comments on three primary areas of concern: water supply, wastewater contamination, and wildfire risk. ORG5-02

Water supply – Previous reaction to this project from Tuolumne County residents at the town hall meeting and in comment letters are dominated by deep concerns about the likelihood that water use by this huge development will have severe impact on local residential water supply. These folks still remember the recent multiyear drought that was truly frightening in reducing the amount and reliability of the water supply to the local community.

It is worth repeating that this site is an area with **no aquifers** and "…*subsurface material consists primarily of impermeable granitic and greenstone bedrock which can result in a low groundwater yield.*" and "*The characteristics of the fractured rock and weather fluctuations have led to some wells providing unreliable sources of water."* (previous IS/MND). Even the current DEIR for this project notes that "*Fractured rock provides inconsistent groundwater conditions; some parcels are underlain by small pools of groundwater that are reliable, and others tap into less reliable subsurface rills and streamlets. The Tuolumne-Stanislaus Integrated Regional Water Management Plan determined that existing data are insufficient to quantify the total available sustainable groundwater supply. This is not atypical in fractured rock environments such as those that occur throughout the Sierra foothills*". ORG5-03

This DEIR further admits that this type of groundwater source is significantly influenced by yearly variation in precipitation. This is something that you do not need to tell the local residents; they saw how the effects of a multiyear drought consistently lowered the water levels in their wells. Given that groundwater supply is so strongly influenced by annual variation in precipitation, it is completely misleading to use pumping estimates from test wells taken in October 2019. **Why?** Because the snowpack in 2018-19 was **double** the normal amount and one of the highest in the last 50 years. As a result, these water supply numbers are not even good for normal years, much less an estimate of pumping capacity during a multiyear drought. In addition, there is no scientific evidence provided to support the contention that the 50% reduction factor will come even close to accurately predicting reduced capacity during multiyear droughts. **ORG5-03 cont.**

The use of this highly atypical pumping capacity estimate (38,160 gpd) is the first component of a deceptive analysis used to minimize the impact of water use by this project. The second deceptive component of this flawed analysis is to grossly underestimate the potential water demand of the project. The DEIR indicates that **16,640 gpd** is sufficient to supply 500+ people with their daily water requirements. Assuming 500 people, this results in **only a 33 gpd allocation per person**!

To inject some reality into this analysis, it is helpful to look at a more realistic rate of water consumption that is still highly conservative. A recent water use conservation goal that has gotten a lot of attention is the 55 gpd per person limit (https://docs.house.gov/meetings/II/II13/20190924/109994/HHRG-116-II13-20190924-SD004.pdf).

As has been noted repeatedly, this is a very tough water conservation goal. Nonetheless, if one uses a 55 gpd consumption rate per person for 500 people, the daily demand at Terra Vi is now estimated to be **27,500 gpd**. This more realistic demand comes much closer to the highly optimistic (i.e. very wet year) pumping rate of **38,160 gpd**. To exceed the pumping capacity, consumption would only have to increase to 77 gpd per person (not unlikely). **ORG5-04**

Even worse, this analysis does not seriously consider the cumulative effects that water pumping by the proposed Under Canvas Yosemite project just across the road will have on groundwater supply. Under Canvas Yosemite DEIR daily water use (using another unrealistically low estimate of 20 gpd per person) was estimated at **7,755** gpd. Given the close proximity of these two developments, it is not unreasonable to suspect that they share groundwater sources and so, with the Under Canvas use added in, the demand is now **35,255 gpd** which is almost equal to the optimistic pumping capacity of **38,160 gpd**.

If I had a home near this project, I would be very concerned about the future viability of my well. Finally, (just like the Under Canvas project) there is no potential back-up water supply if wells prove inadequate during a drought period because this site is not located near any municipal source of water.

Wastewater treatment and potential groundwater contamination – Even if one uses the very low estimate of pumping rate of 16,640 gpd for this project, wastewater production will exceed **6 million gallons per year**. The DEIR estimates that 7,000 gpd of grey water will be produced and used for irrigation. Thus, over **2.5 million gallons** of grey water would be available for irrigation; that is **a lot** of irrigation for native vegetation! Realistically, and as noted in the DEIR, there will thus be a surplus of grey water that will also have to be released into the leach fields.

Combining this grey water surplus with the remaining **3.5 million gallons of blackwater sewage**, the load on the septic system is immense. Given this incredible loading, it is absolutely astounding that there is not a real analysis of whether the proposed leach fields will be able to accommodate this wastewater load. The only evidence provided is a quote from the soil analyst that **ORG5-05** the site “should provide a more than adequate area for the wastewater system”. However, the analyst also said that “The exact amount of area needed for the commercial development wastewater system can only be determined during the wastewater system design process”.

Because there does not appear to be any real design at this point, the ability of these leach fields to handle this load is completely unknown. As far as I can tell, the DEIR does not give even the most minimal tests that are used in designing leach fields such as a percolation test or soil loading rates. These are tests that are commonly used even when designing septic systems for single family dwellings. The fact that this has not been done for a huge development truly boggles the mind. The DEIR assumes without evidence that this wastewater will have been adequately treated before moving into the groundwater. Percolation tests are necessary to determine whether the wastewater will be sufficiently treated before it mixes with the groundwater. ORG5-05 cont.

The soil analyst also notes that “This area is a low-lying saddle that has the potential to accumulate excess moisture from winter storm events.” Accumulation of excess moisture means that the soils at this site could become saturated. This soil saturation can cause backups of the entire wastewater treatment system and thus increase the chance of groundwater contamination. Again, percolation tests and soil loading studies are needed to assess the possibility of this major malfunction in wastewater storage capacity.

Finally, this flawed analysis of the wastewater load from Terra Vi does not even consider the potential wastewater input from the nearby proposed Under Canvas project. In sum, this analysis of the potential problems with wastewater disposal and groundwater contamination is totally inadequate.

Wildfire risk – The project area is located within a CALFIRE “**Very High Fire Hazard Severity Zone**” and so the concentration of a very large number of people in a relatively isolated (and highly flammable) location is a very bad idea. In fact, it seems pretty unconscionable to expose the 500+ folks at this facility (plus an additional 250+ at the proposed Under Canvas Project) to the extreme fire danger at this site when the closest fire station is a half hour away in Groveland. The crew from Groveland has only one engine and if there is a significant wildfire at this site, the crew would face an almost impossible job of trying to adequately protect this project and the Under Canvas development (and other facilities); especially difficult given that they would likely arrive fairly late to the fire scene. In addition, during a large wildfire event the station would likely prioritize Groveland and thus this site would be completely unprotected. ORG5-06

The potentially deadly traffic congestion that might result during combined evacuation of this facility and the Under Canvas glamping project across the street bring to mind visions of what happened at Paradise on a road that was bigger than Route 120. One of the more bizarre suggestions in this DEIR to reduce evacuation congestion was to have people shelter in place; apparently in a basement room that somehow would maintain proper ventilation for those inside while a firestorm rages above (!).

Although the DEIR argues that this development will reduce the danger of wildfire at the site, one only must look at the plans to visually screen the development from the road to see this is not the case. In Figures 4.1 – (6a through 9c), the growth of landscape plantings at different locations is ORG5-07 projected over a 10-year period to demonstrate effective visual screening for aesthetics. When I looked at these projections, all I saw was the growth of ladder fuels and a dramatic increase in fuel loading at the site. The canopies of the trees within these landscape plantings are completely overlapping in what looks like a tree plantation desperately in need of thinning! This is definitely not fuel reduction. **ORG5-07 cont.**

As a final example of the vague rationale that is often found in this DEIR, the solution proposed to reduce overcrowding on the YARTS transportation system is to hire a transportation coordinator. This coordinator is somehow supposed to solve the problem of not enough seats on YARTS. How this is to happen is not explained. **ORG5-08**

As noted earlier, this DEIR disingenuously dismissed the possibilities of the alternate site (i.e. the "Scar" site) by inaccurately minimizing impacts of the current project; significant impacts that would be truly mitigated at an alternate site. For example, the very real problems with water supply and wastewater disposal would be adequately addressed at the alternate site because of the capacity for municipal water supply and sewage service. Similarly, wildfire risk issues would be mitigated by being closer to the fire station and a reduced necessity for landscape screening (AKA fuel loading).

I really believe that the Tuolumne Group – Sierra Club would not have a problem with this project if it were at the alternate site. However, as currently proposed, this project is a total environmental and socio-economic disaster for the people of Tuolumne County. The residents of this County depend on their elected officials and planners to do the right thing for their well-being in the face of financially driven development. **ORG5-09**

Please do the right thing and deny this project as it currently stands and encourage the developer to seriously consider the alternate site.

Thank you again for considering our evaluation of this DEIR.

Sincerely,

Dr. Kevin Rice, Ph.D. in Ecology
Email – kjrice@ucdavis.edu
Conservation Chair
Tuolumne Group of the Sierra Club

COMMENT LETTER # ORG6

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July 29, 2020

Via E-Mail and U.S. Mail

Quincy Yaley
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County of Tuolumne
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Re: Draft Environmental Impact Report for the Terra Vi Lodge Yosemite Project

Dear Ms. Yaley:

On behalf of Save Sawmill Mountain, we have reviewed the Draft Environmental Impact Report ("DEIR") for the proposed Terra Vi Lodge Yosemite Project ("Project") in Tuolumne County ("County"). We submit this letter to state our position that the DEIR fails to meet the requirements of the California Environmental Quality Act ("CEQA"), Public Resources Code § 21000 et seq., and the CEQA Guidelines, California Code of Regulations, title 14, § 15000 et seq. ("Guidelines"). Like all concerned members of the public, Save Sawmill Mountain relies on the environmental review document required by CEQA for an honest and thorough assessment of the environmental impacts of a project such as this. We urge the County to correct the errors in the DEIR and provide the required assessment.

ORG6-01

The EIR is "the heart of CEQA." *Laurel Heights Improvement Assn. v. Regents of University of California* (1988) 47 Cal.3d 376, 392. It "is an environmental 'alarm bell' whose purpose it is to alert the public and its responsible officials to environmental changes before they have reached ecological points of no return. The EIR is also intended 'to demonstrate to an apprehensive citizenry that the agency has, in fact, analyzed and considered the ecological implications of its action.' Because the EIR must be certified or rejected by public officials, it is a document of accountability." *Id.* (citations omitted).

After carefully reviewing the DEIR for the proposed Project, we have concluded that it fails in numerous respects to comply with the requirements of CEQA. As described below, the DEIR violates the statute because it fails to: (1) analyze the significant environmental impacts of the Project, including impacts involving wildfire risk, emergency access and evacuation, hydrology, water quality, water supply, noise, and transportation; and (2) propose adequate mitigation measures and alternatives to address those impacts. **ORG6-01 cont.**

To comply with CEQA and to ensure that the public as well as the County's decisionmakers have adequate information to consider the effects of the proposed Project, the County must prepare and recirculate a revised draft EIR that properly analyzes Project impacts, and considers adequate mitigation measures that would address those impacts.

In addition, numerous aspects of the Project are inconsistent with the Tuolumne County General Plan, thereby violating the California Planning and Zoning Law, Gov. Code § 65000 et seq. Because these conflicts result in significant environmental impacts, the County's failure to identify them in the EIR violates CEQA as well. Therefore, the County may not legally approve the Project or certify the EIR. **ORG6-02**

I. THE DEIR'S INADEQUATE ANALYSIS OF AND MITIGATION FOR THE IMPACTS OF THE PROPOSED PROJECT VIOLATES CEQA.

A. The DEIR Lacks Evidence that the Project Would Not Expose People and Structures to Significant Risks Relating to Wildland Fire.

The DEIR dramatically understates the Project's potential wildfire risks and fails to provide an adequate analysis in support of its conclusion that these risks are less than significant. The end result is a document which is so deficient that decision makers and the public are left with no real idea as to the severity and extent of the Project's environmental impacts. *See, e.g., Berkeley Keep Jets Over the Bay Comm. v. Bd. of Port Comm'rs*. (2001) 91 Cal.App.4th 1344, 1370-71; *Galante Vineyards v. Monterey Peninsula Water Management Dist.* (1997) 60 Cal.App.4th 1109, 1123. **ORG6-03**

The proposed Project lies within a Very High Fire Hazard Severity Zone. DEIR p. 4.19-19. The Project site itself has burned at least three times, most recently in the 2013 Rim Fire, and there have been six wildfires in the immediate vicinity of the Project within the last 100 years. DEIR, Fig. 4.17-1. From 2001 to 2016, twelve fires have occurred in or near Tuolumne County that destroyed over 750 acres, while the 2013 Rim Fire burned a total of 257,314 acres, including the Project site. DEIR p. 4.9-12.

Although the DEIR recognizes that the Project will inherently increase the risk of fire ignitions by bringing people and vehicles to the area, DEIR p. 4.17-30 (Impact WF-3), the document erroneously concludes that "[t]he [P]roject would not expose people or structures, either directly or indirectly, to a significant risk of loss, injury, or death involving wildland fires." DEIR p. 4.19-19 (Impact HAZ-7). The DEIR's analysis is inadequate for several reasons. First, the DEIR fails to provide any substantive analysis of wildfire-related impacts, opting instead to simply list Project design features that would purportedly reduce these risks. Second, although the DEIR admits that fire protection services would be unable to reach the Project within established response times, the DEIR never actually grapples with this issue (i.e., never discloses the actual effects of a wildfire igniting on or near the Project site and the inability of emergency responders to access the site in a timely manner). Third, the DEIR fails to adequately analyze or mitigate public health impacts resulting from human exposure to wildfire. **ORG6-03 cont.**

1. The DEIR Provides No Evidence that Project Design Features Would Reduce Wildfire Risk to a Less than Significant Level.

ORG6-04

Instead of analyzing Project impacts involving wildfire risk, the DEIR relies on incorporation of Project design features and other measures intended to mitigate that risk, then boldly asserts that these features would reduce the impacts of wildland fires to a less than significant level. DEIR p. 4.19-19 (Impact HAZ-7). As an initial matter, CEQA does not allow an environmental document to fold an assumed mitigation measure (i.e., the Project design features) into the project description. The Project's significant impacts must be determined first, and then the EIR must identify enforceable mitigation that will "offset" the impacts. *See Lotus v. Department of Transportation* (2014) 223 Cal.App.4th 645, 656, 658 (rejecting EIR that relied on project designs to find no significant impact, instead of identifying significant impacts and considering potential mitigation measures). In *Lotus*, the court held that an EIR was legally inadequate where it assumed certain mitigation techniques would be incorporated into the project, and thus the EIR did not disclose the impacts of the project without those special techniques. *See id.* Further, the court in *Lotus* criticized the EIR's failure to consider whether other possible mitigation measures would be more effective than the ones that were assumed to be incorporated into the Project. *Id.* at 657. Here, by listing what are effectively mitigation measures as part of the Project, the EIR replicates the error made by the agency in *Lotus*.

The Project design features include separations between buildings, fire-resistant exterior building materials, an early evacuation protocol, an underground basement which could be used as a temporary shelter, a Vegetation Management Plan, "[p]rohibitions against risky behaviors," a construction fire prevention plan, fire pits operated by hotel staff, a communication plan, weather stations with alert protocols, employees trained as emergency responders, access to SR-120, compliance with the National Fire Protection Association's fire protection system, and an emergency helipad. DEIR p. 4.19-19 (Impact HAZ-7). However, the DEIR contains no analysis of the effectiveness of *any* of these Project features in mitigating wildfire risk, and it certainly provides no evidence that these features would be sufficient to make the development "safe."

Common sense dictates that many of the listed Project features would be insufficient to protect the Project and its occupants in the event of a large wind-driven wildfire. For example, while the DEIR asserts that fire risk would be reduced by an early evacuation protocol, the DEIR provides no evidence regarding the feasibility of early evacuation or the likely effectiveness of such a protocol. Wildfires may ignite suddenly, with little or no notice, and spread quickly with the wind, providing little time for early evacuation to occur. Wildfire early warning systems have often failed to work effectively in practice. *See, e.g.* Paige St. John, *Alarming* failures *left many in path of California wildfires vulnerable and without warning*, Los Angeles Times (Dec. 29, 2017), attached as Exhibit A (noting that in the October 2017 Tubbs fire in Santa Rosa, efforts to warn residents of approaching flames were successful only 50% of the time, and the entire warning system was fraught with multiple levels of malfunction and incompleteness). As discussed in detail below, the DEIR does not analyze evacuation scenarios and fails to evaluate the adequacy of SR-120 as an evacuation route. Also as discussed below, the DEIR suggests that Project occupants could shelter in place, yet it makes no attempt to evaluate whether this "shelter" would be a viable and safe alternative to evacuation.

ORG6-04 cont.

Nor does the DEIR analyze the effectiveness of the Project design features intended to reduce the potential for a wildfire ignition or acknowledge that ignitions could occur despite such features. For example, the DEIR suggests that "prohibitions against risky behaviors" would be developed, such as limiting smoking to a designated smoking area, prohibiting barbecues during times of high fire danger, educating guests and personnel on fire-safe behaviors, and providing trash cans to reduce litter. DEIR p.3-23. Yet, it is important to reiterate that the Project will inherently increase the risk of fire ignitions because it will introduce roads, paths, and parking areas into areas where they were previously absent, providing access for people and their vehicles. DEIR p. 4.17-30 (Impact WF-3). The Project would accommodate up to 400 guests in addition to staff, and a large wildfire can easily be started by a single individual taking risky or "prohibited" actions, as happened with the 2013 Rim Fire. *See* Eric Heinz, *Rim Fire Cause Determined by Investigators*, Tahoe Daily Tribune (Sept. 6, 2013), attached as Exhibit B (noting that Rim Fire was caused by a hunter's illegal fire that escaped out of control). Indeed, a fire can start from mere acts of carelessness (e.g., falling asleep before extinguishing a wildfire or disposing of a lit cigarette in a trash can) or through no human

ORG6-05

action at all (e.g., parts of a car or trailer dragging on the ground or a vehicle's exhaust system parked or driving through extremely dry vegetation). **ORG6-05 cont.**

The DEIR also does not provide the required evidentiary support for its conclusion that the use of ignition-resistant buildings materials or vegetation management techniques (e.g. low-fuel landscaping) would reduce wildfire risks to a less than significant level. The 2013 Rim Fire destroyed 112 structures, including 11 residences and several commercial buildings. *See* Headwaters Economics, *Rim Fire - California, 2013* (2018), attached as Exhibit C. Fire-resistant building codes and vegetation management plans are not enough to protect communities at high risk of wildfire. Ignition-resistant modern building materials are less flammable than their older counterparts, but this does not make them "safe" or immune to wildfire. Indeed, the Thomas Fire in December 2017 showed that the highest fire-resistant building standards were not enough to protect structures from destruction. More than 90% of the structures destroyed had fire resistant construction. *See* JP Theberge, *Stop Dismissing Concerns About The Risks Of New Homes In Wildfire Zones*, Voice of San Diego, June 5th, 2019, attached as Exhibit D. Similarly, in the Tubbs Fire in October 2017, 86% of the homes destroyed were built after 2008 and used the highest wildfire construction standards. *Id*. As these fires demonstrated, noncombustible siding and roofing, interior sprinklers, and enclosed eaves are no match for softball-size embers slamming into homes at 60 mph. *Id*. The DEIR fails to recognize that building the Project within a Very High Fire Hazard Severity Zone (on a site that has already burned three times) inherently poses severe wildfire risks to the Project occupants and the surrounding communities, even where fire-resistant building materials and landscaping are used. **ORG6-06**

The DEIR also baselessly suggests that because certain Project features would comply with regulatory requirements intended to reduce wildfire risk, those features would therefore reduce the Project's wildfire risks to a less than significant level. *See* DEIR p. 4.19-19 (Impact HAZ-7) (noting that building materials would be compliant with Chapter 7A of the California Building Code and that construction would be in compliance with the National Fire Protection Association's fire protection system); *see also* DEIR p. 4.17-31 (noting that Project would be designed to comply with State Responsibility Areas Fire Safe Regulations, California Fire Code, Tuolumne County General Plan policies, and Tuolumne County Code of Ordinances, Chapter 15.20). Regulatory compliance does not mean Project features are sufficient to protect people from a significant risk of injury or death from wildland fires. Even if the Project developer does adopt these design features, the DEIR's reliance on asserted compliance with regulatory requirements cannot be used to bypass the County's obligation to study the Project's potentially significant impacts, and to mitigate those impacts. *See* **ORG6-07**

Communities for a Better Environment v. Cal. Resources Agency (2002) 103 Cal.App.4th 98, 111-14 (compliance with an environmental regulatory program cannot displace an agency's *separate* obligation to consider whether a project's environmental impacts are significant); *Californians for Alternatives to Toxics v. Department of Food & Agriculture* (2005) 136 Cal.App.4th 1, 15-17 (same). Regulatory compliance does not determine the significance of impacts nor the effectiveness of mitigation measures. **ORG6-07 cont.**

2. The DEIR Entirely Ignores Wildfire Risks Resulting From Inadequate Fire Protection Services.

As discussed further below, the DEIR acknowledges that the Project will not be adequately served by existing fire protection services, as firefighters will not be able to reach the Project site in a timely manner. DEIR p. 4.14-7. However, the DEIR fails to evaluate the impacts of inadequate fire service response times on wildfire risk at the site. The closest staffed fire station to the Project site, the Groveland Community Services District ("CSD") station, is located approximately 17 miles away, which translates to an approximately 22-minute response time *with no traffic*.[1] DEIR p. 4.14-3. The service standard goal for the Groveland CSD fire station is to respond to 90 percent of calls for service within the GCSD boundaries within 7 minutes. DEIR p. 4.14-4. Given the distance between the Project site and the Groveland CSD station, the DEIR acknowledges that is not possible for firefighters to achieve this service standard when responding to calls to the Project site. DEIR p. 4.14-4. The already inadequate 22-minute estimated fire service response time from Groveland CSD represents a best-case scenario, and the DEIR does not analyze the even longer response times that would result from traffic on SR-120 during a wildfire evacuation, including traffic from the surrounding community. The DEIR must consider the likelihood of longer fire response times during wildfire evacuation scenarios and their potential effects on wildfire risk at the Project site. **ORG6-08**

Moreover, in addition to inadequate fire service response times, the DEIR must also address the possibility that during a large wind-driven wildfire, the Groveland CSD fire station and other, more distant fire stations in the area (e.g. the Tuolumne County Fire Department and CAL FIRE).may need to direct their limited firefighting resources and equipment elsewhere in order to combat the fire. The fire engines from these stations may be needed for fire suppression activities or protection of other threatened structures across a large service area. As a result, there may not be adequate firefighting equipment available to protect the Project site, possibly only one fire engine or even none at all. During a large wind-driven wildfire, a single fire engine would be entirely inadequate to **ORG6-09**

[1] It is our understanding that Bob Asquith, Groveland CSD, identified a 45 minute response time from the Groveland station.

protect the Project and its hundreds of guests, not to mention other nearby lodging facilities. Until the DEIR discusses these implications, it has no basis to conclude that impacts relating to wildfire exposure would be less than significant. **ORG6-09 cont.**

3. The DEIR Fails to Adequately Analyze or Mitigate Public Health Impacts From Wildfire-related Pollutant Concentrations.

The DEIR acknowledges that the Project has the potential to expose people to elevated pollutant concentrations due to wildfire. DEIR p. 4.17-26 (Impact WF-2). It states that "due to the location of the proposed Project in a forested area, historic fires in the region, and the fact that the proposed Project would bring people and vehicles to a site within a fire-prone area, the Project has the potential to exacerbate wildfire risks and thereby expose Project occupants to pollutant concentrations from a wildfire or the uncontrolled spread of a wildfire." DEIR p. 4.17-28. This statement is no substitute for a detailed analysis of these impacts. Under CEQA, such self-evident ruminations cannot substitute for meaningful analysis. *City of Antioch v. City Council* (1986) 187 Cal.App.3d 1325. Rather, an EIR must contain analysis sufficient to allow informed decision making. Here, the DEIR must actually analyze the potential levels of human exposure to air pollutants which might result during a wildfire at the Project site, including projected air pollutant concentrations.

The DEIR lists Project features that it asserts would reduce potential wildfire hazards, including landscaping measures intended to reduce fire risk, but immediately acknowledges that "planting placement, density, and species on the Project's landscaping plans are not consistent with these proposed wildfire hazard reduction features." DEIR p. 4.17-29. The DEIR then identifies mitigation measures, including the preparation of a Wildland Fire Prevention Plan and Vegetation Management Plan, and revising the Project site plan and landscaping to conform to this Vegetation Management Plan. DEIR p. 4.17-29. However, the DEIR provides no evidence that these mere landscaping features would be sufficient to protect public health from wildfire-related pollutant concentrations. When a lead agency relies on mitigation measures to find that project impacts will be reduced to a level of insignificance, there must be substantial evidence in the record demonstrating that the measures are feasible and will be effective. *Sacramento Old City Assn. v. City Council of Sacramento* (1991) 229 Cal.App.3d 1011, 1027; *Kings County Farm Bureau v. City of Hanford* (1990) 221 Cal.App.3d 692, 726-29. To conclude, as the DEIR does, that an impact is less than significant, substantial evidence must demonstrate that mitigation measures will reduce an impact to a less-than-significant level. Substantial evidence consists of "facts, a reasonable presumption predicated on fact, or expert opinion supported by fact," not "argument, speculation, unsubstantiated opinion or **ORG6-10** narrative." Pub. Res. Code § 21080(e)(1)-(2). Because the DEIR's conclusion of insignificance is premised on unsupported assumptions, it falls far short of this threshold. ORG6-10 cont.

4. The DEIR Fails to Analyze the Project's Cumulative Impacts on Wildfire Risk.

An EIR must discuss a project's significant cumulative impacts. CEQA Guidelines § 15130(a). The cumulative impacts concept recognizes that "[t]he full environmental impact of a proposed . . . action cannot be gauged in a vacuum." *Whitman v. Board of Supervisors* (1979) 88 Cal.App.3d 397, 408. Cumulative impacts are defined as "two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts." CEQA Guidelines § 15355(a). "[I]ndividual effects may be changes resulting from a single project or a number of separate projects." CEQA Guidelines § 15355(a). "Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time." CEQA Guidelines § 15355(b). A legally adequate cumulative impacts analysis views a particular project over time and in conjunction with other related past, present, and reasonably foreseeable future projects whose impacts might compound or interrelate with those of the proposed project. Here, the DEIR fails to provide any analysis of the Project's cumulative wildfire-related impacts and is therefore legally inadequate.

ORG6-11

The DEIR concludes that "the [P]roject would not contribute to significant cumulative wildfire impacts." DEIR p. 4.17-34 (Impact WF-5). Once again, the DEIR provides no analysis to support this conclusion. The DEIR lists other nearby development projects that contribute to fire risk, including the proposed Yosemite Under Canvas development located to the south of the Project site across SR-120, the Thousand Trails/Yosemite Lakes RV Expansion, the Berkeley Tuolumne Camp Restoration project southeast of the Project site, and the Mountain Sage Conditional Use Permit project located west of the site. *Id*. The DEIR then simply asserts that "[c]ompliance with regulatory requirements, proactive fire suppression design features, the inclusion of project components that would reduce wildfire risks," and the implementation of mitigation measures would reduce the impacts from the proposed Project to less than significant. DEIR p. 4.17-35. As explained above, regulatory compliance cannot substitute for informed impact analysis. The DEIR must actually analyze the potential cumulative effects of the Project in combination with fire risks posed by other developments. A critical component of this analysis will be an evaluation of how the proposed Project, together with cumulative development, would affect fire protection services.

In conclusion, the EIR must be revised to provide a comprehensive analysis of the Project's potential to expose people and structures to wildfire-related risks. As part of this analysis, the EIR must undertake fire behavior modeling to document the type and intensity of fire that would be expected in the Project area. This analysis must take into account cumulative impacts and identify feasible mitigation measures or Project alternatives capable of reducing these impacts. **ORG6-11 cont.**

B. The DEIR Provides No Evidence that Impacts Relating to Emergency Access, Emergency Evacuation, and Emergency Response Would Be Less Than Significant.

The DEIR addresses emergency access and emergency evacuation in several areas of the EIR. In each instance, after a cursory discussion, the document concludes that the Project's impacts would be less than significant. As discussed below, the DEIR lacks the required analytical support for these conclusions. **ORG6-12**

1. The DEIR Does Not Analyze the Project's Impacts on Emergency Access.

The DEIR's one-paragraph discussion of the Project's impacts on emergency access is entirely inadequate, as it lacks any substantive analysis. DEIR p. 4.15-21 (Impact TRANS-4). Once again, the document is so deficient that decisionmakers and the public are left with no real idea as to whether access during an emergency such as a wind-driven wildfire would even be possible. **ORG6-13**

The DEIR simply asserts that because the Project includes two driveways providing vehicle access to Forest Route1S03, also known as Sawmill Mountain Road, and a third driveway providing access to SR-120 for emergency vehicles only, the Project would not result in inadequate emergency access and the Project's impacts in this regard would be less than significant. DEIR p. 4.15-22. The existence of three driveways connecting the Project to adjacent roads is not sufficient to demonstrate that there would be no significant impacts on emergency access.

As an initial matter, the DEIR fails to accurately describe Forest Route1S03. The EIR refers to this route as Sawmill Mountain Road. Forest Route1S03 is a 22-foot wide Forest Service route with no shoulders ending in a cul-de-sac. The applicant proposes that access to the Project be from this Forest Service route rather than from the main highway, SR-120. This is entirely illogical, as Forest Route1S03 was never intended for commercial access. **ORG6-14**

In another egregious error, the DEIR appears to intentionally ignore the fact that Forest Route1S03 provides access to about 15 residences and two large campgrounds. In the event that a fire erupts on or near the Project site, residents in the area and campers (including those with RVs!), along with the Project's occupants and employees, would all rely on Forest Route1S03 to escape, while emergency responders would need to use this same 22-foot route to access the fire. The EIR's failure to disclose accurate information about Forest Route1S03 or the land uses that are located along this route is a fatal flaw. The revised EIR must identify each of the land uses that rely on Forest Route1S03 and then analyze whether this route would provide adequate access and egress during an emergency such as a major wildfire. ORG6-15

Nor does the DEIR consider the capacity of SR-120 or the amount of traffic that could be on this roadway in the event of a wildfire evacuation, which could impede access by emergency vehicles. The revised EIR must provide this information. It must also examine whether fire or other natural hazards could obstruct SR-120, thereby limiting the ability of emergency vehicles to reach the Project area. ORG6-16

While the DEIR asserts that the inclusion of a helipad in the Project "would provide improved emergency helicopter access," DEIR p. 4.17-25, this is not a substitute for ground-based emergency vehicle access, and the DEIR includes no substantive analysis of the helipad's potential limitations in providing emergency access to the site. Nor does the DEIR provide any analysis of impacts caused by the helipad's location directly adjacent to residents' access driveways off Forest Route1S03. The revised DEIR must explicitly identify the location of each driveway that has access from Forest Route1S03 and evaluate whether these driveways would be obstructed as a result of helicopter operations. ORG6-17

Given the wildfire crisis plaguing the West, it is imperative that EIRs comprehensively analyze emergency access impacts especially for projects that are located within Very High Fire Hazard Severity zones. The revised EIR must include this critical analysis. Given that the emergency access impacts would undoubtedly be significant, the revised EIR must also evaluate an alternative to the Project in which access to the Project site is from SR-120 instead of Forest Route1S03. ORG6-18

2. The DEIR Fails to Evaluate Any Evacuation Scenarios.

In the hazards chapter of the DEIR, the document acknowledges that the Project would be reliant on SR-120 as the primary means of evacuation from the site. DEIR p. 4.19-19 (Impact HAZ-7). Yet the DEIR makes no attempt to determine the adequacy of this primary evacuation route. It does not consider whether SR-120 could accommodate ORG6-19 the Project's traffic together with the traffic from other evacuees during a wildfire event, nor does it address the possibility that SR-120 might be blocked during a wildfire. Instead, the DEIR merely assumes, with no evidence, that emergency evacuation from the site will be feasible.

During the 2013 Rim Fire, which burned approximately 402 square miles, including the Project site, an 18-mile segment of SR-120 passing through the fire area was closed to traffic for *nine days*, forcing many people to seek alternative evacuation routes. *See* Mary Forgione, *Rim fire: New road closure, long detours for some Yosemite visitors*, Los Angeles Times (Aug. 28, 2013), attached as Exhibit E ("Tioga Road, also known as Highway 120, was closed between Tamarack Flat and Yosemite Creek campgrounds, a roughly 18-mile stretch"); *Highway 120 to reopen after Rim fire closure*, Modesto Bee (Sept. 6, 2013), attached as Exhibit F. The DEIR fails to mention this fact, let alone analyze how the Project's occupants would fare when another wildfire affects the Project area. Moreover, even if SR-120 remains open, evacuation during a wildfire event would almost certainly be impeded by heavy traffic, as many evacuees would simultaneously attempt to flee the area.

In the DEIR's wildfire chapter, the document simply asserts that guests would be notified early of any natural hazards requiring evacuation, and that guests could shelter in place at the Project site if evacuation were not feasible. DEIR p. 4.17-25 ("If evacuations are needed, guests would be notified early to minimize peak traffic on SR-120 in the event of an incident that requires evacuation. The expectation is that the guests and employees would remain on-site in the event of a wildfire or other disaster when early evacuation is not possible."). However, the DEIR fails to analyze the feasibility of evacuation or the effectiveness of shelter-in-place measures. In the event of a severe wind-driven wildfire, early evacuation may not be feasible, as wildfires may arise quickly and may block egress via SR-120.

ORG6-19 cont.

Despite the expectation that guests and employees may have to shelter in place, the DEIR lacks the necessary information to determine whether shelter-in-place would even be a viable and safe alternative to evacuation. Asking Project occupants to shelter in place and thereby experience the danger of an extreme wind-driven fire is not a substitute for offering them a reliable means of evacuation from the site. While the DEIR notes that the Project will include a basement that could be used as a shelter in the event of a fire, DEIR p. 4.19-19 (Impact HAZ-7), it lacks critical details that would allow for a determination of the safety and effectiveness of this shelter during a prolonged wildfire (e.g., whether the basement would be large enough to accommodate all guests and employees, the effectiveness of the basement's ventilation system in the event that the above-ground building burns, or details regarding how long the basement could provide effective shelter). Regardless of any shelter-in-place protocol, it is likely that in the event of a severe wind-driven wildfire, many guests will attempt to flee the area.

It is imperative that the DEIR comprehensively analyze emergency evacuation, yet the document fails to identify the amount of time needed to implement a full evacuation of the Project site, including whether the evacuation could be accomplished within an acceptable time period. It is now common practice for local agencies to require the preparation of evacuation analyses for land use development projects. These analyses identify the time it will take an area to evacuate by dividing the number of vehicles that need to evacuate by total roadway capacity. *See e.g.*, Safari Highlands Ranch and Citywide SOI Update Wildfire Hazard Analysis, attached as Exhibit G. These evacuation analyses also routinely take into account the fact that neighboring communities could also be evacuating in a similar time frame. *Id*. These analyses actually model various scenarios of wildland fire that could occur in a project's vicinity based on various factors to determine whether project residents or visitors would have adequate time to escape, and the ability of emergency services to access the site in a timely manner, consistent with emergency service provider's response time goals. It is essential that such an analysis be conducted for the proposed Project, given its location in a Very High Fire Hazard Severity Zone and because SR-120 would likely experience heavy traffic congestion during a wildfire evacuation (e.g. a westward evacuation of Yosemite National Park). **ORG6-19 cont.**

In short, the EIR will remain inadequate until the following questions are answered:

- If a fire is approaching from a direction that necessitates travel to the west on SR-120, does this two-lane road have adequate capacity to accommodate all of the Project and non-Project-related traffic, and emergency response vehicles that might be on the road during an evacuation?

- If a fire is approaching from a direction that necessitates travel to the east on SR-120, does this two-lane road have adequate capacity to accommodate all of the Project and non-Project-related traffic, and emergency response vehicles that might be on the road during an evacuation?

- How long would it take to evacuate the Project site in the event of a wildland fire?

- Could an evacuation of the Project site and nearby community be successfully accomplished?
- Would multi-jurisdictional fire efforts truly be able to provide adequate emergency response?

ORG6-19 cont.

3. The DEIR Fails to Adequately Analyze or Mitigate Impacts Relating to An Increased Demand for Fire Protection Services.

The DEIR acknowledges that the Project will not be adequately served by existing fire protection service and will put additional strain on already-overburdened fire departments. DEIR p. 4.14-7. The closest staffed fire station to the Project site is the Groveland Community Services District ("CSD") station in Groveland. The Groveland CSD Station is located approximately 17 miles from the Project site, which translates to an approximately 22-minute drive time *with no traffic*. DEIR p. 4.14-3. Other fire stations are located even further away. The service standard goal for the Groveland CSD fire station is to respond to 90 percent of calls for service within the GCSD boundaries within 7 minutes. DEIR p. 4.14-4. The DEIR acknowledges that given the distance between the Project site and the Groveland CSD station, it is not possible for the CSD to achieve this service standard when responding to calls to the Project site. DEIR p. 4.14-4.

The DEIR also acknowledges that "[t]he [P]roject would result in the need for new or physically altered fire protection facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times, or other performance objectives." DEIR p. 4.14-7 (Impact PS-1). Instead of actually grappling with this serious impact by examining how, for example, the County could add additional fire protection to meet the needs of the Project and analyzing the associated environmental impacts, the EIR looks to a series of Project features that could purportedly limit the number of incidents on the Project site. DEIR p. 4.14-7. Again, as we explained previously, the DEIR cannot substitute the implementation of Project features for a detailed analysis of impacts. *See Lotus v. Department of Transportation*, 223 Cal.App.4th at 656, 658. Setting aside this legal error, the DEIR concedes that these Project features (which include measures such as fire-resistant physical design features, a fire extinguishing and alarm system, on-site water storage, a helipad, emergency communications equipment, and employee training) would not resolve Project impacts relating to fire response time deficiencies. DEIR p. 4.14-8. The DEIR correctly identifies this as a significant impact. *Id*.

ORG6-20

However, the DEIR then identifies a mitigation measure which differs only slightly from the aforementioned Project features, and inexplicably asserts that while those Project features would not reduce impacts to a less than significant level, the very similar mitigation measure would in fact reduce impacts to be less than significant. *Id*. This mitigation measure calls for staff training, this time in accordance with "Tuolumne County Fire Department volunteer fire service standards," DEIR p. 4.14-8 (Mitigation Measure PS-1), yet it does not explain how the simple act of training staff could begin to substitute for the provision of actual firefighting units which would of course be needed to protect the site in the event of a large wildfire. Mitigation Measure PS-1 also calls for emergency communications equipment, but the DEIR does not explain how this would differ from the other emergency communications equipment which the DEIR previously concluded was insufficient to avoid significant impacts to fire protection services. *See* DEIR p. 4.14-7 (explaining that the Project's features relating to enhanced communications would not be sufficient to maintain adequate fire response times). **ORG6-20 cont.**

The DEIR's failure to adequately analyze these impacts or identify effective mitigation measures is a fatal flaw requiring that the EIR be revised and recirculated for public review and comment.

4. The DEIR Does Not Analyze the Project's Impacts on the County's Emergency Response and Evacuation Plans.

The DEIR asserts that the Project would not interfere with the County's emergency response plans or emergency evacuation plans but provides no evidence in support of this claim. The DEIR notes the existence of Tuolumne County's Multi-Jurisdictional Hazard Mitigation Plan (HMP), Emergency Operations Plan, and various General Plan policies related to emergency response, claiming that "[c]ompliance with applicable laws and regulations regarding emergency preparedness, and the General Plan policies, would ensure that the proposed [P]roject would not interfere with an adopted emergency response plan or emergency evacuation plan and impacts would be less than significant." DEIR p. 4.9-18. However, the DEIR never explains how compliance with these plans and policies would reduce Project impacts to less than significant levels, or why the Project would not interfere with emergency operations. **ORG6-21**

While the County's Emergency Operations Plan sets emergency response policy, assigns emergency response responsibilities, and coordinates planning for disasters including wildfires (DEIR p. 4.9-8), the existence of the plan does not negate the Project's potential impacts. Similarly, the County's Hazard Mitigation Plan and General Plan policies do not eliminate the need to evaluate the Project's impacts under CEQA. Compliance with applicable laws and regulations is not sufficient and does not demonstrate that the Project's impacts would be less than significant. As we explained previously, alleged regulatory compliance cannot substitute for detailed analysis of impacts. Even if a project complies with all applicable regulations, the project is still subject to CEQA's full disclosure requirements. *Kings County Farm Bureau v. City of Hanford* (1990) 221 Cal.App.3d 692, 716 (permit applicant could not rely on conformance with local air district rules to establish that the project would have no significant impact for CEQA purposes). Consultation and compliance with agencies' rules do not cure the errors in an environmental document that "leave the reader in the dark about what land management steps will be taken, or what specific criteria or performance standard will be met." *San Joaquin Raptor Rescue Center v. County of Merced* (2007) 149 Cal.App.4th 645, 670. Here, the DEIR must actually explain how the Project would comply with the specific requirements of these plans. **ORG6-21 cont.**

5. The DEIR Fails to Analyze Cumulative Impacts Relating to Emergency Access, Emergency Response and Fire Protection Services.

The DEIR lists several other developments in the vicinity of the Project, including the proposed Yosemite Under Canvas development located to the south of the Project site across SR-120, the Thousand Trails/Yosemite Lakes RV Expansion, the Berkeley Tuolumne Camp Restoration project southeast of the Project site, and the Mountain Sage Conditional Use Permit project west of the site. DEIR p. 4.15-22. Like guests at the Project, occupants of those other developments would very likely use SR-120 as an evacuation route. Simultaneous evacuation of occupants from multiple developments in the area due to wildfire would likely cause traffic congestion on SR-120 and would thus have cumulative effects on emergency evacuation and emergency vehicles. However, the DEIR fails to analyze how the Project, together with cumulative development in the area, would impact emergency access, emergency evacuation, and emergency response. **ORG6-22**

Rather than analyze these impacts, the DEIR once again asserts that compliance with applicable local, state, and federal regulations means the Project's cumulative impacts on fire risk, emergency response plans, and emergency evacuation plans would be less than significant. DEIR p. 4.9-20 (Impact HAZ-8). As explained above, the DEIR's reliance on asserted compliance with regulatory requirements cannot be used to bypass the County's obligation to study the Project's potentially significant impacts, and to mitigate those impacts.

Notably, the latest plans for the Yosemite Under Canvas project, located immediately south of the Project site across SR-120, indicate that the development will include an emergency access road providing a second means of egress to SR-120 in addition to the main entrance on Hardin Flat Road. *See* Yosemite Under Canvas Draft Environmental Impact Report (June 2020), p. 2-5, Fig. 3; excerpts attached as Exhibit H. The Under Canvas project's second access road would connect to SR-120 via Forest Service Road 1S09, which intersects SR-120 approximately 100 feet west of SR-120's intersection with Forest Route1S03. *Id*. pp. 2-5, 2-10. The close proximity of these two intersections could create dangerous traffic conditions during an emergency evacuation. In the event of a wildfire, evacuating traffic from the Terra Vi Project would combine with traffic from homes on Forest Route1S03, traffic from the Under Canvas project, and other traffic on SR-120, including other evacuation traffic and emergency vehicle traffic. The DEIR must evaluate the cumulative effects of Project traffic and Under Canvas traffic on SR-120 during an emergency evacuation. **ORG6-22 cont.**

Regarding fire protection services, the DEIR does acknowledge that the Project, in combination with other nearby projects, could result in significant cumulative impacts, as these developments would collectively place further strain on already overstretched fire departments. DEIR p. 4.14-9 (Impact PS-2). Again, the DEIR includes no analysis of these cumulative impacts. As noted above, in addition to inadequate fire service response times, the DEIR must also address the possibility that during a large wind-driven wildfire, the Groveland CSD fire station and other fire stations in the area may need to direct their limited firefighting resources and equipment elsewhere in order to combat the fire. Their fire engines may be needed for fire suppression activities or protection of other threatened structures across a large service area. As a result, there may not be adequate firefighting equipment available to protect the Project site along with other nearby developments. By placing hundreds of guests in harm's way in a Very High Fire Hazard Severity Zone, the Project would exacerbate firefighting capacity challenges. **ORG6-23**

The DEIR must disclose and analyze these cumulative impacts and may not simply declare them to be significant without any substantive discussion. A conclusion of significance cannot take the place of description and analysis of a project impact. As the courts have made clear, "[t]his approach has the process exactly backward and allows the lead agency to travel the legally impermissible easy road to CEQA compliance. Before one brings about a potentially significant . . . change to the environment, an EIR must be prepared that sufficiently explores the significant environmental effects created by the project." *Berkeley Keep Jets Over the Bay*, 91 Cal.App.4th at 1371; *see also Stanislaus Natural Heritage Project v. County of Stanislaus* (1996) 48 Cal.App.4th 182 (invalidating EIR that had failed to adequately analyze water supply impacts but found them to be significant). **ORG6-24**

The DEIR relies on the same mitigation measures proposed for Impact PS-1 (e.g. communications equipment and emergency fire response training for Project staff), **ORG6-25** suggesting that they would be sufficient to reduce cumulative impacts on fire protection services, but provides no evidence or analysis in support of this conclusion. DEIR p. 4.14-9. Because the DEIR fails to provide adequate mitigation for the Project's impacts on fire protection services, its conclusion that such impacts would be less than significant cannot be sustained. **ORG6-25 cont.**

6. The DEIR Fails to Adequately Analyze the Project's Numerous Inconsistencies with the General Plan's Wildfire/Emergency Evacuation-Related Policies.

If approved, the Project would be clearly inconsistent with a number of goals and policies in the Tuolumne County General Plan, yet the DEIR fails to identify these inconsistencies as significant impacts. In other instances, the DEIR fails to undertake the analysis clearly required by the General Plan.

The Project would be located in a Very High Fire Hazard Severity Zone and would subject its occupants and nearby communities to a severe risk of exposure to wildfire. The Project is therefore inconsistent with General Plan Goal 17A, which calls for the County to "[a]void the exposure of people and structures to potential substantial adverse effects, including the risk of loss, injury or death involving natural hazards," DEIR p. 4.17-8. The Project is also inconsistent with General Plan Policy 17.E.1, which seeks to "[r]educe the exposure to risk from wildland fire to an acceptable level by only allowing development in high or very high fire hazard areas if it can be made safe by planning, construction, or other fire safety measures." DEIR p. 4.9-10. The DEIR does not demonstrate that any of the proposed Project features or mitigation measures would be sufficient to make the development "safe." **ORG6-26**

As discussed above, the Project would contribute to traffic congestion during an evacuation, thereby worsening delays by emergency responders. Implementation Program 9.E.b calls for the County to "[r]equire that new development be provided with access roads that allow for safe and efficient response by emergency apparatus and the safe evacuation of residents in the event of structural or wildland fire." DEIR pp. 4.17-7. To further this goal, General Plan Policy 9.E.1 calls for the County to "evaluate the circulation system to identify areas causing delay of emergency vehicle response and evacuation due to traffic congestion." DEIR pp. 4.14-2, 4.17-7. The DEIR fails to undertake the analysis explicitly required by this policy. What little information that has been provided reveals that the Project would interfere with safe evacuation and emergency response, which is in direct violation of this General Plan Implementation Program. **ORG6-27**

The Project is also blatantly inconsistent with General Plan policies pertaining to fire protection service levels. General Plan Goal 9E calls for the County to "[p]rovide structural fire protection to persons and property within Tuolumne County consistent with the needs dictated by the level of development and in accordance with current Federal, State, and local fire protection agency regulations and policies." DEIR pp. 4.14-2. General Plan Policy 9.E.2 calls for the County to "[m]aintain adopted levels of fire protection service," and General Plan Policy 9.G.3 requires the County to "[d]etermine the impact proposed development will have on the provision of fire protection services and maintain the established level of service as outlined in the current Tuolumne County Fire Department Service Level Stabilization Plan." DEIR pp. 4.17-7; 4.17-8. As discussed above, under the best of circumstances, the Project would not come close to achieving the service standard goal for the Groveland CSD fire station. **ORG6-28**

The aforementioned General Plan goals and policies are critically important, as they were adopted specifically to protect public safety in a County with a well-known history of devastating wildfires. The DEIR's failure to undertake the analyses required by these goals and policies and to identify these inconsistencies as significant effects of the Project are fatal flaws requiring that the EIR be revised and recirculated.

D. The DEIR's Analysis of and Mitigation for the Project's Water Quality and Hydrology Impacts is Inadequate.

Along with Greg Kamman, a hydrologist with CBEC Eco Engineering, we have reviewed the DEIR's water quality, hydrology, and water supply sections. *See* CBEC Eco Engineering, Report re: Terra Vi Lodge DEIR, July 27, 2020, attached as Exhibit I and incorporated by reference into this letter. As discussed below, and further explained in the CBEC report, the DEIR fails to adequately analyze and mitigate the Project's water quality and hydrology impacts. **ORG6-29**

1. The DEIR Does Not Adequately Analyze or Mitigate the Project's Stormwater and Drainage Impacts on Water Quality.

The DEIR acknowledges that the proposed Project would impact drainage patterns and increase the overall amount of impervious surfaces, thus increasing runoff, creating changes to stormwater flows, and potentially degrading water quality. DEIR pp. 4.10-8, 4.10-13, 4.10-14. However, the DEIR fails to analyze these impacts. Instead, the document simply notes that the Project will produce stormwater runoff, which "typically" includes pollutants such as oil and sediment from parking lots or pesticides from landscaped areas. DEIR pp. 4.10-8, 4.10-9. As the CBEC report explains, EIRs typically include detailed hydrologic analyses to quantify the magnitude of project runoff in order **ORG6-30** to evaluate if it would exceed the capacity of existing or planned storm water drainage systems structures (e.g., the existing drainage culvert under Highway 120) or otherwise degrade water quality. CBEC report at 1. As with other sections of the DEIR, the document substitutes the required analysis of impacts with a list of Project features (e.g., use of drainage swales and landscaped stormwater detention areas) that would allegedly reduce impacts. DEIR pp. 4.10-9, 4.10-13. However, the DEIR makes no attempt to explain how these features would protect water quality. Moreover, despite calling for the implementation of these features, the DEIR concludes that without mitigation, the Project would have significant impacts on water quality. DEIR p. 4.10-8, 4.10-10 (Impact HYD-1).

ORG6-30 cont.

Rather than identify mitigation measures that would effectively reduce water quality impacts, the DEIR defers development of these measures until after the Project is approved. CEQA allows a lead agency to defer mitigation only when: (1) an EIR contains criteria, or performance standards, to govern future actions implementing the mitigation; (2) practical considerations preclude development of the measures at the time of initial project approval; and (3) the agency has assurances that the future mitigation will be both "feasible and efficacious." *Communities for a Better Environment v. City of Richmond* (2010) 184 Cal.App.4th 70, 94-95 ("*CBE*"); *San Joaquin Raptor Rescue Center v. County of Merced* (2007) 149 Cal.App.4th at 669-71; CEQA Guidelines § 15126.4(a)(1)(B). Here, the DEIR identifies two measures, Mitigation Measure HYD-1a, calling for preparation of a drainage plan, and Mitigation Measure HYD-1b, calling for stormwater facilities to be designed to County standards. DEIR p. 4.10-10. Yet the DEIR fails to provide any performance standards to govern future implementation of these measures, does not give any reason why it would be impractical to develop mitigation measures now, and contains no assurances that future mitigation will be effective. Moreover, as discussed above, merely promising to comply with applicable regulations is not sufficient to ensure that impacts would be less than significant. *See Kings County Farm Bureau*, 221 Cal.App.3d at 716. As the CBEC report explains, "design of effective runoff and erosion control best management practices (BMPs) requires a hydrologic analysis to quantify the potential changes and impacts associated with project runoff. Thus, in addition to presenting vague and unproven mitigation measures, the DEIR should be deemed incomplete as it does not provide (or defers) a hydrologic analysis necessary to identify and quantify project induced impacts on hydrology and water quality." CBEC report at 2.

ORG6-31

2. The DEIR Provides No Analysis in Support of its Conclusion that Water Quality Impacts Relating to the Project's Septic Systems and Drinking Water Contamination Levels Would Be Less Than Significant.

Although the DEIR does not address this, numerous residences in the Project area rely on groundwater as their drinking water supply. Consequently, the DEIR must thoroughly analyze the Project's potential to degrade water quality in these wells. It is particularly concerning that the Project includes a septic system (DEIR, p. 2-1) yet, as the CBEC report explains, the DEIR does not adequately address impacts to groundwater quality from this system. Here too, the DEIR wrongly claims that wastewater impacts would be less than significant simply because the Project's wastewater treatment system and leach field would comply with applicable regulations. DEIR p. 4.10-11. As explained above, Project features' compliance with relevant regulations does not mean the Project's septic system would not harm water quality. *See Communities for a Better Environment,* 103 Cal.App.4th at 111-14; *Californians for Alternatives to Toxics,* 136 Cal.App.4th at 15-17. ORG6-32

The DEIR notes that subsurface conditions in the Project area consist of fractured bedrock. DEIR p. 4.10-6. Although the DEIR's discussion of the Project's septic system does not address this, the document's technical appendix explains that groundwater storage in the underlying bedrock is associated with interconnected fractures. DEIR Appendix G, p. 6-7. Water levels in many Project production wells, monitoring wells and adjacent residential wells are hydraulically connected by these fractures. *See* CBEC report at 2. Project plans and fracture maps indicate that the Project's septic system would be located within the interconnected fracture zone area that supplies groundwater to the Project, and to monitoring wells and off-site wells. *See id*. The Project's production wells would cause drawdown of fracture water levels. *Id*. This will result in induced recharge of leach field water into the fracture aquifer and preferentially capture leach field infiltration into the fractured bedrock aquifer, potentially causing adverse impacts to aquifer water quality. *Id*. Despite this fact, the DEIR fails to provide *any* analysis of how infiltration from the Project's leach fields will interact with the fractures and associated groundwater system. The failure of the DEIR to evaluate how the Project's septic system would impact neighboring wells is a fatal flaw, and the EIR must be revised and recirculated to correct it. ORG6-33

The DEIR fares no better in its analysis of potential impacts relating to contamination in the Project's drinking water supply. Here, the DEIR notes that water wells at the Project site contain arsenic, iron, turbidity, and color levels that exceed drinking water maximum contaminant standards. DEIR p. 4.10-12. The DEIR calls for ORG6-34 further water testing and asserts that if contaminant levels remain high, the Project would install a water treatment unit, which it claims would reduce impacts to be less than significant. *Id*. However, the DEIR fails to provide any detail about this water testing or the water treatment unit. Again, the DEIR's "trust us" approach lacks the required factual support that the Project's impacts involving violation of drinking water quality standards would be less than significant.

ORG6-34 cont.

The revised DEIR must identify all of the residential wells in the Project vicinity and then analyze the Project's potential to impact these wells.

3. The DEIR Provides No Analysis in Support of its Conclusion that the Project Would Not Obstruct or Conflict with the Implementation of a Water Quality Control Plan or Sustainable Groundwater Management Plan.

The DEIR simply claims that the Project would not conflict with water quality control plans or sustainable groundwater management plans, and that impacts would be less than significant because the Project would comply with applicable State and County regulations. DEIR p. 4.10-15 (Impact HYD-5). This lack of analysis is inadequate. As explained above, the DEIR cannot simply rely on asserted regulatory compliance to support a conclusion that impacts would be less than significant. *See Kings County Farm Bureau*, 221 Cal.App.3d at 716. Instead of merely claiming the Project would comply with applicable regulations, the DEIR must actually analyze the Project's consistency with water quality control plans and sustainable groundwater management plans. *See Communities for a Better Environment*, 103 Cal.App.4th at 111-14; *Californians for Alternatives to Toxics*, 136 Cal.App.4th at 15-17. The EIR should be revised to include this analysis and recirculated for public review and comment.

ORG6-35

4. The DEIR Fails to Analyze Construction Impacts on Water Quality.

The DEIR notes that "[c]learing, grading, excavation, and construction activities would have the potential to impact water quality through soil erosion and increased silt and debris discharged into runoff." DEIR p. 4.10-9. However, instead of analyzing water quality impacts from Project construction, the DEIR asserts that the Project's impacts would be less than significant because construction would comply with applicable regulations such as a Construction General Permit issued by the State Water Resources Control Board and Tuolumne County's erosion control plan requirements. DEIR p. 4.10-9. As discussed above, regulatory compliance does not mean water quality impacts from construction would be insignificant. *See Kings County Farm Bureau*, 221 Cal.App.3d at

ORG6-36

716. The DEIR must actually analyze construction water quality impacts. *See Communities for a Better Environment*, 103 Cal.App.4th at 111-14; *Californians for Alternatives to Toxics,* 136 Cal.App.4th at 15-17. ORG6-36 cont.

5. The DEIR Fails to Analyze Cumulative Impacts on Water Quality.

The DEIR concludes that the Project, in combination with the Yosemite Under Canvas project, Thousand Trails/ Yosemite Lakes RV Expansion, Berkeley Tuolumne Camp Restoration project, and Mountain Sage Conditional Use Permit project, would result in less-than-significant cumulative impacts on hydrology, water quality, and groundwater. DEIR pp. 4.10-15, 4.10-16 (Impact HYD-6). However, the DEIR contains no analysis in support of this conclusion, instead relying on Project features and regulatory compliance to claim impacts would be less than significant. Once again, a DEIR cannot rely on a recitation of project features to avoid analysis of a project's impacts. *See Lotus v. Department of Transportation*, 223 Cal.App.4th at 656, 658. Moreover, as explained, asserted regulatory compliance cannot be used to support a conclusion that a project's impacts would be less than significant. *See Kings County Farm Bureau*, 221 Cal.App.3d at 716. ORG6-37

E. The DEIR's Analysis of the Project's Water Supply Impacts is Inadequate.

CEQA requires that an EIR present decisionmakers "with sufficient facts to evaluate the pros and cons of supplying the amount of water that the [project] will need." *Vineyard Area Citizens for Responsible Growth, Inc. v. City of Rancho Cordova* (2007) 40 Cal.4th 412, 430-31. This includes identifying and analyzing water supplies that "bear a likelihood of actually proving available; speculative sources and unrealistic allocations ('paper water') are insufficient bases for decision making under CEQA." *Id*. at 432. Here, the DEIR fails to adequately analyze the Project's water supply impacts. ORG6-38

1. The DEIR Underestimates the Project's Water Demand.

The DEIR estimates that the Project's water demand will be 16,636 gallons per day. DEIR pp. 4.10-12, 4.10-13, 4.16-4, 4.16-5; *see also* Appendix G, Shamim Engineering Consultants, Inc. Report (March 30, 2020). However, the DEIR's water demand study calculates water demand based solely on domestic visitor use associated with guest rooms, cabins, and employee housing. DEIR Appendix G, p. XX. The DEIR's estimated water demand calculations fail to include the Project's other water- consuming components, including food preparation and dining, cleaning and maintenance activities ORG6-39 of facilities, the swimming pool, and firefighting water storage. Therefore, the DEIR's water demand estimate does not account for all water demands associated with the Project, and the DEIR is inadequate in characterizing and quantifying potential adverse impacts to groundwater supply. This failure to fully account for the Project's water demand violates CEQA. *City of Rancho Cordova*, 40 Cal.4th at 430. **ORG6-39 cont.**

2. The DEIR Lacks Adequate Analysis in Support of its Conclusion that the Project Would Not Substantially Interfere with Groundwater Recharge.

The Project is located on a watershed divide and is in an area of groundwater recharge. DEIR Appendix G, pg. 16. The DEIR states that captured roof drainage and surface runoff will be redirected via a grey water system for landscaping irrigation and other uses. DEIR p. 4.10-13. There is no analysis in the DEIR of how this change will affect the volume and timing of water available for infiltration and groundwater recharge. The DEIR states that minimizing water consumption, use of grey water systems for landscape irrigation, use of low-flow plumbing fixtures, capture of rainwater to be used for other non-potable uses, and return flow from the grey water irrigation system and from the on-site septic systems will provide additional recharge to the groundwater aquifer. DEIR pp. 4.10-13, 4.16-8. The DEIR concludes that the Project would not substantially interfere with groundwater recharge, and that impacts would be less than significant. DEIR p. 4.10-13, 4.16-7, 8. However, the document fails to provide analysis in support of this conclusion. As the CBEC report explains, no water balance analysis has been prepared to demonstrate how these reallocations will balance out against the losses in recharge due to Project-induced changes in surface water runoff. CBEC report at 3. The DEIR's failure to provide factual support for its conclusion that impacts would be less than significant is inconsistent with CEQA's clear requirements. *Sierra Club v County of Fresno* (2018) 6 Cal.5th 502, 522; *Citizens of Goleta Valley v Board of Supervisors* (1990) 52 Cal.3d 553, 568. The revised EIR should include a water balance analysis. **ORG6-40**

3. The Project Would Exacerbate Existing Groundwater Depletion at the Site.

The DEIR notes that the Project area includes several springs. *See* DEIR p. 4.3-47. However, the DEIR's hydrogeology analysis finds that these springs are no longer active or producing. DEIR Appendix G, Geoscience Hydrogeology Study, p. 7. Appendix G finds that "[t]his is likely because wells in the area have drawn the groundwater surface below the surface elevation of the former springs." *Id*. at 7. The Appendix concludes that these springs "are no longer flowing, which suggests groundwater levels are currently **ORG6-41** lower than they have been historically." *Id*. at 8. Although the main body of the DEIR does not discuss this, these statements indicate that groundwater supply within the Project area is currently in a state of depletion, and that any further groundwater extraction will lead to further depletion, as the CBEC report explains. CBEC report at 4. In addition to worsening groundwater depletion, the Project will further exacerbate the ecological impacts associated with lost spring flow. *Id*. The depleted springs likely provide ecologically valuable habitat to sensitive species, whether seasonal or year-round. The DEIR must disclose and fully analyze the possibility that the Project will exacerbate existing groundwater depletion at the site. ORG6-41 cont.

4. The DEIR Does Not Include Sufficient Analysis in Support of its Conclusion that the Project Would Have Sufficient Water Supplies to Meet Demand During Multiple Dry Years.

The DEIR relies on a well pump test conducted over a 10-day period in October 2019 to assert that two onsite wells would be adequate to supply the Project's estimated water demand. DEIR pp. 4.16-5, 4.16-7, 4.16-8. The DEIR claims that applying a 50 percent capacity pumping rate to Project wells based on a 10-day capacity test per County standards provides an adequate safety margin to avoid supply deficiencies during dry years and multiple-year dry periods. DEIR p. 4.16-7. As the CBEC report explains, however, the October 2019 groundwater pump test does not demonstrate that the Project wells would be adequate to meet the Project's projected water demand. 2019 was a wet year-type occurring within a 4-year period of average to predominantly above-normal precipitation (i.e., a multi-year wet period). DEIR Appendix G, Geoscience Hydrogeology Study, Fig. 9. The DEIR provides no quantitative assessment of how Project well pumping would impact groundwater supplies during dry years or multi-year dry periods, i.e. droughts. Excess stress and adverse impacts to California water resources are far more likely to occur during dry years or drought than during wet years or multi-year wet periods. As noted above, evidence suggests the groundwater supply beneath the Project site has already been depleted, and the County standards for pump capacity testing are therefore inadequate, as they are likely intended for applications to groundwater systems in a natural or unimpacted condition. *See* CBEC report at 3. The DEIR must analyze the effect of Project water demand on groundwater supplies during dry years and multi-year droughts. ORG6-42

5. The DEIR Fails to Analyze the Adequacy of Fire Protection Water Supply.

The DEIR states that water for firefighting would be provided using reclaimed, grey, and potable water, which would be retained in a storage system and augmented with ORG6-43 wildland fire hoses, and notes that onsite fire suppression systems and hydrants would meet regulatory requirements. DEIR pp. 3-25, 3-26, 4.10-12, 4.16-4, 4.17-24. However, the DEIR does not analyze the adequacy of onsite storage tanks and water wells for firefighting purposes. The DEIR must examine whether the onsite storage tanks and wells would provide sufficient water for firefighters to protect the Project site and nearby area in the event of a major wildfire. This analysis is especially important because the Project site is within a Very High Fire Hazard Severity zone and would not be adequately served by existing fire protection services (e.g. the Groveland CSD), which the DEIR acknowledges would not be able to reach the site within established response times. During a large wildfire, firefighting resources may need to be deployed elsewhere, and there may not be a water tanker truck available to serve the Project site. Analysis of onsite water storage and well capacity for firefighting purposes is essential. In the absence of a verifiable supply and storage system for firefighting water, the DEIR has no basis to conclude that the Project's impacts relating to wildfire risk and emergency response would be less than significant. **ORG6-43**

6. The DEIR Lacks Adequate Analysis in Support of its Conclusion that Cumulative Water Supply Impacts Are Less than Significant.

The DEIR notes the existence of four nearby projects which will contribute to area water demand: the Under Canvas project across SR-120, the Berkeley Tuolumne Camp Restoration project, the Thousand Trails / Yosemite Lakes RV Expansion project, and the Mountain Sage Conditional Use Permit project. DEIR p. 4.16-9. The DEIR acknowledges that wells drilled for these projects may tap into groundwater reserves that are interconnected with those used by the Project's wells, and that cumulatively these projects may decrease groundwater supplies in the area. *Id*. However, the DEIR does not contain any analysis of these cumulative impacts, simply asserting with no evidence that cumulative impacts would be less than significant. *Id*.; *see also* CBEC report at 4,5. The DEIR asserts that because well pump testing at the Project site was conducted concurrently with well testing at the adjacent Under Canvas site, that analysis already addresses the cumulative water supply impacts of the Project together with the Under Canvas project. *Id*. However, as discussed above, well pump testing for both projects was conducted in 2019, a wet year, and does not reflect available water supply in a dry year or multi-year drought. Moreover, the DEIR makes no attempt to analyze the cumulative impact of water pumping from the Berkeley Tuolumne Camp Restoration project (which would install new on-site wells) or the Thousand Trails / Yosemite Lakes RV Expansion project, or increased water demand from the Mountain Sage Conditional use Permit Project (which would use Groveland CSD public water utilities). The DEIR therefore **ORG6-44** fails to support its conclusion that cumulative water supply impacts would be less than significant. ORG6-44 cont.

F. The DEIR's Analysis of and Mitigation for the Project's Noise and Vibration Impacts is Inadequate.

We have reviewed the DEIR's noise analysis and commissioned an independent review by professional acoustic and vibration consultants. *See* Papadimos Group Report re: Terra Vi Lodge Project DEIR, July 28, 2020, attached as Exhibit J and incorporated by reference into this letter. As discussed below, and further explained in the Papadimos report, the DEIR does not identify all noise- and vibration-sensitive land uses adjacent to the Project site, fails to rely on appropriate significance criteria to evaluate the Project's impacts, does not accurately identify existing ambient noise and vibration levels at adjacent sensitive receptors, fails to adequately evaluate noise impacts, and lacks evidentiary support that mitigation measures would effectively reduce the Project's noise impacts. ORG6-45

1. The DEIR Fails to Identify the Location of All Nearby Sensitive Noise Receptors.

An accurate depiction of existing environmental conditions is critical to a complete assessment of project impacts. "[T]o inform decision makers and the public of any significant adverse effects a project is likely to have on the physical environment . . . , an EIR must delineate environmental conditions prevailing absent the project, defining a baseline against which predicted effects can be described and quantified." *Neighbors for Smart Rail v. Exposition Metro Line Construction Authority* (2013) 57 Cal.4th 439, 447. Investigating and reporting existing conditions are "crucial function[s] of the EIR." *Save Our Peninsula Comm. v. Monterey County* (2001) 87 Cal.App.4th 99, 122 ("*SOPC*"). "[W]ithout such a description, analysis of impacts, mitigation measures and project alternatives becomes impossible." *County of Amador v. El Dorado County Water Agency* (1999) 76 Cal.App.4th 931, 953. Decisionmakers must be able to weigh the project's effects against "real conditions on the ground." *City of Carmel-by-the-Sea v. Bd. of Supervisors* (1986) 183 Cal.App.3d 229, 246. Here, the DEIR fails to meet CEQA's clear requirements because it fails to identify all of the noise-sensitive land uses that would be impacted by the Project's increase in noise. ORG6-46

The DEIR's noise analysis specifically identifies only a single sensitive noise receptor, a residence located immediately north of the Project. Figure 4.12-1, DEIR p. 4.12-9. The DEIR states that this residence is located approximately 250 feet from the

Project site. DEIR p. 4.12-20. The DEIR also generally acknowledges that "noise-sensitive land uses which would potentially be affected by the project" include existing "single-family residential land uses located to the north of the [P]roject site." DEIR p. 4.12-8. The DEIR elsewhere notes that the site is "surrounded by rural residential homes on Sawmill Mountain Road [to the] north and northeast," DEIR p. 4.1-4, including homes "immediately north of the [P]roject site." DEIR p. 4.1-29. However, the DEIR fails to specify the number of homes in this area or identify the specific location of these sensitive receptors or their distance from the Project.

Although the DEIR also acknowledges that places where people recreate "are generally considered to be sensitive to noise," the DEIR's noise section downplays the possibility of nearby noise receptors by asserting that the public forest lands and commercial recreation uses adjoining the Project site "are typically not considered to be noise sensitive." DEIR p. 4.12-8. The DEIR provides no support for this assertion. Elsewhere, however (in the air quality section), the DEIR concedes that "[s]ensitive receptors to the proposed [P]roject include . . . recreational land users in the area at nearby campsites, trails, or other recreational sites." DEIR pp. 4.2-8, 4.2-11.

As discussed above, there are at least 15 residences and at least two campgrounds in the immediate Project vicinity. Until the DEIR identifies all of the nearby sensitive receptors in the area, it is not possible to identify existing ambient noise levels at each receptor location or to determine the appropriate significance criteria. *See* Table 4.12-6 (identifying significance thresholds based on existing ambient noise levels). Moreover, without identifying the location of all sensitive receptors in the area, it is not possible to evaluate how noise from construction and operation of the Project will impact those sensitive receptors. Once the DEIR is revised to provide this information, it will then be able to identify appropriate significance thresholds, quantify and analyze the Project's noise impacts on each receptor location, and identify appropriate mitigation for the Project's significant noise impacts.

ORG6-46 cont.

The DEIR's failure to identify the location of sensitive noise receptors also makes it impossible to determine compliance with the Tuolumne County General Plan. The General Plan's Noise Element requires that "the exterior noise level standard[s] shall be applied to the property line of the receiving land uses." However, the DEIR does not delineate the receiving land uses' property lines. Until the EIR identifies these property boundaries, it is not possible to evaluate the Project's noise impacts or determine the Project's consistency with the General Plan.

2. The DEIR Does Not Adequately Analyze Existing Noise or Vibration Conditions in the Project Vicinity.

In addition to failing to identify the location of sensitive noise receptors near the Project site, the DEIR also fails to adequately characterize or measure existing baseline ambient noise conditions in the vicinity. In addition to the long-term noise measurements (LT-1 & LT-2) documented near Forest Route 1S03, the DEIR should have monitored existing ambient noise at all sensitive receptor locations that could potentially be affected by the Project's noise. In particular, locations set back further from existing roads in the Project vicinity would be expected to have lower ambient noise than monitoring locations LT-1 & LT-2. *See* Papadimos report, pp 4,5. DEIR Table 4.12-8 includes the *highest* reported noise level at each monitoring location. This could be an appropriate metric for evaluating noise impacts within the Project (such as the ability of lodge construction materials to control interior noise levels attributable to outside noise). However, it is not appropriate for measuring existing ambient noise conditions at surrounding receptors that would be affected by Project-generated noise. *See* Papadimos report, pp 4,5. The DEIR should be revised to include existing background ambient noise levels at each monitoring location in order to properly evaluate the Project's impacts on adjacent noise-sensitive receptors. ORG6-47

The DEIR also fails to adequately disclose existing vibration levels in the Project vicinity. Papadimos report, pp 2, 3. The DEIR asserts that because "vibration levels were below the threshold of perception at the [P]roject site and in the immediate project vicinity" during a site visit in May 2019, "the existing vibration environment in the immediate project vicinity is considered to be negligible." DEIR p. 4.12-11. The DEIR does not include any evidence to support this claim. Furthermore, DEIR Appendix H notes that baseline vibration levels were "below 0.1 inches per second if converted to peak particle velocity." DEIR Appendix H, p.35. Again, the DEIR fails to provide any supporting documentation regarding vibration measurement methodology (e.g. location, duration, postprocessing, etc.) or reported results. If ambient vibration levels in the immediate Project vicinity are below the threshold of perception, this suggests that adjacent receptors would be *especially* sensitive to increased vibration that may result from Project construction and operation, given the low existing baseline.

3. The DEIR Relies on Inadequate Significance Criteria to Evaluate Project Impacts.

The DEIR relies on flawed significance thresholds that do not sufficiently protect the environment. CEQA Guidelines § 15064.7 (d) (2). According to the Papadimos report, the ambient noise standard ((Ldn/CNEL) + 5 dB) presented in Table 4.12.5 to ORG6-48 evaluate cumulative noise exposure from the Project is too permissive. *See* Papadimos report at 3. The ambient noise level is often defined as the L90 or L99 statistical level using a time interval between 15 minutes and one hour. Increases on the ambient (L90 or L99) statistical noise level on an hourly basis would be more appropriate for this analysis. The DEIR states that L90 hourly levels at the Project site were measured to be about 30 dBA on average, and as low as 21 dBA (DEIR Appendix H, 'Noise Study' – Appendix D & E). Typically, an increase as low as 3 dB in the ambient noise due to a project is used as a threshold to identify significant impacts. *See* Papadimos report at 3. Moreover, as noted above, the DEIR's failure to identify the location of all sensitive noise receptors near the Project site also makes it impossible to determine appropriate significance criteria or meaningfully evaluate Project impacts. **ORG6-48 cont.**

4. The DEIR Lacks Evidentiary Support for its Conclusion that the Project's Operational Noise Impacts Would Be Less Than Significant.

The DEIR concludes that unmitigated noise levels associated with the Project's operations would be significant. DEIR p. 4.12-18. The sources of noise identified in the DEIR include vehicle traffic, parking, truck circulation, use of the loading dock, HVAC systems, garbage trucks, and the Project's maintenance yard, which will include a generator. DEIR p. 4.12-19. However, as the Papadimos report explains, this is not a complete list of the Project's significant noise-generating components. Notably, although the Project would allow events and would include a 3,000 square-foot ballroom/event space as well as an outdoor swimming pool, barbecue area and outdoor dining area (DEIR p. 3.16), the DEIR fails to disclose or analyze the potential for amplified music or other noise resulting from these uses. *See* Papadimos report at 8. The DEIR must identify the noise associated with each of these Project components and analyze its impact on nearby sensitive receptors, with reference to appropriate significance criteria. **ORG6-49**

The DEIR also lacks support for its conclusion that noise impacts resulting from Project-generated traffic or cumulative traffic would be less than significant. DEIR pp. 4.12-12, 4.12-13. The DEIR finds that "cumulative traffic increase is predicted to exceed the [Tuolumne County] General Plan cumulative noise increase significance criteria along Sawmill Mountain Road north of the SR 120." DEIR p. 4.12-13. However, instead of proposing and evaluating mitigation measures to address this Project impact, the DEIR merely offers unsupported assumptions and reasons for its claim that this impact should be interpreted as less than significant. *Id*. The DEIR's conclusion that increased ambient noise levels in the Project vicinity due to cumulative traffic increases are less than significant ignores the Tuolumne County General Plan interior noise level standard of 45 **ORG6-50** dB Ldn, which is applicable to transportation noise exposures at receiving land uses. The revised EIR must identify this as a significant impact of the Project. ORG6-50 cont.

The DEIR also fails to provide adequate support for its conclusion that noise impacts from on-site traffic circulation, vehicle parking or loading docks would be less than significant. DEIR pp. 4.12-14, 4.12-15. The DEIR purports to calculate "worst-case" on-site traffic circulation noise based on the assumption that "all of the on-site vehicle trips would occur at one location, when realistically it would likely be more spread out throughout the development". *Id*. However, the DEIR does not explain which "one location" has been assumed for all on-site traffic circulation, making it difficult to evaluate the claim that the DEIR's noise impact predictions are worst-case and conservative. *See* Papadimos Report at 6. Also, the DEIR's assessment of on-site traffic circulation uses L_{eq} predictions to evaluate Project impacts against Tuolumne County General Plan noise standards for exposure from *stationary* noise sources, which is not appropriate for an evaluation of mobile noise sources such as vehicle circulation. *Id*. In addition, the DEIR's conclusion that noise impacts from the Project's loading dock would be less than significant (DEIR p. 4.12-15) relies on an underestimate of predicted loading dock noise. Based on comparable projects, predicted loading dock noise levels could be reasonably expected to be 10 dB higher than the DEIR assumes. Papadimos Report at 7. ORG6-51

The DEIR also lacks evidence to support its conclusion that HVAC and other mechanical equipment at the Project site would have less than significant noise impacts. DEIR p. 4.12-15. The DEIR describes noise impacts typically associated with only one particular type of rooftop air conditioning system which might be used on the Project's guest cabins, but does not address the noise and vibration impacts associated with the larger HVAC equipment that would be used on the Project's main hotel building or the public market. The DEIR must analyze the noise impacts of all HVAC equipment on the Project site, considering the equipment location and specific noise output based on manufacturer sound data, the noise content and existing ambient noise environment. ORG6-52

5. The DEIR Lacks Evidentiary Support for its Conclusion that the Proposed Mitigation Measures for Operational Noise Would be Effective.

The DEIR proposes a few mitigation measures to reduce operational noise produced by the Project. However, the DEIR fails to provide evidence to support its conclusion that these measures will be sufficient to reduce impacts to a less than significant level. As we explained, a DEIR's conclusions regarding the effectiveness of measures to mitigate project impacts must be supported by substantial evidence. ORG6-53

Mitigation Measure NOI-1.1, for example, calls for the construction of an 8-foot wood or masonry noise barrier around the maintenance yard and asserts that the Project's generator would produce noise no louder than 70 dB at a distance of 50 feet. DEIR p. 4.12-16. The DEIR provides no evidence that that the barrier wall would be sufficient to noise reduce impacts below the General Plan limits. Nor does it provide any indication that the Project will be able to obtain a generator that will produce noise less than 70 dB at 50 feet. A 50kW diesel generator can typically produce around 85 dB(A), as loud as city traffic. A 1500kW engine can be as loud as, if not louder than a jet engine 1000 feet overhead (105 dB(A)). *See* Generator Basics: Sound Attenuation, Woodstock Power, attached as Exhibit K. The DEIR must provide supporting documentation showing that each of these proposed mitigation measures would be feasible and would effectively reduce the Project's noise impacts to a less than significant level. To support a conclusion that a project would have less-than-significant impacts, an EIR "must provide a quantitative or qualitative determination or estimate of the mitigation measures' effect" on project impacts. *Friends of Oroville v. City of Oroville* (2013) 219 Cal.App.4th 832, 845. Here, the EIR neither actually calculates nor otherwise analyzes the amount of the alleged noise reduction. **ORG6-53 cont.**

Mitigation Measure NOI-1.2a fares no better, as it calls for limiting on-site truck deliveries and refuse collection to daytime hours. DEIR p. 4.12-19. The DEIR asserts that limiting truck deliveries will reduce noise to insignificant levels, but it does not provide any analytical support for this conclusion. *Id*. Moreover, truck noise is just one of the noise sources identified in the DEIR. The DEIR does not explain how the Project will mitigate noise produced by other sources, including vehicle traffic, parking, HVAC equipment and from amplified music or any public announcement system. Because the DEIR fails to demonstrate the effectiveness of the proposed mitigation measures, the document lacks support for its conclusion that the Project's noise impacts would be less than significant. **ORG6-54**

6. The DEIR Fails to Adequately Analyze the Project's Construction-related Noise Impacts.

The DEIR determines that during Project construction, noise generated by construction equipment could be as loud as 76 dB. DEIR p. 4.12-20. Despite this, the DEIR concludes that construction noise impacts would be less than significant because construction noise would be short-term in duration and would have only intermittent frequency. DEIR p. 4.12-20. The DEIR provides no support for this conclusion. The DEIR cannot rely on the alleged short term or intermittent nature of construction noise to support a finding of a less than significant impact. Project construction would span a two-year period. *See* DEIR p. 4.2-10, Table 4.2-4; DEIR p. 4.8-10 (noting that construction is **ORG6-55** planned to occur on a "two-year timeline"). Construction-related noise that is projected to span a two-year period would likely have substantial impacts on nearby sensitive land uses. Moreover, CEQA does not distinguish between short-and long-term impacts, and short-term impacts are not exempt from analysis. *See* CEQA Guidelines § 15126.2(a) (agency must analyze both short- and long-term impacts). **ORG6-55 cont.**

In addition, as the Papadimos report explains, the DEIR ignores noise impacts resulting from the full range of construction activities that would occur at the Project site, such as grading, excavation, foundation work, erection of structures, paving, and use of heavy equipment in staging areas. *See* Papadimos Report at 9. **ORG6-56**

The DEIR also inappropriately asserts that construction noise impacts would be less than significant because construction would comply with the construction-related noise criteria and implementation measures established in Policy 5.A.5 of the Tuolumne County General Plan. DEIR p. 4.12-20. However, a mere promise to comply with County policies does not mean impacts would be insignificant. *See Communities for a Better Environment v. Cal. Resources Agency* (2002) 103 Cal.App.4th 98, 111-14 (compliance with regulations cannot displace an agency's *separate* obligation to consider whether a project's environmental impacts are significant); *Californians for Alternatives to Toxics v. Department of Food & Agriculture* (2005) 136 Cal.App.4th 1, 15-17 (same); *Protect the Historic Amador Waterways v. Amador Water Agency* (2004) 116 Cal.App.4th 1099, 1108–09 (environmental effect may be significant despite compliance with regulatory requirements). General Plan Policy 5.A-5 calls for implementation of all feasible noise-reducing measures. DEIR p.4.12-7. To comply with this Policy (and to reduce the Project's significant construction-related noise impacts), the DEIR must actually *identify* specific noise reducing measures, commit to implementing those measures, and evaluate whether they would be effective. The DEIR does none of this and is therefore legally deficient. Moreover, because the DEIR provides no evidence that these noise reducing measures would be implemented, the Project is inconsistent with the General Plan. **ORG6-57**

7. The DEIR Fails to Adequately Analyze and Mitigate Impacts Relating to Helicopter Noise.

The DEIR acknowledges that helicopter takeoff and landing from the Project's helipad would produce "substantial temporary increases in ambient daytime and/or nighttime noise levels at nearby existing sensitive uses," including a residence located about 430 feet from the proposed helipad, and concludes that this impact would be significant and unavoidable. DEIR pp. 4.12-23, 4.12-24. The DEIR also mentions that "noise exposure associated with the [helicopter's] selected flight path could impact *other* sensitive uses along the route," but does not identify those other receptors or analyze their **ORG6-58** exposure to Project impacts. DEIR p. 4.12-23. (emphasis added). A conclusion that an impact is significant and unavoidable does not excuse the lead agency from its responsibility to analyze that impact. *Berkeley Keep Jets Over the Bay*, 91 Cal.App.4th at 1371; *accord, Cleveland National Forest Foundation v. San Diego Assn. of Governments* (2017) 3 Cal.5th 497, 514-15. A lead agency may not, as the County attempts to do here, "travel the legally impermissible easy road to CEQA compliance . . . [by] simply labeling the effect 'significant' without accompanying analysis . . . ." *Berkeley Jets*, 91 Cal.App.4th at 1371. Rather, "a more detailed analysis of how adverse the impact will be is required." *Galante Vineyards*, 60 Cal.App.4th at 1123. The public and decisionmakers have a right to know whether noise impacts from helicopter use will merely cause a nuisance, or if they will lead to more serious consequences for Project neighbors. The DEIR's failure to provide this information violates CEQA. In addition, the DEIR provides no support for its assertion that "[i]t is reasonable to assume that noise levels associated with emergency services, such as those proposed at the project emergency helipad, would likely be exempt from Tuolumne County noise level criteria." DEIR p. 4.12-23. The DEIR must explain why helicopter-related noise would be exempt from the County's noise standards. **ORG6-58 cont.**

In addition, as discussed above, the DEIR must identify the location of *all* potentially affected sensitive receptors near the Project, not only the closest receptor to the helipad site. The DEIR must then identify the helicopters' expected flight paths and then evaluate how these flights will impact all sensitive receptors. This analysis must describe how helicopters could disrupt the existing tranquil, rural environment near the Project site. It is particularly concerning that helicopters are expected to fly at night. DEIR p. 4.12-23. Nighttime flights could have severe impacts on people living in residences adjacent to the Project, yet the DEIR does not analyze these impacts. Moreover, single-event noise levels such as those associated with helicopters have been shown to be likely to result in negative health outcomes, sleep disruption, speech interference, and heightened levels of stress and annoyance. *See* Mathias Basner and Sarah McGuire, *WHO Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Effects on Sleep*, 15 Intl. J. of Environmental Research & Public Health 519 (March 2018), attached as Exhibit L. **ORG6-59**

The DEIR asserts that "mitigation measures related to flight path design and helipad location could potentially be effective in reducing noise levels at the existing residences nearest to the project emergency helipad." DEIR p. 4.12-23. However, the DEIR makes no attempt to identify any such measures. Instead, it simply asserts that such measures would be infeasible, "due to the nature of the operations associated with the proposed helipad (emergency situations)." *Id*. The DEIR therefore concludes that **ORG6-60** significant noise impacts on nearby existing sensitive receptors is unavoidable. DEIR p. 4.12-24. The DEIR's approach is contrary to CEQA. Again, a lead agency cannot simply conclude that an impact is significant and unavoidable without further analysis. The DEIR should have made some attempt to identify feasible mitigation measures to reduce helicopter noise impacts on nearby receptors. For example, the DEIR could have evaluated the feasibility of alternative flight paths, a prohibition on nighttime flights except during dire emergencies, and alternative locations for the helipad, including other locations on the Project site and alternative off-site locations. **ORG6-60 cont.**

Notably, the DEIR *does* identify project features and mitigation measures to reduce noise impacts (including helicopter noise) on guests in the Project's hotel rooms, DEIR pp. 4.12-24, 4.12-25, but does not explain why these mitigation measures could not also be applied to reduce noise experienced by existing nearby residents. To reduce helicopter (and likely other Project-related noise) noise impacts on Project guests, the DEIR calls for mechanical ventilation (air conditioning) to be provided for all of the Project's hotel rooms so that windows can be closed to reduce noise. DEIR p. 4.12-24. The DEIR should evaluate a mitigation measure in which nearby residents' homes are retrofitted with air conditioning for the same reason. To address helicopter noise experienced by Project guests, Mitigation Measure NOI-3.2a calls for window and door assemblies of all lodging within the Project development to be upgraded to a minimum STC rating of 32. DEIR p. 4.12-25; *see also* DEIR Volume 2, Technical Appendix, Environmental Noise & Vibration Assessment, p. 39. The DEIR should evaluate a similar noise mitigation measure to upgrade windows and doors in neighboring residences to the same standard. **ORG6-61**

8. The DEIR Does Not Adequately Evaluate How the Project's Increase in Noise and Vibration Would Impact Special-Status Animal Species.

The DEIR lists many "Special-Status" animal species present on the Project site but only identifies one species, the Olive-sided flycatcher, as noise- and vibration-sensitive. DEIR p. 4.3-38 (noting that "[c]onstruction could adversely impact nesting species through noise and vibrations, and this would be a significant impact on the species' population.") As the Papadimos report explains, the DEIR ignores the effect that the Project's noise and vibration would have on other species, including other bird species, consistent with relevant guidelines. *See* Papadimos report at 2 and *Effects of Traffic Noise and Road Construction on Birds,* Caltrans, June 2016, attached to the Papadimos report. The revised EIR should comprehensively evaluate how noise and vibration would impact wildlife and propose effective mitigation for impacts that are determined to be significant. **ORG6-62**

G. The DEIR's Transportation Analysis Fails To Adequately Analyze Or Mitigate Impacts Relating to Roadway Hazards.

1. The DEIR Fails to Identify the Deficiency of the SR-120 Eastbound Receiving Lane as a Significant Roadway Hazard.

The increased traffic generated by the Project would require several roadway improvements in order to mitigate a substantial increase in roadway hazards resulting from the Project. These roadway improvements include the development of an eastbound receiving lane on SR-120 for cars turning left off of Forest Route1S03 onto SR-120. DEIR p. 4.15-19; *see also* DEIR p. 3-30, Figure 3-14. During busy times, the receiving lane would permit motorists to make a two-step left turn by first turning into the lane and subsequently merging with eastbound through traffic. The proposed receiving lane would be about 150 feet long and followed by a 75-foot bay taper. *Id*. However, the DEIR acknowledges that "full acceleration from a stop to 55 mph by a passenger vehicle would require 1,000 feet on level ground, *and full acceleration is not accommodated with the proposed receiving lane*." DEIR p. 4.15-19 (emphasis added). Rather than identify potential solutions for this public safety hazard, the DEIR defers this problem for Caltrans to resolve concluding that the receiving lane will not be provided if Caltrans requirements exceed the proposed design. *See id*. If left unresolved, the inadequate length of the proposed receiving lane on SR-120 would result in a significant public safety risk. The County must recognize this as a significant impact and identify appropriate mitigation measures to protect public safety. **ORG6-63**

2. The DEIR Fails to Identify Feasible Mitigation For the Project's Significant Impact Relating to Available Sight Distance.

The DEIR acknowledges that there would not be adequate sight distance along SR-120 for Project-generated traffic turning right (westbound) from Forest Route1S03 onto SR-120. DEIR pp. 4.15-20, 4.15-21. The document notes that looking right (west) from Forest Route1S03 (which it refers to as Sawmill Mountain Road), SR-120 curves to the north, and as a result the view is limited by a hillside and trees. DEIR p. 4.15-20. However, the DEIR fails to acknowledge that in addition to the curve, visibility along SR-120 at the intersection with Forest Route1S03 is also impaired by a slope and hill crest on SR-120. Travelling east to west, SR-120 slopes steeply upwards towards a hill crest near the western edge of the Project site, just before the intersection with Forest Route1S03. The hill crest creates a dangerous blind spot, so that high-speed eastbound traffic driving up SR-120 cannot see vehicles entering or exiting the highway at the intersection with Forest Route1S03, and vice versa, posing a significant collision hazard **ORG6-64** for Project-generated traffic. From the intersection with Forest Route1S03, the DEIR states that roughly 400 feet of sight distance is available to the west along SR-120, which does not meet the minimum sight distance standard of 500 feet for a 55-mph highway. DEIR pp. 4.15-20. Thus, despite ignoring the dangers posed by the hill crest on SR-120, the DEIR concludes that without mitigation, the inadequate sight distance along the highway constitutes a significant impact. DEIR p. 4.15-21 (Impact TRANS-3). **ORG6-64 cont.**

Mitigation Measure TRANS-3 asserts that construction of a proposed new eastbound left turn lane from SR-120 onto Forest Route1S03 would "require cutting the hillside and vegetation removal [along the north side of SR-120] in conformance with Caltrans standards, which will open the line of [sight] to an acceptable distance, as determined by Caltrans." DEIR p. 4.15-21. The DEIR concludes that this mitigation measure would reduce the Project's impacts on sight distance from Forest Route1S03 to a less than significant level. *Id*. However, the DEIR fails to provide any analysis demonstrating that construction of the proposed left turn lane is feasible, or that hillside cutting and vegetation removal along SR-120 to accommodate the left turn lane would adequately mitigate the sight distance hazard along the highway curve. Moreover, construction of the proposed eastbound left turn lane would do nothing to mitigate the additional visibility impairment and resulting traffic hazard caused by the slope and hill crest on SR-120, which the DEIR ignores.

ORG6-65

The DEIR states that the eastbound left turn lane "would be about 390 feet long and be proceeded by a 50-footlong bay taper." DEIR p. 4.15-19. However, the DEIR does not include any engineering details or preliminary schematics for this left turn lane.[2] The DEIR states that the adjoining hillside would need to be cut back (i.e. regraded) to satisfy Caltrans standards, DEIR p. 4.15-21, but it does not describe what this seemingly major infrastructure project would entail. The DEIR acknowledges that roadway improvements along SR-120 at the intersection with Forest Route1S03 (including the left turn lane west of the intersection as well as the receiving and right turn lanes east of the intersection) would require changes to the existing drainage along SR-120 and would collectively involve removal of 29 trees, but does not include any more specific information about the left turn lane. DEIR pp. 3-28; 4.15-15. The DEIR notes that "[t]hese improvements are outside of the project site within the Caltrans right-of-way and would require an encroachment permit." *Id*. However, the DEIR does not identify the

[2] The DEIR does include a preliminary schematic diagram which includes the proposed *receiving* lane on SR-120 *east* of the intersection with Forest Route1S03, DEIR p. 3-30, Fig. 3-14, but that diagram does not show the proposed left turn lane west of the intersection.

relevant Caltrans standards which would apply, discuss whether it will be feasible to meet them, or indicate whether Caltrans has approved the proposed design for the left turn lane. Moreover, the DEIR does not evaluate whether this roadway improvement will result in new significant impacts (e.g., loss of habitat, slope stability, erosion, aesthetic impacts, or cultural resources impacts).

When a lead agency relies on mitigation measures to find that project impacts will be less than significant, the DEIR must include substantial evidence demonstrating that the mitigation measures are feasible and will be effective in reducing impacts to a less than significant level. *Sacramento Old City Assn. v. City Council of Sacramento* (1991) 229 Cal.App.3d 1011, 1027; *Kings County Farm Bureau*, 221 Cal.App.3d at 726-29. Substantial evidence consists of "facts, a reasonable presumption predicated on fact, or expert opinion supported by fact," not "argument, speculation, unsubstantiated opinion or narrative." Pub. Res. Code § 21080(e)(1)-(2). Here, the DEIR falls far short of this threshold. The DEIR's conclusion that construction of the left turn lane would reduce sight distance hazards to a less than significant level is premised on unsupported assumptions, not supported by substantial evidence as required by CEQA. The DEIR's failure to discuss impacts resulting from construction of the left turn lane also violates CEQA. If a mitigation measure would cause one or more significant effects in addition to those that would be caused by the project as proposed, the effects of the mitigation measure must be discussed, although in less detail than the significant effects caused directly by the project. *Stevens v. City of Glendale* (1981) 125 Cal.App.3d 986. The EIR should be revised to include sufficient information to allow the public and decisionmakers to determine whether this mitigation is feasible and whether it would effectively reduce the Project's significant sight distance impacts. **ORG6-65 cont.**

3. The DEIR Fails to Analyze Roadway Safety Hazards that Would Occur During Project Construction.

The DEIR finds that construction of the Project will cause traffic generated by trucks and other vehicles driving to and from the site during the two-year construction period. DEIR p. 4.15-15; DEIR p. 4.8-10 (construction planned to occur on a "two-year timeline"). Construction will also require lane closures along SR-120, and the DEIR acknowledges that construction may result in "occasional one-way controlled traffic." DEIR p. 4.15-15. Construction trucks and equipment attempting to make turns out of Forest Route1S03 when leaving the project site will experience the same sight distance constraints discussed above. At the same time, motorists on SR-120, some of whom will be traveling at speeds of 55 mph or more, will encounter these slow-moving construction trucks and equipment. The DEIR fails to evaluate the potential for accidents caused by these construction-related activities. The EIR identifies the disruption of background **ORG6-66** traffic flow as a significant impact, DEIR p. 4.15-15, but it does not analyze the issue of roadway safety hazards during Project construction. The DEIR's failure to analyze roadway safety hazards during construction further violates CEQA. ORG6-66 cont.

4. The DEIR Fails to Adequately Analyze Safety Risks to Bicyclists and Pedestrians.

The DEIR concludes, without evidentiary support, that the Project would not substantially increase safety hazards for bicyclists or pedestrians. DEIR pp. 4.15-21 (Impact TRANS-3). The document acknowledges that development of the proposed Project could result in an increase in bicyclists and pedestrians between the Project site, adjoining residences along Forest Route1S03, and developments along Hardin Flat Road. DEIR p. 4.15-14. The DEIR asserts that access to the Project site by bicycle will be adequate and safe because cyclists and pedestrians would need to travel only the segment of SR-120 between Forest Route1S03 and Hardin Flat Road, and because SR-120 has a 4-foot wide paved shoulder along that segment. DEIR p. 4.15-15. (The DEIR notes that travel along SR-120 outside the paved 4-foot shoulder is often impossible due to roadway cut or fill slopes, including the area between Forest Route1S03 and Hardin Flat Road. DEIR p. 4.15-8.) The DEIR asserts that the Project's impacts are insignificant because "the distance that . . . bicyclists and pedestrians may have to travel along SR 120 is relatively short." *Id*.

There is no basis for the DEIR's assumption that cyclists or pedestrians would only travel between the Project, residences on Forest Route1S03, and developments along Hardin Flat Road, or that bike or pedestrian traffic would be limited to the short segment of SR-120 between Forest Route1S03 and Hardin Flat Road. The DEIR ignores the likelihood of bicycle and pedestrian traffic between the Project and other points, such as Yosemite National Park, which could require much more extensive bicycle travel along SR-120. The DEIR also fails to take into account that pedestrians from the Under Canvas Project may cross SR-120 to access the Terra Vi store or restaurant. The DEIR also ignores the Project's possible safety impacts on recreational cyclists, potentially including Project guests, who may elect to ride along SR-120 for recreational purposes, rather than as a means of transportation between Point A and Point B. The DEIR's failure to analyze bicycle and pedestrian safety hazards violates CEQA. *See* CEQA Guidelines § 15151; *Environmental Planning & Information Council v. County of El Dorado* (1982)131 Cal.App.3d 350, 357. ORG6-67

As discussed above, the Project will have roadway safety impacts along SR-120, including an inadequate receiving lane which may impede merging of eastbound traffic, insufficient sight distance at the Forest Route1S03 intersection, and safety hazards due to

Project construction. In light of these safety impacts, the DEIR must thoroughly analyze how the increase in vehicle traffic generated by the Project would impact bicycle and pedestrian safety along SR-120. The DEIR must first disclose and evaluate existing bicycle and pedestrian activity in the vicinity of the Project, then analyze how the increase in both vehicle and bicycle traffic generated by the Project, combined with the insufficient sight distance and other roadway safety hazards noted above, could cause an increase in collisions between bicycles, pedestrians and vehicles. **ORG6-67 cont.**

5. The DEIR Ignores Cumulative Roadway Safety Impacts.

The DEIR concludes that the Project would not result in significant cumulative impacts on transportation and traffic. DEIR p. 4.15-22 (Impact TRANS-5). The DEIR identifies four other projects in the vicinity that would contribute to the Project's cumulative traffic impacts, including the proposed Yosemite Under Canvas development located to the south of the Project site across SR-120, the Thousand Trails/Yosemite Lakes RV Expansion, the Berkeley Tuolumne Camp Restoration project southeast of the Project site, and the Mountain Sage Conditional Use Permit project west of the site. *Id.* However, in clear violation of CEQA, the DEIR makes no attempt to analyze how traffic from the proposed Project, together with traffic from the four other projects, would cumulatively affect the roadway safety issues created by the Project. CEQA Guidelines § 15355(b). The DEIR therefore lacks factual support for its conclusion that the project's cumulative transportation impacts would be less than significant.

ORG6-68

As noted above, the latest plans for the Yosemite Under Canvas project, located immediately south of the Project site across SR-120, indicate that the development will include an access road providing a second means of egress to SR-120, in addition to the main entrance on Hardin Flat Road. *See* Yosemite Under Canvas Draft Environmental Impact Report (June 2020), p. 2-5, Fig. 3; excerpts attached as Exhibit H. The Under Canvas project's second access road would connect to SR-120 via Forest Service Road 1S09, which intersects SR-120 approximately 100 feet west of SR-120's intersection with Forest Route1S03. *Id*. pp. 2-5, 2-10. The close proximity of these two intersections could create dangerous roadway conditions, creating an increased risk of collisions between traffic on SR-120, Terra Vi Project traffic entering and exiting SR-120 via Forest Route1S03, and Under Canvas traffic entering and exiting SR-120 via Forest Service Road 1S09. During a wildfire emergency, hazardous conditions at these two intersections could impede evacuation traffic and emergency vehicle access to and from both developments. The DEIR must analyze the cumulative effects of Project traffic and Under Canvas traffic and the resulting roadway safety hazards at these intersections.

H. The DEIR Must Be Revised and Recirculated.

Under California law, the present DEIR cannot properly form the basis of a final EIR. CEQA and the Guidelines describe the circumstances that require recirculation of a draft EIR. Such circumstances include: (1) the addition of significant new information to the EIR after public notice is given of the availability of the DEIR but before certification, or (2) the draft EIR is so "fundamentally and basically inadequate and conclusory in nature that meaningful public review and comment were precluded." Guidelines § 15088.5. ORG6-69

Here, both circumstances apply. Decisionmakers and the public cannot possibly assess the Project's impacts or even its feasibility through the present DEIR, which is riddled with errors. Among other fundamental deficiencies, the DEIR repeatedly understates the Project's significant environmental impacts and assumes that unformulated or clearly useless mitigation measures will effectively reduce these impacts. In order to resolve these issues, the County must prepare a revised EIR that would necessarily include substantial new information. This revised EIR must then be recirculated for public review and comment.

II. APPROVAL OF THE PROJECT WOULD VIOLATE CALIFORNIA PLANNING AND ZONING LAW.

The State Planning and Zoning Law (Gov. Code § 65000 et seq.) requires that development decisions be consistent with the jurisdiction's general plan. As reiterated by the courts, "[u]nder state law, the propriety of virtually any local decision affecting land use and development depends upon consistency with the applicable general plan and its elements." *Resource Defense Fund v. County of Santa Cruz* (1982) 133 Cal.App.3d 800, 806. Accordingly, "[t]he consistency doctrine [is] the linchpin of California's land use and development laws; it is the principle which infuses the concept of planned growth with the force of law." *Families Unafraid to Uphold Rural El Dorado County v. Bd. of Supervisors* (1998) 62 Cal.App.4th 1332, 1336 (citations and internal quotations omitted). ORG6-70

General plans establish long-term goals and policies to guide future land use decisions, thus acting as a "constitution" for future development. *Lesher Communications, Inc. v. City of Walnut Creek* (1990) 52 Cal.3d 531, 540. The policies in the General Plan must be internally consistent. Gov. Code § 65300.5. To promote coordinated land use policies and practices, state law requires local governments not just to formulate theoretical land use plans, but also to conform their development and land use projects and approvals with those duly certified plans. *Citizens of Goleta Valley v.*

Bd. of Supervisors (1990) 52 Cal.3d 553, 570; *see also* Gov. Code § 65860 (requiring consistency of zoning to general plan); *id.* §§ 65359 & 65454 (requiring consistency of specific plan and other development plan and amendments thereto to general plan).

It is an abuse of discretion to approve a project that "frustrate[s] the General Plan's goals and policies." *Napa Citizens for Honest Government v. Napa County Bd. of* Supervisors (2001) 91 Cal.App.4th 342, 357, 378-379. The project need not present an "outright conflict" with a general plan provision to be considered inconsistent; the determining question is instead whether the project "is compatible with and will not frustrate the General Plan's goals and policies." *Id.* at 379.

Here, for the reasons described above, the proposed Project is inconsistent with Tuolumne County's General Plan. Because of these inconsistencies, approval of this Project would violate State Planning and Zoning Law.

ORG6-70 cont.

III. CONCLUSION

As set forth above, the DEIR for the Terra Vi Lodge Yosemite Project suffers from numerous deficiencies, many of which would independently render it inadequate under CEQA. Taken as a whole, the deficiencies of the DEIR necessitate extensive revision of the document and recirculation for public comment. Moreover, as currently designed, the Project conflicts with the Tuolumne County General Plan. Save Sawmill Mountain respectfully requests that the County reevaluate the Project in light of its inconsistencies with these plans and ordinances and make changes to the Project to reduce its serious environmental impacts.

ORG6-71

Very truly yours,

SHUTE, MIHALY & WEINBERGER LLP

Laurel L Impett

Laurel L. Impett, AICP, Urban Planner

Patrick Woolsey

Patrick L.Woolsey

List of Exhibits:

Exhibit A: Paige St. John, *Alarming failures left many in path of California wildfires vulnerable and without warning*, Los Angeles Times (Dec. 29, 2017)

Exhibit B: Eric Heinz, *Rim Fire Cause Determined by Investigators*, Tahoe Daily Tribune (Sept. 6, 2013)

Exhibit C: Headwaters Economics, *Rim Fire - California*, *2013* (2018)

Exhibit D: JP Theberge, *Stop Dismissing Concerns About The Risks Of New Homes In Wildfire Zones*, Voice of San Diego (June 5th, 2019)

Exhibit E: Mary Forgione, *Rim fire: New road closure, long detours for some Yosemite visitors*, Los Angeles Times (Aug. 28, 2013)

Exhibit F: *Highway 120 to reopen after Rim fire closure*, Modesto Bee (Sept. 6, 2013)

Exhibit G: Safari Highlands Ranch and Citywide SOI Update Wildfire Hazard Analysis

Exhibit H: Excerpts from Yosemite Under Canvas Draft Environmental Impact Report (June 2020)

Exhibit I: Greg Kamman, CBEC Eco Engineering, Report re: Terra Vi Lodge DEIR (July 27, 2020)

Exhibit J: Papadimos Group Report re: Terra Vi Lodge Project DEIR (July 28, 2020)

Exhibit K: Generator Basics: Sound Attenuation, Woodstock Power

Exhibit L: Mathias Basner and Sarah McGuire, *WHO Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Effects on Sleep*, 15 Intl. J. of Environmental Research & Public Health 519 (March 2018)

cc: Ben Gardella, Save Sawmill Mountain

1263322.11

Note to Amanda:
For the news articles, rather than putting the actual article content into the matrix, I think the matrix can just say:
Exhibit A: [Newspaper Name, Article Title, Date]

ORG6-72

EXHIBIT A

Los Angeles Times

LOG IN

CALIFORNIA

Alarming failures left many in path of California wildfires vulnerable and without warning

A fire truck pulls responds to fires burning near homes on East Mountain Drive in Montecito. (Marcus Yam / Los Angeles Times)

By PAIGE ST. JOHN | STAFF WRITER

DEC. 29, 2017 | 5 AM

Reporting from NAPA, Calif. — The Sonoma ridgeline was a sunrise of flame as Sgt. Brandon Cutting led deputies up country roads to pound on doors, hollering “Sheriff’s Office!”

ORG6-72 cont.

Thirty minutes later, with Cutting huffing from exertion and choking in thick smoke, the evacuation of Redwood Hill was still playing out one door at a time. He followed the sound of shouts to an officer struggling to carry a disabled woman. Her house was on fire. Her shoe on the ground. The night around them was orange in every direction.

It was 11 on a Sunday night, the beginning of what would be the most destructive fire siege in California history. Frantic rescues were taking place across wine country as heavy winds ripped down power lines and the dry hills lit up in flames. Modern technology in the form of robocalls and digital alerts would not join the fight to roust sleeping residents for another half an hour.

When the warnings came, they were not received by many of those in the most peril.

ORG6-72 cont.

Two months after the wine country fires, officials still debate whether more could have been done to give residents earlier warnings before the fires swept in, ultimately killing 44 people and destroying more than 10,000 homes.

I can use my cellphone to order a pizza and it gets here. Why can't I have that same system to save people's lives?

ROB LEWIN, DIRECTOR OF THE SANTA BARBARA COUNTY OFFICE OF EMERGENCY MANAGEMENT

The fires highlighted the inadequacies of the emergency warnings officials employed and have prompted a push for new safety protocols. Some of the same problems occurred two months later when the Thomas fire — the largest on record in California — swept through Santa Barbara and Ventura counties.

In the end, the warnings that officials did send reached only a fraction of those in the path of the fire, and emergency agencies struggled to target their warnings to the correct geographic areas. The situation left officials frustrated and looking for answers.

"I can use my cellphone to order a pizza and it gets here," said Rob Lewin, director of the Santa Barbara County Office of Emergency Management. "Why can't I have that same system to save people's lives? To get people out of harm's way?"

The struggle to warn wine country

Although weather forecasters told fire departments across Northern California to prepare for incendiary conditions, decisions to broadcast evacuation orders did not take place until hours after the fires started and residents were already trapped. Those caught by surprise jumped into swimming pools or water tanks, or ran through vineyards.

Fires flanked tourists and residents alike in Napa from three sides, but Napa County relied on sending cellphone text messages to the small population that had the foresight to register in advance. It uses the same tool to announce parades and water main breaks.

Electronic logs show that not until the following afternoon did the county attempt to broaden its warnings to include some 53,000 landlines gleaned from AT&T — a broad message asking residents to refrain from dialing 911.

The effort made no allowance for the tourists who are the lifeblood of the Napa economy. Hotel staff at a luxury golf resort pulled guests from their rooms in pajamas even as a highway patrol medevac team plucked trapped residents off the ridge above by helicopter. The deputies attempting to knock on doors to spread evacuation orders couldn't even get up the fire-blocked road.

Sonoma County sent text messages and robocalls, but records obtained under the California Public Records Act show only 50% of the numbers on its call list worked. An analysis of the calls shows the county attempted to reach less than a tenth of those living in the targeted warning area. Fewer than a third of that one-tenth would pick up the phone.

ORG6-72 cont.

Every county had the capacity for alerts carried on a federal system that would loudly buzz every cellphone within range of a working tower — by sending the messages either on their own or through the state. Of the eight counties hit by 14 fires that night, only one — Lake County — employed the system. A neighboring county that had no fire, Marin, used the system to tell fire evacuees where shelters were open.

Firetrucks monitor a blaze that threatens the Oakmont community along Highway 12 in Santa Rosa. The retirement community was evacuated on the second day of the Northern California fire. (Genaro Molina / Los Angeles Times)

ORG6-72 cont.

In Sonoma, where Cutting was stationed that night, emergency managers said they decided against the federal wireless warning system. County emergency manager Chris Helgren said he was worried the notoriously imprecise system would trigger a countywide panic. Mass evacuations on the single highway through town would have made the emergency even more dire. In the end, dozens died in Sonoma as the Tubbs fire swept from the mountain vale of Calistoga into a suburb of Santa Rosa.

Phone records show fire evacuation warnings in Mendocino were delayed by overwhelmed sheriff's dispatchers.

Mendocino County was 90 minutes into its wildfire when the first call came from the field for evacuation warnings. The dispatcher wrestled 10 minutes with the wording, then called a lieutenant at home. He encouraged a valley-wide warning "just so we can get people awake." But she worried about downed power lines, and they agreed to "hold off, because we have to figure out where [residents] are going to go."

It was 43 minutes before the county launched its phone-dialing system to ring some 4,000 numbers in Redwood Valley, already engulfed in fire. The automated phone messages were limited to incomplete phone lists, and then blacked out when cell towers were lost to the fire.

Nine people died in that valley, in their homes or attempting to leave.

Firefighters monitor the flames Saturday from a staging area near Parma Park in Montecito. (Marcus Yam / Los Angeles Times)

ORG6-72 cont.

During Thomas fire, 'throwing horseshoes and hand grenades'

When wildfires hit Southern California in December, officials were more aggressive about using various electronic communications systems, including an unprecedented seven-county alert on the eve of Santa Ana winds telling millions of Californians to keep a watch through the night for fire. But emergency managers say their efforts to warn residents were hampered by its own share of technological faults.

Santa Barbara County used the federal wireless system 13 times over the course of a week to send cellphone alerts. Three times it sought to contain the warnings to small areas drawn on alert maps sent to FEMA, but county officials said they presume even those alerts were cast broadly and confused those not in danger.

"It's like throwing horseshoes and hand grenades," said Santa Barbara County Emergency Manager Jeff Gater.

The 5-year-old wireless alert system — the same network used to buzz phones with Amber alerts — falls under the joint control of the Federal Emergency Management Agency and the Federal Communications Commission.

Participation by cellphone carriers is voluntary. The messages are limited to 90 characters and broadcast from cell towers like radio signals, not phone calls, so they consume minimal bandwidth.

Original regulations required only that carriers restrain those broadcasts to the county level. The FCC in September 2016 issued an order requiring better targeting, but this year interpreted that ruling to allow cellphone carriers to define the "best approximate" target of a message as an entire county.

A text alert sent to millions during the Thomas fire (State of California.)

Emergency managers told the FCC that alerts can come close to their intended marks in dense urban areas where there are many towers. But in rural areas — wildfire terrain — so-called "boomer" towers cast warnings 20 miles outside the intended alert area.

Therefore, Santa Barbara stuffed so much geography into 90 characters its emergency evacuation orders looked like this:

"EVAC ORDER: Montecito S. of 192, N. of 101, W. of Toro Cyn, E. of Summit Rd & Country Club"

FEMA staff confirmed that cell carriers can choose which cell towers transmit the emergency warning, and it is up to them whether to even send a warning where the alert area is less than the cell tower coverage area. They are not required to make those policies public, robbing emergency managers of the chance to know in advance how their message will be carried and adjust accordingly.

ORG6-72 cont.

“Right now if we draw a polygon [to target an alert], we have the potential to do more harm than good,” said Francisco Sanchez, emergency manager for Harris County, Texas, which includes Houston, and a primary champion of new FCC rules to improve wireless alerts.

Sanchez’s concerns are the same ones that Sonoma County’s Helgren raised: Mass alerts can make matters worse, especially in regions with limited routes in and out of a disaster area. Despite handling a disaster roster that included Hurricane Harvey this fall, Sanchez has issued a wireless alert only once — to tell county residents to not call 911 so that emergency calls could get through.

Warnings failed to reach many

When homes phones largely ran on copper wire land lines, emergency officials could use their 911 systems as a calling tree to deliver warnings. Private vendors have since stepped in to provide those services as well as the software and servers to call up cellphone owners.

The reach of those systems are limited by the phone lists they use — usually a combination of data bought from private marketers, telephone companies and numbers provided by voluntary subscribers.

ORG6-72 cont.

Call records provided by Sonoma County show its efforts to warn residents of the deadly Tubbs fire were a success just 50% of the time — counting calls that went straight to answering machines. Numbers provided by residents subscribing to the county’s system had a 90% success rate. But those numbers made up only 15% of the dialing list. For the first warning of the Tubbs fire that meant only 213 numbers in an area with more than 13,000 residents, according to U.S. census data.

Meanwhile the thousands of numbers provided by the county’s vendor failed to be answered 62% of the time.

Shortly after the October fire siege, Sacramento County ran a test of its own emergency dialing system, provided by a different vendor. Data shared with The Times show Sacramento had similarly low call completion rates: Out of more than 34,000 calls, just over 2,000 were answered and 3,000 went to voicemail.

During the December fires, Santa Barbara’s direct dialing system’s call completion rates ranged between 15% and 55%.

Sacramento County pays to update its phone calling list every six months, county officials said, but to reduce error rates the county is considering buying new numbers every quarter. Sonoma County, Helgren said, had not updated its phone list since signing up for the private service in mid-2016.

Technological advances have further eroded the usefulness of other warning tools, managers said, including the emergency broadcast system that once was the backbone of the country's civil alert muscle.

Television and radio stations, unlike cellphone carriers, are still required to participate in what is now called the Emergency Alert System — the service that begins a public warning with blaring tones. But the network was built to work with analog broadcasting, not the digital technology in use today.

As a result, when Santa Barbara tried to send an EAS broadcast this year to warn residents of flash floods, no message appeared on viewers' screens. Something else happened. Their channels changed to C-SPAN.

ORG6-72 cont.

County officials, cable providers and federal officials are still trying to figure out what happened, said Lewin, director of the Santa Barbara County Office of Emergency Management. In the meantime, even with wildfire forcing evacuations in his backyard, he will not use the system.

Lewin is looking for a technological fix to these gaps in his warning tools.

Hundreds of miles north in Mendocino County, where emergency managers have now discovered steep ridges block even the radio signals of National Oceanic and Atmospheric Administration weather alerts, Sheriff Thomas Allman has settled on a different path.

He is buying air sirens.

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CALIFORNIA

Paige St. John

Twitter Instagram Email Facebook

Paige St. John covers criminal justice, disasters and investigative stories for the Los Angeles Times from Northern California.

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EXHIBIT B

ORG6-73

EXHIBIT B

Rim Fire cause determined by investigators

Local FOLLOW LOCAL | September 6, 2013

Eric Heinz
eheinz@tahoedailytribune.com

A Hotshot fire crew member rests near a controlled burn operation at Horseshoe Meadows, as crews continue to fight the Rim Fire near Yosemite National Park in California on Sept. 4.
AP Photo/U.S. Forest Service, Mike McMillan | USFS

The Rim Fire was caused by a hunter's illegal fire that escaped out of control, the U.S. Forest Law Enforcement and Investigations with Tuolumne County District Attorney's Office announced Thursday

The hunter's name is currently being withheld pending the investigation.

According to the U.S. Forest Service Lake Tahoe Basin Management Unit Order No. 19-13-06, signed July 1, violating prohibitions of forest fires can be punishable by $5,000 for an individual or $10,000 for an organization, or imprisonment of no more than six months in jail.

Intentionally starting a wildfire can come with more serious consequences depending on the severity of the fire and damage caused.

The Forest Service made note that the fire was not caused by a marijuana cultivation operation, as no sites were found in the area.

ORG6-73

ORG6-74

EXHIBIT C

Rim Fire - California, 2013

The Rim Fire was the third-largest in California's recorded history, burning 402 square miles and destroying 112 structures primarily in drought-stricken national forest and national park lands.

Blackened ecosystems ranged from lower-elevation wet meadows and chaparral to diverse subalpine forests of pine, oak, and aspen. Important nesting areas for spotted owls and goshawks were destroyed. The burned area supplies drinking and irrigation water to the San Francisco Bay Area and California's Central Valley. The fire quickly and completely consumed dense stands of pine and other vegetation on high ridges and in steep canyons, but burned as a lower-intensity (some say beneficial) ground fire around a critical reservoir.[1]

Rim Fire, Yosemite and Stanislaus (NASA, International Space Station, 08/26/13). Image credit: NASA

DATA COLLECTION

The San Francisco Public Utilities Commission hired Earth Economics – a Tacoma, WA-based organization that specializes in putting a dollar value on "ecosystem services" – to collect environmental data and compile a rapid assessment of economic impacts. Based on satellite data collected in mid-September 2013 before the fire was completely contained, Earth Economics estimated losses for the first year based on a range of environmental values available in academic, peer-reviewed literature. Losses to 10 categories of environmental benefits (ecosystem services) totaled $100 million to $736 million and considered air quality, carbon sequestration, moderation of extreme events, soil retention, biological control, water regulation, pollination, habitat and biodiversity, aesthetic values, recreation and tourism.[2]

SUMMARY

Date: August-October 2013

Setting: The Sierra Nevada Mountains of central California, east of San Francisco in the Stanislaus National Forest and Yosemite National Park.

Burned area:
257,314 acres (402 square miles)

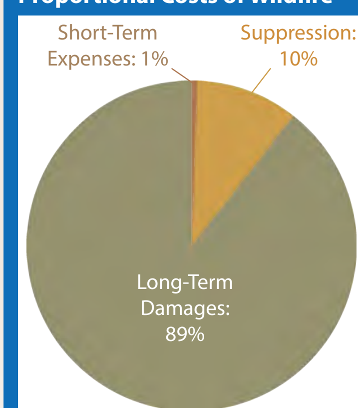
Buildings destroyed:
- 3 commercial buildings
- 98 outbuildings
- 11 residences

Injuries: 10

Land ownership:
- 91% federal
- 9% private

Estimated costs:
$388 million to $1.271 billion

Proportional Costs of Wildfire



ORG6-74

EXPENSES AND DAMAGES

USFS image of a firefighter after starting back fires to help suppress the Rim Fire. Photo: Mike McMillan, USFS

The cost of fire suppression was more than $127 million.[3] The cost included the loss of several commercial buildings and 11 residences. In addition, the fire cost:

- $8.5 million for emergency road, trail, and watershed stabilization [4,5]
- $900,000 to purchase alternative energy when three hydroelectric powerhouses had to be taken offline
- Losses "in the millions" to the ranching community for destroyed grazing land, killed livestock, and damaged infrastructure
- Between $102 million and $797 million for the loss of carbon storage
- Between $49.7 million and $265 million for losses to private property values
- Between $100 million and $736 million for loss of ecosystem services – that is, environmental benefits. (These costs are being tabulated more often as ecosystem service valuation becomes more accepted in courts to support damage assessments.)

COSTS NOT EVALUATED

- Ecosystem services not evaluated due to lack of data or absence of appropriate studies included food provisioning, raw materials, medicinal resources, soil formation, and science and education
- Impacts on water supply, quality, timing, and reliability
- Impacts of hydrophobic soils (i.e., ash-encrusted soil that repels water, thereby increasing runoff and decreasing infiltration)
- Longer-term economic damages (loss of property taxes, decreased economic activity, increased insurance premiums, etc.)
- Rehabilitation and restoration
- Public health including physical and mental injury, stress, and trauma incurred during the fire and in succeeding years

WHO PAYS

In the case of the Rim Fire which burned primarily on federal land, the federal government paid for most of the firefighting costs. However, ongoing environmental costs will be paid by the general public, including the 2.6 million Bay-area users of drinking water that originates in the Rim Fire area.

ORG6-74

1 Batker D, Christin Z, Schmidt R, and de la Torre I. 2013. *The Economic Impact of the 2013 Rim Fire on Natural Lands: Preliminary Assessment.* Tacoma, WA: Earth Economics. http://www.energyenvironmentallaw.com/files/2014/01/Earth-Economics-Rim-Fire-Report-11.27.20131.pdf.

2 Ibid (Batker et al.)

3 InciWeb Incident Information System https://inciweb.nwcg.gov/incident/3660/

4 Sierra Nevada Conservancy. *The Rim Fire: Why investing in forest health equals investing in the health of California.* Auburn, CA: State of California. http://www.sierranevada.ca.gov/factsheets/10.31rimfirefactsheet.pdf

5 http://www.energyenvironmentallaw.com/files/2014/01/Earth-Economics-Rim-Fire-Report-11.27.20131.pdf

ORG6-75

EXHIBIT D

- Voice of San Diego - https://www.voiceofsandiego.org -

Stop Dismissing Concerns About the Risks of New Homes in Wildfire Zones

Posted By *JP Theberge* On June 5, 2019 @ 2:23 pm

The framework of a home remains standing after the Lilac Fires engulfs a Fallbrook community. / Photo by Adriana Heldiz

ORG6-75 cont.

In the past 20 months, California has seen seven of the largest [1] fires in state history and lost more than 22,000 homes to wildfires. A million homes face [2] wildfire risk in California, 88,000 in San Diego alone. Scientists and the state [3] are telling us that wildfires will increase in frequency [4] and severity over the coming decades, that we need to shift our building pattern from sprawl in rural areas to more urbanized infill areas. With that backdrop, well-meaning but tone-deaf advocates for car-centric sprawl attempt to blindly dismiss concerns about fire risk in a recent letter to the editor [5].

One argument the authors make (echoing the building industry line [6]) for making exceptions to the county's general plan for high-risk sprawl projects is that the entire San Diego region is in a "very high fire severity zone," therefore limiting construction in those zones would essentially kill construction everywhere. No one is suggesting that, and furthermore, it is incorrect.

LETTERS
Notes from Our Readers

Cal Fire's scientifically derived "fire hazard severity zones [7]" overlays are based on available fuel load, topography and a high likelihood that a fire could start and spread quickly in a particular area. If you look at the map of San Diego County [8] you will see that, indeed, much of it is covered in "very high fire hazard severity zones." The largest, contiguous swaths of these zones are in the undeveloped areas of East County and North County. It is why the general plan avoids density in those areas. In the western, more urbanized parts of the county, the "very high" fire hazard zones are isolated areas adjacent to canyons, parks or open space (like Torrey Pines or Miramar).

These are clearly very different areas. One is more defensible because it has urban development surrounding it, limiting fuel for a fire to spread. The other has over a million acres of contiguous brush and open space, creating the conditions for wildfires like the Cedar Fire [9] in October 2003 that burned at the rate of 46 football fields *per minute* for a total of 273,000 acres, destroying 2,800 structures and killing 12 people.

Established science shows that the majority of property damage and destruction [10] from wildfire in California is located in less dense, rural areas, where there's more fuel and a higher likelihood of structure loss. This is why the county's general plan avoids those areas. This is not controversial.

A recent report [11] by Gov. Gavin Newsom's wildfire strike force wisely recommends that the state "begin to deprioritize new development in areas of the most extreme fire risk. In turn, more urban and lower-risk regions in the state must prioritize increasing infill development and overall housing production."

Outgoing CalFire Director Ken Pimlott told the Associated Press [12] last fall, "we must consider prohibiting construction in particularly vulnerable areas." Even Sen. Scott Weiner's recent controversial housing bill, SB 50, created exemptions to increased density in "very high" fire zones.

Some of our decision-makers recognize that encouraging infill and urban density is more sustainable, reduces commutes and greenhouse gases and, importantly, is much less likely to be destroyed by the increasingly frequent wildfires the state will be facing [3] in the coming decades.

Pro-sprawl activists claim that the county will protect these far-flung sprawl developments through hardened construction standards [13], shelter-in-place policies and orderly, staged evacuations. But none of this is backed by science and, in fact, puts people at risk. **ORG6-76 cont.**

Existing construction standards for homes in high fire-risk areas are already very stringent. The Thomas Fire in December 2017 showed that the highest standards were not enough. More than 90 percent [14] of the structures destroyed had fire-resistant construction. In the Tubbs fire in October 2017, 86 percent of the homes destroyed were built [15] after 2008, with the highest wildfire construction standards. Non-combustible siding and roofing, interior sprinklers, enclosed eaves were no match for softball-sized embers slamming into homes at 60 miles per hour. Shelter-in-place should only be used as a last resort, not as the primary means to protect a community.

The Associated Press recently evaluated [16] California communities and evacuation routes and found numerous areas in San Diego County that were in the top 1 percent of worst communities when it comes to population-to-evacuation-route ratios including Jamul, Ramona and Scripps Ranch.

The head of the County Fire Authority, Chief Tony Mecham, has given his blessing to sprawl projects in high-risk areas (including waivers to secondary egress requirements) by saying that the errors of the past will be corrected by a more "surgical" evacuation whereby people will be evacuated by block in order to avoid gridlock. During Coco's Fire [17] in May 2014 thousands of cars were at a standstill for close to two hours while wildfire burned less than a mile uphill from residents of San Elijo Hills. Only a last-minute change of wind directionprevented a catastrophe. And rigorous studies [18] have shown that "staged" evacuations do not help in rural areas.

The mayor of Paradise, a traffic specialist by trade, meticulously planned [19] for fire evacuations, including communitywide drills and staged evacuations. Needless to say, that system failed spectacularly, and the entire town was destroyed. San Diego County has not implemented the same level of planning. In essence, those charged with our safety are using anecdote and ignoring science to dismiss fire safety concerns.

As the county contemplates approving general plan amendment projects in fire corridors and rural areas of the county such as Lilac Hills and Otay 14, they have ignored the realities of evacuating rural communities. Incredibly, developers are only required to look at mythical evacuation scenarios whereby only the project's residents' vehicles would be evacuating, conveniently ignoring the existing residents and their many vehicles. For one project, independent fire and traffic consultants concluded [20] that in a standard fire scenario, "catastrophic losses are not only probable, but expected."

ORG6-76 cont.

It is time we start taking this seriously before it is too late.

JP Theberge runs a public opinion and market research company and is the creator of Grow the San Diego Way, providing data and analysis on housing issues in San Diego County.

Article printed from Voice of San Diego: **https://www.voiceofsandiego.org**

URL to article: **https://www.voiceofsandiego.org/topics/opinion/stop-dismissing-concerns-about-the-risks-of-new-homes-in-wildfire-zones/**

URLs in this post:

[1] seven of the largest: **https://www.npr.org/2018/08/07/636458618/why-todays-wildfires-are-hotter-and-more-destructive**
[2] million homes face: **https://www.latimes.com/projects/la-me-california-buildings-in-fire-zones/**
[3] state: **http://www.climateassessment.ca.gov/state/docs/20190116-StatewideSummary.pdf**
[4] increase in frequency: **https://www.marketwatch.com/story/california-wildfires-could-increase-by-50-by-2050-beaches-fully-erode-report-finds-2018-08-28**
[5] recent letter to the editor: **https://www.voiceofsandiego.org/topics/opinion/new-developments-in-fire-hazard-areas-are-safer-than-ever/**
[6] the building industry line: **https://www.sandiegouniontribune.com/opinion/commentary/sd-utbg-wildfires-development-safety-20190102-story.html**
[7] fire hazard severity zones: **http://www.fire.ca.gov/fire_prevention/fire_prevention_wildland_zones**
[8] map of San Diego County: **https://egis.fire.ca.gov/FHSZ/**
[9] Cedar Fire: **https://www.10news.com/news/remembering-the-cedar-fire-15-years-later**
[10] the majority of property damage and destruction: **https://www.sciencedirect.com/science/article/pii/S0959378018313293?via%3Dihub**
[11] recent report: **https://www.gov.ca.gov/wp-content/uploads/2019/04/Wildfires-and-Climate-Change-California's-Energy-Future.pdf**
[12] told the Associated Press: **https://www.kcra.com/article/cal-fire-chief-state-must-adapt-to-new-wildfire-norm/25475297**
[13] hardened construction standards: **https://www.biasandiego.org/2018/12/03/abusing-fire-risk-to-block-new-homes/**
[14] More than 90 percent: **https://www.vcstar.com/story/news/local/2018/04/10/thomas-fire-damage-destruction-scale/395893002/**
[15] 86 percent of the homes destroyed were built: **https://www.revealnews.org/article/should-development-be-extinguished-on-californias-fire-prone-hills/**
[16] evaluated: **https://www.nbcsandiego.com/news/local/California-Wildfire-Evacuation-Routes-Analysis-509083321.html**
[17] During Coco's Fire: **https://www.sandiegouniontribune.com/sdut-san-elijo-traffic-review-cocos-fire-san-marcos-2014jun07-story.html**
[18] rigorous studies: **https://www.researchgate.net/publication/32043088_Agent-Based_Modelling_and_Simulation_of_Urban_Evacuation_Relative_Effectiveness_of_Simultaneous_and_Staged_Evacuation_Strategies**
[19] meticulously planned: **https://www.nytimes.com/2018/11/11/us/california-fire-paradise.html**
[20] concluded: **https://www.growthesandiegoway.com/download/rahn-report-final-6-13-17-002.pdf**

ORG6-77

EXHIBIT E

TRAVEL

Rim fire: New road closure, long detours for some Yosemite visitors

ORG6-77

The western entrance to Yosemite National Park at Big Oak Flat remained shut Wednesday. Park officials also closed a portion of the park's major artery, Tioga Road, to aid fire suppression efforts. (Don Bartletti / Los Angeles Times)

By MARY FORGIONE

AUG. 28, 2013 | 12 AM

DAILY DEAL AND TRAVEL BLOGGER

Another key roadway in Yosemite National Park closed at noon Wednesday as part of a firefighting defense against the massive Rim fire, a closure that blocks the east-west route across the park and one expected to remain in effect through Labor Day weekend.

Tioga Road, also known as Highway 120, was closed between Tamarack Flat and Yosemite Creek campgrounds, a roughly 18-mile stretch that makes access to popular Yosemite Valley from the east an incredibly long drive-around.

ORG6-77

"That will limit the access for visitors to and from the east side of the park, quite possibly over Labor Day weekend, which will have a significant economic impact on the area and [be] an inconvenience for visitors," Yosemite spokesman Tom Medema told Reuters.

It's the second closure to affect access to part of the park. The Big Oak Flat entrance to the park at Highway 120 has been closed for days.

ORG6-77

The park suggests these detours while Tioga Road remains temporarily closed:

-- Visitors coming to Yosemite Valley from the park's eastern entrance should drive around the park and enter from Fresno on Highway 41 or from Merced on Highway 140.

-- Visitors entering on the west side who want to go to the back country at Tuolumne Meadows (where the campground and visitor services are open) also have to drive around the park. One option is to take Highway 50 from Sacramento to South Lake Tahoe and drop down Highway 395 to enter the park on the part of Highway 120 that's still open.

Yosemite lists campground and road closures as well as alternative driving directions during the Rim fire on its website.

The fire, burning in the western part of the park and the Stanislaus National Forest, is now in its 12th day, with containment at 23%. Park officials have said that lodgings and campgrounds in Yosemite Valley remain unaffected and are welcoming visitors for the busy holiday weekend.

ORG6-77

Check the Rim fire website for updates on conditions at Yosemite, or call (209) 372-0200 for a recorded message about conditions. Call centers also are answering questions about the fire at (209) 372-0327 and (209) 372-0329.

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TRAVEL

Mary Forgione

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As Los Angeles Times assistant Travel editor, Mary Forgione writes and edits stories for the digital and print Travel section. She loves tips and stories about running, hiking and anything to do with the outdoors.

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ORG6-78

EXHIBIT F

LOCAL

Highway 120 to reopen after Rim fire closure

BEE STAFF REPORTS
SEPTEMBER 06, 2013 08:06 AM , UPDATED SEPTEMBER 06, 2013 09:35 AM

A DC-10 drops fire retardant over the Rim fire east of Ferretti Road in the Stanislaus National Forest on Thursday, Aug. 22, 2013.
THE MODESTO BEE

UPDATE: Highway 120 into Yosemite National Park will reopen at noon today, authorities said.

The highway through Groveland will be open to all traffic, but stopping along the roadway is prohibited.

"The public is advised to use extreme caution as firefighting activities continue in this area," park rangers said in a statement issued this morning. Cherry Lake Road, Evergreen Road, Old Yosemite Road, Harden Flat and all other secondary roads and trailheads off of Highway 120 remain closed.

ORG6-78

Modesto confirms COVID-19 among 'fewer than 10' of its city workers

The highway also remains closed from Crane Flat to White Wolf within the park.

The Rim fire grew overnight, climbing a spot in the chart of largest wildfires in state history. The fire, burning in Tuolumne and Mariposa counties since Aug. 17, has consumed 246,350 acres and remains 80 percent contained, the United States Forest Service said this morning.

According to authorities, fire activity increased within containment lines in unburned portions of the blaze on Thursday. ORG6-78

Roughly 3,600 firefighters remain on site, battling the blaze that broke out Aug. 17, the result of a hunter's illegal fire.

Hot and dry weather accompanied by gusty south and southeast winds are expected to persist through the weekend, officials said.

COMMENTS

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Stanislaus County is hammered by the coronavirus. Will schools reopen in August?

BY KEN CARLSON

JULY 07, 2020 04:54 PM , UPDATED 47 MINUTES AGO

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JULY 06, 2020 12:23 PM

TURLOCK

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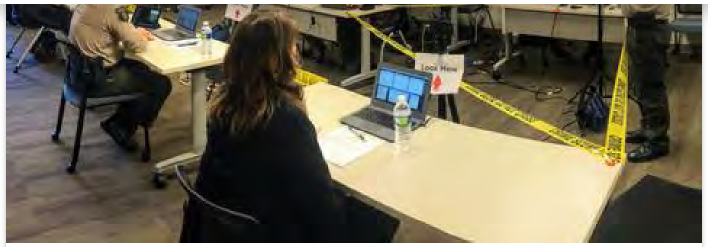
JULY 07, 2020 11:27 AM



CORONAVIRUS

Stanislaus reports 2,670 coronavirus cases. The state says the county has 1,000 more

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Amanda, for this one you can write *"Exhibit G: Excerpt from [Document title/date/]*

ORG6-79

EXHIBIT G

2.14. Wildfire Hazards

This section addresses potential wildfire hazards impacts that may result from construction and/or operation of the proposed Safari Highlands Ranch (SHR) project. The following discussion addresses existing wildfire hazard conditions of the project site and surroundings, considers applicable goals and policies, identifies and analyzes environmental impacts, and recommends measures to reduce or avoid adverse impacts anticipated from project implementation, as applicable.

The analysis in this section is largely based on the Fire Protection Plan (FPP), Safari Highlands Ranch, prepared by Dudek (2017) and peer-reviewed by Anchor Point and Michael Baker International. The report is included in its entirety in **Appendix 2.14**.

The table below summarizes the wildfire hazards impacts detailed in **Section 2.14.4.**

Summary of Wildfire Hazards Impacts

Threshold Number	Issue	Determination	Mitigation Measures	Impact After Mitigation
1	Exposure to Wildland Fire Risk	Less than Significant Impact	None required	Less than Significant Impact
2	Emergency Response and Evacuation	Potentially Significant Impact	WF-1	Less than Significant Impact
3	Physical Impacts from Provision of New Fire Protection Facilities	Less than Significant Impact	None required	Less than Significant Impact

ORG6-79

2.14.1. Existing Conditions

A wildfire is a nonstructural fire that occurs in vegetative fuels, excluding prescribed fire. Wildfires can occur in undeveloped areas and spread to urban areas where the landscape and structures are not designed and maintained to be ignition resistant. A wildland-urban interface is an area where urban development is located in proximity to open space or "wildland" areas. The potential for wildland fires represents a hazard where development is adjacent to open space or within close proximity to wildland fuels or designated fire severity zones. Steep hillsides and varied topography within portions of the City also contribute to the risk of wildland fires. Fires that occur in wildland-urban interface areas may affect natural resources as well as life and property.

The California Department of Forestry and Fire Protection (Cal Fire) has mapped areas of significant fire hazards in the state through its Fire and Resources Assessment Program (FRAP). These maps place areas of the state into different fire hazard severity zones (FHSZ) based on a hazard scoring system using subjective criteria for fuels, fire history, terrain influences, housing density, and occurrence of severe fire weather where urban conflagration could result in catastrophic losses. As part of this mapping system, land where Cal Fire is responsible for wildland fire protection and generally located in unincorporated areas is classified as a State Responsibility Area (SRA). Where local fire protection agencies, such as the City of Escondido Fire Department (EFD), are responsible for wildfire protection, the land is classified as a Local Responsibility Area (LRA). Cal Fire currently identifies the project site as an SRA. In addition to establishing local or state responsibility for wildfire protection in a specific area, Cal Fire designates areas as very high fire hazard severity (VHFHS) zones or non-VHFHS zones. The project site is designated as VHFHS by the State of California.

The project site is located within the service boundaries of the Cal Fire Valley Center Fire Protection District. The Escondido Fire Department (EFD) provides fire protection and emergency medical services to the City and, through a contractual arrangement established in 1984, the Rincon Del Diablo Fire Protection District. A staff of 93 full-time safety (including Chief Officers), 18 full-time non-safety, 10 full-time administration, 3 part-time administration, and 27 senior volunteer personnel provide such services to a population of approximately 153,614 in an area covering 50 square miles in North San Diego County, California.

The EFD currently operates 7 fire stations which house emergency response personnel and equipment. The EFD addresses fire emergencies (e.g., structural, vegetation, and automobile); medical aid emergencies (all chief complaints including vehicle accidents); special rescue emergencies (e.g., confined space rescue, trench rescue, low angle rescue, high angle rescue, and water rescue); hazardous materials incidents (including explosive devices and weapons of mass destruction); and mass disaster incidents (e.g., earthquakes, flooding, and wind). **Table 2.14-1** summarizes the EFD's fire and emergency medical delivery system.

Table 2.14-1. Escondido Fire Department Responding Stations Summary

Fire Station	Address (all in Escondido)	Apparatus	Staffing (Total/Station)	Maximum Travel Distance*	Travel Time**
1	310 North Quince	Paramedic Engine Truck Company Brush Engine 2 Ambulances	27	7.3 miles	16 minutes
2	421 North Midway	Paramedic Engine Brush Engine Ambulance	9	6.2 miles	13 minutes
3	1808 Nutmeg Street	Paramedic Engine Brush Engine	9	9.3 miles	17 minutes
4	3301 Bear Valley Parkway	Paramedic Engine Brush Engine	9	6.1 miles	10 minutes
5	2319 Felicita Road	Paramedic Engine Brush Engine Ambulance	15	6.9 miles	15 minutes
6	1735 Del Dios Road	Paramedic Engine	9	7.8 miles	14 minutes
7	1220 North Ash	Paramedic Engine Ambulance	9	7 miles	15 minutes

* Distance measured to project entry gate located on Safari Highlands Ranch Road at the southern edge of the property.
** Assumes travel to the primary project's northern boundary and speeds calculated with the Insurance Service Office (ISO) travel time formula: Time = 0.65+1.7 (Distance)

ORG6-79

The City of Escondido's Quality of Life Standard is to respond to all priority Level One or emergency-type calls within 7 minutes and 30 seconds, a total of 90 percent of the time. In 2012, the EFD's response time for all stations was 6 minutes and 32 seconds for all urgent calls (Dudek 2017, page 50; **Appendix 2.14**).

The outbreak and spread of wildland fires within the project area is a potential danger, particularly during the hot, dry summer and fall months. The buildup of dry brush provides fuel to result in potentially larger, more intense wildland fires. Various factors contribute to the intensity and spread of wildland fires: humidity, wind speed and direction, vegetation type, the amount of vegetation (fuel), and topography. The topography, climate, and vegetation of much of the project area are conducive to the spread of wildland fires once started.

Particularly at risk are the houses and structures in the inner rural and rural zones surrounding the project area. The project site is surrounded by the communities of Rancho San Pasqual and Rancho Vistamonte, residences in nearby unincorporated County of San Diego areas, and the San Diego Zoo Safari Park. The area to the north of Highway 78 is also adjacent to open space or agricultural fields, both of which are susceptible to wildland fires.

Since 1910, numerous wildfire events in the direct vicinity of the project site have been recorded by Cal Fire (Dudek 2017, page 31; **Appendix 2.14**). These fires, occurring in 1910, 1911, 1912, 1913, 1914, 1919, 1927, 1938, 1943, 1945, 1946, 1949, 1950, 1951, 1952, 1955, 1956, 1962, 1965, 1967, 1970, 1972, 1974, 1975, 1978, 1979, 1980, 1981, 1984, 1985, 1987, 1988, 1989, 1991, 1993, 1995, 1997, 2003, 2004, 2007, and 2013, burned within 5 miles of the project site. The site was burned completely in the 1910s, 1950s, 1993 (Guejito Fire), and 2007 (Witch Fire) and was partially burned in the 1930s. This information excludes fires less than 10 acres. However, there have been multiple fires throughout inland North San Diego County of less than 10 acres. Rapid and overwhelming response to these fires has resulted in their containment before they could grow to the size that would include them in Cal Fire's database. **ORG6-79**

The project site and several undeveloped natural areas to the east and west of the site last burned approximately nine years ago. These natural landscapes, as with much of the open space in the region, in their present state, represent a potential threat to the many existing homes scattered along Cloverdale Road, the San Diego Zoo Safari Park to the south, and the small avocado ranches and semi-rural homes along the northern and northwestern side of the project and beyond, which are all at risk from a Santa Ana wind driven wildfire (Dudek 2017, page 31; **Appendix 2.14**). Since the time of the last fire, the site has recovered with the natural vegetation having generally grown back.

With the proposed annexation of the project site to the City of Escondido, the San Diego Local Agency Formation Commission (LAFCO) would be approving a detachment from CSA #135 (SD Regional Communications) to the City.

2.14.2. Regulatory Framework

Federal

There are no federal regulations that apply to the proposed project with regard to wildfire hazards.

State

California Department of Forestry and Fire Protection

Cal Fire protects the people of California from fires, responds to emergencies, and protects and enhances forest, range, and watershed values providing social, economic, and environmental benefits to rural and urban citizens. Cal Fire's firefighters, fire engines, and aircraft respond to an average of more than 5,600 wildland fires each year (Cal Fire 2012).

The Office of the State Fire Marshal supports Cal Fire's mission by focusing on fire prevention. It provides support through a wide variety of fire safety responsibilities including by regulating buildings in which people live, congregate, or are confined; by controlling substances and products which may, in and of themselves, or by their misuse, cause injuries, death, and destruction by fire; by providing statewide direction for fire prevention in wildland areas; by regulating hazardous liquid pipelines; by reviewing regulations and building standards; and by providing training and education in fire protection methods and responsibilities.

State Fire Regulations

Fire regulations for California are established in Sections 13000 et seq. of the California Health and Services Code and include regulations for structural standards (similar to those identified in the California Building Code); fire protection and public notification systems; fire protection devices such as extinguishers and smoke alarms; standards for high-rise structures and childcare facilities; and fire suppression training. The State Fire Marshal is responsible for enforcement of these established regulations and building standards for all state-owned buildings, state-occupied buildings, and state institutions within California. **ORG6-79**

California Fire Plan

The Fire Plan is a cooperative effort between the State Board of Forestry and Fire Protection and the California Department of Forestry and Fire Protection. By placing the emphasis on what needs to be done long before a fire starts, the Fire Plan looks to reduce firefighting costs and property losses, increase firefighter safety, and to contribute to ecosystem health. The current plan was finalized in early 2010.

California Public Resources Code

Fire Hazard Severity Zones – Public Resources Code Sections 4201–4204

Public Resources Code (PRC) Sections 4201–4204 and Government Code Sections 51175–89 direct Cal Fire to map areas of significant fire hazards based on fuels, terrain, weather, and other relevant factors. These zones, referred to as fire hazard severity zones (FHSZ), define the application of various mitigation strategies to reduce risk associated with wildland fires. The project site is not designated as a fire hazard severity zone within the Local Responsibility Area for Escondido (Cal Fire 2009). However, as stated above, Cal Fire identifies the project site as a State Responsibility Area and designates the property as a VHFHS zone.

California Fire Code

The 2016 California Fire Code (Title 24, Part 9 of the California Code of Regulations) establishes regulations to safeguard against the hazards of fire, explosion, or dangerous conditions in new and existing buildings, structures, and premises. The Fire Code also establishes requirements intended to provide safety for and assistance to firefighters and emergency responders during emergency operations. The provisions of the Fire Code apply to the construction, alteration, movement, enlargement, replacement, repair, equipment, use and occupancy, location, maintenance, removal, and demolition of every building or structure throughout California. The Fire Code includes regulations regarding fire-resistance-rated construction, fire protection systems such as alarm and sprinkler systems, fire services features such as fire apparatus access roads, means of egress, fire safety during construction and demolition, and wildland-urban interface areas. The City of Escondido has adopted the California Fire Code as part of its building regulations (Municipal Code Chapter 11, Article 2, Division 1, Section 11-17) and implements these standards through its building permit process.

Senate Bill 1241

In 2012, Senate Bill 1241 added Section 66474.02 to Title 7 Division 2 of the California Government Code, commonly known as the Subdivision Map Act. The statute prohibits subdivision of parcels designated very high fire hazard, or that are in a State Responsibility Area, unless certain findings are made prior to approval of the tentative map. The statute requires that a city or county planning commission make three new findings regarding fire hazard safety before approving a subdivision proposal. The three findings are, in brief: (1) the design and location of the subdivision and its lots are consistent with defensible space regulations found in PRC Section 4290-91, (2) structural fire protection services will be available for the subdivision through a publicly funded entity, and (3) ingress and egress road standards for fire equipment are met per any applicable local ordinance and PRC Section 4290. ORG6-79

Local

San Diego County Multi-Jurisdictional Hazard Mitigation Plan

The purpose of the County's Multi-Jurisdictional Hazard Mitigation Plan (San Diego County 2010) is to identify the county's hazards, review and assess past disaster occurrences, estimate the probability of future occurrences, and set goals to mitigate potential risks to reduce or eliminate long-term risk to people and property from natural and man-made hazards. The City of Escondido participates in the Multi-Jurisdictional Hazard Mitigation Plan. An important component of the plan is the Community Emergency Response Team, which educates community members about disaster preparedness and trains them in basic response skills, such as fire safety, light search and rescue, and disaster medical operations. The City of Escondido is one of 20 jurisdictions that support and participate in the team.

County of San Diego Consolidated Fire Code

The County of San Diego, in collaboration with local fire protection districts, created the first Consolidated Fire Code in 2001. The Consolidated Fire Code contains amendments to the California Fire Code. The purpose of consolidation of the County's and the local fire districts' adopted ordinances is to promote consistency in the interpretation and enforcement of the code for the protection of public health and safety, which includes permit requirements for the installation, alteration, or repair of new and existing fire protection systems, and penalties for violations of the code. The code establishes the minimum requirements for access, water supply and distribution, construction type, fire protection systems, and vegetation management. Additionally, the Consolidated Fire Code regulates hazardous materials and includes associated measures to ensure that public health and safety are protected from incidents relating to hazardous substance releases.

County of San Diego Code of Regulatory Ordinances Sections 96.1.005 and 96.1.202, Removal of Fire Hazard

The San Diego County Fire Authority, in partnership with Cal Fire, the Bureau of Land Management (BLM), and the US Forest Service (USFS), is responsible for the enforcement of defensible space inspections. Inspectors are responsible for ensuring that adequate defensible space has been created and maintained around structures. If violations of the program requirements are noted, inspectors list the required corrective measures and provide a reasonable time frame in which to complete the task. If violations still exist upon re-inspection, the local fire inspector will forward a complaint to the County for further enforcement action.

City of Escondido Weed and Rubbish Abatement Program

Municipal Code Chapter 11, Article 2, Division 2 establishes the City's Weed and Rubbish Abatement Program. The purpose of this ordinance is to designate the responsibility of the owners of real property in the City of Escondido in the elimination of the public nuisance created by weeds, rubbish, and refuse on or around their property. Section 11-41 declares the following as a public nuisance or fire hazard: all weeds growing upon the streets, sidewalks, parking, and private property in Escondido; and all rubbish upon the streets, sidewalks, parking facilities, and private property in the city. The Chief of the Escondido Fire Department, or any agent thereof, is vested with the authority to determine if vegetation on private property results in a fire hazard and must be removed. **ORG6-79**

City of Escondido General Plan

The City's General Plan Community Protection Element outlines goals and policies to achieve community protection standards. Relevant goals and policies include:

GOAL 1: A prepared and responsive community in the event of disasters and emergencies.

Emergency Services Policy 1.1
Provide for emergency response during and after catastrophic events.

Emergency Services Policy 1.2
Maintain and upgrade the city's disaster response plans and continue to participate in appropriate Mutual Aid Agreements that enhance disaster preparedness and emergency response.

Emergency Services Policy 1.3

Conduct periodic emergency exercises to test and improve jurisdictional and inter-department coordination and response to emergencies brought about by catastrophes such as fire, flood, earthquakes, and hazardous spills.

Emergency Services Policy 1.4

Plan for the continued function of essential facilities such as hospitals, fire stations, and emergency command centers following a major disaster to facilitate post-disaster recovery.

Emergency Services Policy 1.6

Require minimum road and driveway widths and clearances around structures consistent with local and state requirements to ensure emergency access.

Emergency Services Policy 1.8

Regularly review and revise identified evacuation routes for the public's use in the event of an emergency to ensure adequacy.

Emergency Services Policy 1.9

Promote public awareness through the Community Emergency Response Team (CERT) of possible natural and man-made hazards and measures which can be taken to protect lives and property during and immediately after emergencies.

Emergency Services Policy 1.10

Maintain and periodically update a database documenting wildfire, flooding, and seismic hazard areas and risks as input for the city's Emergency Preparedness and Response programs. The database shall include debris management operations and landfill diversion requirements for the safe and responsible removal and disposal of debris after an emergency that maximizes recycling and minimizes materials disposed in landfills. **ORG6-79**

GOAL 2: Protection of life and property through adequate fire protection and emergency medical services.

Fire Protection Policy 2.1

Regularly review and maintain the Standards of Response Coverage and the Fire Department Strategic Plan to address staffing, facility needs, and service goals.

Fire Protection Policy 2.2

Provide Fire Department response times for no less than 90 percent of all emergency responses with engine companies by achieving the following service standard:

- Provide an initial response time of seven and one-half (7½) minutes for all structure fire and emergency Advanced Life Support (ALS) calls and a maximum response time of ten (10) minutes for supporting companies in urbanized areas of the city.

Fire Protection Policy 2.3

Provide a minimum total of seven (7) fire stations each sized and staffed with facilities, services and equipment to meet current and anticipated needs including, but not limited to, engine and truck units and crews and Advanced Life Support (ALS) staff prior to General Plan build out to the extent economically feasible.

Fire Protection Policy 2.4

Require new residential and non-residential development to be constructed consistent with the California Fire Code and the requirements set by the state.

Fire Protection Policy 2.5

Commit to the use of state-of-the-art equipment, technologies, and management techniques for fire prevention and suppression.

Fire Protection Policy 2.6

Require new development to contribute fees to maintain fire protection service levels without adversely affecting service levels for existing development.

Fire Protection Policy 2.7

Continue to include the Fire Department in the review of development proposals to ensure that projects adequately address safe design and on-site fire protection.

Fire Protection Policy 2.8 **ORG6-79**

Consider provisions for adequate emergency access, driveway widths, turning radii, fire hydrant locations, and Needed Fire Flow requirements in the review of all development applications to minimize fire hazards.

Fire Protection Policy 2.10

Establish and maintain an adequate fire flow in relation to structure, size, design, and requirements for construction and/or built-in fire protection.

Fire Protection Policy 2.11

Maintain and enhance an emergency vehicle traffic signal activation system to improve fire station service area coverage in conjunction with planned improvements to the city's major circulation system.

Fire Protection Policy 2.12

Maintain close coordination between planned roadway and other circulation improvements in the city to assure adequate levels of service and response times to all areas of the community.

Fire Protection Policy 2.13

Utilize Mutual Aid and Automatic Aid Agreements with other jurisdictions when appropriate to supplement fire station service area coverage and response times to all portions of the community.

Fire Protection Policy 2.14

Require new development in high wildfire risk areas to incorporate site design, maintenance practices, and fire-resistant landscaping to protect properties and reduce risks.

Fire Protection Policy 2.15

Continue to remove excessive/overgrown vegetation from city-owned properties, and require private property owners to remove excessive/overgrown vegetation to the satisfaction of the Fire Department, to prevent and minimize fire risks to surrounding properties.

Fire Protection Policy 2.16

Require fire protection plans for mitigation of potential grass and wildland fires within designated high fire hazard areas and other areas required by the Fire Department, that address the need for fire systems, water availability, secondary emergency access routes, construction requirements, and fire-resistant landscaping and appropriate defensible space around structures.

Fire Protection Policy 2.17

Maintain programs to minimize impacts on sensitive biological habitat and species when suppressing wildland fires, when feasible.

Fire Protection Policy 2.18

Educate the public about wildland fire prevention techniques to minimize the potential hazards of wildland fires. **ORG6-79**

2.14.3. Thresholds for Determination of Significance

City of Escondido Environmental Quality Regulations (Zoning Code Article 47) and Appendix G of the California Environmental Quality Act (CEQA) Guidelines as amended contain analysis guidelines related to the assessment of wildfire hazards impacts. A project would result in a significant impact if it would:

1. Expose people or structures to a significant risk of loss, injury, or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands.
2. Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan.
3. Result in substantial adverse physical impacts associated with the need and provision of new or physically altered fire protection facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times, or other performance objectives for fire protection.

2.14.4. Analysis of Project Effects and Determination of Significance

Threshold 1: Would the project expose people or structures to a significant risk of loss, injury, or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?

Wildfires may potentially occur in wildland areas adjacent to the project site, or in on-site undeveloped open space or recreational areas. Under existing conditions, the project site includes numerous potential fire issues, including unmaintained, fire-prone vegetation. The project would include conversion of approximately 30 percent of the site to maintained urban development with designated landscaping and fuel modification areas. A fuel modification zone is a strip of land where combustible vegetation has been removed and/or modified and partially or totally replaced with more adequately spaced, drought-tolerant, fire-resistant plants in order to provide a reasonable level of protection to structures from wildland and vegetation fires.

The types of potential ignition sources that currently exist in the project area include vehicles, electrical transmission lines, machinery associated with agricultural operations, and residential neighborhoods, as well as arson. The existing physical condition poses as a challenge for fire protection to the surrounding communities because of heavy, flammable vegetation plant communities, lack of access due to topography and roads, and/or firefighter exposure. There are also no vegetation management actions based on prior fuel reduction projects.

The project would introduce new potential ignition sources in the form of building materials (e.g., wood, stucco), vegetation for landscaping, vehicles, and small machinery (e.g., for typical residential and landscape maintenance), but would also result in a large area separating ignition sources from native fuels as well as the conversion of existing ignitable fuels to maintained landscapes that are ignition-resistant. Therefore, the project would function as a fuel reduction project by helping create context-sensitive development and a new first-fuel break line of defensible space. In addition to current codes and standards which require defensible space to be provided around all structures located within a High Fire Hazard Area, the FPP prepared for the project identifies various policies and management actions for vegetation management. The vegetation management areas include private property, where vegetation management would occur in cooperation with the future landowners, as well as common areas. The FPP also outlines a suite of vegetation management methods to reduce wildland fuel hazards in and near the High Fire Hazard Area. This would ultimately reduce the potential flammability of the landscape. In addition, the project provides improved access throughout the site, which improves firefighters' access for wildland firefighting efforts. **ORG6-79**

In compliance with the County's Consolidated Fire Code (Section 96.1.4907.2) and the California Public Resources Code, the project proposes fuel modification zones (FMZ) ranging from a minimum of 100 feet to 200 feet, twice the required distance, or provides alternative measures to meet the intent of the FMZ requirement.

The FMZ would include two zones: Zone 1 and Zone 2. Lands within Zone 2 would require 50 percent thinning (removal of dead and dying, non-native, and fire-prone species), thereby slowing and reducing the intensity of an advancing fire as it approaches Zone 1. Zone 2 would be maintained on an annual basis to ensure that the reduced fuels remain at approximately 50 percent of typical. Zone 1 areas would require removal of all existing fuels during the project grading phase. These areas would be replanted with drought-tolerant species able to withstand ongoing irrigation to maintain high fuel moistures and maintenance to fire-safe conditions. Zone 1 areas would be maintained as reduced fuel zones to ensure that vegetation is not dense or continual. Plants in Zone 1 would be irrigated and be of higher moisture content and are intended to further reduce the potential for wildfire to advance or spread. Refer also to **Section 2.3, Biological Resources**, for discussion of potential project impacts on sensitive biological resources that may occur as the result of thinning and/or maintenance activities that would occur within the FMZs.

Additionally, the reduction of vegetation within the FMZs could cause a post-treatment, localized increase in soil erosion or potential downstream sedimentation. Therefore, Best Management Practices may be applied during fuel reduction activities that occur on on-site steep slopes. As appropriate, measures identified in the Fuel Modification Plan will be implemented to ensure that vegetation management activities do not result in an increased potential for erosion to occur. Refer also to **Section 2.8, Hydrology and Water Quality,** for discussion relative to maintaining storm water quality.

Acceptable plantings and required landscaping and maintenance are detailed in Section 7.4.1 of the FPP (Dudek 2017, page 62; **Appendix 2.14**). In addition, the developed portions of the site would be converted from native fuels to ignition-resistant managed and maintained landscapes and residences. These areas, combined with the perimeter fuel modification areas, would serve as a new fuel break that would further buffer communities to the south and east from advancing wildfires. In addition, the project applicant would remove invasive plants that have colonized the treated areas. Invasive plants are those that readily invade disturbed areas within native habitat areas, exhibit high rates of growth, and displace or otherwise adversely affect native vegetation due to their rapid and aggressive growth habits. The removal of such species would protect and possibly enhance native habitats in the High Fire Hazard Area. Native species are generally more adaptable to fire, and many are fire resistant. **ORG6-79**

Additionally, as identified in the FPP, all fuel modification area vegetation management shall occur as-needed for fire safety, compliance with the FMZ requirements detailed in the FPP, and as determined by the EFD. The project HOA or other established funding and management entity for each development area or neighborhood if separate, shall be responsible for all vegetation management throughout the respective project sites, in compliance with the requirements detailed herein and Fire Authority Having Jurisdiction requirements. The HOA(s) shall be responsible for ensuring long-term funding and ongoing compliance with all provisions of the FPP, including vegetation planting, fuel modification, vegetation management, and maintenance requirements throughout the project site (Dudek 2017, page 67; **Appendix 2.14**). Responsibility for fuel modification requirements will be identified in the Conditions of Approval adopted for the project.

The project would be subject to compliance with the 2016 California Building Code (or the most current version) and the 2016 edition of the California Fire Code (Part 9 of Title 24 of the California Code of Regulations), which would include ignition-resistant construction automatic interior fire sprinklers, a robust water delivery system, fire apparatus access, and defensible space, among others. All structures within a wildland-urban interface, as defined in the San Diego County Building Code, must be built using ignition-resistive construction methods (San Diego County Code of Regulatory Ordinances Title 9, Division 2, Chapter 1). Project construction must meet all current Building Code (Chapter 7A) requirements for construction in wildland areas. Project conformance with ignition-resistant building requirements would greatly reduce the threat of wildfire, particularly with regard to flying embers entering a structure through attic ventilation or landing on a fuel and starting a new fire. Fire-resistive building features and/or landscape features that will be incorporated in the project are found in Section 7.2 of the FPP (Dudek 2017, page 59; **Appendix 2.14**).

Escondido is covered under the San Diego County Emergency Operations Plan (2014) and the San Diego County Operation Area Multi-Jurisdictional Local Hazard Mitigation Plan (2010). These plans provide guidance in effectively responding to any emergency, including wildfires. Implementation of these plans and policies in conjunction with compliance with the Fire Code would minimize the risk of loss due to wildfires.

The fire season typically runs from early May through October. Compounding the problem are Santa Ana wind conditions frequently experienced during the autumn months. The Escondido Fire Department has mandated conditions of approval for the SHR project (see Dudek 2017, Section 7.4, page 62; **Appendix 2.14**) to reduce the potential risk of wildfire at the project site. The project design would be required to conform to such measures to ensure that potential hazards relative to exposure of people or structures to significant risk of loss, injury, or death involving wildland fires are reduced to the extent feasible. The inclusion of such conditions in the project design will be verified by the City of Escondido Planning, Engineering, and Fire departments prior to issuance of a building permit. **ORG6-79**

As mentioned, the proposed project would improve fire protection to developed areas to the south/west by breaking up fuels and slowing fire spread. The project also includes provisions for an on-site fire station. The communities of Rancho San Pasqual and Rancho Vistamonte, residences in nearby unincorporated county areas, and the San Diego Zoo Safari Park would benefit from the project's conversion of wildland fuels and location upwind, which is anticipated to interrupt typical fire spread conditions. Additionally, the on-site fire station would provide a fire and medical emergency response capability that is not currently available in the area. The ability to respond quickly to emergencies proportionately raises the probability of successful outcomes.

The project would comply with applicable fire and building codes and would include a layered fire protection system designed to meet or exceed current codes and incorporate site-specific measures to achieve a development that is less susceptible to wildfire than surrounding landscapes and that would facilitate firefighter and medical aid response. Therefore, this impact is considered **less than significant**.

Threshold 2: Would the project impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?

The project includes a comprehensive circulation plan that provides access to the project site and facilitates vehicular circulation throughout the property in accordance with City standards. To minimize impediments to emergency access, all on-site roadways would be designed in compliance with the County Consolidated Fire Code and EFD standards, as shown in Section 7.1 of the FPP (Dudek 2017, page 55; **Appendix 2.14**).

The San Diego County Sheriff's Department, California Highway Patrol, and other cooperating law enforcement agencies have primary responsibility for evacuations. These agencies work closely within the Unified Incident Command System, with the County Office of Emergency Services, and with responding fire department personnel who assess fire behavior and spread, which ultimately influence evacuation decisions. As of this time, EFD, Cal Fire, City of San Diego Fire Department, San Diego County Fire Authority, County of San Diego Office of Emergency Services, San Diego County Sheriff's Department, and others have not adopted a comprehensive emergency evacuation plan applicable to this area. Section 9, Emergency Pre-Planning – Evacuation, of the Safari Highlands FPP (Dudek 2017, page 73; **Appendix 2.14**) is consistent with County evacuation planning requirements and can be integrated into a regional evacuation plan if area officials and emergency management stakeholders prepare and adopt one in the future. Refer also to **Figure 2.14-1**, which illustrates the proposed evacuation routes from the project site.

All evacuations in the County follow pre-planned procedures to determine the best plan for the type of emergency. The designated County emergency evacuation and law enforcement coordinator is the sheriff. The evacuation coordinator is assisted by other law enforcement and support agencies in emergency events. Law enforcement agencies, highway/street departments, and public and private transportation providers would conduct evacuation operations. Activities would include law enforcement traffic control, barricades, signal control, and intersection monitoring downstream of the evacuation area, all with the objective of avoiding or minimizing potential backups and evacuation delays.

Another factor in the evacuation process would be a managed and phased evacuation declaration. Evacuating in phases, based on vulnerability, location, or other factors, enables subsequent traffic surges on major roadway to be minimized over a longer time frame and can be planned to result in traffic levels that flow more efficiently than when mass evacuations include large evacuation areas simultaneously. Law enforcement personnel and Office of Emergency Services staff would be responsible for ensuring that evacuations are phased appropriately, taking into consideration the vulnerability of communities when making decisions. ORG6-79

Evacuation Routes

Evacuation routes are generally identified by fire protection and law enforcement personnel, are determined based on the location and extent of the incident, and include as many predesignated transportation routes as possible. Primary evacuation routes within the Safari Highlands Ranch community would be accessed through a series of internal neighborhood roadways, which would intersect with the primary ingress/egress roads that intersect off-site primary and major evacuation routes. The community would be able to evacuate to the north (once off-site), south, east, and west depending on the nature and location of the emergency. Available evacuation routes for the residents and guests of Safari Highlands Ranch include the following:

- **Egress to the west and south via Rockwood Road** – Rockwood Road is the primary Safari Highlands Ranch access road that would interconnect with Cloverdale Road to the west. Cloverdale Road to the north is a dead end. Cloverdale Road to the south offers travel options to State Route (SR) 78 east or west, or continuing south to

San Pasqual Road, which intersects Bear Valley Parkway to the south and west and leads into Escondido.

- **Egress to the south and west on Zoo Road** – This gated secondary access road would provide a route to Old Battlefield Road (gated road into the existing Eagle Crest Golf Course community) which connects into Rockwood Road and then to the south and west as described above. Zoo Road continues south past Old Battlefield Road to SR 78, for a distance of approximately 0.8 mile, from which point travel to the east or west is possible.
- **Egress to the west via north emergency secondary egress route** – This gated emergency-only secondary access road, approximately 4 miles long, along Stonebridge Road would interconnect with Meadow Creek Lane to the west, which would then intersect Hidden Trails Road. Hidden Trails Road offers travel to Highway S6 (Bear Valley Parkway/Valley Center Road) or continued travel to the west into urban areas of Escondido. Travel to the west along this emergency secondary egress would be under the direction of law enforcement. The road will be improved to offer two 12-foot wide travel lanes along with turnouts. The City will require that water storage be provided along this road, and regular maintenance will be provided by the HOA along the roadway to ensure that fuel modification zones are properly maintained.
- **Emergency Access Road Improvements** – Both emergency access roads would be improved to a minimum paved width of 24 feet. Other improvement standards including inclination, turning radii, paving specifications and turnouts would be subject to review and approval by the EFD.

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Depending on the nature of the emergency requiring evacuation, it is anticipated that the majority of residents would exit the project site via Rockwood Road or Zoo Road. These are the most direct routes from the Village Core. The northern emergency access route may be used by the northerly neighborhoods, including E-1, E-2, R-4, and R-5, depending on the time available for evacuation and the need for additional movement via the northerly route. In a typical evacuation that allows several hours or more (as experienced in the 2003, 2007, and 2010 wildfires), all traffic may be directed to the south and out Rockwood Road and/or Zoo Road. If less time is available, fire and law enforcement officials may direct some neighborhoods, primarily E-1 and E-2, to use the northerly gated route.

Evacuation Analysis

Roadway capacity represents the maximum number of vehicles that can reasonably be accommodated on a road. Roadway capacity is typically measured in vehicles per hour and can fluctuate based on the number of available lanes, number of traffic signals, construction activity, accidents, and obstructions, as well as positive effects from traffic control measures.

Each roadway classification has a different capacity based on level of service, with freeways and highways having the highest capacities. Based on traffic engineer estimates (Linscott, Law & Greenspan 2017) and using peak numbers and a conservative estimate, roads that would be the most likely available to Safari Highlands Ranch residents and their hourly capacities are:

1. ***Rockwood Road*** – 2,600 vehicles per hour

2. ***Zoo Road*** – 1,900 vehicles per hour
3. ***Cloverdale Road*** – minimum 2,600 vehicles per hour
4. ***Northerly emergency evacuation route*** – 1,000 vehicles per hour

Using these averages, the time it will take for an area to evacuate can be determined by dividing the number of vehicles that need to evacuate by the total roadway capacity. Based on Safari Highland Ranch's estimated 550 single-family homes, and assuming 2.2 cars per household, during an evacuation, it is calculated that up to 1,210 vehicles could be evacuating in a major incident that required full evacuation of the community (Dudek, page 82; **Appendix 2.14** 2017). This is a conservative estimate. That number would likely be far lower, as many families would likely drive in one vehicle versus in multiple vehicles and depending on the time of day, many of these vehicles may already be off-site, such as if a fire occurred during typical work hours.

Neighboring communities that may be evacuating in a similar time frame, depending on the type of wildfire emergency, are the 580-unit Rancho San Pasqual community (accessed via Rockwood Road and Cloverdale Road) and the 80-unit Rancho Vistamonte community (accessed via Rockwood Road). Additionally, San Pasqual Union School located off Rockwood Road would affect typical evacuations.

Based on the number of units or daily use averages (school), the estimated time requirement for evacuation was calculated as follows:

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Rancho San Pasqual: 580 units x 2.2 vehicles = 1,276 vehicles

Rancho Vistamonte: 80 units x 2.2 vehicles = 176 vehicles

San Pasqual Union School: 560 students and staff, 180 from outside the area = estimated 200 vehicles (others are already accounted for in community estimates)

Based on the combined vehicle estimates for existing communities and land uses neighboring the Safari Highlands Ranch project during an evacuation, it is calculated that up to 1,652 vehicles in addition to the 1,210 vehicles from Safari Highlands Ranch (total of 2,862 vehicles) could be evacuating in a similar time frame during a major incident that required full evacuation of the area, although, for reasons previously stated, this is a conservative estimate.

Based on the internal and external roadway capacities and using the lowest capacity roadway (bottleneck) as the determining factor, and discounting the capacity for the possibility that traffic would move slower during some evacuations, it is estimated that between 1 to 2 hours may be necessary for a complete evacuation of Safari Highlands Ranch. Evacuation of the neighboring communities and school is estimated to require approximately the same time frame. When occurring simultaneously, it is estimated that an additional hour may be necessary for evacuation of all communities (3 hours total).

As detailed in Section 5.2 of the FPP (Dudek 2017, beginning on page 32; **Appendix 2.14**), two main scenarios were modeled to determine the potential behavior of a wildland fire that could occur in the project vicinity: (1) a potential Santa Ana wind-driven fire approaching from the east-northeast ("peak weather condition"); and (2) a potential fire approaching from the west-southwest during typical onshore weather patterns ("summer weather condition").

For the first scenario, the arrival time to the project boundary is estimated to be approximately 4 hours from the modeled ignition locations near the intersection of State Routes 76 and 79. For the second scenario, the estimated arrival time to the project boundary would be approximately 40 minutes from the nearest ignition location (end of Wild Oak Lane), while fires originating along San Pasqual Road and Cloverdale Road were estimated to take 3 to 5 hours to reach the project boundary, as advancement of the fire would be slowed by existing development along Rockwood and Harwood roads.

Therefore, while under the most common scenario of a Santa Ana wind-driven fire approaching from the open lands to the east-northeast, there would be adequate time for a full evacuation of the project site and surrounding communities (4 hours for fire to reach Safari Highlands Ranch site and 3 hours maximum evacuation of all communities), other scenarios could result in inadequate evacuation times. Perhaps the "worst-case" scenario is a wildfire that encroaches upon Safari Highlands Ranch and neighboring communities in a short time frame, with Rockwood Road becoming the only viable exit for Safari Highlands Ranch residents due to blockages or hazards on the alternate egresses. In this scenario, law enforcement would have the option to conduct a phased evacuation of Safari Highlands Ranch residents, relocate residents within the project, or even instruct all residents to take temporary refuge in their homes or designated facilities within the Village Core.

While Safari Highlands Ranch is not officially designated a shelter-in-place community, the structures would be ignition-resistant, defensible, and designed to require minimal resources for protection, thereby enabling contingency options that may not be available to the neighboring communities. These project design features would enable law enforcement (Escondido Police Department or County Sheriff) to effectively manage the outflow of Safari Highlands Ranch residents' vehicles onto Rockwood Road, such that existing evacuation times for the neighboring Rancho Vistamonte and Rancho San Pasqual communities are not adversely affected. Accordingly, impacts would be **less than significant**. ORG6-79

Emergency Response

The EFD documented 14,536 total emergency calls in 2015. The project's estimated 1,760 residents (assumes an average of 3.2 occupants per residence for this type of community) would generate roughly 182 calls per year (or 0.5 calls per day), most of which are expected to be medical-related calls (approximately 80.4 percent of total emergency incidents). Service level requirements are not expected to be significantly impacted with the increase of 182 calls per year. The actual number of calls would likely be based on the EFD's per capita volume (i.e., the average number of calls per Escondido citizen per year).

Performance objectives for fire protection services are identified in Quality of Life Standard 3 of the General Plan Community Protection Element, which states that in urbanized areas of the city, an initial response time of 7.5 minutes for all structure fire and emergency Advanced Life Support (ALS) calls and a maximum response time of 10 minutes for supporting companies shall be maintained. Response to the project site from the closest existing EFD fire stations would not achieve the response time standard of 7.5 minutes for the first fire truck to arrive at the site. Station 4 response is calculated at roughly 10 minutes to the SHR community's main entrance. The full effective firefighting force is estimated to arrive within 16 minutes. Therefore, the project does not comply with the city's response time standard (Dudek 2017, page 50; **Appendix 2.14**).

Because of the project's location, a new fire station would be required in order to meet response time goals. The primary response (first in) would be provided by the proposed on-site fire station. This station may be a co-located station including the EFD and the City of San Diego Fire Department. The fire station would also improve emergency response for fire and medical emergencies in the area, thereby benefitting existing residents.

The developer is proposing to build and dedicate to the City of Escondido a fire station that would be located at the southern tip of the project boundary, near the main entrance of the site off Safari Highlands Ranch Road (refer to **Chapter 1.0, Project Description**). The new station would be approximately 6,000 to 7,000 square feet with three bays for apparatus and five dorm rooms for staff. The station would be staffed 24/7 at the discretion of the Fire Chief. The station would likely have one paramedic engine, one brush engine, and one ambulance, also at the discretion of the Fire Chief. Travel time from the new station to the most remote (distant) lot within the project boundaries is estimated to be 5.8 minutes. This time frame would allow under 2 minutes for dispatch and turnout and is considered to meet the 7.5-minute EFD response goal (Dudek 2017, page 50; **Appendix 2.14**).

As of this time, there is no mechanism in place to fund personnel, maintenance, and operational costs. These costs would be subject to further negotiations between the City of Escondido and any other funding source it may identify, such as shared responsibility with other fire districts or municipalities that may also benefit from the fire station's location. **ORG6-79**

Additional resources would be available from EFD Stations 2 and 4, which are not considered to be busy fire stations, having 1,034 and 2,676 engine company calls during 2015, or roughly 2.8 and 7.3 calls per day, respectively. The addition of 182 calls per year (0.5 calls per day) to both stations is considered substantial, but Stations 2 or 4 have available capacity to respond to the additional calls, as analyzed in Section 6.3 of the FPP. The anticipated 3.3 or 7.8 calls per day would be below the number considered a busy station. For perspective, urban fire stations that respond to 5 calls per day are considered average and 10 calls per day would be considered a busy station, while a suburban/rural station that responds to roughly 6 calls per day can be considered busy (Dudek 2017, page 53; **Appendix 2.14**).

The new on-site fire station would be adequate to respond to project-generated calls and would have significant capacity to respond to other calls from outside of Safari Highlands Ranch in a time frame that would represent a substantial improvement as compared to existing service. However, without assurances that the fire station is adequately staffed, equipped, and maintained, the project would have the potential to physically interfere with an adopted emergency response plan, and a **potentially significant** impact would occur. Implementation of mitigation measure **MM WF-1** would reduce the potential impact to a **less than significant** level.

Resident Awareness and Education Program

The Safari Highlands Ranch community will be registered with Reverse 911, Alert San Diego, and the local Escondido Community Notification System. Notification to SHR residents will be provided as needed in the event of an emergency through standard operating procedures implemented with these programs. In addition, the community homeowners association (HOA) would organize annual evacuation public outreach activities as well as maintain a fire-safe page on the community's web page, including key sections of the Safari Highlands Ranch FPP (e.g., Section 9.0 of the FPP (Dudek 2017; **Appendix 2.14**), which discusses proposed evacuation procedures), and links to important citizen preparedness information. Evacuation procedures would be regularly updated, as appropriate, with lessons learned from actual evacuation events, as they were following the 2003, 2007, and 2010 San Diego County wildfires.

As discussed in Section 9.0 of the FPP (Dudek 2017, page 73; **Appendix 2.14**), the proposed evacuation plan for the project would require implementation of a program known as "Ready, Set, Go." The focus of the program is on the public's awareness and preparedness, especially for those living in the wildland-urban interface areas. The program is designed to incorporate the local fire protection agency as part of the training and education process in order to ensure that the information is disseminated to those subject to the impact from a wildfire.

For the reasons above, it is not anticipated that the project would impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan. Impacts in this regard would be **less than significant.**

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Mitigation Measures

MM WF-1 The project applicant, homeowners association (HOA), or property owners shall be required to pay fair-share costs for the staffing, equipment, and maintenance of the proposed fire station, for the life of the project. Payment mechanisms (e.g., HOA assessment, property tax assessment, or similar) and the funding amount for the fire station shall be determined by the City of Escondido, the Cal Fire Valley Center Fire Protection District, and any other applicable agencies and shall be memorialized in a Fire Service Agreement to be completed prior to map recordation.

Timing/Implementation: *Prior to map recordation*

Enforcement/Monitoring: *City of Escondido Planning Division; Cal Fire Valley Center Fire Protection District*

Level of Significance After Mitigation

The project would introduce 550 new residential units that would increase demand for area fire protection services. Such additional demand may potentially affect emergency response times, thereby impairing implementation of or physically interfering with an adopted emergency response plan.

With project implementation, access for emergency fire protection service vehicles would be improved by the proposed extension of two roadways providing new site access points. These roadway extensions would result in improved emergency response accommodation. The new emergency access roads would be provided at the northwestern and southern property boundaries. The northwestern road would connect to Stonebridge Road in the Hidden Hills Trails development. The southern road would connect to the gated emergency access on Zoo Road with access to Highway 76. Both roads would be upgraded to meet the Escondido Fire and City Engineering Departments' requirements. Additional construction permits would also need to be obtained from San Diego County and the City of San Diego. Such improvements would effectively provide new and improved access out of the Rancho San Pasqual and Rancho Vistamonte communities, residences in nearby unincorporated County of San Diego, and the San Diego Zoo Safari Park in the event of an emergency.

In addition, to ensure that the project does not adversely affect the provision of area fire protection services over the long term, mitigation is proposed to require the project applicant, HOA, or property owners, to make fair-share payment for ongoing operation and maintenance costs resulting with the new fire station (mitigation measure **MM WF-1**). The project's appropriate portion would be determined by the City based upon a fair-share formula. Given compliance with all proposed state, City of Escondido, and County of San Diego requirements related to land management within a Very High Fire Hazard Severity Zone, including the preparation of a Fuel Modification Plan, the project would not diminish the staffing or existing response times of existing fire stations in Escondido, nor would it create a special fire protection requirement on the site that would result in a decline in existing services levels in the Valley. Funding for maintenance and operation of the proposed fire station for the life of the project would ensure response times are adequate, and resulting impacts would therefore be **less than significant**. ORG6-79

Threshold 3: Would the project result in substantial adverse physical impacts associated with the need and provision of new or physically altered fire protection facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times, or other performance objectives for fire protection?

Refer to Threshold 2 above for a discussion of emergency response times. There are no direct or indirect impacts on the environment resulting with physical construction of the fire station or the provision of emergency ingress/egress that have not been addressed elsewhere in this EIR. Construction of the west emergency access road and the fire station would have the potential to result in impacts related to construction air quality, noise, cultural resources, biological resources, and other resource areas. These impacts are evaluated within the context of the entire project in **Sections 2.1** through **2.13** of this EIR. Thus, for purposes of this section, and so as not to be duplicative of others, physical impacts related to the provision or alteration of fire protection facilities are considered **less than significant.**

2.14.5. Sources Cited

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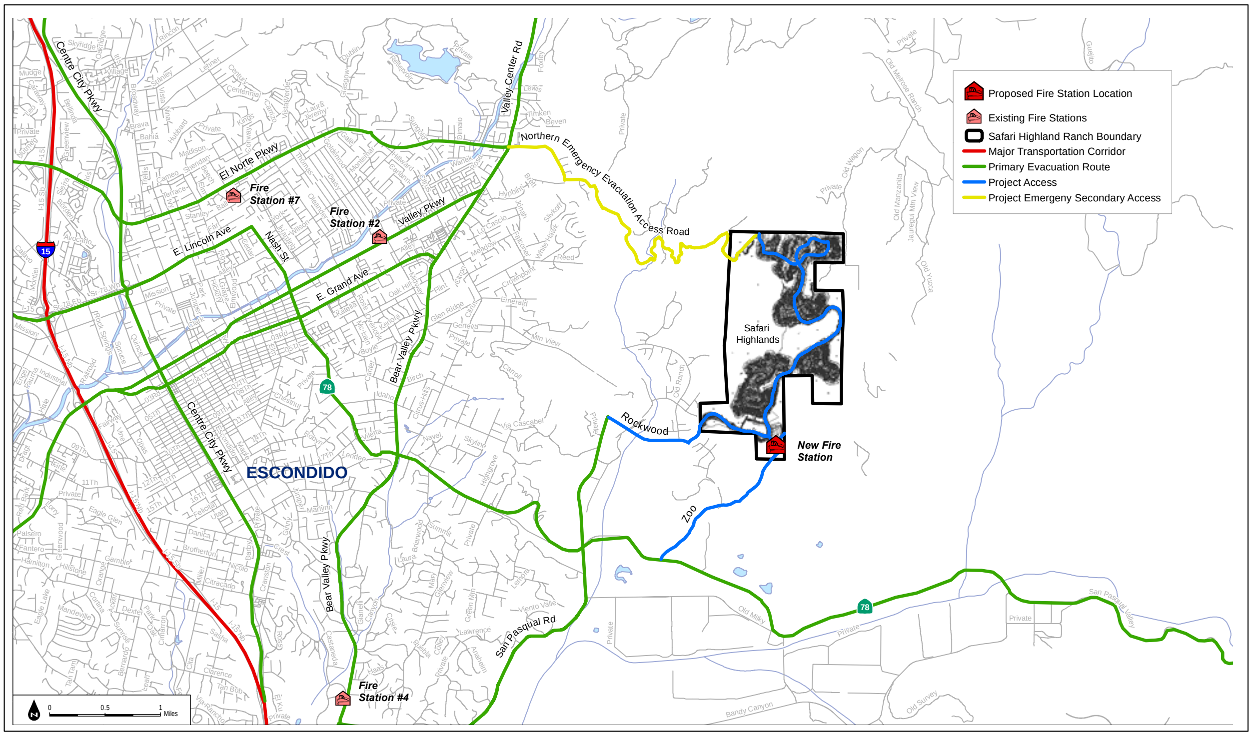

Michael Baker INTERNATIONAL

Source: Dudek, October 2016.
153095Figures.indd

Safari Highlands Ranch and Citywide SOI Update • Environmental Impact Report

SAFARI HIGHLANDS RANCH WILDLAND FIRE EVACUATION PLAN

Figure 2.14-1

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EXHIBIT H

CHAPTER 2
Project Description

2.1 Project Overview

Under Canvas Inc. (Under Canvas or project applicant) is proposing the Yosemite Under Canvas Project (project), which is a 99-tent campground with supporting facilities located adjacent to State Route 120 (SR-120) in the vicinity of Hardin Flat, east of the community of Groveland and west of Yosemite National Park, in Tuolumne County, California. Yosemite Under Canvas is a transient tent (no fixed structures) camp for guests to stay March to October as weather allows. Under Canvas Inc. specializes in camps with added amenities and currently has eight operational camps within the United States, responding to the increased demand for camping accommodations where the host provides all the provisions necessary to camp in a particular location. Under Canvas camps provide guests with canvas tents, beds, bathroom facilities, meals, and community fire pits. Potable water and sanitary sewer would be provided by on-site public systems owned and operated by Under Canvas. A total of 99 tents are proposed for the Yosemite Under Canvas camp along with an office/ guest check-in tent, commercial kitchen, communal bathrooms, and a number of support tents. **ORG6-80**

2.2 Project Objectives

CEQA Guidelines Section 15124(b) requires the project description in an EIR to state the objectives sought by the project. Section 15124(b) provides in part:

> A clearly written statement of objectives will help the Lead Agency develop a reasonable range of alternatives to evaluate in the EIR and will aid the decision makers in preparing findings or a statement of overriding considerations, if necessary. The statement of objectives should include the underlying purpose of the project and may discuss the project benefits.

The underlying purpose of the project is to provide seasonal tent camping with added amenities, including tents with beds, bathroom facilities, and a dining facility. The project objectives are:

1) Help meet the demand for lodging facilities near Yosemite National Park and surrounding outdoor recreational resources.

2) Provide a camping experience with full-service amenities for visitors to Yosemite National Park and the surrounding area in an outdoor setting.

3) Assist the County in meeting its General Plan goals and policies, particularly those related to natural resources, public safety, natural hazards, and economic development.

4) Plan for land use compatibility with adjacent landowners and land use activities through effective placement, orientation, and screening of project facilities.

5) Reduce hazardous wildfire fuel and timber conditions on the project site.

6) Provide on-site infrastructure improvements relating to potable water delivery, wastewater management, and drainage.

7) Develop a financially sustainable project that can fund the construction and operation of the facilities and services that are needed to serve the project.

2.3 Project Location and Surrounding Uses

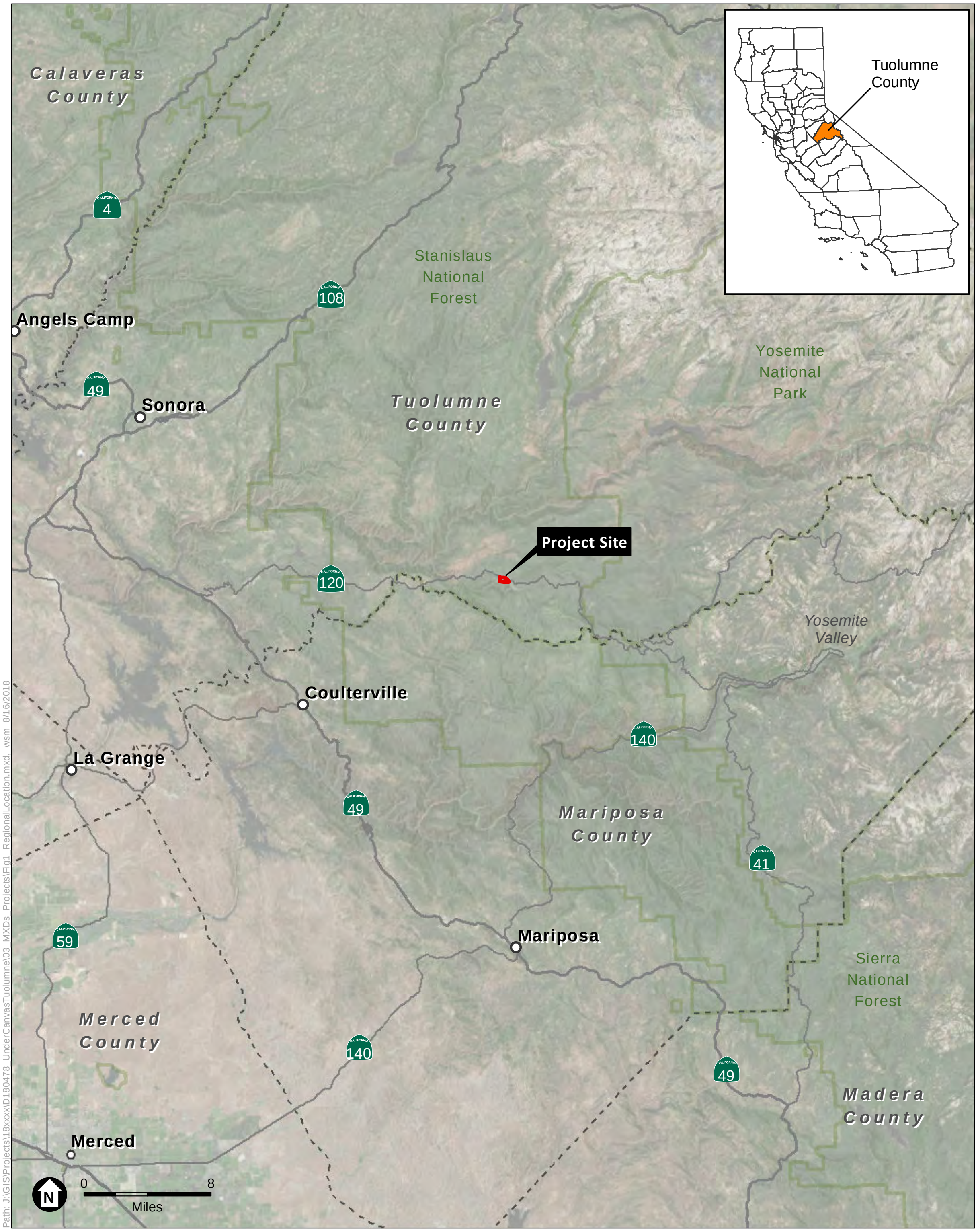
The project site is east of the town of Groveland and west of Yosemite National Park in southern Tuolumne County and is located on the Ascension Mountain, CA 7.5' U.S. Geological Survey (USGS) Quadrangle (**Figures 2-1** and **2-2**), on a private inholding within the Stanislaus National Forest. It falls within the southeastern portion of Section 26, Township 1 South, Range 18 East, Mount Diablo Baseline and Meridian. The project site is located within unincorporated Tuolumne County, and is comprised of two parcels (APNs 68-120-62 and -63), totaling approximately 80.1 acres. Figure 2-2 shows the zoning for the site. The western parcel is zoned Commercial Recreation (C-K), and the eastern parcel is zoned Commercial Recreation (C-K) and Open Space-1 (O-1).

Access to the site is provided by Hardin Flat Road via SR-120. The site consists of undeveloped land and was previously used for forestry and logging. Adjacent land uses include scattered private residences, recreation facilities, and open space. The nearest building is a Caltrans snow plow garage approximately 1,250 feet north across SR-120 from the nearest proposed project facilities. The nearest residence is approximately 1,300 feet southeast of the nearest proposed project facilities. Elevation in the project site ranges from 3,740 feet above mean sea level in the east to 4,050 feet above mean sea level in the west. **ORG6-80**

2.4 Project Description

Figure 2-3 shows the proposed project site plan. Per the requirements of Tuolumne County Code Section 17.68.100, approval of the conceptual plans for the project would require issuance of a site development permit. As shown in Figures 2-2 and 2-3, the bulk of the project's development would occur on the C-K portion of the site, though some development would also occur on the C-K/O-1 portion of the site. Development within the C-K/O-1 portion of the site would require issuance of a use permit, as provided for in the County's Zoning Code (County Code Chapter 17.15.030). Of the 80.1 acres on the overall project site, less than half of that amount would be developed for the proposed use, and the remaining portions would remain undeveloped.

Traditional buildings with concrete foundations are not proposed for the project. However, there would be communal bathrooms, a commercial kitchen, laundry and housekeeping, and a lobby tent with a dining area. These facilities would not be permanent fixtures on the land. Utility improvements to support the camp would include water supply wells, wastewater treatment, and commercial power supplied to the kitchen, laundry, and communal bathrooms. Details on guest amenities and supporting infrastructure are provided below.



SOURCE: Esri, 2015; ESA, 2018

Yosemite Under Canvas Project

Figure 2-1
Regional Location

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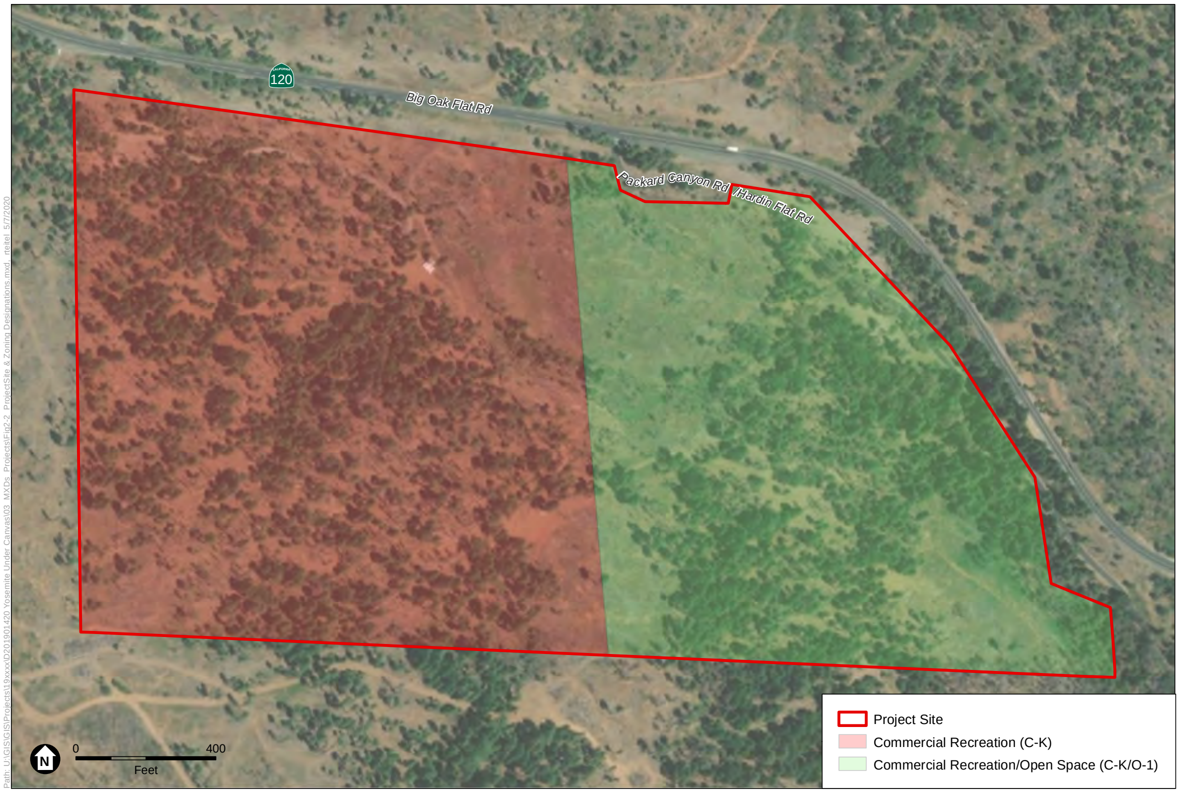

SOURCE: USDA, 2016; ESA, 2020

Yosemite Under Canvas Project
Figure 2-2
Project Site and Zoning Designations

ESA

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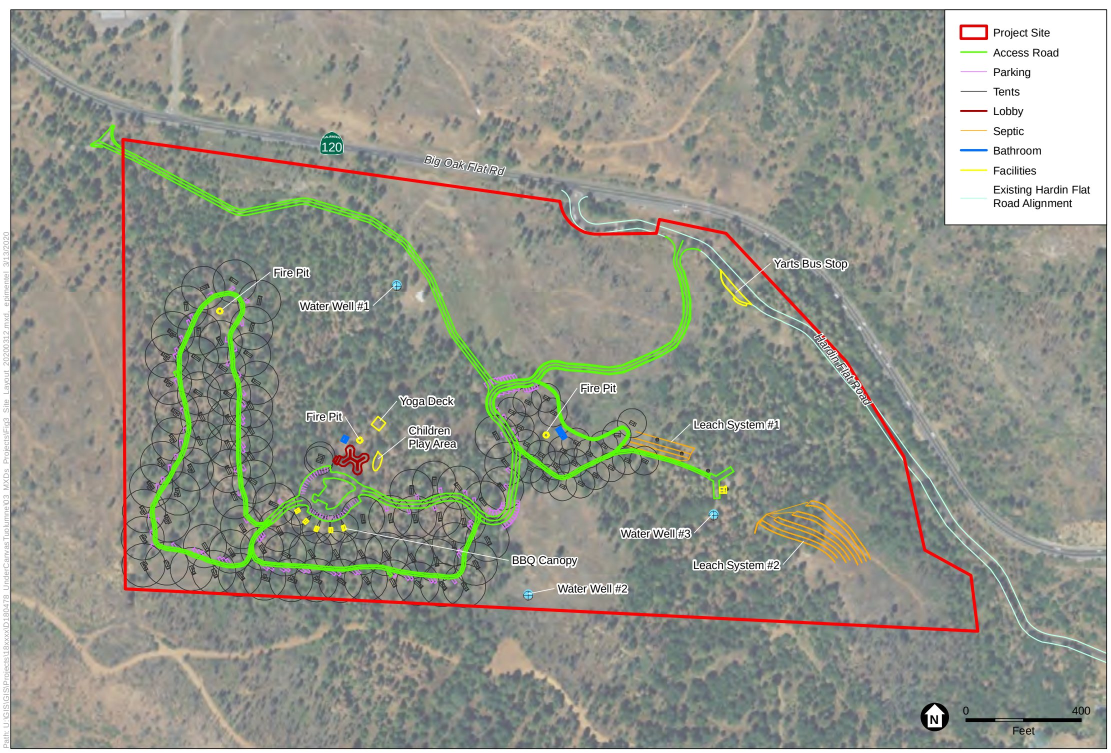

SOURCE: USDA, 2016; ESA, 2020

Yosemite Under Canvas Project
Figure 3
Project Site Plan

ESA

2.4.1 Guest Amenities and Supporting Facilities

Guest Tents

Figure 2-3 shows the overall site plan. The tent sites shown are approximate locations; exact tent locations would be determined with completion of final engineering design. The project proposes a total of 99 guest tents with 77 suite tents with an in-suite washbasin, shower, and toilet, and twenty-two safari tents with access to a communal bathroom. Four of the suite tents would be Americans with Disabilities Act (ADA) compliant. The approximate tent footprints would range from 200 to 400 square feet. Tents would be made from fire-retardant-treated canvas mounted on non-permanent wooden decks. Decks would typically be mounted on moveable above-ground concrete footings. The tents would be removed at the end of each season in October, with the decks remaining in place. The tents would be stored on-site in shipping containers, though some could be transported off-site for use at other Under Canvas facilities. **Figure 2-4** shows photographs of typical tents found at existing Under Canvas facilities.

Bathroom Facilities

To serve the safari tents without in-suite bathroom facilities, two communal bathroom facilities would be provided, which would be manufactured off-site and contain six stalls, with each stall consisting of a toilet, sink, and shower. The units would be prefabricated and mounted on wheels, and would be non-permanent in nature, but would likely remain on-site during the off season, though they could be transported off-site for use at other Under Canvas facilities. **Figure 2-5** shows a typical communal bathroom facility.

ORG6-80

Reception, Dining, and Support Facilities

One reception/dining tent would be provided, as well as an adjacent commercial kitchen trailer and a number of support (housekeeping and maintenance) portable storage containers. The project's commercial kitchen trailer would prepare and serve single-service meals to guests staying at the camp. Figure 2-5 shows a typical reception/dining tent at an existing Under Canvas facility.

As with the guest tents described previously, the reception/dining tent would be disassembled at the end of each season and stored in an on-site shipping container. The commercial kitchen trailer would be prefabricated and mounted on wheels, and would be non-permanent in nature, but would likely remain on-site during the off season, though it could be transported off-site for use at other Under Canvas facilities. The remaining housekeeping and maintenance support containers would also likely remain on-site during the off-season.

Outdoor Campfires and Heating Stoves

The project would provide up to three traditional, communal campfire pits interspersed around the project site. **Figure 2-6** shows a typical communal campfire pit. The lighting, maintenance, and extinguishing of these campfires would be managed by camp staff. See below in Section 2.4.7, *Timber Management and Wildfire Prevention*, for a detailed description of wildfire prevention practices to be employed by the project.

Typical "Deluxe" guest tent, with in-suite bath. This example is from the Under Canvas Mount Rushmore campground.

Typical "Safari" guest tent. This example is from the Under Canvas Mount Rushmore campground.

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SOURCE: ESA, 2020

Figure 2-4
Typical Guest Tents

ESA

Typical mobile bathroom facility. This example is from the Under Canvas Mount Rushmore campground.


Typical reception/dining tent. This example is from the Under Canvas Zion campground.

ORG6-80

SOURCE: ESA, 2020

Yosemite Under Canvas Project

Figure 2-5
Typical Bathroom Facilities and Reception/Dining Tent


This example is from the Under Canvas Moab campground.

ORG6-80

D180478.00 - Under Canvas Tuolumne\05 Graphics-GIS-Modeling\Illustrator

SOURCE: ESA, 2020

Figure 2-6
Typical Community Fire Pit

ESA

The project would provide heating within the guest tents on an as-needed basis through the use of wood heating stoves. The current-specification wood stove used at most of the existing Under Canvas facilities is the “Hunter” stove, manufactured by Cylinder Stoves.[1]

2.4.2 Access and Internal Circulation

Internal circulation would be provided by a main internal access road (Under Canvas Way) and internal cart paths and footpaths. There is existing access to the property by way of Hardin Flat Road via SR-120. The proposed Under Canvas Way would begin from Hardin Flat Road at a point approximately 500 feet south from the intersection of SR-120 and Hardin Flat Road. A secondary point of access would be provided for emergency purposes on the northwest side of the site via an existing unimproved roadway that connects to Forest Service Road 1S09. This road would be maintained for emergency use through an agreement with the Stanislaus National Forest, and obtaining this permit would be a condition of project approval. Onsite roadways would not be paved, but would be topped with gravel where needed. Portions of the existing emergency access road may require grading and the addition of gravel, and rolling dips are proposed to improve drainage conditions.

The construction of Under Canvas Way within the project site would require two primary crossings over ephemeral drainages and minor crossings over smaller features as described below:

- A culvert crossing is proposed near the project access to Hardin Flat Road in the northeastern portion of the project site. This crossing would utilize a 36-inch diameter corrugated metal pipe covered with a minimum cover of two feet, including at least 10-inch thick compacted aggregate base. Both ends would be fitted with a concrete headwall and to prevent erosion. The outlet would include riprap for energy dissipation. **ORG6-80**

- A steel bridge with concrete deck is proposed just northeast of the common parking area to cross another drainage. Rock head walls would utilize 4-foot minus rock and extend 25 to 35 feet in each direction of flow. Bridge design would be based on American Association of Highway and Transportation Officials bridge standards for low-volume traffic, and would be designed and maintained to support the imposed loads of fire apparatus, up to a 4,000-gallon water tender, a semi transport with dozer, or a large semi with 48-foot trailer. Radii for approach and departure would support these large vehicles. The two-lane bridge width would be 24 feet wide and designed for HS-20 loading. All bridge components and associated construction activities would be located outside of the defined bed and bank of the channel.

- Under Canvas Way crosses a small drainage feature in the southwest portion of the project site in two locations. These locations would utilize 18-inch diameter corrugated metal pipes covered with one foot of minimum compacted base. Multiple check dams would be located upstream and downstream of these crossings to reduce flow velocity.

Internal roads and pathways would be gravel-covered, as needed, and not paved, though several ADA-designated parking spaces would be paved to comply with applicable regulations. All roads would be constructed to have an unobstructed width of not less than 20 feet and an unobstructed

[1] Cylinder Stoves, Inc. Hunter Stpvehttps://www.cylinderstoves.com/hunter-stove.html.

vertical clearance of not less than 13.5 feet. For dead-end roadways in excess of 150 feet in length, the project would provide a turnaround for fire apparatus.

Parking would be provided along proposed camp roads and would be located near the deluxe/ suite tents. The safari tents would have a common parking area. Approximately 130 total parking spaces would be provided for guests and employees. All of the tents would be accessed via gravel paths and trails.

Transit Accessibility

A bus stop for the Yosemite Area Regional Transportation System (YARTS) is proposed on the west side of Hardin Flat Road at the entrance to the Yosemite Under Canvas facility, approximately 800 feet south of the Hardin Flat Road/SR-120 intersection. The bus stop would be designed to accommodate a typical 45-foot YARTS coach. The stop would be designed in consultation with YARTS with respect to design and safety criteria. The stop would provide Yosemite Under Canvas guests with the option to use the regional public transit system to access Yosemite National Park and other regional destinations. YARTS currently operates between May and September and offers three round trips per day into Yosemite National Park.

2.4.3 Potable Water Supply and Use

Drinking and potable water at the camp would be provided by groundwater source wells. The source would be developed as a Public Water System, and classified as a Transient Non-Community water system, as defined in California Health and Safety Code Section 116275. Water distribution would include storage cisterns, small diameter distribution lines, re-pressure pumps, source development, and services to the laundry, lobby tent, bath units, and deluxe/suite tents. **ORG6-80**

Estimated instantaneous flows for the distribution system are 80 gallons per minute (gpm). General system layout would be finalized pending development of a groundwater source, and design documents for the proposed system would be submitted for agency approval. Water use at existing Under Canvas camps in other parts of the U.S. is typically under 12 gallons per day (gpd)/person. As with all Under Canvas facilities, water usage monitoring would be implemented to verify daily water use of 20 gpd per person or less. To meet this goal, the project would incorporate a number of water efficiency features that have been implemented at other operational Under Canvas facilities, including the use of water fixtures that use minimal water, shower facilities with shower heads and faucets that turn on by pulling a handle or pushing a knob and turn off as soon as the handle or knob is released, and toilets that would use 0.8 to 1.2 gallons of water per flush. Preliminary water supply requirements for the site at full occupancy are listed in **Table 2-1**.

Based on this analysis, the water source(s) would need to be developed to supply an average demand of 7,755 gpd. Accordingly, the proposed groundwater source wells would be developed to supply 20 to 30 gpm. Wells 1 and/or 2 would be used to supply water for the project, with Well 3 retained as a backup. The locations of the wells are shown in Figure 2-3. The wastewater and water use quantities would be monitored and submitted to the Tuolumne County Community Development Department, Environmental Health Division.

TABLE 2-1
EXPECTED TOTAL DAILY WATER USE

Proposed Use	Design GPD	Unit Per	Number of Units	GPD	Notes
Expected Guest Demand (99 tents, 2.5 guests/tent)	20	Person	247.5	4,950	20 gpd/guest x 247.5 guests
Employees	10	Person	20	200	10 gpd/employee x 20 employees
Laundry Facility	42.5	Machine	26	1,105	42.5 gallons per wash x 26 washes
Food Preparation	4	Service	375	1,500	4.0 gpd x 375 meals
Total Expected Daily Water Use (full occupancy)				**7,755**	

NOTE: The expected water use values presented here are representative of expected potable water use at the site, as based on recorded observations at other Under Canvas facilities. However, the impact analysis for the project, as presented in Section 3.5, *Hydrology and Water Quality/Utilities and Service Systems*, assumes a greater quantity of water use to provide for a worst-case scenario analysis.

The site's water and wastewater systems would be winterized after closing for the season. The systems would be tested by a State Water Board Division of Drinking Water certified laboratory prior to being placed in use each season. Once in use, potable water samples would be tested the first Tuesday of each month for bacteria.

2.4.4 Wastewater Management

Wastewater treatment would be designed to meet the County's guidelines for design and evaluation of special design on-site sewage treatment and disposal systems, and would comply with Tuolumne County Ordinance Code Section 13.08.270A, as overseen by the County's Environmental Health Division. Wastewater would be treated on-site through the use of two separated systems. Sewer mains would be constructed to convey the wastewater to the two systems, which would be located near the southeastern area of the site, as shown in Figure 2-3. Wastewater System #1 would be a domestic strength wastewater system which would receive primary treatment from code compliant septic tanks, and would be delivered to gravel filled leach trenches via pressure dosing. Wastewater System #2 would be a hybrid system to manage the high strength food facility wastewater, and the domestic strength wastewater from the laundry facilities. The high strength food facility waste would have primary treatment via a code compliant grease interceptor and septic tank. High strength food facility wastewater would then receive secondary treatment from a properly sized moving bed bio-film reactor (MBBR) to reduce the high strength wastewater to domestic strength wastewater. Both employee generated wastewater and laundry service wastewater would be treated as domestic strength wastewater, and would receive primary treatment from code compliant sized septic tanks. The treated food facility wastewater, employee generated wastewater, and the laundry service wastewater would be combined and delivered to a gravel filled leach system via pressure dosing. **Table 2-2** shows the designed capacity of the wastewater system, at full occupancy. **ORG6-80**

The daily wastewater calculations presented above represent maximum daily volumes at maximum occupancy. Maximum occupancy is likely to be achieved only occasionally, so actual wastewater volumes are likely to be much less. Accordingly, the values shown represent a maximum or worst-case scenario.

TABLE 2-2
PEAK DAILY WASTEWATER DISPOSAL

Proposed Use	Design GPD	Unit Per	Number of Units	GPD
Wastewater System 1				
Tents (99) at maximum occupancy	30	Person	276	8,280
Total Wastewater System 1				**8,280**
Wastewater System 2				
Food Service Wastewater (276 guests x 3 meals/day)	2	Meal	828	1,656
Employee Generated Wastewater	20	Employee	40	800
Laundry Service	42.5	Laundry Load	26	1,105
Total Wastewater System 2				**3,561**
TOTAL				**10,841**

NOTE: All wastewater flow rate calculations and tank sizing specifications were derived from Appendix H of the 2016 California Plumbing Code. Specifically, 2016 California Plumbing Code, Estimated Waste/Sewage Flow Rates, Table H 201.1 (2), 9. Hotels (No kitchen); 30 gpd/person. Also Chart H 901.7 Design Criteria for commercial kitchen/food preparation wastewater treatment and dispersal using disposable utensils. Per Tuolumne County Environmental Health policy, the maximum daily volumes used for wastewater system design must represent maximum daily volumes at maximum occupancy. The maximum occupancy and employee/staff information was supplied by Under Canvas.

2.4.5 Electricity and Lighting

Electric power for the camp would be provided by a local utility company, but most electricity demand would be met using low voltage solar systems. Lighting for the lobby tent, common areas, and guest tents would be low voltage solar lighting. All light fixtures and the use thereof would be International Dark Sky Association (IDA) compliant, while still providing safety and guidance for guests. Incorporated lighting standards would include: **ORG6-80**

1. Lights would be on only when needed, and would only light those areas that require it.
2. Lighting would be no brighter than necessary.
3. Blue light emissions would be minimized, with LED fixtures utilizing color temperatures no greater than 3000 Kelvins.
4. All light fixtures would be down-shielded and would be pointed downwards.

To provide electric power to the site during power outages, a 70 kW propane-powered standby generator would be placed adjacent to Well #1 (see Figure 2-3). The generator would be placed inside its own enclosure for protection against the elements and for noise abatement purposes.

2.4.6 Solid Waste Management

Trash from the guest tents would be collected daily as part of normal housekeeping activities. All solid waste produced at the site, particularly food waste, would be stored in locking wildlife-resistant containers and then removed from the site by a commercial hauler for disposal at a permitted landfill.

2.4.7 Timber Management and Wildfire Prevention

Fuel Reduction

Most of the site was severely burned during the 2013 Rim Fire. Much of the Stanislaus National Forest lands adjacent to the site have undergone extensive timber salvage and fuels management activities since that time to remove excess dead and downed wood that resulted from the fire. These types of activities have not yet occurred on the project site, and significant quantities of downed wood and standing snags remain on the site. These conditions present a substantial hazard, both from a fuels management perspective and a hazardous tree perspective. Consequently, any development on the site would need to be preceded by fuel reduction operation to remove standing and dead trees that pose a threat to users. Fuel treatment would involve mastication of standing dead snags and surface fuels. It is possible that some of the material would be hauled offsite if economically feasible.

The project development plan would involve conversion of greater than three acres of timberland. Both the fuel reduction efforts and conversion activities would meet the definition of timber operations as defined in the Forest Practice Act and will require development of a Timber Harvest Plan (THP), described below in Section 2.4.8. A THP is the environmental review document submitted by landowners to the California Department of Forestry and Fire Protection (CAL FIRE) that outlines what timber the landowner wants to harvest, how it will be harvested, and the steps that will be taken to prevent damage to the environment. The THP would use the environmental documentation contained in this EIR to make its own determination concerning the environmental effects of implementing the plan, and the THP would be subject to approval by CAL FIRE. **ORG6-80**

Wildfire Prevention

In addition to the fuels reduction and road construction that would be undertaken as part of the THP, the site would be subject to ongoing fuel and vegetation management treatments as prescribed in the project's Wildfire Mitigation Plan. The plan would be subject to review and approval by the Tuolumne County Fire Department (TCFD) in cooperation with CAL FIRE. The plan would include a number of standard prescriptions to be utilized in the future, including, but not limited to:

- Removal of necessary dead, down, dying, diseased, and hazardous trees.
- Removal of ladder fuel and dead limbs in trees to a minimum of 20 feet above ground level.
- Implementation of a ground litter reduction and removal program.
- Potential thinning of the trees and other vegetation that have grown since the 2013 Rim fire.
- Provision of defensible space around all areas of proposed development.
- Provision of defensible space on each side of project roadways.
- Where and necessary, establishment of defensible space, to include vegetation removal, thinning and eliminating ladder fuels within the site perimeter to a distance of 100 to 200 feet, depending on the slope.

- Fuel reduction and mitigation on and around an area recommended for designation as a temporary Refuge Zone Area for project guests and staff.

To prevent the ignition of wildfires from the project site, a number of measures would be implemented, including:

- All tent fabrics would be California State Fire Marshall approved.
- All heating stoves on the site would be equipped with spark arrestors, which would be constructed of woven or welded wire screening of 12 USA standard gage wire (0.1046 inch) having openings not exceeding 1/2-inch. The net free area of the spark arrestor would not be less than four times the net free area of the outside of the chimney outlet.
- The ashes from the stoves would be removed by camp staff in metal containers and disposed of in a steel container. Firewood and combustible materials would not be stored in unenclosed spaces, beneath tents, or on decks under eaves, canopies or other projections or overhangs. Fire wood and combustible material would be stored in defensible space, and separated from the crown of trees by a minimum horizontal distance of 15 feet.
- Smoking would be restricted to designated areas with receptacles for cigarette waste. The area and a minimum 50-foot buffer would have vegetative material cleared to bare mineral soil.
- Community campfire rings would be enclosed within a large metal ring to contain burning material, and would be installed 12 inches into the ground, with a minimum of 12 inches extending above the ground. A mesh screen would be installed to encompass and cover the fire as a spark arrestor. Branches and other vegetation above each fire area would be removed, and a cone of clearance to the sky would be established. A large metal cover would be provided to cover the fire ring when not in use and nightly after the fire is extinguished by camp staff. A hose bib would be provided in proximity to each fire ring to extinguish fires prior to covering. Remote web cameras of fire pit areas would be installed to monitor each fire pit, and would be monitored from the campground office and mobile devices. Fires would not be allowed whenever the U.S. Forest Service imposes restrictions on campfires due to the proximity of the Forest boundary. **ORG6-80**
- The mobile kitchen facility would be equipped with a hood and range dry chemical extinguishing system.
- Fire tool lockers and fire extinguishers would be provided throughout the site, meeting the requirements of Public Resources Code (PRC) 4428 and 4429. Fire extinguishers would be located in each guest tent structure, as well as in all other facilities.
- Fire hose stations with fire hoses and nozzles would be provided within the site, with 200 feet of fire hose provided at each station. These stations would be located in such a manner that no tent structure would be greater than 150 feet from a fire hose station.

Prior to operation, an Emergency Operations Plan would be developed to address wildfire and other emergency incidents at the site. This plan would be subject to review and approval by applicable emergency services providers. The plan would include, at a minimum:

- A Training and Exercise Plan, to be implemented annually with all employees, covering the Emergency Operation Plan and issues such as response to fire, fire extinguisher and firehose use, first aid and emergency medical response, and dealing with problem guests.

- An orientation briefing for guests concerning potential hazards and what to do in the event of an emergency incident.
- Provision of a site fire and emergency alert system to notify site occupants in the event of an emergency.
- A site evacuation plan, defining routes of ingress and egress, rally points, and protocols for disabled guests and/or guests without their own transport.
- Establishment and maintenance of temporary refuge areas if evacuation is not possible.
- Establishment of an emergency helicopter landing site. The site would not be a permitted heliport as described in California Code of Regulation 3554, and would be maintained for use in emergencies only.
- Basic fire and first aid training would be provided to all employees, with at least one employee onsite at any given time with advanced first aid training (Emergency Medical Technician or similar).

2.4.8 Timber Harvest Plan

The timber harvest plan (THP) would involve removal of dead and dying trees and treatment of live surface and ladder fuels along with down woody material utilizing mastication machinery. Davey Tree Service conducted an arborist inspection of the project area between March 9, 2019 and April 30, 2019. A total of 511 dead standing trees were assessed and determined to pose a safety threat. These trees would be removed as part of the project.

ORG6-80

Outside of the timber conversion area, a defensible space silvicultural prescription would be utilized. The intent of this prescription would be to retain all live green trees and to remove dead standing trees and down logs less than 20 inches in diameter on the larger end and greater than 20 feet in length. Trees to be saved in this area would be tagged by an arborist with numbered aluminum tags. Standing dead and dying trees to be removed would be marked. Surface and ladder fuels would be treated to reduce total 1,000-hour fuel loads to a residual level of less than 5 tons per acre. Down logs greater than 3 inches in diameter and less than 20 inches in diameter would be chipped on site as part of the mastication process or removed to disposal areas and chipped on site or chipped and/or hauled to a biomass facility. Down material less than 3 inches in diameter and less than 18 inches in length would be masticated to achieve a minimum standard that results in 80 percent of the post treatment material being less than 18 inches in length and at least 60 percent being less than 12 inches in length. In addition, mastication would remove dead brush throughout 85 percent of the treatment area and would also remove live ladder fuels from within the dripline of residual trees. Areas where live brush would be retained would be marked prior to the start of operations. Post treatment depth of surface fuels would be less than 3 inches over 80 percent of the treatment area. Logs greater than 20 inches in diameter and greater than 20 feet in length would be retained on site.

Large snags and decadent black oaks are valuable wildlife habitat resources, which develop slowly and are hard to replace on the landscape. Given the habitat value of larger snags and black oak, the following measures would be applicable to tree removal operations conducted under the THP.

- Snags larger than 26 inches in diameter and all living black oak trees greater 8 inches in diameter and 20 feet in height would be retained unless a determination is made by a certified arborist in consultation with the project biologist that removal is absolutely necessary to protect life and property.
- Removal of black oaks greater than 15 inches in diameter within the fuel treatment areas or those black oaks marked for retention within the road right of way would be avoided and the road alignment adjusted to avoid individual black oak trees which meet the diameter retention threshold.
- Fuel treatment and mastication would avoid black oak sprout clumps. Dead standing black oak boles greater than 3 feet in height and less than 15 inches in diameter would be masticated while avoiding black oak sprouts, if present.

It is also recognized that understory vegetation is important to a number of wildlife species for cover, perching, nesting, and foraging habitat. To ensure retention of areas of developing understory, the following measures would be applicable to mastication operations conducted under the THP.

- To encourage more rapid development of understory brush, seedlings, and saplings to benefit wildlife generally and nesting birds specifically, the mastication treatment would retain designated understory retention areas as flagged on the ground by the project wildlife biologist or registered professional forester. Retention areas would be focused on creating minimum patch sizes of 15 feet in diameter and where available would be placed in areas with a mix of brush species, grasses and conifer seedlings. **ORG6-80**

To provide for wildlife habitat needs, all dead stem material greater than 16 inches in small end diameter outside bark and greater than 20 feet in length on site up to a maximum of three pieces per acre would be retained. Down logs which meet this description would be moved to other areas within the project area as necessary to achieve fire reduction and guest safety objectives.

2.5 Operational Characteristics

The operational season for the site would generally be from mid-March to mid-October, depending on weather conditions. The average occupancy at existing Under Canvas facilities is approximately 2.5 guests per tent. Most guests arrive for the night and then leave the site in the morning to pursue recreational and sightseeing opportunities in the area, and then return later in the day following the day’s activities. Quiet hours are enforced from 10:00 p.m. to 7:00 a.m. Operation of the facility would not employ any regular sources of amplified noise. Occasional special events (weddings, etc.) could occur on the site that could include temporary sources of amplified noise, and these events would be conducted in accordance with General Plan requirements for stationary noise sources. An emergency notification public address system would also be included as part of the project, but would only be used in the event of an emergency and for occasional testing.

Between 20 and 30 staff members would be employed by the project during the operational season, with 10 to 15 personnel working on the site at any given time. Employees would largely be drawn from the local community, though some could be recruited from elsewhere. If they desire, seasonal employees from elsewhere without housing in the local community would be housed in rental units facilitated and paid for by the project proponent.

2.6 Construction

Methods and Design

Site development activities would be preceded by an extensive timber salvage program, concurrent with implementation of a hazardous fuel reduction effort to make the site accessible and safe for use. These efforts have been discussed previously in Sections 2.4.7 and 2.4.8. Following this preliminary site preparation, construction of the campground facility itself would employ currently accepted and typical construction methods. The contractor would establish access routes and staging areas, within the proposed development area, for travel within the site and storage of materials and equipment. If needed, dust control would employ a standard water truck equipped with spray nozzles. The site plans are based on minimal site disturbance based on seasonal occupancy. Few permanent or "hard" facilities would be present. Wooden tent decks would require minimal excavation for moveable concrete footers. Access roads and paths would be designed and constructed to minimize cut and fill requirements. The project would follow Low Impact to Hydrology (LITH) Design Guidelines for the design of roads and paths. Infrastructure for wastewater collection and water distribution would be designed and constructed to minimize trenching depths and disturbance. Wherever possible, water lines and other utility infrastructure would be placed underground beneath roadways, paths, or disturbed areas.

ORG6-80

Schedule and Work Hours

Construction of the project is expected to take one construction season, starting in Summer 2020 and extending to October 2020, for about five months of construction activity. Though the County does not have a specific noise ordinance that defines acceptable working hours, construction activity would comply with standards that are typical for other jurisdictions in California, which relegate noise-producing construction activities in non-residential areas to the hours of 7:00 a.m. to 7:00 p.m., Monday through Saturday.

Equipment

Anticipated construction equipment is shown in **Table 2-3**. The actual equipment used during construction would be determined by the contractor and the construction schedule.

TABLE 2-3
CONSTRUCTION EQUIPMENT

Equipment	Construction Purpose
Bulldozer	Earthwork construction and clearing and grubbing
Grader	Ground leveling
Mini Excavator	Soil manipulation
Skid Steer Loader	Soil or gravel manipulation
Trencher	Trench digging

2.7 Project Entitlements and Approvals

The Tuolumne County Community Development Department would review the EIR and Mitigation Monitoring and Reporting Plan (MMRP), and the Planning Commission would certify the EIR as the lead agency. Additionally, the following permits, reviews, consultations, and approvals (see **Table 2-4**, below) would be required to be completed or approved prior to the commencement of project construction.

TABLE 2-4
PERMITS AND APPROVALS NEEDED

Agency	Permit/Approval
Federal	
U.S. Army Corps of Engineers	Clean Water Act Section 404 Permit
U.S. Forest Service (USFS)	Temporary Road Use Permit for construction access across USFS lands
U.S. Forest Service	Special Use Permit for seasonal access across USFS lands
State	
California Department of Fish and Wildlife (CDFW)	California Fish and Game Code Section 1600-1602 Streambed Alteration Agreement
California State Water Resources Control Board (SWRCB)	National Pollutant Discharge Elimination System (NPDES) Construction Stormwater Permit
California Department of Forestry and Fire Protection	Timber Harvest Plan
Central Valley Regional Water Quality Control Board	Clean Water Act Section 401 Water Quality Certification
Local	
Tuolumne County	Site Development Permit
Tuolumne County	Use Permit for development of campground uses in the Commercial Recreation/Open Space (C-K/O-1) portion of the site
Tuolumne County	Tuolumne County Grading Permit
Tuolumne County Fire Department	Wildfire Mitigation Plan, Emergency Operations Plan

ORG6-80

ORG6-81

EXHIBIT I

cbec eco engineering
Hydrology | Hydraulics | Geomorphology | Design | Field Services

July 27, 2020

Ms. Laurel Impett
Shute, Mihaly & Weinberger LLP
396 Hayes Street
San Francisco, CA 94102-4421

Subject: Review of Draft Environmental Impact Report
SCH No. 2019110286
Terra VI Lodge Project, Tuolumne County, CA

Dear Ms. Impett:

I am a state licensed Professional Geologist and Certified Hydrogeologist with over thirty years of technical and consulting experience in the fields of geology, hydrology, and hydrogeology. I have been providing professional hydrology and hydrogeology services throughout California since 1989 and routinely manage and lead projects in the areas of surface- and groundwater hydrology, water supply, water quality assessments, water resources management, and geomorphology. A copy of my resume is attached. ORG6-81

I have been retained by Shute, Mihaly & Weinberger LLP (SMW) to review and evaluate the Draft Environmental Impact Report (DEIR) for the Terra VI Lodge Project, Tuolumne County, California. Based on my review of this document, it is my professional opinion that the DEIR is inadequate in evaluating and mitigating the potential significant impacts of Project actions on hydrology, groundwater supply and biological resources. The rationale for these opinions is based on multiple findings presented below.

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Environmentally sustainable solutions for the water resources industry

1. Deferred Mitigation

The DEIR states that "[t]he proposed project would affect drainage patterns and increase the overall amount of impervious surfaces, thus creating changes to stormwater flows and water quality." DEIR p. 4.10-8. The DEIR contains no assessment of this impact. It is my experience that EIRs typically include detailed hydrologic analyses to quantify the magnitude of project runoff in order to evaluate if it would exceed the capacity of existing or planned storm water drainage systems/structures (e.g., the existing drainage culvert under Highway 120) or otherwise degrade water quality. The DEIR fails to disclose that increased runoff within and leaving the site will increase erosion potential and water quality impacts to on-site and receiving channels. In addition, the DEIR contains no Drainage Plan to indicate how the stated increases in runoff volume from the project site will be mitigated. The DEIR defers development of Hydrology and Water Quality mitigation measures, necessary to address the stated change in conditions. Mitigation Measure HYD-1a states that "[a] Drainage Plan for the site shall be prepared that specifies how runoff on the site will be managed in order to protect water quality." DEIR p. 4.10-10. Similarly, Mitigation Measure HYD-1b defers the design and analysis of detention and/or retention facilities intended to mitigate for known and stated increases in the rate of surface runoff from the site. *Id*. The DEIR states that "[w]ithout mitigation the proposed project could modify the timing and volume of runoff and expansion of existing stormwater facilities or the construction of new facilities by the County may be required. Therefore, the project would result in a significant impact with respect to storm drain facilities." DEIR p. 4.10-14. The DEIR clearly indicates development of mitigation measures to address this impact will be deferred to a later time. However, design of effective runoff and erosion control best management practices (BMPs) requires a hydrologic analysis to quantify the potential changes and impacts associated with project runoff. Thus, in addition to presenting vague and unproven mitigation measures, the DEIR should be deemed incomplete as it does not provide (or defers) a hydrologic analysis necessary to identify and quantify project induced impacts on hydrology and water quality. ORG6-82

2. Unaddressed Potential Impacts to Groundwater Quality

Appendix G of the DEIR indicates that the site groundwater storage contained in the underlying bedrock is associated with interconnected fractures. DEIR Appendix G, p. 6-7. The appendix indicates that the water levels in many Project production wells, monitoring wells and adjacent residential wells are hydraulically connected by these fractures. DEIR Appendix G, p. 16. Review of project plans (Sheets T0.03 and T0.04, DEIR Appendix B) and fracture maps (Figures 5 and 6, DEIR Appendix G) indicate that the proposed wastewater systems are located within the interconnected fracture zone that supplies groundwater to the project, monitoring and off-site wells. The DEIR does not address or evaluate how ORG6-83 infiltration from the leach fields will interact with the fractures and associated groundwater system. Based on the magnitude of observed changes in groundwater levels recorded during the SWRCB 10-day pumping test and water quality sampling (Figures 10-22, DEIR Appendix G), the project production wells would clearly cause drawdown of fracture water levels. This will result in induced recharge of leach field water into the fracture aquifer and preferentially draw leach field infiltration into the fractured bedrock aquifer potentially causing adverse impacts to aquifer water quality. Because many on- and off-site wells share the groundwater supply of the interconnected fracture system, groundwater recharge from the Project leach fields could be drawn to surrounding off-site residential wells. This process and potential impacts to both on- and off-site wells are not acknowledged, let alone addressed in the DEIR. Therefore, the DEIR does not adequately address potential impacts to groundwater quality.

ORG6-83 cont.

3. Unaddressed Potential Reduction in Groundwater Recharge

The DEIR states, “The Project site and Tuolumne County are not within a designated groundwater basin or recharge area.” DEIR pg. 4.10-13. It is not clear what authority or jurisdictional designation of groundwater basin and recharge area is being referred to in this statement. Regardless, the Project is located on a watershed divide and is an area of groundwater recharge to the underlying fractured bedrock aquifer. The authors of the DEIR’s Hydrogeology Study state that greywater irrigation, septic systems along with “natural recharge” from the project site are sources of recharge to the underlying groundwater “basin”. DEIR Appendix G, pg. 16.

The DEIR states that captured roof drainage and surface runoff will be redirected. DEIR pg. 4.10-9. There is no analysis in the DEIR of how this change will affect the volume and timing of water available for infiltration and groundwater recharge. The DEIR states that minimizing consumption; use of grey water systems for landscape irrigation and use of low-flow plumbing fixtures; capture of rainwater to be used for other non-potable uses; and return flow from the grey water irrigation system and from the on-site septic systems will provide additional recharge to the groundwater aquifer. DEIR p. 4.10-13. However, no water balance analysis is presented to demonstrate how these reallocations will balance out against the losses in recharge due to project-induced changes in surface water runoff. The DEIR conclusion that there will be no change in the volume of groundwater recharge is unsubstantiated as the DEIR presents no technical or quantitative analysis of how changes in surface water hydrology will impact groundwater supply. In short, the DEIR fails to demonstrate or quantify how the project changes in surface water conditions will affect groundwater recharge and existing groundwater supplies.

ORG6-84

4. Incomplete Estimate of Water Demands

The derivation of the project water demand estimate (16,636 gallons per day) is presented in the report prepared by Shamim Engineering Consultants, Inc. (dated March 30, 2020). Attachment E to DEIR Appendix G. The water demands in this study are based solely on domestic visitor use associated with guest rooms, cabins and employee housing. There are no estimates of the following water uses included into the project water demand estimate, including but not limited to: food preparation and dining; cleaning/maintenance activities of facilities; swimming pool; and fire water storage. Therefore, it is my opinion that the water demand estimate does not account for all water demands provided in the Project Description and the DEIR is in adequate in characterizing and quantifying potential adverse impacts to groundwater supply. ORG6-85

5. No analysis of Groundwater Pumping impacts during Dry years and Drought Periods

The groundwater pump test completed to determine the available groundwater supply to the Project was completed in October of 2019. Per Figure 9 of the Geoscience Hydrogeology Study, 2019 was a wet year-type occurring within a 4-year period of average to predominantly above normal precipitation (i.e., multi-year wet period). DEIR Appendix G, Fig. 9. The DEIR provides no quantitative assessment of how Project well pumping will impact groundwater supplies during dry or multi-year dry periods (i.e., drought). It is my experience that excess stress and adverse impacts to California water resources commonly occur during dry years or drought, but typically do not occur during wet years or multi-year wet periods. The DEIR claims that applying a 50 percent capacity pumping rate to project wells based on the 10-day capacity test per SWRCB standards will provide an adequate safety factor to overcome supply deficiencies during dry and multiple dry year periods. DEIR p. 4.16-7. However, beyond this SWRCB-accepted rule of thumb, the DEIR offers no analysis or evidence that the proposed project groundwater withdrawals will not have an adverse impact on groundwater supply during dry year or multi-year drought periods. As described in the next section of my comments, the groundwater supply beneath the project site has already been depleted and the SWRCB standards are inadequate as they are likely intended for application to groundwater systems in a natural or unimpacted condition. Given the groundwater supplies beneath the project site are already in a state of depletion, the DEIR has provided no analysis of whether groundwater pumping associated with project actions will or will not have an adverse impact on groundwater supply during dry year or drought periods. This is further compounded by the lack of analysis as to whether the project will increase or decrease the amount of groundwater recharge to the depleted aquifer. ORG6-86

6. Project will Contribute to Existing Impact on Groundwater Supply and Reduced Spring Supply and Associated Ecological Habitat

The DEIR's hydrogeology analysis found that springs within the project influence area shown in 1992 topographic maps are no longer active or producing. DEIR Appendix G, p. 7. The report finds that "[t]his is likely because wells in the area have drawn the groundwater surface below the surface elevation of the former springs." *Id*. at 7. The report concludes that these springs "are no longer flowing, which suggests groundwater levels are currently lower than they have been historically." *Id*. at 8. Although not acknowledged and discussed in the DEIR, these statements indicate that groundwater supply within the project area is currently in a state of depletion and any further groundwater extractions will lead to further depletions. This will not only further deplete groundwater supply, but further exacerbate the ecological impacts associated with lost spring flow, assuming the springs are valuable contributions to ecological and aquatic habitat to sensitive species, whether seasonal or year-round. **ORG6-87**

7. DEIR Does Not Account for the Project's Cumulative Impacts on Groundwater Supply

The DEIR cumulative water supply impact assessment identified four projects within the vicinity that, in combination with the Project, could potentially decrease groundwater supplies. DEIR pg. 4.16-9. Two of the off-site projects will not draw upon groundwater to satisfy water demands. However, the DEIR fails to analyze the impacts associated with the remaining two off-site projects that will draw upon the common groundwater supply. In fact, instead of making a reasonable assumption for Thousand Trails/Yosemite Lakes RV Expansion groundwater demands, the DEIR simply disregards the project from analysis completely. In addition, the DEIR fails to include the cumulative impact associated with pumping from surrounding residential domestic wells, some of which are known to be drawing upon the same groundwater supply as the Project. **ORG6-88**

Another deficiency in the cumulative water supply impact assessment is the failure to acknowledge or address the existing cumulative adverse impact of depleted water storage as discussed under item 6 above. Pumping and groundwater depletions associated with the project will only perpetuate and add to adverse impacts that are already occurring. Nor does the DEIR evaluate cumulative, let alone individual, impacts during dry year or drought periods (i.e., a reasonable worst-case scenario in identifying impacts). Given all these deficiencies in impact analyses, the DEIR conclusions that both individual and cumulative impacts will be less than significant are unsubstantiated. Therefore, it is my opinion that the DEIR has not addressed, let along acknowledged the existing and potential adverse impacts on groundwater supplies and associated beneficial uses.

ORG6-88 cont.

Please feel free to contact me with any questions regarding the material and conclusions contained in this letter.

Sincerely,

Greg Kamman, PG, CHG
Senior Ecohydrologist

cbec
eco engineering
Hydrology | Hydraulics | Geomorphology | Design | Field Services

Amanda, the matrix can say "Resume, Greg Kamman, PG, PHG"

Greg Kamman, PG, PHG
Senior Ecohydrologist

Education
MS, 1989, Geology, Sedimentology and Hydrogeology, Miami University, Oxford, OH

AB, 1985, Geology, Miami University, Oxford, OH

Professional Registration
1993, Professional Geologist, California, #5737

1995, Certified Hydrogeologist, California, #360

Professional Experience
cbec, inc., eco-engineering, West Sacramento, CA, Senior Ecohydrologist, 2020-present

Kamman Hydrology & Engineering, Inc., San Rafael, CA, Principal Hydrologist/Vice President, 1997-2020

Balance Hydrologics, Inc., Berkeley, CA , Sr. Hydrologist/ Vice President, 1994-1997

Geomatrix Consultants, Inc., San Francisco, CA, Project Geologist/Hydrogeologist, 1991-1994

Environ International Corporation, Princeton, NJ, Sr. Staff Geologist/Hydrogeologist, 1989-1991

Miami University, Oxford, OH, Field Camp Instructor and Research Assistant, 1986-1989

Greg Kamman is a professional geologist and certified hydrogeologist with over 30 years of technical and consulting experience in the fields of geology, hydrology, and hydrogeology. He specializes in directing and managing projects in the areas of: surface- and ground-water hydrology; stream and tidal wetland habitat restoration; water supply and water quality assessments; water resources management; and geomorphology. Mr. Kamman has worked extensively on California coastal watersheds and estuaries as well as on projects in Oregon and Hawaii.

Mr. Kamman's experience and expertise includes: evaluating surface- and ground-water resources and their interaction; stream and wetland habitat restoration assessments and design; characterizing and modeling basin-scale hydrologic and geologic processes; assessing hydraulic and geomorphic responses to land-use changes in watersheds and causes of stream channel instability; and designing and implementing field investigations characterizing surface and subsurface hydrologic and water quality conditions. Greg commonly works on projects that revolve around sensitive fishery, wetland, wildlife and/or riparian habitat enhancement within urban and rural environments. Mr. Kamman performs many of these projects in response to local, state (CEQA) and federal statutes (NEPA, ESA), and other regulatory frameworks. Mr. Kamman frequently applies this knowledge to the review and expert testimony on state and federal water operation plan EIR/EIS reports, Groundwater Sustainability Plans, biological assessments and Habitat Conservation Plans.

Mr. Kamman is accustomed to working multi-objective projects as part of a multi-disciplined team including biologists, engineers, planners, architects, lawyers, and resource and regulatory agency staff. Mr. Kamman is a prime or contributing author to over 360 technical publications and reports in the discipline of hydrology – the majority pertaining to the protection and enhancement of aquatic resources. Mr. Kamman has taught the following courses: stream restoration through U.C. Berkeley Extension (2001-2008); wetland hydrology through San Francisco State University's Romberg Tiburon Center (2007 and 2012-2014); and presented webinars (2020) to California Water Boards staff on hydrologic and hydraulic modeling. He has devoted his career to the protection, enhancement and sustainable management of water resources and associated ecosystems.

ORG6-89

SELECTED EXPERIENCE

Floodplain Management Projects

Flood Reduction, Mitigation Planning, and Design on Yreka Creek , Siskiyou County, CA
City of Yreka as subcontractor to WRA, Inc., 2008-2010

Mr. Kamman completed a series of field and hydraulic model investigations for restoration planning and design along Yreka Creek to reduce flood hazards and potential damage to the City's water treatment plant and disposal field infrastructure. This work also addresses and satisfies dike repair mitigation conditions stipulated by state resource agencies. While achieving these goals, Mr. Kamman tailored analyses and study objectives to assist the City in: enhancing the ecological floodplain restoration along Yreka Creek; providing opportunities for expanded public access and trail planning consistent with the goals of the Yreka Creek Greenway Project; and improving the water quality of Yreka Creek.

Key elements of this work included: review and synthesize existing information; identify and analyze the feasibility for three conceptual alternatives; and conceptual design and report preparation. Funding for implementation of restoration work over such a large area was a significant concern to the City. Therefore, designs identify and define phasing in a fashion that gives the City flexibility in implementation.

SELECTED EXPERIENCE *(CONTINUED)*

West Creek Drainage Improvement Assessment, Marin County, CA
Marin County Flood Control, 2006-2008

Mr. Kamman prepared a study focused on characterizing existing flood conditions and developing and evaluating flood reduction measures along West Creek in Tiburon. The work was completed through the implementation of hydrologic and hydraulic feasibility and design assessments. The conceptual design and analysis of potential flood reduction strategies (alternatives) was completed through the development of a HEC-RAS hydraulic model that simulates historic, existing and proposed project flood conditions. It was intended that the conceptual design developed under this scope of work would be of sufficient detail and quality to initiate project permitting and the environmental compliance process and documentation. Opportunities for riparian corridor and aquatic habitat enhancement were also considered and integrated into the conceptual design. Mr. Kamman also developed and assessed six alternative flood hazard reduction measures. The hydraulic model results for each alternative were compared against baseline conditions in order to evaluate their ability to alleviate flood hazards.

Gallinas Creek Restoration Feasibility Assessment, Marin County, CA
San Francisco Bay Institute, 2003-2005

Mr. Kamman completed a feasibility assessment for restoration of Gallinas Creek in northern San Rafael. Restoration will require removal of a concrete trapezoidal flood control channel and replacement with an earthen channel and floodplain in a “green belt” type corridor. Work included the collection of field data and development of a HEC-RAS hydraulic model to evaluate and compare existing and proposed project conditions. Designs must continue to provide adequate flood protection to the surrounding community. The study also includes and evaluation of existing habitat values, potential habitat values, and restoration opportunities and constraints.

Hydrologic and Hydraulic Evaluation for Trinity County Bridge Replacement, Trinity County, CA
Trinity County Planning Department, 2002

Mr. Kamman completed technical peer review of peak flow estimates and hydraulic design parameters associated with the replacement of 4 bridges across the upper Trinity River in Trinity County, California. A primary study component was accurately predicting the magnitude and frequency of flood releases from Trinity Dam. Numerous flood frequency analytical approaches were evaluated and used throughout this study.

Restoration of Lower Redwood Creek Floodway and Estuary, Humboldt County, CA
California State Coastal Conservancy and Humboldt County DPW, 2002-2003

Mr. Kamman provided technical review for the development of a hydraulic model to evaluate river and estuary restoration alternatives along the lower portions of Redwood Creek between Orrick (Highway 1) and the Pacific Ocean (only the lower half of the leveed floodway). This work was completed to evaluate the feasibility for creek/estuary restoration alternatives developed by the County and effects on flood hazards along this flood-prone reach.

In order to better address and evaluate the current flood hazards along the entire floodway and identify potential flood hazard reduction measures, Mr. Kamman was retained to update HEC-2 models previously prepared by the Army Corps and evaluate the impacts of vegetation encroachment (increased roughness) and sediment deposition on floodway conveyance. In essence, the Corps hydraulic model was expanded with newly completed channel surveys and channel roughness observations. The impetus for this work was to assist the County in identifying mutually beneficial strategies for ecosystem restoration and flood hazard reduction. Technical work was completed under close coordination and communication with County engineers. Study results and findings were presented at public meetings of local area landowners and stakeholders.

Tembladero Slough Small Community Flood Assessment, Monterey County, CA
Phillip Williams & Associates, Ltd., 1997

Mr. Kamman completed a flood information study of Tembladero Slough near Castroville on behalf of the San Francisco District Corps of Engineers. The purpose of this work was to identify and document local flood risks existing in the community and propose potential floodplain management solutions as part of the Corps 1995/1997-flood recovery process. Work centered on conducting a field reconnaissance, reviewing available historical data, and conducting discussions/ interviews with local landowners and agency personnel.

Fluvial Projects

Muir Woods National Monument Bank Stabilization Plan for Conlon Creek, Marin County, CA
Golden Gate National Parks Conservancy (GGNPC), 2018-present

Mr. Kamman developed a grading and drainage plan for the Conlon Avenue Parking Lot, located adjacent to Redwood Creek and sensitive Coho salmon habitat. More recently, he has assisted GGNPC and the NPS in assessing the planning and design for creek bank stabilization and ecological enhancement at a failed culvert on a tributary channel at the project site. This work includes constructing a HEC-RAS model to evaluate: culvert removal and channel design; fish passage; and water quality impacts. Work is currently in development of 50% engineering design.

Hydrology and Hydraulic Assessments for Design of Butte Sink Mitigation Bank Project, Colusa County, CA
WRA, Inc., 2017-2018

Mr. Kamman was retained to provide hydrology and hydraulic modeling support in the development of design and Draft Prospectus for the Butte Sink Mitigation Bank (Bank). This work entailed developing the necessary hydrology information, hydraulic model and documentation to support further design, environmental compliance and agency approvals/permitting of the Bank. The main objective of work was to develop a design that provides the necessary ecological conditions and functions for successful establishment and operation of the Bank.

Lagunitas Creek Salmonid Winter Habitat Enhancement Project, Marin County, CA
Marin Municipal Water District, 2013-2018

Mr. Kamman designed and led a study to evaluate opportunities to enhance winter habitat for coho and other salmonids in Lagunitas Creek and its largest tributary - Olema Creek. This work was done as a two-phase assessment and design effort. The first phase (completed in 2013) included a winter habitat assessment to evaluate existing juvenile salmonid winter habitat in Lagunitas Creek and lower Olema Creek. The results of this assessment were used to prioritize winter habitat needs, and identify opportunities for winter habitat enhancement to increase

ORG6-89

SELECTED EXPERIENCE *(CONTINUED)*

the winter carrying capacity of coho salmon and steelhead. The second phase (completed in 2017) consisted of a designing winter habitat enhancements. These enhancements focused on restoring floodplain and in-channel habitat structures. Winter habitat enhancement work also needed to consider potential impacts to or benefits for California freshwater shrimp (Syncaris pacifica), a federally endangered species.

This work included field reconnaissance, topographic surveys and the preparation of final design drawings at nine different project sites. An overall self-maintaining design approach was developed to guide individual project plan, with minimal earthwork and disturbance to existing riparian and wetland habitat. Self-sustained, natural evolution of a multi-thread channel within a more active floodplain is a desired outcome of project actions. Design elements and structures are intended to enhance or restore natural hydrologic processes to promote geomorphic evolution of more active high flow (side) channels and floodplain. Design elements include construction of 24 individual log structures.

MacArthur Meadow Wetland Restoration, San Francisco, CA
Presidio Trust, 2001-present

Mr. Kamman has been working on over a dozen independent wetland and creek restoration planning and design efforts within the Presidio of San Francisco since 2001. Recently (2016), Mr. Kamman developed a wetland restoration grading plan for the MacArthur Meadow Wetland Restoration Project in the central portion of the Tennessee Hollow watershed. As part of the site assessment, he characterized and modeled surface and groundwater interactions and identified a unique opportunity to restore 4 acres of mixed meadow, natural wetlands and creek/riparian corridor. This was possible due to the discovery of shallow groundwater conditions beneath this historically disturbed landscape. Various design components were integrated into the grading plan in order to enhance groundwater recharge and storage in the Meadow, while retarding runoff and drainage out of the wetland, including: daylighting storm drain runoff into the Meadow; reconfiguring internal channel alignments to enhance channel habitat and groundwater recharge; creation of wetland depressions to retain and recharge surface water; and removal of fill material to decrease the depth to the water table. Notable challenges of this work include restoring heavily disturbed natural resources in an urban setting while integrating designs with archeology/cultural resources, education and remediation programs.

Lower Miller Creek Management and Channel Maintenance, Marin County, CA
Las Gallinas Valley Sanitary District, 2013-2015

Mr. Kamman was commissioned to formulate and implement a plan for sediment removal and improved flood flow conveyance in the Lower Miller Creek channel. The need for improved flood and sediment conveyance is driven by the following. Progressive accumulation of course sediment in the project reach is reducing area wide discharge efficiencies along Miller Creek and at District outfalls. The District has an immediate need to dredge Lower Miller Creek to protect existing operations and facilities. Miller Creek supports a population of federally listed Steelhead and adjacent wetland/marsh areas potentially support other state and federally listed special status species. Therefore, permitting requirements and cost efficiency will require minimizing the extent and frequency of channel excavation/maintenance that may adversely impact habitats in the wetland and riparian corridor.

The design objective of the project is to define and optimize an integrated channel maintenance and flood and sediment management plan that protects existing facilities from stream and coastal flood hazards. The plan should minimize costs and ecological impacts of future anticipated and designed maintenance activities required under District operations. Working with District Staff, Mr. Kamman developed a suite of potential project alternatives and identified a preferred approach. Mr. Kamman completed all CEQA compliance (IS/MND) and permitting. Mr. Kamman also managed and directed development of engineered drawings and assisted in bid document preparation.

Mr. Kamman provided site assessment, long term management planning and channel maintenance support to the Sanitary District to maintain flood conveyance, manage sediment aggrading at District outfalls, and improve ecological values in the intertidal Bayland reaches of Miller Creek. The creek supports multiple federal and state listed endangered species. Initial work included completing hydraulic and geomorphic assessments to characterize causes of channel aggradation, and quantify sediment yields. Assessments included evaluation of climate change impacts on habitat and flood hazards, and water quality modeling of District outfalls to quantify tidal exchange and dilution. Based on this analysis and supporting Biological resources assessments, Mr. Kamman identified alternatives for channel maintenance, performed a cost benefit assessment of dredging alternatives, and is assisting the District in developing short and long term management objectives. He also led a multidisciplinary design team in the preparation of engineering plans and specifications as well as permits and environmental compliance documents.

Vineyard Creek Channel Enhancement Project, Marin County, CA
Marin County Department of Public Works, 2007-2013

Mr. Kamman managed the preparation of designs and specifications for a flood conveyance and fish habitat and passage improvement project on Vineyard Creek. Creek corridor modifications included replacing the box culvert at the Center Road crossing with a free span bridge or bottomless arch culvert (civil and structural design by others), providing modifications to the bed and bank to eliminate erosion risks to adjacent properties and improve water quality, promoting active channel conveyance of both water and sediment and providing improved low- and high-flow fish passage, improved low flow channel form and enhanced in-stream habitat, repairing eroding banks, and expanding/enhancing adjacent channel floodplains. The riparian corridor was replanted to provide a low density native under-story, "soft" bank erosion protection and increased tree canopy along the tops of banks. Mr. Kamman also prepared the JARPA for the project and has been following through with permit compliance/negotiations will all participating resource agencies. Designs and permitting also address the known presence of Native American artifacts. This work was contracted under and expedited design schedule and phased construction was initiated the summer of 2008 and continued the summer of 2009.

Bear Valley Creek Watershed and Fish Passage Enhancement Project, Marin County, CA
The National Park Service and Point Reyes National Seashore Association, 2005-2013

Working on behalf of the NPS and PRNSA, Mr. Kamman completed a watershed assessment and fish passage inventory and assessment for Bear Valley Creek. Work included a geomorphic watershed assessment and completing field surveys and hydraulic modeling (including flood simulations) of ten road/trail crossings to

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identify and prioritize creek and watershed restoration efforts while considering and addressing current flooding problems at Park Headquarters – a major constraint to channel restoration efforts that would likely exacerbate flooding. Mr. Kamman also completed a suite of conceptual restoration designs (Phase 1) including: the replacement of two county road culvert crossings with bridges; channel creation through a ponded freshwater marsh (former tidal marsh); and replacement of 4 trail culverts with prefabricated bridges; and associated in-channel grade control and fishway structures. Engineered drawings and specifications were also developed for some of these sites to assist PORE with emergency culvert replacements after damages sustained during the New Year's Eve flood of 2005. Mr. Kamman also directed geotechnical, structural and civil design of project components.

Two projects were completed in 2006 on emergency repair basis resulting from flood damages suffered during the New Year's Eve storm of 2005. The two most recent projects were constructed in 2013, consisting of a large bank repair and adjacent to main access road/trail and culvert replacement further upstream on same road. The bank repair utilized bioengineering approaches including engineered log revetments and log diversion vanes.

Kellogg Creek Restoration Project, Contra Costa County, CA
Olberding Environmental on behalf of the Contra Costa County Water District, 2012-2013

Mr. Kamman led the development of PS&E to restore 3,000 linear feet of riparian and associated creek corridor habitat. Project was designed as compensatory mitigation for direct and indirect impacts to jurisdictional waters from the Los Vaqueros Reservoir Expansion Project that Contra Costa Water District. Work included field investigations and data analysis to characterize hydrologic/ geomorphic conditions and numerical modeling to optimize desired inundation and hydroperiods. Work was completed under subcontract to.

Miller Creek Sanitary Sewer Easement Restoration, Marin County, CA
Las Gallinas Valley Sanitary District, 2010

Working on behalf of the District, Mr. Kamman completed field surveys and technical feasibility studies to develop engineering plans and specifications for a stream bank restoration project to protect an exposed sanitary sewer pipeline, stabilize incised banks, and promote an ecologically healthy stream corridor along an approximately 50 linear foot damaged reach of Miller Creek. The design includes backfill and materials to accommodate construction of a vegetated stabilized slope. The eroded bank repair included design of a 1:1 Envirolok vegetated slope with geogrid reinforced soil lifts extending eight to ten feet back from the slope face. One-quarter-ton rock will be placed in front of the Envirolok wall at the toe of the reconstructed bank to provide added scour protection. In order to perform the work, the project site will be dewatered. An existing felled tree perpendicular to the creek flow will be relocated and secured into the right creek bank with root wad remaining in active channel. All work on the bank and within the creek bed must be completed pursuant to project permits due to presence of steelhead trout.

California Coastal Trail Planning and Design at Fitzgerald Marine Reserve, San Mateo County, CA
WRA, Inc., 2008-2009

Mr. Kamman provided hydrology and hydraulics expertise in the planning and design for the 0.25-mile segment of the California Coastal Trail at the Fitzgerald Marine Reserve. The project was overseen by the San Mateo County Parks Department. This segment of Coastal Trail provides improved access from the trailhead to the beach as well as a free span bride over Vicente Creek. Greg completed the field surveys and hydraulic modeling to assist an interdisciplinary team to design the project. Understanding the hydrology of Vicente Creek and quantifying flood conditions was critical to successfully designing and constructing the free span bridge. He also evaluated how creek hydrology and coastal wave processes interact at the beach outfall in order to identify opportunities and constraints to beach access improvements (which will include crossing the creek on the beach) during both wet and dry season conditions in order to evaluate both permanent and seasonal crossing design alternatives.

Hydrologic Assessment and Conceptual Design for Conservation and Wetland Mitigation Bank Project, Stanislaus County, CA
WRA, Inc., 2009

Working as a subcontractor to WRA, Inc., Mr. Kamman provided hydrology, geomorphology and engineering support for the planning and design for a Conservation and Wetland Mitigation Bank on the San Joaquin River, in the Central Valley near Newman, California. The property is currently owned by the Borba Dairy Farms. The primary objective of the study was to characterize the hydrologic and geomorphic controls on the spatial distribution of habitat types. To meet this objective, Mr. Kamman's assessment included: (1) collecting and synthesizing hydrologic data to characterize existing and historic streamflow, geomorphic and shallow groundwater conditions; (2) filling a data gap by collecting topographic data of hydrologic features; (3) developing a hydraulic model capable of predicting water surface profiles for a range of design flows; and (4) quantifying the linkage between surface water/groundwater conditions and specific vegetation communities and habitat types through implementation of reference site assessments. Mr. Kamman also provided conceptual design and permitting support in evaluating habitat enhancement and creation opportunities on the site.

Redwood Creek Floodplain and Salmonid Habitat Restoration, Marin County, CA
Golden Gate National Recreation Area and Golden Gate Parks Conservancy, 2005-2008

Mr. Kamman lead development of a preferred project alternative and final project design drawings and specifications for a floodplain and creek restoration and riparian corridor enhancement effort on lower Redwood Creek above Muir Beach at the Banducci Site. A primary objectives of the project was to: improve salmonid passage/rearing/refugia habitat; riparian corridor development to host breeding by migratory song birds; and wetland/pond construction to host endangered red-legged frog. The preferred design includes: excavation along the creek banks to create an incised flood terrace; engineered log deflector vanes; removing and setting back (constructing) approximately 400-feet of levee; creating in- and off-channel salmonid rearing and refugia habitat; reconnecting tributary channels to the floodplain; and creating California red-legged frog breeding ponds. Designs were completed in 2007 and the project constructed in the summer of 2007.

Considerable hydraulic modeling was completed to evaluate and develop means to help reduce chronic flood hazards to surrounding roadways and properties. Alternatives that included set-back levees and road raising were developed and evaluated. Detailed and careful hydraulic (force-balance) analyses and computations were completed as part of engineered log deflector designs. These

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were unique and custom designed structures, building on past project efforts and in consultation with other design professionals.

This project demonstrates Mr. Kamman's ability to work closely with the project stakeholders to develop a preferred restoration alternative in a focused, cost-effective and expedited fashion. This was achieved through close coordination with the NPS and the effective and timely use of design charrette-type meetings to reach consensus with participating stakeholders. Conceptual through full PS&E were completed on-time and on-budget in 2007 and was project constructed in the fall of 2007. Mr. Kamman worked closely with NPS staff to "field fit" the project, by modifying grading plans to protect existing riparian habitat. Mr. Kamman also provided construction management and oversight to floodplain grading and installation of engineered log structures. Based on field observations, the project is performing and functioning as desired.

Pilarcitos Creek Bank Stabilization Project, San Mateo County, CA
TRC Essex, 2006-2007

Mr. Kamman directed field surveys and technical modeling analyses to develop restoration design alternatives for a Bank Stabilization Project on Pilarcitos Creek in unincorporated San Mateo County, California. This work included hydrology and hydraulic design and preparation of plan sheets and technical specifications as well as a revegetation plan. Due to the importance of protecting an existing gas mainline, the design package will be completed in close coordination with TRC Essex geotechnical staff and revegetation subcontractor and PG&E civil staff. Design feasibility analyses focused on developing hydraulic design criteria for the project, including: estimates of design flood flow magnitudes (2-, 5-, 10-, 25-, 50- and 100-year floods); water surface elevation estimates for a suite of design floods; associated average channel velocities and shear stresses; and estimates for riprap sizing for channel bank toe protection. Plan sheets, technical specifications and cost estimates were provided for review and approval.

Watershed Assessments

Evaluation of Project Impacts on Oregon Spotted Frog, Klamath County, OR
Oregon Water Watch and Earthjustice, 2016-2019

Mr. Kamman designed a suite of hydrologic, hydraulic and geomorphic studies to evaluate proposed change operations of the Crane Prairie, Wickiup and Crescent Lake dams and reservoirs as related to harm to Oregon spotted frogs. Work began with analyzing impacts associated with proposed water delivery operations and developing a proposed alternative prioritizing protection and enhancement of frog habitat. This work followed with a technical review and critique of the USFWS's Biological Assessment. Work included preparation of four declarations for the clients.

Tennessee Hollow Creek Riparian Corridor Restoration, San Francisco County, CA
Presidio Trust, 2001-present

Mr. Kamman has been leading and assisting the Trust and Golden Gate National Recreation Area (GGNRA) in the planning and design on over a dozen multi-objective riparian corridor restoration and watershed management projects in the Tennessee Hollow/Crissy Marsh watershed since 2001. Specific project objectives include: daylighting creeks; riparian corridor restoration; expanding Crissy Marsh; enhancing recreation, education, archeological, and cultural resource opportunities; improving water quality discharges to San Francisco Bay; and remediation of numerous landfills within the watershed. Typical initial phases of work focus on characterizing surface and groundwater conditions within each project area and identifying opportunities and constraints to restoration of natural wetlands and creek/riparian corridors. Notable challenges of this work include restoring heavily disturbed natural resources in an urban setting while integrating designs with recreation, archeology/cultural resources, education and remediation programs. Mr. Kamman has acted as lead hydrologist and designer on eight separate reaches in the 271-acre Tennessee Hollow Creek watershed and several other projects within and in the vicinity of Mountain Lake.

All task authorizations under these on-call and individual design contracts and included hydrology and water quality assessments and conceptual restoration planning and design. The project areas overlapped both the Presidio Trust and NPS-GGNRA management areas. Preliminary construction cost estimates for project alternatives within the Tennessee Hollow watershed range from $10- to $20- million. Several restoration projects are also tied to providing mitigation for the current San Francisco Airport expansion and Doyle Drive Seismic Improvement projects. Several projects have been constructed since 2012 (Thompson's Reach, El Polin Loop), two projects (East Arm Mtn. Lake and YMCA Reach) were constructed in 2014, and MacArthur Meadow restoration in 2016.

This work illustrates the Mr. Kamman's ability to complete a broad variety of hydrologic analyses, including: multiple years of rigorous and thorough surface water and groundwater hydrologic and water quality monitoring throughout the entire watershed to characterize and quantify existing hydrologic conditions; development of a detailed watershed-scale water budget for existing and proposed land-used conditions (capturing existing and proposed vegetation cover types and land use activities) to calculate groundwater recharge estimates input into the numerical watershed model; preparation of EA sections on water resources and water quality (NEPA compliance) regarding Environmental Conditions, proposed Impacts, and Proposed Mitigations associated with the project; preparing detailed alternative plans; and coordination and preparation of engineered plans/specifications for construction. All work was completed on budget and in a timely fashion.

Mountain Lake Water Budget, San Francisco County, CA
Presidio Trust, 2012-2017

Mr. Kamman was retained to develop a water balance model for Mountain Lake in the Presidio of San Francisco. Through development of a water balance model, the Trust seeks to understand: the major source(s) of inflow to both Mountain Lake; anticipated seasonal (monthly) changes in water level relative to various outflow assumptions; and the relationship of surface and groundwater interaction. This information gained from this study will be used to: 1) better understand and manage lake levels for ecological habitats; 2) identify flood storage capacity of Mountain Lake and fluctuations in lake level under various storm conditions; 3) better understand and maintain wetland habitat in the east arm; and 4) complete mass balance calculations to assess water quality in and feeding into the lake.

To implement this study, Mr. Kamman developed a water budget model to identify and quantify the primary water inputs and outputs to the lake and determine major controls over water storage. Primary water budget variables analyzed includes: precipitation; evaporation/evapotranspiration; groundwater exchange; and surface runoff. This study also included a long-term field investigation completed between 2012 and 2016 to: identify all point source inputs such as culverts and

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drainage outlets; identify diffused surface runoff inputs from surrounding lands, including a golf course; better characterizing the function and performance of the primary lake outfall structure; monitor groundwater levels surrounding the lake; and continuously monitor lake water level and storage over a mult9i-year period. These data were used to quantify water budget variables used to build the water budget model. Precipitation and barometric pressure data used in the model was provided by the Trust maintained weather station. Model daily evaporation estimates came from a variety of local area gauges maintained by state agencies.

The water budget model developed for this study is successful in accurately simulating historic water level conditions. The model using a daily time-step appears more accurate than model using a weekly time-step, but both provide reasonable agreement with observed conditions. The model is highly sensitive to groundwater exchange with the lake. The water budget is also a proven useful tool for the design and analysis of improvements to the lake outfall structure and establishing flood storage needs to protect the adjacent highway.

Cordilleras Creek Hydrologic Assessment, San Mateo County, CA
City of Redwood City, 2002-2003

Mr. Kamman assisted the Cordilleras Creek Watershed Coordinator in planning, seeking funding, and implementing a hydrologic and biologic assessment of the Cordilleras Creek watershed. Work completed included completing a full creek reconnaissance and channel stability assessment, preparation of a watershed assessment work plan, presentations at public meetings, and study/review of flooding issues in the watershed. Challenges faced in this predominantly privately owned watershed include removal of numerous fish passage barriers and educating/coordinating property owners.

Capay Valley Hydrologic and Geomorphic Watershed Assessment, Yolo County, CA
Yolo County RCD, 2008-2010

Mr. Kamman designed and supervised a hydrologic/geomorphic watershed assessment and conceptual restoration design for the Capay Valley segment of Lower Cache Creek with funding from a CALFED Watershed Program grant. The Capay Valley reach of Cache Creek experiences considerable stream bank erosion, which contributes to downstream sedimentation. The channel instability also threatens adjacent homes, and can negatively impact the riparian habitat along the creek that functions as an important wildlife corridor from the Western Coastal Range to the Yolo Bypass. Additionally, a significant proportion of methylmercury transported into the Bay-Delta originates from the Cache Creek watershed. The main goal of this proposed study is to address both the causes and the above-mentioned consequences of bank erosion.

The assessment is designed to evaluate and quantify changes in hydrologic and geomorphic conditions in response to historical changes in land-use and water development (e.g., diversions, reservoir construction, groundwater pumping, etc.) as well as identify existing spatial and temporal conditions that are trending towards or away from geomorphic equilibrium. This assessment also evaluates how historic human-induced changes in hydrologic/geomorphic conditions affect riparian ecology in terms of the lost or altered floodplain area, character and inundation frequency. A key product of this assessment will be to distinguish between "natural" and "accelerated" bank erosion, and to identify the underlying causes (both natural and anthropogenic) so that appropriate solutions can be developed. Desired outcomes of the study include: reduce bank erosion by developing restoration designs for typical trouble sites; produce a ranking system to prioritize sites for stabilization and restoration; contribute to community education through watershed science education and the Yolo STREAM Project outreach program; improve water quality through reduction in accelerated erosion; and contribute to riparian corridor restoration and support the RCD's Wildlife Conservation Board funded efforts to remove non-native tamarisk and around from the creek corridor. Work is being completed through a broad spectrum of field and analytical investigations under close review by the RCD, stakeholders and a Technical Advisory Committee.

Ventura River Unimpaired Flow and Habitat Assessment, Ventura County, CA
City of Buenaventura and Nautilus Environmental, 2006-2007

Mr. Kamman completed a hydrology feasibility assessments as part of evaluating the reuse of Ojai Valley Sanitary District (OVSD) effluent for other beneficial uses. Currently, OVSD discharges treatment plant effluent to the lower Ventura River. The City and OVSD recognize that the reduction in the discharge of treated effluent to the Ventura River could have an environmental effect on sensitive and endangered species. In light of these concerns, this study was conducted to determine if a reuse project is feasible without significant environmental harm.

The assessment included hydrologic and geomorphic field and analytical assessments of past (unimpaired), current and proposed surface and groundwater flow conditions over a wide range of dry- through wet water year-types. The main objective if these analyses was to determine the linkage to water quality and aquatic habitat conditions including: flow durations; extent of gaining vs. losing reaches; low flow inundation/wetted area; and influence on barrier beach dynamics. Mr. Kamman collaborated with a team of other professionals to prepare a facility plan documenting the analyses and conclusions of respective water recycling investigations.

Hydrologic Analysis of FERC Minimum Flows on Conway Ranch Water Rights, Mono County, CA
Law Office of Donald Mooney, 2001-2002

Mr. Kamman completed a hydrologic analysis to evaluate if FERC's proposed Minimum Flow Plan for Mill Creek would interfere with the exercise of the Conway Ranch's water rights from Mill Creek. The approach to this analysis was to quantify the duration of time the Conway Water right was met under historic gaged and simulated proposed Minimum Flow Plan conditions. The primary objective of the analysis was to evaluate impacts during the winter period when flows are typically limited due to water storage as snow pack. Minimum Flow Plan conditions were simulated by developing a spreadsheet model that redistributes actual (historic) Lundy Lake releases in a fashion that maintains a minimum flow of 4 cfs to Mill Creek to accommodate the downstream Southern California Edison's (SCE) power plant. The analysis period for both historic and simulated Minimum Flow Plan conditions consisted of water years (WY) 1990 through 1998 to capture an exceptionally diverse range of wet and dry year-types.

The primary method used to quantify changes in flow between historical and simulated Minimum Flow Plan conditions was to prepare and compare flow duration curves for each condition during both the winter and summer periods during a variety of water year types. Model results were tabulated for each conditions to determine the differences in the percentage of time target flows were equaled or exceeded. Based on these findings, Greg was contracted to complete more in-depth monthly modeling.

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Groundwater Management Projects

Assessments of Groundwater-Surface Water Interaction, Stanislaus County, CA
The Law Offices of Thomas N. Lippe, APC and California Sportfishing Protection Alliance, 2015-present

Since 2015, Mr. Kamman has been assessing groundwater conditions within Stanislaus County and evaluating potential impacts of groundwater pumping on surface water flow and aquatic habitat of the Stanislaus, Tuolumne and San Joaquin Rivers. Mr. Kamman completed a comprehensive review and synthesis report of available groundwater and interconnected surface water (ISW) reports and data. Using available soils, geology and hydrology information, Mr. Kamman also delineated and mapped subterranean streams and Potential Stream Depletion Areas (PSDAs) to identify stream corridors susceptible to adverse impacts from groundwater pumping. This information is intended to help Groundwater Sustainability Agencies identify potential impacts to ISW.

Most recently, Mr. Kamman has been retained to review and comment on 7 Groundwater Sustainability Plans (GSPs) for critically overdraft groundwater subbasins within or adjacent to Stanislaus County. This review focused on how GSPs address Groundwater Dependent Ecosystems (GDE) and ISW. Comments included recommendations on monitoring and study plans to identify and quantify impacts of groundwater pumping on stream flow rates and associated ecological habitats.

Assessment of Surface Water-Groundwater Interaction, Humboldt County, CA
Friends of the Eel River (FOER), 2020-present

Mr. Kamman is currently providing technical assistance in understanding surface water-groundwater interactions in the Lower Eel River Valley. Work includes reviewing and synthesizing available reports and hydrologic data and providing a science-based opinion on the role groundwater plays in supporting stream flow and aquatic habitats. This analysis addresses conditions and changes associated with seasonal and long-term wet-dry cycles. Data gaps will be identified and documented during the analysis.

This work is being completed to support FOER efforts at protecting aquatic resources within the framework of current water management practices and the public trust doctrine under California law. Additionally, this work includes providing hydrologic and hydrogeologic review, comment and recommendations during development of the basin's Groundwater Sustainability Plan (GSP) under the California Sustainable Groundwater Management Act (SGMA).

Scott Valley Subbasin Technical Hydrogeologist Assistance, Siskiyou County, CA
Klamath Tribal Water Quality Consortium and Quartz Valley Indian Reservation, 2019-present

Mr. Kamman is providing technical review and comment on the groundwater models and associated studies in the Scott Valley groundwater subbasin under the Sustainable Groundwater Management Act (SGMA) process. Work includes: review of groundwater models; synthesis and review of available groundwater quality data; assisting to identify constituents of concern; and review of the planning and technical studies being used to develop a basin Groundwater Sustainability Plan (GSP).

Green Gulch Farm (GGF)/Zen Center Water Resources Investigation, Marin County, CA
Green Gulch Farm, 1998-2019

Mr. Kamman completed a multi-phase study to evaluate the short- and long-term water uses and resources at GGF. Work was initiated by developing comprehensive water usage/consumption estimates and assessing available water resources, including spring, surface water, and ground water sources. Water demand estimates included quantifying potable and agricultural water usage/demands. Once reliable water supplies were identified and water usage/demand figures calculated, Mr. Kamman provided recommendation for improvements to water storage and distribution systems, land-use practices, conservation measures, treatment methods, waste disposal, and stream and habitat restoration. The initial phase of work included: in-depth review of available reports and data; review of geology maps and aerial photography; review of water rights and historic land use records; field reconnaissance including year-round spring flow monitoring; mapping and quantifying existing runoff storage ponds; and surface water peak- and base-flow estimates.

The second phase of work included identification of possible groundwater sources and siting and installation of production wells. This included sighting three drilling locations, obtaining County and State well drilling permits for a domestic water supply; coordination and oversight of driller; and directing final well construction. Upon completion of a well, Mr. Kamman directed a well pumping yield test and the collection and analysis of water quality samples (including Title 22) for small water supply system use. The final phase of work included assisting GGF with water treatment system options at the well head and integration of the groundwater supply into an existing ultra-violet light treatment system servicing spring water sources. Work was completed in 2000 with a budget of approximately $25,000, including all driller and laboratory subcontracting fees.

Middle Russian River Valley Shallow Groundwater Storage Enhancement Study, Sonoma County, CA
Friends of the Eel River, 2016

Working on behalf of Friends of the Eel River, Mr. Kamman completed a study to identify and quantify the volume of recoverable aquifer storage along two independent 6-mile reaches within the alluvial fill valley of the Russian River. The approach to this study was to quantify how channel incision has reduced shallow groundwater levels and quantify how much aquifer storage can be increased if channel bed elevations are restored to historic levels. The goal of this investigation was to identify feasible approaches to increase groundwater storage that would off-set losses associated with the termination of out-of-basin diversions from the Eel River. This work was completed through: intensive review and mapping of available groundwater level data; quantification of aquifer hydraulic properties; and calculating the shallow aquifer storage volume. In total, reclaiming the shallow aquifers within these two areas yield a total added storage volume of over 20,000 AF.

Stanford Groundwater Assessments, Santa Clara County, CA
Stanford University Real Estate Division, 2012-2016

Mr. Kamman provided technical hydrogeologic services to evaluate groundwater conditions and drainage requirements associated with the construction of several new facilities on or near Page Mill Road. The main objective of this study is to determine the seasonal depth to groundwater beneath the project site under existing and potential future conditions and provide an opinion on if the project is

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required to comply with the City of Palo Alto, Public Works Engineering Basement Exterior Drainage Policy (effective October 1, 2006). This work included obtaining and reviewing available technical reports, maps and literature pertaining to groundwater conditions in the project vicinity. Based on this review, we have prepared a letter report of findings and recommendations.

Bodega Bay Wetland Water Supply, Sonoma County, CA
Friends of Bodega Bay, 2007

Mr. Kamman Conducted an evaluation of the groundwater underflow feeding a large coastal wetland in Bodega Bay and recommended mitigation measures for potential losses in supply associated with proposed residential development in recharge areas. Work included: long-term monitoring of ground water quality and supply; monitoring surface water and spring flow and water quality; assessing and characterizing the interaction between surface and subsurface water sources during different seasons and water year-types; developing a detailed water budget for the site to assess impacts to recharge areas; and developing a number of physical solutions to mitigate for recharge losses.

L.A. Department of Water and Power, Groundwater Recharge Facility Operation Study, Los Angeles County, CA
ICF Consulting, 2006

Working as a subcontractor to ICF Consulting of Laguna Niguel, California, Mr. Kamman provided technical assistance in the hydraulic modeling of sediment accumulation in selected spreading ground facilities owned and operated by the Los Angeles Department of Public Works. The object of this work is to evaluate changes in infiltration and groundwater recharge rates over time within the spreading grounds in association with sediment accumulation from turbid waters.

Corde Valle Golf Club Surface-Groundwater Interaction Study, Santa Clara County, CA
LSA Associates, 2004

On behalf of LSA Associates of Pt. Richmond, CA, Mr. Kamman completed a 3rd party independent review of available reports and data sets (boring logs, well water levels, groundwater quality, aquifer pump-test, and surface water monitoring) to evaluate if pumping of the Corde Valle irrigation well is adversely impacting flow in West Llagas Creek. This investigation was implemented in response to a concern expressed by California Department of Fish and Game staff regarding the potential for differential drying of the West Branch of Llagas Creek along Highland Avenue. The analysis was also complicated by the likely effects of pumping from surrounding off-site wells.

Aquifer Testing for Tennessee Hollow Watershed Project, San Francisco County, CA
Presidio Trust, 2002

The Mr. Kamman assisted in the design and implementation of an aquifer test at the Presidio of San Francisco. We prepared an aquifer test work plan and conducted step-drawdown and constant-rate aquifer tests at the site using both manual and electronic data collection methods. This work included interpretation of the aquifer test results using software-based solution methods and prepared a written summary of methods and findings. In addition, Mr. Kamman located, coordinated and managed a drilling effort for the logging and installation of several groundwater monitoring wells in the project area to address identified data gaps.

San Joaquin River Riparian Corridor Restoration Project, San Joaquin Valley, CA
McBain-Trush, 2002

Mr. Kamman completed an assessment of historic and existing shallow groundwater conditions beneath and adjacent to the San Joaquin River between Friant Dam and the Merced River. This work focused on reviewing available reports and flow/groundwater- level data to characterize surface water and groundwater interaction and implications for riparian vegetation, water quality and fishery habitat restoration. Hydrologic analyses were performed to identify the location and seasonal evolution of losing and gaining reaches an implication on future restoration planning and design efforts. The main deliverable for this analysis was a report section focused on describing the historical changes in regional and local groundwater conditions in the San Joaquin Valley and evolution of anthropogenic activities (e.g., groundwater withdrawals, irrigation drainage systems and return flows, development of diversion structures, changes in land-use; and introduction of CVP/State Water Project deliveries) and associated impacts on deep/shallow groundwater levels, surface water flows, and surface and groundwater quality.

Tidal, Estuarine & Coastal Projects

Quartermaster Reach Wetland Restoration Project, San Francisco County, CA
Presidio Trust, 2006-present

Mr. Kamman was retained in 2006 as part of a multi-disciplinary team to develop restoration alternative designs for a 10-acre filled and paved site marking the historic confluence of Tennessee Hollow Creek and Crissy Marsh adjacent to San Francisco Bay. The Trust's planning documents define the main objectives for Tennessee Hollow restoration as: a) "Restoration [of Tennessee Hollow] will expand riparian habitat and allow for an integrated system of freshwater streams and freshwater, brackish, and tidal marsh, re-establishing a connection to Crissy Marsh" and b) "Restore and protect Tennessee Hollow as a vibrant ecological corridor". The project is located within the setting of a National Park and a National Historic Landmark District. Thus, another goal for the project is to protect the area's historic buildings and sensitive cultural and archeological resources to the extent possible, to enhance visitor experience to the area, and to integrate creek restoration with other urban land uses.

Mr. Kamman provided H&H technical input and consultation to the design team to develop a restoration project consisting of a creek-brackish marsh-salt marsh interface and associated upland habitats. His work included evaluating surface water, groundwater and tidal sources. In addition, the development of a hydrodynamic model has informed and guided a preferred project design, including evaluation of storm surge, road crossing and Tsunami impacts to the project. A technical challenge addressed with the use of the model included predicting and quantifying salt/brackish marsh habitat zones within the restored wetland in response to periodically but prolonged closed-inlet conditions to Crissy Marsh - a water body that serves as the downstream connection to the proposed project.

Another unique challenge to this project includes integrating restoration planning and design efforts with the replacement and retrofit of Doyle Drive, the main on/off-ramp for the Golden Gate Bridge, being replaced along the entire northern boundary of the Presidio. Mr. Kamman is providing long-term technical review

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of this project to the Trust with respect to impacts to water resources and associated existing ecological habitats. The Quartermaster project also falls within the managerial jurisdiction of both the Presidio Trust and NPS-GGNRA, requiring work in close cooperation with both Presidio Trust and National Park Service (NPS) staff.

Salt River Ecosystem Restoration Project, Humboldt County, CA
Humboldt County RCD, 2005-2019

Mr. Kamman provided hydrology, engineering and environmental compliance services towards the planning and design of river and 247-acre tidal wetland restoration on the Salt River (Eel River Delta plain) near Ferndale, California, in Humboldt County. The purpose of the Salt River Ecosystem Restoration Project (SRERP) is to restore historic processes and functions to the Salt River watershed. These processes and functions are necessary for re-establishing a functioning riverine, riparian, wetland and estuarine ecosystem as part of a land use, flood alleviation, and watershed management program. The Salt River Project has three components: 1) dredging the lower Salt River and lower Francis Creek from near the Wastewater Treatment Plant downstream for 2.5 miles; 2) restoring wetland estuary habitat in the lower Salt River within the 440-acre former dairy; and 3) reducing sediment inputs from tributary watersheds. The Salt River Project was designed using an "ecosystem approach" to address hydrology, sedimentation and fish and wildlife habitat.

As part of project development and feasibility assessment, Mr. Kamman completed a hydrologic and water quality monitoring program and MIKE11 hydrodynamic model development of the lower Salt River and Eel River estuary in Humboldt County for the Humboldt County RCD. The purpose of this work is to complete a hydrologic, geomorphic, and hydraulic modeling assessments of the character and dominant physical processes controlling flow of water and sediment through the lower Salt River. Land use changes in the area have caused significant aggradation and infilling of the Salt River, significantly reducing tidal exchange, fish passage, and exacerbating flooding in upland areas. A primary goal of this study is to evaluate the feasibility of proposed restoration elements intended to increase tidal prism and exchange and in-channel sediment scour and transport. The desired outcome is a sustained increase in river conveyance capacity to improve drainage of surrounding flood-prone lands and improve aquatic, wetland and riparian habitat.

Western Stege Marsh Restoration Project, Contra Costa County, CA
Tetra Tech, 2008-2010

Mr. Kamman provided technical hydrology and wetland hydraulics support to post-project monitoring of the Western Stege Marsh Restoration Project. His involvement began by providing an independent technical review of previous year's hydrologic monitoring results to evaluate the proposed monitoring success criteria and the rationale used to develop these criteria. This work entailed reviewing historic monitoring data and available natural slough channel geometry data-sets for San Francisco Bay area marshes. Mr. Kamman's study approach was to independently develop desired and sustainable channel geometry relationships for natural, healthy San Francisco Bay salt-marshes and compare them to the published success criteria. Greg was also retained to implement the Year 4 post-project hydrologic monitoring, with modifications to aid in better linking hydrologic processes to ecological conditions and function within the restored marsh. This work consisted of completing more targeted water level monitoring and channel geometry surveys in reference marsh areas containing desired physical and ecological attributes. These data were used to develop geomorphic success criteria (target channel geometry) more tailored to the project marsh and augment the criteria provided in available literature. Working closely with the project team of scientists, Mr. Kamman compared these hydrologic monitoring results to available vegetation surveys to better assess the overall success and evolutionary trend of the marsh.

Giacomini Wetland Restoration Project, Marin County, CA
The National Park Service and Point Reyes National Seashore Association, 2003-2012

Mr. Kamman managed a multi-year project for the NPS in the design and feasibility analysis of a tidal wetland-riparian-freshwater marsh complex on the 500-acre Giacomini Dairy Ranch at the South end of Tomales Bay. This work began in 2003 and included completing hydraulic/hydrologic/geomorphic assessments to characterize existing physical conditions, developing restoration alternatives, and completing hydrologic feasibility analyses. Restoration alternatives evaluated creation of a mosaic of subtidal through upland wetland and riparian habitat zones as well as improvements to salmonid passage, red-legged frog habitat, tidewater goby habitat and clapper-rail habitat. Emphasis was placed on completing detailed studies to evaluate/quantify project-induced changes in flood frequency, magnitude and duration, impacts on water quality to local groundwater supply wells, and changes in sediment and water quality conditions in Tomales Bay.

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Beginning in 2006, Mr. Kamman managed and assisted design engineers, preparing PS&E for a three phased construction schedule completed in the summer of 2008. This project illustrates Mr. Kamman's ability to complete a broad variety of hydrologic feasibility analyses, including: flood frequency analyses for contributing watersheds; reproducing historic flood events through numerical modeling; flow duration analysis and evaluation of environmental flow regimes; development of a water budget for created freshwater marsh and frog breeding ponds; sediment yield estimates; completing field monitoring (flow, water level, groundwater level, sediment, and water quality monitoring) to characterize existing site hydrologic and geomorphic conditions (fluvial and tidal); wind-wave setup and run-up for levee stability determination and construction design; coordinating and performing topographic and hydrographic surveys; performing hydrodynamic and water quality modeling of existing and alternative conditions; developing detailed construction cost estimates; preparation of technical reports and design drawings/ specifications in support of NEPA/CEQA environmental compliance; and public meeting presentation and participation. In addition, Mr. Kamman managed staff in the generation of DEM and TIN models of the existing site and all action alternatives. All work has been completed on budget and in a timely fashion, even with repeated expansions to the project boundary and affected area and last minute changes driven by endangered species issues.

Critical Dune Habitat Restoration to Protect Threatened and Endangered Species, Marin County, CA
The National Park Service, 2009-2010

Mr. Kamman provided and managed engineering, design, and implementation planning support for the restoration of 300 acres of critical dune habitat at Abbots Lagoon within the NPS Point Reyes National Seashore. He developed engineered drawings, technical specifications and engineer's cost estimates, and assisted NPS in defining a range of methodologies suitable to local conditions and sensitive flora and fauna. This area of the park supports the best remaining intact dune habitat, including some of the largest remaining expanses of two rare native

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plant communities: American dune grass (Leymus mollis) foredunes, and beach pea (Lathyrus littoralis). European beach grass and iceplant were removed from the project site using mechanical removal and hand removal techniques. The project goal was to remove these invasive species from approximately 135 acres of prime dune habitat in the 300-acre project site, while not impacting sensitive species and habitats. The intended result was to remobilize this historic dune field and restore their natural form and migratory processes.

This project illustrates Mr. Kamman's ability to work closely with NPS staff to balance habitat protection and restoration across the landscape. As part of project design, he developed grading plans, and specified work flow, equipment movement and access routes which minimize impacts to special status species. Extensive fencing and exclusions zone planning was required to protect existing native habitats, and minimize tracking of plant stock to or through restored sties. In addition work elements had to be structured and prioritized to maximize ground work subject to budgetary constraints and work flow uncertainties. All work has been completed on budget and in a timely fashion, even with repeated expansions to the project boundary and affected area and last minute changes driven by endangered species issues.

Lower Gualala River and Estuary Assessment and Management Plan, Mendocino County, CA
California State Coastal Conservancy and Gualala River Watershed Council, and Sotoyome RCD, 2002-2005

Mr. Kamman worked with fisheries biologists to evaluate the hydrologic and water quality conditions in the lower Gualala River and estuary and identify and evaluate potential impacts to summer rearing habitat for salmonids and other aquatic organisms. This work included: assessing how the impacts of upstream land use (logging and water diversions) have altered water delivery and water quality to the Lower River and estuary over time; characterizing the physical coastal and riverine processes controlling opening and closure of the estuary inlet and lagoon morphology; monitoring and characterizing real-time and seasonal changes in lagoon water level and water quality; and evaluating the sediment transport capacity and geomorphic condition of the lower river and estuary. Mr. Kamman took the lead in developing and editing a management plan for the lagoon, prescribing actions to preserve, protect and enhance ecological habitats (with emphasis on salmonids) within the lagoon and lower Gualala River.

This project was completed on-time and on-budget and demonstrates Mr. Kamman's ability to integrate physical, water quality and biological data and information into a coherent and understandable description of the interrelated processes controlling the aquatic ecology of a lagoon system. A big challenge on this project was completing a high-quality and defensible field monitoring program on a "shoe-string" budget. The outcome of this study provides important understanding on how and why steelhead are surviving in a heavily logged (95% private ownership) watershed. The management plan prescribes recommendations to preserve and protect the lagoon as primary rearing habitat for steelhead.

Suisun Bay Tidal Wetland Restoration Design, Contra Costa County, CA
East Bay Regional Park District and LSA Associates, 1999-2005

Mr. Kamman provided hydrologic design services to the restoration of a 55-acre tidal wetland on Suisun Bay. The design will maximize habitat for special status fish species, and (to the extent possible) habitat for other special status animal and plant species. Working with a multi-disciplinary design team, Mr. Kamman assisted in developing a design based on analysis of habitat needs, tidal hydrodynamic and geomorphic processes, sedimentation rates and soil characteristics. Project tasks included: a site analysis defining existing ecological and hydrologic conditions; a hydrologic and biological restoration opportunities and constraints analysis to define restoration and management objectives; and hydrodynamic and sedimentation modeling to evaluate design alternatives. The final restoration and management plan included a grading plan, landscape revegetation plan and monitoring and maintenance plans. This work again illustrates his capabilities in the characterization of physical site conditions, development and feasibility analysis of project alternatives, and preparation of preliminary designs of sufficient detail to allow for environmental compliance through the CEQA/NEPA process.

Santa Clara River Estuary and Lower River Assessment, Ventura County, CA
Nautilus Environmental on behalf of the City of Ventura, Public Works Department, 2003-2004

Mr. Kamman directed a hydrologic and geomorphic assessment of the lower Santa Clara River and estuary. This work was completed for prime contractor in an effort to assist with re-permitting of treated effluent discharges to the estuary. The proposed study entailed characterizing existing and historic hydrologic and physiographic conditions and an assessment of historic changes in inflow to the estuary. This task included a comprehensive review and evaluation of available hydrologic reports and flow data within the watershed to characterize changes in flow associated with development of numerous water projects within the Santa Clara River basin. The main deliverable from this analysis was the development of a historic unimpaired flow record to the estuary based on regional regression analyses and water operations modeling. Within the estuary, Mr. Kamman designed and conducted a multi-year monitoring program of water levels, water quality (temperature, dissolved oxygen, salinity, and pH), and sand-spit morphology in order to evaluate inlet opening/closure frequency and associated changes in aquatic habitat (esp. tidewater goby) and other ecologic communities. A considerable portion of this subtask included detailed coastal process analysis (including wave power analyses and littoral sand transport), which, considered with the inflow analysis, provides a basis to evaluate the seasonal cycle of barrier beach buildup and destruction.

This project illustrates Mr. Kamman's ability to complete a broad variety of hydrologic and coastal process analyses under strict regulatory oversight. A premier study completed on this project was the development of a detailed water and salinity budget model for the estuary to evaluate the impacts of a wide variety of proposed and modified estuary inflow regimes to determine potential future water level and salinity conditions in the lagoon and impact on frequency of inlet breaching. In addition to coordinating and implementing a variety field monitoring and surveys, Mr. Kamman also provided real-time information and input to informational and negotiation meetings with state resource and regulatory agencies.

Eden Landing Ecological Reserve Restoration, Alameda County, CA
East Bay Regional Park District, 2000-2003

Mr. Kamman developed and completed a hydraulic and hydrodynamic modeling assessments for the design of an approximately 1000-acre tidal marsh restoration in former Cargil salt manufacturing ponds located a mile inland of San Francisco

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Bay. The restoration goals required balancing the desires to restore tidal marsh conditions to the site while maintaining and enhancing the open water and salt panne habitats preferred by resident and migratory shorebirds. The restoration plan also needed to incorporate restoration objectives with remediation of high soil salinities resulting from past salt production, subsided ground elevations, dredging of new channels to the bay, existing infrastructure constraints, public access for the San Francisco Bay Trail, and preservation of several important cultural and historical sites. Hydraulic design objectives include maximizing both interior circulation and tidal exchange between the restoration parcel and the bay. A series of one-dimensional unsteady hydrodynamic models (MIKE11) were used to design the channel network, identify high velocity areas requiring erosion protection, and characterize expected habitat conditions. An important component of this design/feasibility assessment was to translate desired ecological habitat conditions identified in the EIR into specific hydrologic design criteria, considering channel velocities, scour, sediment transport, tidal water inundation frequencies and seasonality of ponding. Mr. Kamman worked closely with EBRPD civil engineers, assisting with the translation of hydraulic design criteria into final engineered drawings and specifications.

Wetland & Pond Projects

Design of California Red-Legged Frog Breeding Ponds, San Francisco Bay Area (various), CA
The National Park Service and Golden Gate National Parks Conservancy, 1997-present

Mr. Kamman has lead or provided hydrologic and engineering design assistance to the sighting and design of nearly two dozen breeding ponds for California red-legged frog throughout the San Francisco Bay Area. Work has been completed in Marin, Sonoma, Solano, Contra Costa, Alameda, and Santa Clara Counties under the auspices of numerous federal, state, and local county/city agencies. A common study approach consists of an initial site reconnaissance of watershed conditions and identification of potential sites. The reconnaissance is followed by a surface water hydrologic sufficiency analysis using available meteorologic and stream flow information. An important variable sought during pond sighting is the presence of migration corridors between known breeding areas and/or perennial water sources. Based on in-depth research and post-project monitoring, Mr. Kamman has refined or developed site-specific evapotranspiration estimates, which commonly do not match standard applied values. Accurate evapotranspiration rates are necessary if ponds are intended to periodically dry-down as a means to preclude undesired species such as bullfrog or mosquito fish. In many instances, a seasonal groundwater-monitoring program is implemented in order to better investigate and quantify potential and seasonal groundwater contributions. Other design challenges we commonly experience include: design of impermeable liners for ponds located in upland areas or highly permeable soils; hydraulic analyses and design of outfalls/spillways; sedimentation management/maintenance approaches; and requirements of inoculum and water used to line and fill the pond, respectively.

Hydrologic Feasibility Assessment for Mana Plain Wetland Restoration Project, Kauai, HI
State of Hawaii Department of Land and Natural Resources, 2010-2019

Working on behalf of the Mana Plain Wetland Restoration Partnership, Mr. Kamman completed a hydrologic feasibility assessment for the Mana Plain Wetland Restoration Project proposed by the State of Hawaii Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW) on the island of Kauai. The Mana Plain Wetland Restoration Project site is approximately 105 acres of low-lying abandoned sugarcane fields immediately north of the Kawaiele Waterbird Sanctuary and east of the Pacific Missile Range Facility. The purpose of the Mana Plain Wetland Restoration Project is to maximize the area of constructed wetlands within the restoration site. Palustrine emergent wetlands within the project will create habitat for four species of endangered Hawaiian waterbirds and other sensitive species, including: Hawaiian stilts; Hawaiian ducks; Hawaiian coots; Hawaiian moorhen; migratory waterfowl; and migratory shorebirds. The Mana Plain is of vital importance for the recovery of endangered waterbirds species. This restoration project will be designed to provide important breeding and feeding wetland habitats on an island where; 1) wetlands have been severely degraded, and 2) mongoose, an introduced predator, have not been established.

Mr. Kamman's work on this project included technical assessments and development of proposed restoration alternatives. Analyses completed included: a synthesis of the physical site setting (topography, geology, hydrogeology and soil); reviewing available data to characterize site meteorology, surface water drainage, water quality, and groundwater conditions; preparing a detailed water budget to describe the characteristics and processes of surface water and groundwater movement into and through the project area; evaluating project feasibility, water supply alternatives and costs; and completing a flood hazard impact assessment to evaluate potential project benefits and impacts to local area flooding. Working with the project partners, Mr. Kamman developed a preferred project alternative and supported in preparation of the project Environmental Assessment document. Mr. Kamman's firm was also retained by the State of Hawaii to develop engineering designs of the project.

MacArthur Meadow Wetland Restoration, San Francisco County, CA
Presidio Trust, 2013-2016

Mr. Kamman has been working on over a dozen independent wetland and creek restoration planning and design efforts within the Presidio of San Francisco since 2001. Most recently (2016), he developed a wetland restoration grading plan for the MacArthur Meadow Wetland Restoration Project in the central portion of the Tennessee Hollow watershed. As part of the site assessment, Greg characterized and modeled surface and groundwater interactions and identified a unique opportunity to restore 4 acres of mixed meadow, natural wetlands and creek/riparian corridor. This was possible due to the discovery of shallow groundwater conditions beneath this historically disturbed landscape. Various design components were integrated into the grading plan in order to enhance groundwater recharge and storage in the Meadow, while retarding runoff and drainage out of the wetland, including: daylighting storm drain runoff into the Meadow; reconfiguring internal channel alignments to enhance channel habitat and groundwater recharge; creation of wetland depressions to retain and recharge surface water; and removal of fill material to decrease the depth to the water table. Notable challenges of this work include restoring heavily disturbed natural resources in an urban setting while integrating designs with archeology/cultural resources, education and remediation programs.

Dragonfly Creek Restoration Project, San Francisco County, CA
Presidio Trust, 2007-2011

Mr. Kamman designed and managed hydrologic monitoring and analysis studies in support of planning and design for riparian and wetland habitat restoration

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along approximately 500-linear feet of the Dragonfly Creek corridor near Fort Scott of the Presidio of San Francisco. Work has included completing subsurface investigations including the installation of shallow wells and a sharp-crested weir with recorder to gauge creek flows. Mr. Kamman assisted in the development and selection of a preferred project alternative, considering on-site cultural resource protection, education and resource management issues (including flood control). Mr. Kamman prepared permit applications. Major components of the project included removal of significant fill and building foundations and installation of a new creek road crossing that will maintain the historical alignment, function and architectural character of a culturally significant roadway. Mr. Kamman oversaw development of PS&E for this project, which will create mitigation wetlands for a highway earthquake retrofit project that passes through the Park.

This project illustrates Mr. Kamman's ability to complete a broad variety of hydrologic analyses, including: surface water and groundwater hydrologic monitoring to characterize and quantify existing hydrologic conditions; rainfall-runoff modeling; hydraulic modeling of flood and scour conditions (including road crossing); preservation of existing wetland habitat and vegetation communities; integration with other Presidio Trust programs; and contracting flexibility to assist in conceptual planning and environmental compliance without increasing project design costs.

Mori Point Sensitive Species Habitat Enhancement Project, San Mateo County, CA
Golden Gate National Recreation Area and Golden Gate National Parks Conservancy, 2005-2011

Mr. Kamman provided hydrologic analyses, sighting and engineering design (PS&E) for three California red-legged frog breading ponds within the 105-acre Mori Point area. These efforts were completed in association and collaboration with a larger Coastal Trail improvement and ecosystem restoration effort. Quarrying and off-road vehicle use have left this site heavily scarred. The focus of restoration work was to protect the endangered San Francisco garter snake and the threatened red-legged frog. Most of this work will be focused on invasive species removal and enhancing endangered species habitat. As part of species habitat improvement, Mr. Kamman worked with project ecologists to design the ponds to optimize breeding habitat for California red-legged frog.

Work started with an initial site reconnaissance and study of watershed conditions and identification of potential sites. The reconnaissance was followed by a surface water hydrologic sufficiency analysis using available meteorological and stream flow information and installation and monitoring of shallow piezometers to quantify the proximity and seasonal variability in depth to water table. An important variable sought during pond sighting was the presence of migration corridors between known breeding areas and/or perennial water sources. Based on in-depth research and post-project monitoring for other ponds they created in the San Francisco Bay area, Mr. Kamman refined site-specific evapotranspiration estimates. Accurate evapotranspiration rates are necessary if ponds are intended to periodically dry-down as a means to preclude undesired species such as bullfrog or mosquito fish.

Other design challenges experienced included: design of impermeable liners for ponds located in upland areas or highly permeable soils; hydraulic analysis and design of outfalls/spillways; sedimentation management/maintenance approaches; and requirements of inoculum and water used to line and fill the pond, respectively. Mr. Kamman has designed numerous ponds for the NPS and affiliates within the Bay Area, including Mori Point (constructed 2007), Banducci (constructed 2007) and Giacomini (Phase I and Phase II constructed in 2007 and 2008) project sites.

Hydrologic Assessment and Restoration Feasibility Study for Shadow Cliffs Regional Recreation Area, Alameda County, CA
East Bay Regional Park District, 2009-201X

Mr. Kamman developed and implemented an assessment to identify groundwater levels and supplemental water supplies that will sustain seasonal wetland restoration areas and riparian habitats under an altered future hydrologic regime. This work will inform a forthcoming Land Use Plan Amendment for park occupying a series of former gravel quarry pits. Work included: obtaining and synthesizing available surface water and groundwater data to characterize existing hydrologic and water supply conditions and seasonal variability; quantifying the likely changes in groundwater conditions and quarry pit lake levels in association with changes in regional water transmission and groundwater recharge operations; and identifying, developing and evaluating a suite of ecosystem restoration alternatives. Other important project objectives include: improving habitat for waterfowl and wildlife; broadening recreational use; enhancing visitor education and wildlife interpretation; improve park aesthetics. Mr. Kamman evaluated a preferred park and ecosystem enhancement alternative that involves diverting high winter flows from an adjacent arroyo. This project demonstrates Greg's ability to characterize hydrologic conditions and quantify the relationship between groundwater, surface water and wetland habitat conditions, both under existing conditions and in predicting future hydrologic and ecologic conditions under an altered hydrologic regime (i.e., lower groundwater table).

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Laguna Salada Marsh and Horse Stable Pond Restoration Project, San Mateo County, CA
Tetra Tech, 2007-2009

Mr. Kamman provided technical hydrology and hydraulics support to the planning and conceptual restoration design of Laguna Salada marsh and Horse Stable Pond, located adjacent to Sharp Park Golf Course in the town of Pacifica, California. The primary objectives of the project are: to reduce flood impacts within the project vicinity; improve sustainable ecological habitat for the endangered San Francisco garter snake and the threatened California red-legged frog; better understand and characterize the hydrologic and water quality conditions/processes affecting flood and ecological habitat conditions within the project vicinity; provide an effective pumping operation plan to meet ecological objectives; and develop appropriate hydrologic analytical approaches and models to assist Tetra Tech and the San Francisco Recreation and Park Department in the planning and design for marsh, pond, and creek restoration. The project is also a unique opportunity to connect this resource with the California Coastal Trail, the Bay Area Ridge Trail, and the surrounding GGNRA lands.

Mr. Kamman's work included completing a comprehensive review of available hydrologic and site information and implementing selected field investigations to develop and calibrate an integrated hydrology-flood routing-pond water operations model that will quantify the volume and depth of water moving through the project system. The investigation will also further characterize shallow groundwater conditions and water quality with respect to effects on Laguna Salada and Horse Stable Pond. Analytical and numerical modeling tools are being used to better characterize existing hydrologic and water quality conditions and

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to assist in identifying project opportunities and constraints as well as evaluate potential restoration design components - all necessary to inform a sustainable and successful restoration design.

Tolay Lake Restoration Feasibility Assessment, Sonoma County, CA
Sonoma County Agricultural Preservation and Open Space District, 2003

Mr. Kamman completed a detailed hydrologic feasibility analysis to evaluate a suite of potential freshwater lake/wetland restoration alternatives under existing watershed land-use practices and existing/future water demands (in the form of existing water rights/applications). This analysis consisted of developing a detailed water budget model to simulate alternative restored lake inundation areas and depths under median and dry year conditions as well as a 50-year historic period (1947-1997) displaying highly variable rainfall and runoff supplies. Three lake restoration alternatives were evaluated based on existing topography and likely historic lake configurations. The restoration alternatives include lakes with storage volumes equivalent to 136-, 1100-, and 2550-acre feet.

Haypress Pond Decommissioning and Riparian and Channel Restoration, Marin County, CA
Golden Gate National Recreation Area (GGNRA), 2001-2002

This project restored 170 meters of historic creek and riparian habitat through removal of Haypress Pond dam in Tennessee Valley within GGNRA. The goals of the project were to alleviate long-term maintenance needs and eliminate non-native bullfrog habitat threatening native California red-legged frog habitat in adjacent watersheds.

Working with the Park biologist, Mr. Kamman developed designs to decommission the dam and restore natural riparian and meadow habitat. This work included: characterization of existing topographic conditions; design of a channel profile through the proposed restoration project reach; preparation of a grading plan for the restoration project; and hydrologic and hydraulic analyses to evaluate the performance of the creek channel and flood plain below the former dam during a variety of flows. Challenges of this work included integrating sediment reuse into plans and construction phasing.

Damon Slough Site Seasonal Wetland Design, Alameda County, CA
Port of Oakland, 1999-2001

Working on behalf of the Port of Oakland, Mr. Kamman completed extensive surface and groundwater monitoring and data analyses to develop a detailed water budget to assist in the evaluation and design of a 7.5 acre seasonal freshwater wetland. Primary project objectives included a design that would provide shorebird/waterfowl roosting habitat, minimize impacts to existing seasonal wetland areas, and lengthen the duration of ponding through the end of April to promote use by migratory birds. In addition to developing hydrologic design criteria, responsibilities included development of grading plans to accommodate a local extension of the Bay Trail and wetland outlet works.

Water Quality Projects

Chicken Ranch Beach Soil and Groundwater Quality Investigation and Restoration Planning, Marin County, CA
Tomales Bay Watershed Council, 2007-present

Mr. Kamman is leading scientific and engineering efforts for a wetland and riparian corridor restoration project on Third Valley Creek and Chicken Ranch Beach in Inverness, California. The main project goals are to create a self-sustaining riparian and wetland system (requiring minimal operation and maintenance) and eliminate public exposure to high levels of bacteria that exist in a site drainage ditch discharging to the beach. The design will likely include establishing a blend of habitats, including: riparian stream corridor, seasonal/perennial freshwater marsh, and tidal/saltwater marsh.

Current efforts have included the development and implementation of a soil and groundwater quality investigation to delineate the source of elevated bacteria levels. This work includes: the collection and testing of depth-discrete soil samples; groundwater well installation, sampling and testing; and surface water sampling and testing; analysis of laboratory results; and reporting, including recommendations for further/expanded investigations. Mr. Kamman coordinated this time-sensitive sampling and analysis (six hour hold times) with Brulje and Race Laboratories in Santa Rosa.

Lower Miller Creek Channel Maintenance and Material Reuse Sampling Analysis Plan, Marin County, CA
Las Gallinas Valley Sanitary District, 2015

Mr. Kamman was commissioned to formulate and implement a plan for sediment removal and improved flood flow conveyance in the Lower Miller Creek channel. Accumulation of course sediment in the project reach had reduced discharge efficiencies at District outfalls. Miller Creek supports a population of federally listed Steelhead and adjacent wetland/marsh areas potentially support other state and federally listed special status species. Working with District Staff, Greg developed a suite of potential project alternatives and identified a preferred approach. Mr. Kamman completed all CEQA compliance (IS/MND), permitting and oversaw development of engineered plans and specifications.

In order to evaluate if reuse of excavated material from 2,655 feet of creek corridor in upland areas was feasible, Mr. Kamman developed and implemented a Sampling Analysis Plan (SAP) pursuant to U.S. Army Corps Guidance for Dredging Projects within the San Francisco District. Sample collection, sample handling, and analysis were performed in accordance with the SAP. Results for analytes were compared to a variety of screening criteria to determine the material's suitability for reuse in aquatic environments. A full suite of chemical and physical analyses were performed on soil samples collected from 16 locations, including: metals, PAHs, PCBs, pesticides, TOC, specific conductance, pH, sulfides, percent moisture and grain-size. Mr. Kamman managed all aspects of this effort including reporting and presentations/negotiations at multi-agency meetings through the Corps Dredge Materials Management Office (DMMO).

Lower Pitkin Marsh Hydrologic and Water Quality Monitoring, Sonoma County, CA
Sonoma Land Trust, 2008-2010

Mr. Kamman was retained to develop and implement a hydrologic and water quality monitoring program at Lower Pitkin Marsh outside of Forestville, California. The Pitkin Marsh area is one of the most valuable complexes of mixed riparian woodland and thicket, freshwater marsh, wet meadow, oak woodland and grassland in Sonoma County. The complex interaction of surface water, ground water, and scattered seeps and springs on the site creates unusual hydrologic conditions that promote a rare assemblage of plant species which

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includes several endemics. The primary objective of the hydrologic monitoring program was to understand the annual and season sources of both surface and ground water supplying wetlands. Hydrologic and water quality monitoring was initiated during the winter wet season of 2008/09 and will be conducted for a 12-month period through the ensuing summer dry-down and into the following wet season. Understanding how groundwater levels, spring flow and creek flow rates recede from winter wet to summer dry conditions will provide an important understanding and quantification of the seasonal variability in water supplies feeding selected wetland types. General water quality parameters (temperature, pH, specific conductance, and ORP) are measured at all monitoring locations during each visit. Nutrients (N and P) are measured in selected surface water and groundwater samples collected during at least three monitoring events, including a winter high flow, spring high base flow and summer low baseflow.

Pescadero Lagoon Restoration and Enhancement, San Mateo County, CA
California State Coastal Conservancy, 2005-2006

Mr. Kamman was retained to support restoration and water quality enhancement planning efforts in Pescadero Lagoon. In 2005-2006, he completed a synthesis of available hydrologic and water quality information in responding to requests for development of a hydrodynamic and water quality model of the lagoon. This model was considered as a means to identify causes for repeated fish-kills in the lagoon that occurred during initial breaching of the inlet. Mr. Kamman assisted in preparing a synthesis and model development feasibility report from this effort.

Water Temperature Simulations for Trinity River Fish and Wildlife Restoration Project, Trinity County, CA
Trinity County Planning Department, 1994-2004

For over a decade, Mr. Kamman completed a number of hydrology and water quality investigations in support of alternative feasibility studies on the Trinity River Fish and Wildlife Restoration Project in direct support of the Trinity River Restoration EIR/EIS. Studies involve assessing the effects of proposed flow alternatives on water temperature within and downstream of Lewiston Reservoir. Mr. Kamman was responsible for data collection, processing, and flow/temperature modeling of Lewiston Reservoir as part of a coordinated evaluation including other Trinity River system models. Another study included evaluating how project operations could be implemented or modified to optimize Lewiston Lake release temperatures to meet downstream temperature criteria and compensate for increased warming of the river associated with side channel and feather edge restoration activities. Mr. Kamman continues to evaluate how more recent water projects (raising Shasta Dam, Sites Reservoir, and the Waterfix tunnels) consider and integrate with the Trinity Restoration Project.

Upper Eel River Unimpaired Flow and Water Temperature Assessments, Humboldt County, CA
CalTrout, 1997-1999

Mr. Kamman evaluated changes in the natural flow regime of the upper Eel River, and developed an Upper Eel River proposed release schedule to enhance downstream Chinook and Steelhead spawning and rearing habitat. This work was triggered by proposals set forth by PG&E as part of their Potter Valley Project FERC relicensing process. Work consisted of two main investigations. The first included reviewing results of a ten year PG&E study and development of multivariate regression and stream reach (SSTEMP) temperature models to assess the effects proposed flow alternatives would have on downstream temperatures. The second investigation consisted of characterizing unimpaired flow conditions and developing a daily unimpaired flow record for use in project operation models.

Educational Projects

Stream and Wetland Hydrology Course, Santa Clara County, CA
City of San Jose Environmental Services Department, 2004

In 2004, Greg Kamman co-taught a one-day basic hydrology seminar to the City of San Jose Environmental Services Department, Watershed Protection Division. Numerous other local municipal agency staff attended. The focus of seminar was to introduce basic hydrology and hydraulics principals in the context of stream and wetland restoration. Mr. Kamman has also co-taught on-going fluvial and tidal hydrology and hydraulics courses through the University of California Berkeley Extension and San Francisco State University's Roberg Tiburon Center.

Litigation Support Projects

Kamman, G.R., 2019, Oral Testimony of Greg Kamman for Agricultural Order 4.0 requirements discussion, Public meeting before the Central Coast (Region 3) California Water Board, Watsonville City Council Chambers, Watsonville, CA, March 21.

Kamman, G.R., 2018, Oral Testimony of Greg Kamman for Part 2 of the California Waterfix Change of Diversion Hearing before the State Water Resources Control Board at Joe Serna Jr.-CalEPA Building, Sacramento, CA, April 16.

Mondavi Vineyard Expansion Litigation Support, Napa County, CA
The Law Offices of Thomas N. Lippe, APC

Working on behalf of Lippe Law, Mr. Kamman provided a technical review of the project EIR and supporting hydrology and hydrogeology technical study reports to evaluate potential impacts of vineyard development on local Sonoma Volcanic aquifer(s). This assessment keyed on review of site specific water level and aquifer test data and data and conclusions presented in a 2003 USGS report presenting a characterization of regional hydrology and local groundwater conditions in the surface water and groundwater basins immediately north of the Mondavi project site. This analysis also evaluated potential impacts within the framework of local County statutes regarding permitted groundwater withdrawal rates.

Conference Presentations

Kamman, G.R., 2018, Water is Life! A hydrologist's eye on the Gualala River. Presented to: Friends of the Gualala River and public, Gualala Arts Center, Gualala, CA, May 3.

Kamman, G.R. and Kamman, R.Z., 2015, Landscape Scale Urban Creek Restoration in Marin County, CA - Urban Creek Restoration: Interfacing with the Community. 33rd Annual Salmonid Restoration Conference, March 11-14, Santa Rosa, CA.

Kamman, G.R., R.Z., 2015, Enhancing Channel and Floodplain Connectivity: Improving Salmonid Winter Habitat on Lagunitas Creek, Marin County, CA - Beyond the Thin Blue Line: Floodplain Processes, Habitat, and Importance to

ORG6-89

SELECTED EXPERIENCE *(CONTINUED)*

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ORG6-89

ORG6-90

EXHIBIT J

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28 July 2020

Laurel L. Impett
Shute, Mihaly & Weinberger
396 Hayes Street
San Francisco, CA 94102

SUBJECT: Terra VI Lodge Project – Tuolumne County, CA
Draft EIR Acoustical Review

Dear Laurel:

As requested, I have carried out an acoustic review for Terra VI Lodge Project. This review is based on information made available by Tuolumne County. The Draft Environmental Impact Report (DEIR), dated June 2020 (State Clearinghouse Number: 2019110286), is intended to address the environmental effects associated with approval and implementation of the proposed project.

This letter provides a brief review of the DEIR, especially section 4.12 for Noise—based on the project noise study report, attached to the DEIR as Appendix H, 'Noise Study'—in addition to our comments regarding the DEIR's evaluation of the project's potential noise & vibration impacts.

SUMMARY

In summary, the DEIR requires more technical documentation to support its following conclusions: ORG6-90

- the efficacy of proposed measures (NOI-1.1, NOI-1.2a, NOI-1.2b, NOI-3.2a, & NOI-3.2b) to result in *less-than-significant* impacts
- the project would not result in generation of excessive groundborne vibration or groundborne noise levels (NOI-2)
- the project would result in a less-than-significant cumulative impact with respect to noise (NOI-4)

The DEIR has not identified all noise- and vibration-sensitive land uses adjacent to the project property, has not properly assessed existing ambient noise and vibration levels at adjacent land uses, and has not identified appropriate significance criteria to evaluate project impacts.

The DEIR is also incomplete because it fails to (1) analyze noise from each project element on all of the adjacent noise-sensitive land uses, (2) assess the project's impacts against applicable criteria (California Environmental Quality Act or CEQA, California Building Code or CBC, Tuolumne County General Plan), and (3) evaluate the effectiveness of the proposed mitigation measures. **ORG6-90 cont.**

PROJECT BACKGROUND

DEIR, Section 3.3 'Project Components', page 3-7 to 3-8 states: **ORG6-91**

> The proposed project is designed as a hotel lodge comprised of various single, two-, and three-story elements. The building design accommodates a setback, maximizing the distance between taller structures and adjacent residential properties to minimize visibility from both public and private views. Elements of the project include a public market, general lodge with 100 guestrooms and multi-purpose uses, indoor and outdoor areas, and 26 cabin guestrooms in seven buildings, as well as 5 employee apartments with four rooms in each unit, for a total of 20 employee rooms... The proposed project would develop 18 percent (11.5 acres) of the project site with buildings, roads, and parking. An additional 1.4 acres would be used for the primary septic system.

BIOLOGICAL RESOURCES

This section of the DEIR identifies many "Special-Status" animal species present on the proposed project site but only identifies one species (Olive-sided flycatcher, Section 4.3 'Biological Resources', page 4.3-38) as noise- and vibration-sensitive – "Construction could adversely impact nesting species through noise and vibrations, and this would be a significant impact on the species' population." The DEIR fails to consider noise and vibration impacts to other species. The DEIR should have evaluated impacts to all other bird species, consistent with relevant guidelines and documents such as Caltrans (*Effects of Traffic Noise and Road Construction on Birds, June 2016).* Noise and vibration impacts on existing wildlife should be assessed as part of an appropriate study (see following section) that clearly establishes thresholds of significance for different species and proposes mitigation measures for identified significant impacts. **ORG6-92**

CRITERIA

The DEIR has not identified all noise- and vibration-sensitive land uses adjacent to the project property, has not properly assessed existing ambient noise and vibration levels at adjacent land uses, and has not identified appropriate significance criteria to evaluate project impacts. **ORG6-93**

Standards of Significance

The DEIR references CEQA in its discussion of the legal precedence and interpretation (DEIR, Section 4.12.2.1, 'Regulatory Framework', page 4.12-2),affirming "that CEQA is concerned with the impacts of a Project on the environment, and not the effects the existing environment may have on a Project, with certain exceptions" (DEIR, Section 4.12 'Noise', 'State Regulations', page 4.12-2). The DEIR addresses criteria required by CEQA (see attached Noise checklist in Appendix B, items XI.a-f) in DEIR, Section 4.12.3, ‘Standards of Significance’, page 4.12-11; DEIR, Section 4.12.4, ‘Impact Discussion’, page 4.12-12 to 25; & DEIR, Appendix H, ‘Noise Study’, pages 8-9.

The DEIR states that Tuolumne County does not have standards for groundborne vibration, and that Caltrans vibration impact criteria have been applied to evaluate the generation of excessive groundborne vibration levels (page 4.12-2 and Tables 4.12-1 and 4.12-2).

Tables 4.12-3 to 4.12-6 list project noise standards adopted from the 2018 Tuolumne County General Plan Noise Element. **ORG6-93 cont.**

Table 4.12-4, ‘Maximum Allowable Noise Exposure for Aircraft Noise Sources’, does not include the L_{max} criteria listed in Tuolumne County General Plan, Noise Element, Table 5.2 (also duplicated in DEIR, Vol. II, Appendix H, ‘Noise Study’ – Table 6) for the various adjacent land uses during daytime and nighttime periods. **ORG6-94**

The DEIR relies on an ambient (L_{dn}/CNEL) + 5 dB standard (presented in Table 4.12.5) to evaluate cumulative noise exposure from the project that is too permissive. The ambient noise level is often defined as the L_{90} or L_{99} statistical level (see Appendix A of this review for definitions of common acoustical terms), using a time interval between 15 minutes and one hour. The DEIR should have relied on increases on the ambient (L_{90} or L_{99}) statistical level on an hourly basis. L_{90} hourly levels were measured on site to be about 30 dBA on average, and as low as 21 dBA (DEIR, Vol. II, Appendix H, ‘Noise Study’ – Appendix D & E). Typically, EIRs rely on a threshold of significance of 3 dB (rather than 5 dB). **ORG6-95**

Also, Table 4.12-6 erroneously duplicates notes included in table 4.12-5—see 2018 Tuolumne County General Plan, Noise Element, Table 5.4 (also duplicated in DEIR, Vol. II, Appendix H, ‘Noise Study’ – Table 8). **ORG6-96**

The 2018 Tuolumne County General Plan Noise Element states that “the exterior noise level standard[s] shall be applied to the property line of the receiving land uses.” The DEIR does not identify property lines. As such, it is unclear whether the DEIR’s assessment of project impacts assume the adjacent land use receptor location at the closest point along the property line, or elsewhere. **ORG6-97**

The DEIR should also have addressed impacts on existing wildlife on and immediately adjacent to the project site (see comments on Biological Resources section above), based on clear noise and vibration thresholds of significance to different species in the project area and vicinity. **ORG6-98**

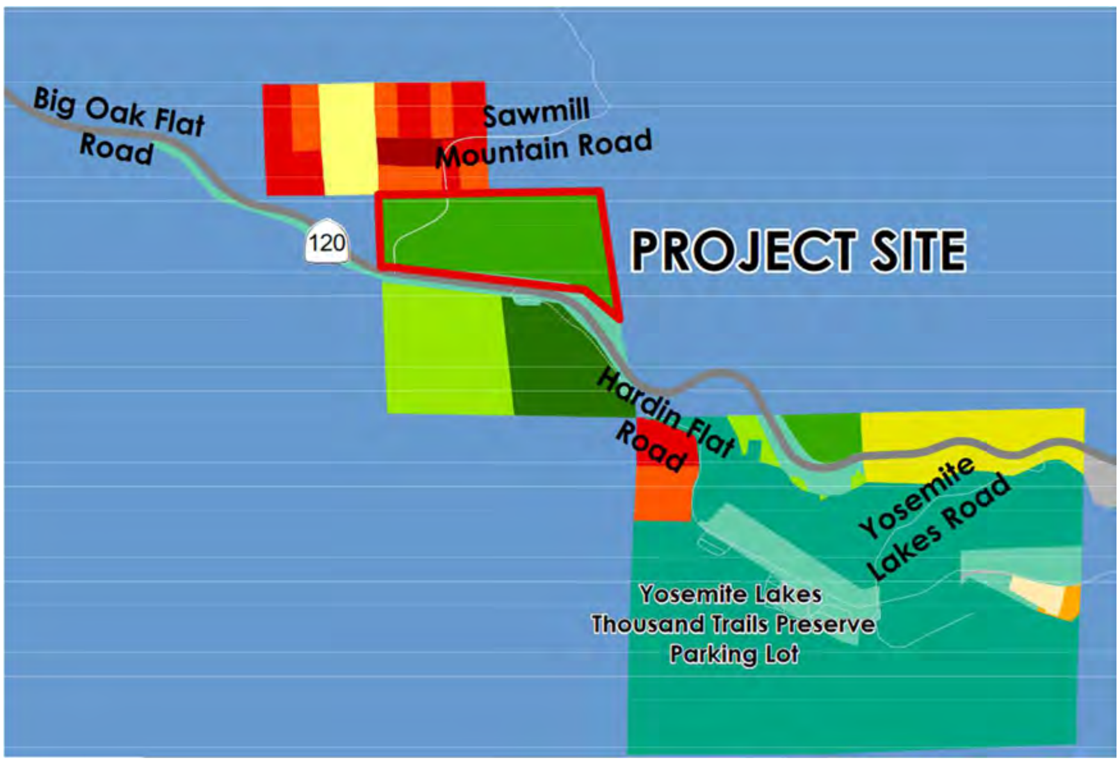
Existing Conditions - Noise

DEIR, Section 4.12.2.2 ‘Existing Conditions’, page 4.12-8: **ORG6-99**

> The noise-sensitive land uses which would potentially be affected by the project consist of the single-family residential land uses located to the north of the project site. **Existing public forest lands and**

> **commercial recreation uses are located to the east, west, and south of the project site, which are typically not considered to be noise sensitive, with the exception of wildlife, which could be noise sensitive** [emphasis added] . The project area and surrounding land uses are shown on Figure 4.12-1.

DEIR Figure 4.12-1 identifies a single residence as the "Nearest Existing Sensitive Receiver (Residence)", but it does not clearly identify or describe the presence of any other noise-sensitive land uses (such as all described in DEIR, Section 3.1.4 'Land Use Designation and Zoning' and depicted in Figures 3-2 'General Plan Land Use' & 3-3 'Zoning', partially copied below, pages 3-3 to 3-5) that could be impacted by the Project. ORG6-99 cont.



The DEIR fails to provide any justification for its assertion that "existing public forest lands and commercial recreation uses are… typically not considered to be noise sensitive". ORG6-100

In addition to the long-term noise survey locations (LT-1 & LT-2) documented near Sawmill Mountain Road, the DEIR should have included measurements set back further from existing roads in the project vicinity. These additional locations, where ambient noise levels would be expected to be even lower, would represent a broader range of noise-sensitive receptors at adjacent land uses. ORG6-101

Also, Table 4.12-8 includes the *highest* reported L_{dn} level at each monitoring location. This may be an appropriate metric for evaluating noise impacts *within* the project, such as the performance of the exterior construction of the lodge to control interior noise levels ORG6-102 attributable to exterior sources (California Building Code).However, the DEIR should also have included existing background noise levels (included in the attached DEIR, Vol. II, Appendix H, 'Noise Study') at each noise sensitive land use location in order to evaluate project impacts to adjacent noise-sensitive receptors. ORG6-102 cont.

Existing Conditions - Vibration

DEIR, Section 4.12.2.2 'Existing Conditions - Existing Ambient Vibration Environment', page 4.12-11 (bold sections added for emphasis):

> During a site visit on May 9, 2019, **it was noted that vibration levels were below the threshold of perception at the project site and in the immediate project vicinity** [emphasis added]. Therefore, the existing vibration environment in the immediate project vicinity is considered to be negligible. ORG6-103

Neither DEIR, Section 4.12 'Noise' nor the attached DEIR, Vol. II, Appendix H, 'Noise Study' include any measurements to support this claim.

Furthermore, DEIR, Vol. II, Appendix H, 'Noise Study' – 'Vibration Impacts Due to Project', on page 35 notes that baseline vibration levels were "below 0.1 inches per second if converted to peak particle velocity." Once again, the DEIR fails to provide any supporting documentation regarding vibration measurement methodology (location, duration, postprocessing, etc) or reported results. ORG6-104

If ambient/baseline vibration levels in the immediate project vicinity are below the threshold of perception, this suggests that adjacent land use receptors are especially sensitive to project construction & operational sources that generate groundborne vibration.

PROJECT OPERATIONAL NOISE

The DEIR is also incomplete because it fails to (1) analyze noise from each project element on all of the adjacent noise-sensitive land uses, (2) assess the project's impacts against applicable criteria (CEQA, CBC, Tuolumne County General Plan), and (3) evaluate the effectiveness of the proposed mitigation measures. ORG6-105

Local Roadway Network

This section of the DEIR discusses FHWA modeling, using the DEIR's transportation impact analysis as inputs for noon peak hour movements. It states that "cumulative traffic increase is predicted to exceed the [Tuolumne County] General Plan cumulative noise increase significance criteria along Sawmill Mountain Road north of the SR 120." Instead of proposing and evaluating mitigation measures for this exceedance of the project criteria, it lists reasons and assumptions why this exceedance should be interpreted as a less-than-significant impact. ORG6-106

The conclusion that impacts from cumulative traffic noise increases, and the subsequent increase in ambient noise levels in the vicinity of the project, are less-than-significant fails to take into account the Tuolumne County General Plan interior noise level standard of 45 dB L_{dn}, applicable to transportation (excluding aviation-related) noise exposures at receiving land uses. ORG6-106 cont.

On-Site Traffic Circulation

The DEIR's assessment is based on the following assumptions: "the nearest existing sensitive use (receiver 1) is located approximately 400 feet from the centerline of the future interior roadway for the development", and that "all of the on-site vehicle trips would occur at one location, when realistically it would likely be more spread out throughout the development". The DEIR also makes the claim that "predicted noise levels at the nearest existing sensitive use are considered to be worst-case". ORG6-107

It is unclear which "one location" has been assumed for all on-site traffic circulation, and as such it is difficult to evaluate the claim that predictions are worst-case and conservative given the Site Circulation Plan provided as Figure 3-12 (page 3-19) in the DEIR.

Also, the DEIR's assessment of on-site traffic circulation uses L_{eq} predictions to evaluate project impacts against Tuolumne County General Plan noise standards for exposure from stationary noise sources. It is unclear why the DEIR relied on noise standards for stationary sources to evaluate traffic-related noise impacts. ORG6-108

Parking Noise

The DEIR asserts that "[t]ypical Sound Exposure Level (SEL) due to automobile arrivals/departures, including car doors slamming and people conversing is approximately 70 dB, at a distance of 50 feet" and that "the maximum noise level associated with parking lot activity typically did not exceed 65 dB L_{max} at the same reference distance," yet it does not include any citation or other supporting documentation. ORG6-109

In order to provide a conservative analysis, the DEIR should have assumed the shortest distance from adjacent sensitive land uses to the guest cabins' parking area. Instead, the DEIR relied on the assumed source location of the "effective noise center of cabins parking area…located approximately 500 feet from receiver 1" for this assessment.

Delivery Trucks

It is unclear how the key propagation distance assumed for this analysis is related to the Site Circulation Plan provided as Figure 3-12 (page 3-19) in the DEIR, or whether this distance would be appropriate to all other adjacent land use noise-sensitive receptors.

Also, the DEIR's assessment of on-site traffic circulation uses L_{eq} predictions to evaluate project impacts against Tuolumne County General Plan noise standards for exposure from stationary noise sources. It is unclear why the DEIR relied on noise standards for stationary sources to evaluate traffic-related noise impacts. ORG6-110

Loading Docks ORG6-111

The DEIR's noise predictions from the project's loading dock—with primary loading dock noise sources listed as air brakes, back-up alarms, and revving truck engines—are based on noise data that cites relatively low source sound levels (63 dB L_{eq} and 75 dB L_{max} @ 50 ft, DEIR, Vol. II, Appendix H, 'Noise Study', page 23). It is our experience that loading dock noise levels would be reasonably expected to be 10 dB higher than what has been assumed in the DEIR.

ORG6-111 cont.

In addition, the DEIR asserts that the loading dock area would include a significant degree of shielding, yet it provides no information about the assumed source, barrier, and receptor heights for each noise-sensitive receptor at adjacent land uses. The estimated minus 15 dB shielding is generally understood to be the maximum mitigation offered by a noise barrier and may not be applicable to all noise transmission paths.

Mechanical Equipment

The DEIR's analysis does not address the potential noise and vibration impacts for the full range of heating, ventilating and air conditioning equipment to be expected at a project of this type.

There is no information about specific types and locations of such equipment, and on that basis the finding that this equipment will not result in a significant impact cannot be supported. A proper study needs to include specific mitigation that identifies equipment location, and specific noise output based on manufacturer sound data, content of noise and existing ambient noise environment.

ORG6-112

Some mechanical equipment generate noise that stands out over the ambient in terms of quality and not loudness (i.e. whining, grinding, hissing, etc. referred to as equipment with tonal qualities). The DEIR should have included a detailed noise analysis that takes this into account in order to develop effective noise control options.

Maintenance Landscaping/Yard

The DEIR's evaluation of the proposed mitigation measure NOI-1.1, which calls for an 8-foot solid noise barrier, requires supporting documentation including the assumed source, barrier, and receptor heights for each noise-sensitive receptor at adjacent land uses.

ORG6-113

There is no supporting documentation addressing the feasibility of adopting the performance standard for the maintenance yard generator to not exceed 70 dBA at a 50 foot distance. The DEIR cites a reference noise level of 82 dB L_{eq} @ 50 ft (DEIR, Vol. II, Appendix H, 'Noise Study', page 26) for Generators.

Emergency Helipad

The DEIR's assertion that "it is reasonable to assume that noise levels associated with emergency services, such as those proposed at the project emergency helipad, would likely be

ORG6-114

exempt from Tuolumne County noise level criteria" contains no citation or supporting documentation.

The DEIR does not analyze impacts to adjacent noise-sensitive land use receptors from operations at the helipad. Nor does the DEIR propose any mitigation for this impact which is determined to be significant and "unavoidable." The DEIR should have included a comprehensive, project-specific analysis and supporting documentation. **ORG6-114**

The DEIR also fails to acknowledge that emergency helicopter operations would have to follow Caltrans Department of Aeronautics Guidelines.

Combined Normal On-Site Noise Operations

The DEIR lacks sufficient supporting documentation for the assertion that limiting on-site truck deliveries and refuse collection activities to daytime hours, through Mitigation Measure NOI-1.2a & NOI-1.2b, would reduce the predicted combined noise level from normal on-site operations from 57 dB L_{eq} and 59 dB L_{max} (Table 4.12-12) to 41 dB L_{eq} and 54 dB L_{max} (Table 4.12-13). The ~15 dB reduction in L_{eq} appears to be driven by the assumed mitigation at the maintenance yard, and not the proposed operation constraints. **ORG6-115**

Other

The study has not addressed other noise generating uses described for the project: event spaces including a 3,000 sq. ft. ballroom / event room or outdoor recreation areas (DEIR, Section 3.3, 'Project Components', page 3-16) where amplified music may be used. **ORG6-116**

PROJECT OPERATIONAL VIBRATION

The DEIR fails to analyze the project's vibration-related impacts on nearby sensitive land uses, against all applicable criteria (CEQA, CBC, Tuolumne County General Plan).

DEIR, Section 4.12.4 'Impact Discussion – Operational Vibration', page 4.12-22:

> The project proposes transient lodging and commercial uses within the development. **Transient lodging and commercial operations do not typically have equipment that generates substantial vibration levels. In addition, the proposed lodging and commercial uses do not propose equipment that will produce appreciable vibration** [emphasis added]. Operational vibration impacts would be *less than significant*.

The emphasized claim is not accompanied by a project-specific analysis of expected building services equipment (heating, cooling, pumps, etc) that would be expected onsite. Nor does the DEIR include any supporting documentation. **ORG6-117**

PROJECT CONSTRUCTION

The DEIR's assessment of noise resulting from the project's construction is inadequate as it does not evaluate how this noise would impact adjacent noise-sensitive land uses. It also does **ORG6-118** not evaluate the project's impacts against all applicable criteria (CEQA, CBC, Tuolumne County General Plan), and documented evaluation of proposed mitigation measures. ORG6-118 cont.

Noise Impacts

While the DEIR acknowledges project construction "would increase ambient noise levels when in use", it makes a determination that these impacts would not be significant because of the following: "the short-term nature of construction noise, the intermittent frequency of construction noise, and the required compliance with the construction-related noise criteria and implementation measures established in Policy 5.A.5 of the Tuolumne County General Plan" (DEIR, Section 4.12.4 'Impact Discussion – Construction Noise, page 4.12-20). This is not supported by any specific analysis and does not address the full range of construction activities such as site preparation, foundation work, erection of structures, staging areas, etc. ORG6-119

The project's construction will include heavy equipment for grading, excavation, paving and other activities that will generate high levels of noise and vibration. A detailed noise control plan should be required based on the actual project schedule broken down by phase, duration and anticipated equipment and techniques used.

Vibration Impacts

DEIR, Section 4.12.4 'Impact Discussion – Construction Vibration', page 4.12-22:

> During project construction heavy equipment would be used for grading excavation, paving, and building construction, which would **generate localized vibration in the immediate vicinity of the construction**. The nearest existing sensitive use to the project area (receiver 1, residence) is located approximately 250 feet from construction activities which would occur on the project site.
>
> Table 4.12-15 includes the range of vibration levels for equipment commonly used in general construction projects at a distance of 25 feet. The Table 4.12-15 data also include predicted equipment vibration levels at the nearest existing sensitive use to the project area located approximately 250 feet away. ORG6-120

The claim highlighted in the selection above implies that vibration generated from heavy construction equipment would be "localized" and contained within "the immediate vicinity" of the project, but these assertions are not supported by any specific analysis.

Table 4.12-15 also does not address the full range of construction activities such as site preparation, foundation work, erection of structures, staging areas, etc. that would be expected to generate vibration. A detailed construction vibration control plan should be required, based on the actual project schedule broken down by phase, duration and anticipated equipment and techniques used. ORG6-121

The citation for the listed PPV levels at 25 feet is the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual, 2018, Table 7-4, page 184. The FTA document provides the following caveat: ORG6-122

> Table 7-4 presents average source levels in terms of velocity for various types of construction equipment measured under a wide variety of construction activities. The approximate rms vibration velocity levels were calculated from the PPV limits using a crest factor of 4, representing a PPV-rms difference of 12 dB. Note that although the table gives one level for each piece of equipment, **there is considerable variation in reported ground vibration levels from construction activities** [emphasis added]. The data in Table 7-4 provide a reasonable estimate for a wide range of soil conditions.

The predicted equipment vibration levels at the nearest existing sensitive, approximately 250 feet away, are not accompanied by a project-specific analysis or supporting documentation of prediction methodology (e.g. assumed soil characteristics for vibration propagation, contingencies to account for variability within vibration predictions, etc.). **ORG6-122**

# # # # # # #

I trust you will find this information useful. Please do not hesitate to contact our office if you require any other information.

Submitted By:

Ashwin Thomas
Senior Consultant

Reviewed By:

Chris Papadimos, INCE
Principal

Enclosures: Appendix A – Definitions of Common Acoustical Terms
Appendix B – Noise excerpt from CEQA Appendix G: Environmental Checklist Form

Amanda, matrix can say "Appendix A: Definitions of Common Acoustical Terms"

APPENDIX A

DEFINITIONS OF COMMON ACOUSTICAL TERMS

Decibel, dB – A unit describing the amplitude of sound, defined as 20 times of the logarithm of the ratio of the sound pressure measured to the reference pressure (20 µPa).

A-weighted Sound Level, dBA – The sound pressure measured using the A-weighting filter network that de-emphasizes the very low and very high frequency components of the sound spectrum in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise.

Ambient Noise – The sound level in a given environment usually comprised of many sources in many directions near and far with no particular sound dominant. It is of the defined as L_{99} or the noise level exceeded 99% of the time.

Background Noise - The total noise from all sources other than the source of interest. It is often defined as L_{90} or the noise level exceeded 90% of the time.

Community Noise Equivalent Level, CNEL – The average A-weighted noise level in a 24-hour day, obtained after adding 5 dB to evening hours (7:00 pm to 10:00 pm) and 10 dB to sound levels measured in the night (between 10:00 pm and 7:00 am).

ORG6-123

Day/Night Noise Level, L_{dn} (or DNL) – The average, 24-hour A-weighted noise level, obtained after adding 10 dB to levels measured at night (10:00 pm to 7:00 am).

Integrated or Equivalent Noise Level, L_{eq} – The energy average A-weighted noise level during the measurement period.

Sound level meter - An instrument that measures sound in dB. Various features are incorporated into such instrument including frequency bands, integration of sound over time and display of average, minimum, and maximum levels.

Sound pressure level - the ratio, expressed in decibels, of the mean-square sound pressure level to a reference mean-square sound pressure level that by convention has been selected to approximate the threshold of hearing (0.0002 µbar)

Frequency – The number of times per second that the oscillation of a wave of sound or that of a vibrating body repeats itself, expressed in Hertz (Hz).

Octave band - The frequency range of one octave of sound frequencies. The upper limit is always twice the frequency of the lower limit. Octave bands are identified by the geometric mean frequency or center between the lower limit and the upper limit.

Amanda, matrix can say "Appendix B: Noise Excerpt from CEQA Appendix G: Environmental Checklist Form"

APPENDIX B

NOISE EXCERPT FROM CEQA APPENDIX G: ENVIRONMENTAL CHECKLIST FORM

XII. NOISE. Would the project result in:				
a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☐	☐	☐	☐
b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?	☐	☐	☐	☐
c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☐	☐
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☐	☐
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☐
f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☐

ORG6-124

Amanda, matrix can say "Attachment to Papadimos Report: [Title of attached report]"

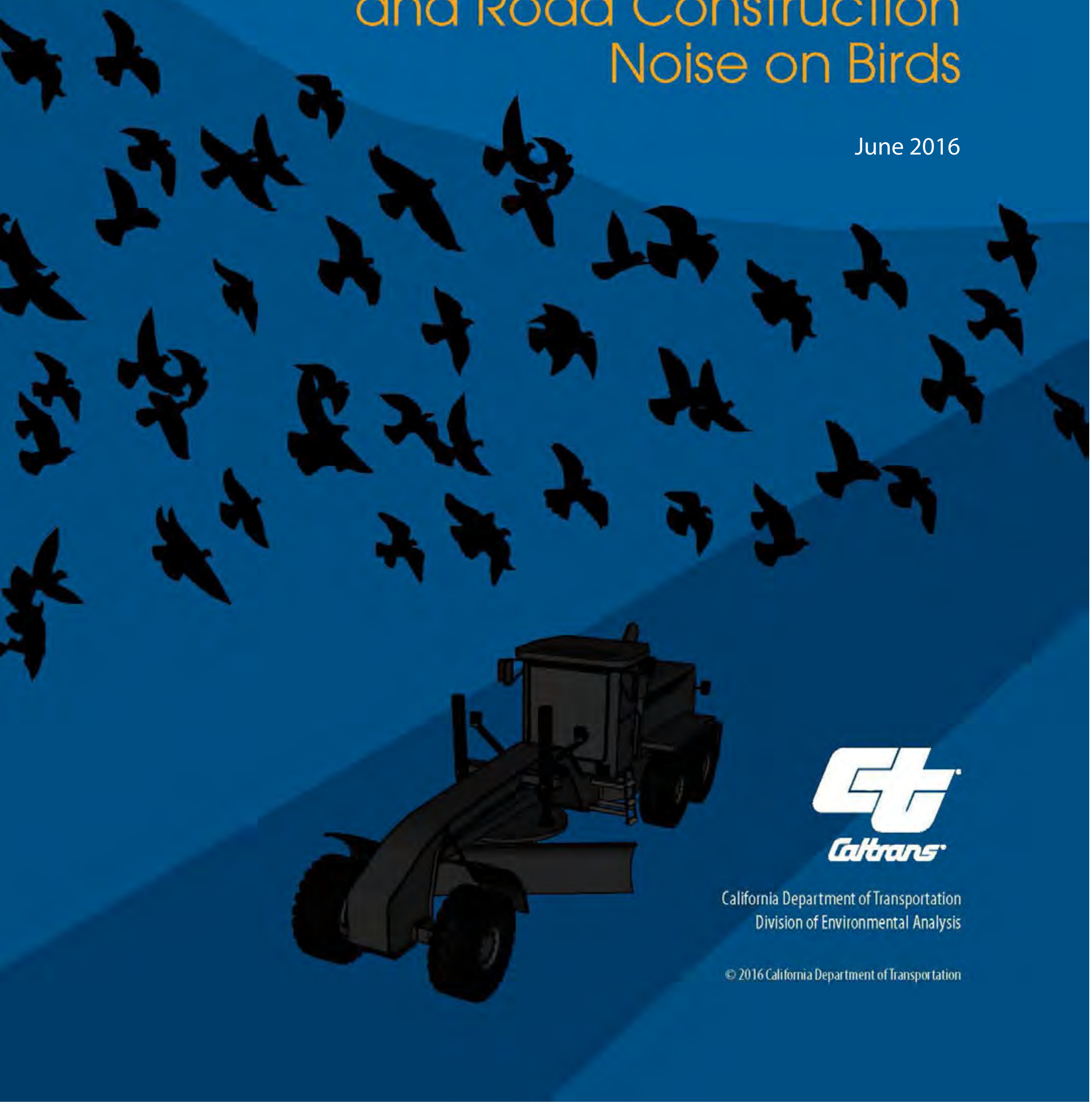
ORG6-125

ATTACHMENT TO PAPADIMOS REPORT

Technical Guidance for
Assessment and Mitigation of the

Effects of Traffic Noise and Road Construction Noise on Birds

June 2016



Caltrans

California Department of Transportation
Division of Environmental Analysis

ORG6-125

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15. Abstract

The purpose of this report is to provide Department engineers, biologists, and consultants with guidance related to the effects of traffic noise and road construction noise on birds. This manual covers bird hearing and communication within the highway operational and construction sound environment. The following topics are discussed: stress and physiological effects, acoustic over-exposure, masking, dynamic behavioral and population effects, extrapolation of data from humans and birds to other species. Interim guidelines for estimating the effects of these noise sources on birds is provided.

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Technical Guidance for Assessment and Mitigation of the Effects of Highway and Road Construction Noise on Birds

California Department of Transportation
Division of Environmental Analysis
1120 N Street, Room 4301 MS27
Sacramento, CA 95814

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Executive Summary

Recent literature on the effects of noise in the environment has shown that the world is becoming a noisier place and that the effects of chronic noise exposure on terrestrial animals, including birds, could be significant. Furthermore, with population increases and urbanization, traffic and road construction are major and increasing sources of environmental noise.

A. Overview of this Guidance Document

There is a long-standing concern that roadway construction noise and subsequent traffic noise may be detrimental to wildlife, and especially birds, which relies heavily on acoustic communication. The Endangered Species Act provides additional, compelling, motivation for understanding the effects of traffic and construction noise on federally listed bird species that are in danger of extinction. Effects of construction and/or traffic noise may be nonexistent in certain circumstances, such as when the level of these noises is below natural ambient noise levels, and insignificant in other circumstances, such as when the noise adds very little to existing ambient noise levels.

In contrast, construction or traffic noise that adds significantly to natural ambient noise has the possibility of producing a suite of significant short- and long-term behavioral and physiological changes in birds. These may include changes in foraging location and behavior; interference with acoustic communicate between conspecifics; failure to recognize other important biological signals, such as sounds of predators and/or prey; decreasing hearing sensitivity temporarily or permanently; and/or increasing stress and altering steroid hormone levels. Any of these effects could have long-term consequences and enduring impacts that include interference with breeding by individuals and populations, thereby threatening the survival of individuals or species. **ORG6-125**

This Guidance Document is an updated version of the 2007 report entitled *The Effects of Highway Noise on Birds* prepared by the authors (Dooling & Popper, 2007).

B. Definitions

Several terms are used in this report. Some of these terms have multiple meanings and are defined herein. Other terms are defined in the glossary.

- **Construction Noise**: Noise produced during the construction of a roadway.
- **Effects**: Any response by birds to traffic and construction noise. This simple definition does not invoke or imply regulatory definitions of "effect" as found in any law or regulation affecting birds.
- **Roadway**: Any paved road on which there is vehicular traffic.
- **Traffic Noise**: Noise produced by vehicles on any paved roadway, ranging from highways to single-lane streets.

C. Findings

A review of relevant literature provided insight on several important issues regarding the effects of traffic and construction noise on birds.

1) Stress and physiological effects:
   a) There are no studies definitively identifying traffic noise as the critical variable affecting bird behavior near roadways and highways.
   b) There are well-documented adverse effects of sustained traffic noise on humans, including stress, physiological and sleep disturbances, and changes in feelings of well-being that may be applicable to birds.
   c) Traffic and construction noise below a bird's masked threshold has no effect.

2) Acoustic overexposure:
   a) Birds are more resistant to both temporary and permanent hearing loss or to hearing damage from acoustic overexposure than are humans and other animals that have been tested.
   b) Birds can regenerate the sensory hair cells of the inner ear, thereby providing a mechanism for recovering from intense acoustic overexposure, a capability not found in mammals.
   c) The studies of acoustic overexposure in birds have considerable relevance for estimating hearing damage effects of traffic noise, non-continuous construction noise, and for impulsive-type construction noise, such as that from pile driving.

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3) Masking:
   a) Continuous noise of sufficient intensity in the frequency region of bird hearing can have a detrimental effect on a bird's ability to detect and discriminate between the vocal signals of other birds.
   b) Noise in the spectral region of the vocalizations has a greater masking effect than noises outside this range. Thus, traffic noise will cause less masking than other environmental noises of equal overall level but that contain energy in a higher spectral region (around 2–4 kilohertz [kHz]) (e.g., insects, vocalizations of other birds).
   c) Generally, human auditory thresholds in quiet and in noise are better than that of the typical bird; therefore:
      (1) The typical human can hear a single vehicle, traffic noise, and construction noise at a much greater distance from the roadway than can the typical bird. This fact provides a valuable, common sense, easy-to-apply risk criterion.
      (2) However, the typical human is also able to hear a bird vocalizing in a noisy environment at twice the distance that a typical bird, which suggests, in this case, that relying on human hearing as the primary criterion seriously underestimates the effects of noise on bird communication.
   d) From knowledge of: (i) bird hearing capabilities in quiet and noise, (ii) the Inverse Square Law, (iii) excess attenuation in a particular environment, and (iv) species-specific acoustic characteristics of vocalizations, reasonable predictions can be made about possible maximum communication distances between two birds in continuous noise.

e) The amount of masking of vocalizations can be predicted from the peak in the total power spectrum of the vocalization and the bird's critical ratio (i.e., signal-to-noise ratio) at that frequency of peak energy.
f) Birds, like humans and other animals, employ a range of short-term behavioral strategies, or adaptations, for communicating in noise resulting in a doubling to quadrupling of the efficiency of hearing in noise.

4) Dynamic behavioral and population effects:
   a) Any components of traffic noise that are audible to birds may have effects independent of and beyond the effects listed above. At distances from the roadway where traffic noise levels fall below ambient noise levels in the spectral region for vocal communication (i.e., 2–8 kHz) (Figure ES1), low-level but audible sound in non-communication frequencies (e.g., the rumbling of a truck) can potentially cause may cause physiological or behavioral responses). Because the more recent literature points to noise as possibly having wide-ranging effects on birds, the additive effects of traffic noise and environmental noise must be considered beyond solely the effects due specifically to traffic noise.

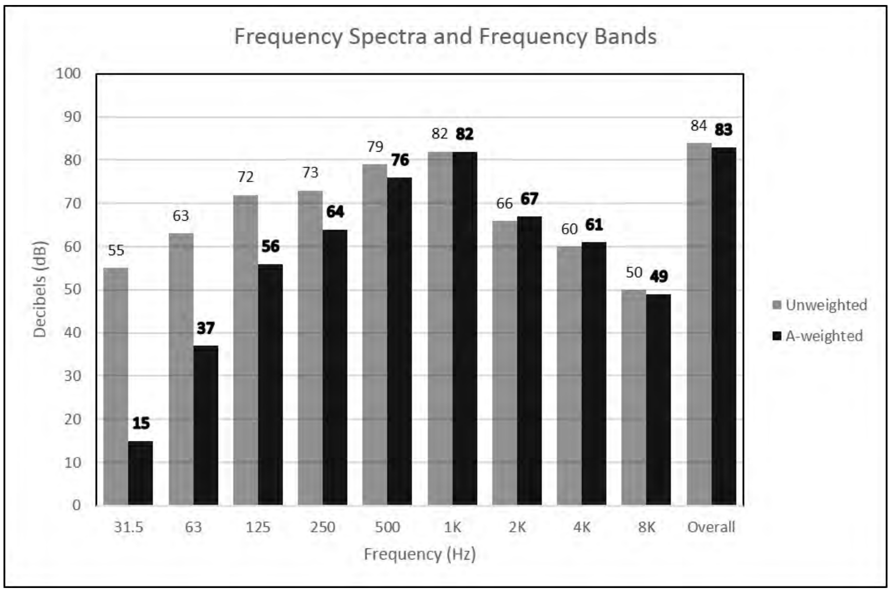

Figure ES1. **Caltrans Traffic Noise Spectra Showing Differences in Unweighted and Weighted Spectra and Overall Levels**[1]

5) Extrapolation of data from humans and birds to other species:
   a) Since there is substantial variation in bird hearing and behavior, considerable care must be taken when trying to extrapolate data between species, particularly when the species have different hearing capabilities and acoustic behaviors.
   b) Data on human hearing has some relevance to understanding effects of sound on birds. In particular, data on physiological effects in humans may have general implications for birds, but applications to specific situations will require additional study.

6) Much more data are needed on:

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[1] Figure from: http://www.dot.ca.gov/hq/env/noise/online_training_module1/slides/slide50.htm

a) Physiological effects of sound on birds.
b) How responses vary between species with regard to masking, hearing loss, and hearing recovery.
c) Hearing in young animals and how it compares to adult hearing.
d) Additional, carefully selected species so there is a large enough database from which to allow extrapolation between species and enable broader generalizations regarding the effects of noise on birds.
e) A broader range of studies, as discussed in detail in Appendix F.

The authors suggest the *interim* compliance guidelines in Figure ES2 and Table ES1 and a science-based approach, using human and avian data from both the laboratory and the field, to address potential impacts of noise on bird species.

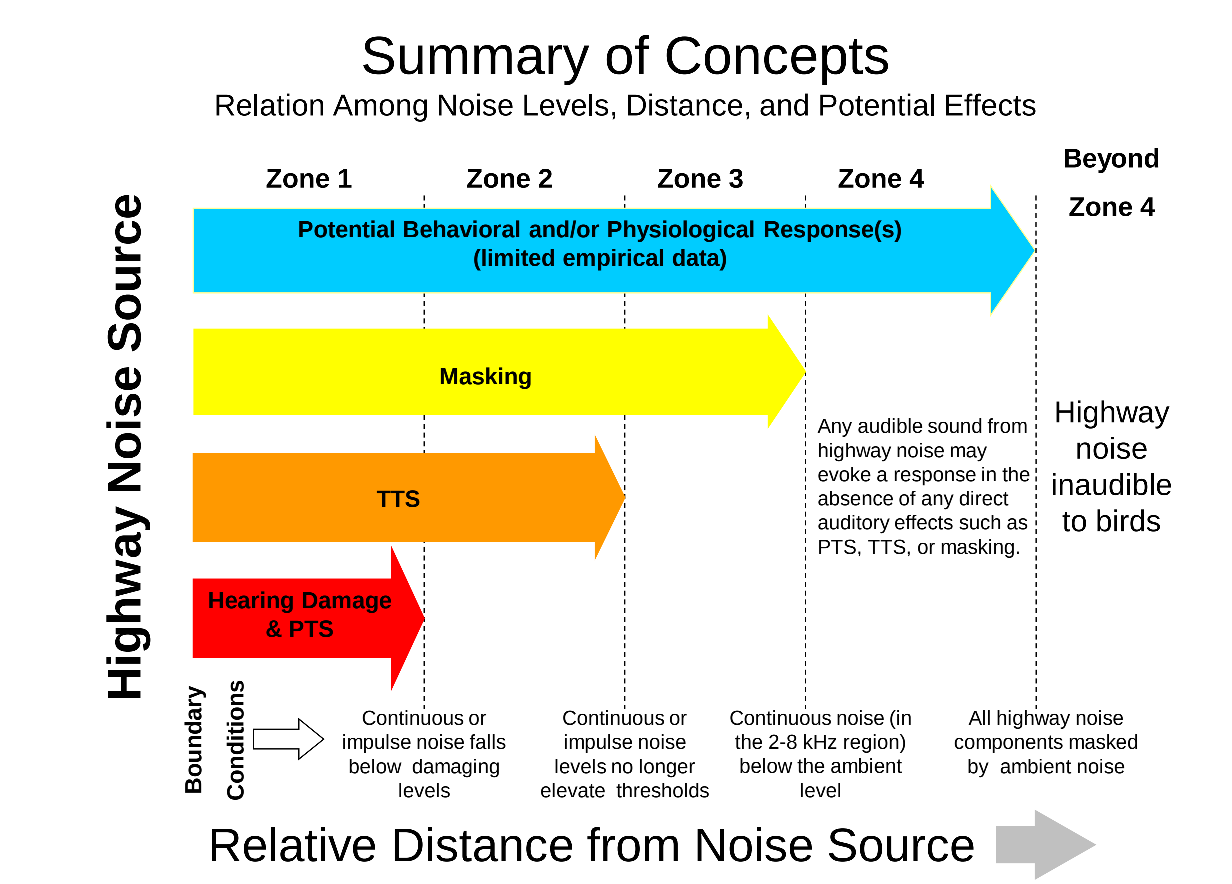

Figure ES2. Effects of Traffic and Construction Noise on Birds

Categories of traffic and construction noise effects on birds with distance from the source. Zone 1 is closest to the source while Zone 4 is farthest away. Sound level decreases farther from the source. See text for discussion.

This Guidance Document reviews four classes of potential effects of traffic noise on birds, as discussed below. The basis for the guidelines for each of the classes differs. Table ES1 provides specific interim criteria.

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1. *Behavioral and/or physiological effects*: There are no definitive studies showing that traffic noise exclusively (as opposed to correlated variables) has an adverse effect on birds. While a wealth of human data and experience suggest traffic noise could have a number of adverse effects, there are several studies (e.g., Awbrey *et al.*, 1995) showing that birds (as well as other animals) adapt quite well, and may even appear to sometimes prefer, environments that include high levels of traffic noise. Given the lack of empirical data on this point, it is recommended that subjective human experience with the noise in question be used as an interim guideline to estimate acceptable noise levels for avoiding stress and physiological effects. Noise types and levels that appear to increase stress and adverse physiological reactions in humans may also have similar consequences in birds.

2. *Damage to hearing from acoustic overexposure*: While many behavioral and physiological studies lack specificity, there are many definitive studies showing precise effects of intense noise on bird hearing and auditory structures. These extensive data show that birds are much more resistant to hearing loss and auditory damage from acoustic overexposure than are humans and other mammals. Traffic and construction noise, even at extreme levels, is unlikely to cause threshold shift, hearing loss, auditory damage, or damage to other organ systems in birds and, therefore, interim guidelines for hearing damage in birds from traffic and construction noise are probably not needed. Nevertheless, in rare instances where birds may be in close proximity to construction noise sources, such as impulse noise from pile driving, such noises may reach high enough levels to cause damage to auditory structures in birds.

3. *Masking of communication signals and other biologically relevant sounds*: Many laboratory masking studies precisely show the effects of continuous noise (including traffic noise) on sound detection in over a dozen species of birds. In a sense, these studies describe a "worst case" scenario because the noise is continuous and the myriad of short-term adaptive behavioral responses for mitigating the effects of noise are not available to the bird in a laboratory test situation. These masking studies led to an overall noise level guideline of around 60 A-weighted decibels (dBA) for continuous noise. A number of things have changed since this 60-dBA criterion was first suggested. Controlled laboratory and field studies have now shown that there are differences among bird species in signal-to-noise ratios at masked threshold. It is also now quite clear that probably all species of birds can use various short-term, adaptive behavioral responses in their natural environments to improve their signal-to-noise ratio. In other words, critical ratios vary across bird species by as much as 10 dB, strongly suggesting that acoustic communication in some species might be affected by an overall traffic and construction noise level of even less than 60 dBA. For some other bird species, communication between individuals, especially if they can employ short-term behavioral strategies for hearing in noise, might be unaffected at even higher levels of noise, perhaps approaching 70 dBA. These short-term behavioral adaptations include scanning (head turning), raising vocal output, and changing singing location. Each of these strategies alone can result in a significant gain in signal level or signal-to-noise ratio (under masking conditions) of about 10 dB, and birds can employ all three strategies simultaneously. **ORG6-125**

4. *Practical guidelines arising from masking studies*: The following are common sense, practical guidelines that emerge from basic hearing knowledge of birds and humans—specifically, the 6-decibel (dB) difference in masking (critical ratio) functions between typical bird and human listeners with normal hearing. 1) Humans can hear traffic noise, in a natural environment, at twice the distance from the roadway than can birds. In other words, if, in a natural environment, distant traffic noise is barely audible to humans, it is certainly inaudible to birds and will have no effect on any aspect of their acoustic behavior. 2) Humans can hear a bird singing against a background of noise at twice the distance than can the typical bird. This provides an informal estimate of maximum communication distance between two birds vocalizing against a background of continuous traffic noise. This works not only for the typical bird, but it is probably also valid for most species.

Table ES1. Recommended Interim Guidelines for Potential Effects from Different Noise Sources

Noise Source Type	Hearing Damage	TTS	Masking	Potential Behavioral/ Physiological Effects
Single Impulse (e.g., starter's pistol 6" from the ear	140 dBA[1]	NA[3]	NA[5]	Any audible component of traffic and construction noise has the potential of causing behavioral and/or physiological effects independent of any direct effects on the auditory system of PTS, TTS, or masking
Multiple Impulse (e.g., jack hammer, pile driver)	125 dBA[1]	NA[3]	Ambient dBA[6]	
Non-Strike Continuos (e.g., construction noise)	None[2]	93 dBA[4]	Ambient dBA[6]	
Traffic and Construction	None[2]	93 dBA[4]	Ambient dBA[6]	
Alarms (97 dB/100 ft)	None[2]	NA[2]	NA[7]	

TTS = temporary threshold shift
dBA = A-weighted decibel
PTS =permanent threshold shift
[1] Estimates based on bird data from Hashino et al. (1988) and other impulse noise exposure studies in small mammals.
[2] Noise levels from these sources do not reach levels capable of causing auditory damage and/or permanent threshold shift based on empirical data on hearing loss in birds from the laboratory.
[3] No data available on TTS in birds caused by impulsive sounds.
[4] Estimates based on study of TTS by continuous noise in the budgerigar and similar studies in small mammals.
[5] Cannot have masking to a single impulse.
[6] Conservative estimate based on addition of two uncorrelated noises. Above ambient noise levels, critical ratio data from 14 bird species, well-documented short-term behavioral adaptation strategies, and a background of ambient noise typical of a quiet suburban area would suggest noise guidelines in the range of 50–60 dBA.
[7] Alarms are non-continuous and, therefore, unlikely to cause masking effects.

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These recommended guidelines for estimating the effects that traffic noise has on masking in birds are interim guidelines for the following reasons.

1. The interim guidelines are based on median data taken from masking studies done for a limited number of bird species. Thus, they represent the typical bird, based on the species studied. However, it is important to recall that different bird species can differ considerably in how they hear in the presence of noise; some have masked thresholds that approach those of humans, while others have masked thresholds that are 3–4 dB worse than thresholds for the typical bird presented here. Therefore, final noise guidelines will

require testing more species with appropriate experimental adjustment for the species in question.

2. Traffic noise characteristics are influenced by transmission through the environment as are the spectral, temporal, and intensive aspects of bird vocalizations through differences in excess attenuation. In other words, there is inherent variability in estimating the signal-to-noise ratio at the bird’s ear in a natural environment. Traffic or construction noise varies from moment to moment. And the level of the signal reaching the receiver’s i.e., the bird) ears will vary depending on the location of both the sender and the receiver. Final guidelines will require more data to quantify this variation.

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The Effects of Traffic Noise and Road Construction Noise on Birds

1. Introduction, Overview, Direction

Recent literature on the effects of noise in the environment has shown that the world is becoming a noisier place and that the effects of chronic noise exposure on terrestrial animals, including birds, could be significant (e.g., Barber *et al.*, 2010; Pijanowski *et al.*, 2011a; Pijanowski *et al.*, 2011b; Luther and Magnotti, 2014; Merchant *et al.*, 2015). Furthermore, with population increases and urbanization, traffic and road construction are increasing sources of environmental noise. However, because environmental noise is an inherently complex topic, it is important to define and isolate the sources of variation in determining when noise produced during the construction and operation of roadways has an impact on bird behavior and physiology.

The Endangered Species Act provides additional compelling motivation for understanding the effects of traffic and roadway construction noise on federally listed species. Effects of such noise may be nonexistent in certain circumstances, such as when the sound level of traffic and construction noise is below natural ambient noise levels, and effects may be insignificant in other circumstances, such as when such noise adds very little to existing ambient noise levels. In contrast, construction or traffic noise that adds substantially to natural ambient noise has the potential to produce a suite of significant short- and long-term behavioral and physiological changes in birds. These may include the following changes.

- Changes in the selection of foraging locations.
- Interference with acoustic communications between conspecifics.
- Failure to recognize other important biological signals such as sounds of predators and/or prey.
- Loss of hearing sensitivity temporarily or permanently.
- Increased stress and/or altered steroid hormone levels or other physiological effects.

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Any of these effects could have long-term consequences and enduring impacts by interfering with breeding by individuals and populations, thereby threatening the survival of individuals or species.

This Guidance Document represent an updated version of the report entitled *The Effects of Highway Noise on Birds* (Dooling and Popper, 2007) prepared by the current authors. It should be noted that the vast majority of the research literature discussed in this document focuses on effects of traffic noise on birds, and there have been few, if any, studies on effects of roadway construction on birds. This is likely because roadway noise is far more prevalent and continuous than construction noise. Consequently, the models and analysis presented in this document focus on traffic noise.

A. Definitions

Several terms are used in this report. Some of these terms have multiple meanings and are defined herein. Other terms are defined in the glossary.

- **Construction Noise**: Noise produced during the construction of a roadway.
- **Effects**: any response by birds to traffic and construction noise. This definition does not invoke or imply regulatory definitions of "effect" as found in any law or regulation affecting birds.
- **Roadway**: Any paved road on which there is vehicular traffic.
- **Traffic Noise**: Noise produced by vehicles on any paved roadway, ranging from highways to single-lane streets.

B. Organization and Purpose of This Guidance Document

Sections 2 and 3 of this Guidance Document discuss bird audition, including how and what birds hear and how environmental noise can generally affect the auditory system and hearing. This is followed by Section 4, which discusses the effects of traffic and construction noise on birds, the challenges in surveying what is known about the effects of traffic and construction noise on birds, and the scientific literature on the topic. Section 5 summarizes the different classes of effects of noise on birds. Finally, Section 6 poses a first set of *interim* criteria to protect birds from traffic and construction noise. For readers interested in additional information, Appendix D discusses fundamentals of traffic noise (prepared by ICF Jones and Stokes), Appendix E presents a review of the older literature from the 2007 report, and Appendix F describes recommendations for critical future research that the authors suggest would enhance overall understanding of effects of traffic noise on birds.

The purpose of this Guidance Document is two-fold. First, it critically discusses what is known about the effects of highway construction and traffic noise on birds, with emphasis on the best available science. Generally, the reviewed literature has been directed at assessing and mitigating the impacts of noise produced by highway construction and operation on birds. This Guidance Document shows that there are still major gaps in this body of literature and very few firm conclusions, although there has been a substantial increase in knowledge since the first report (Dooling and Popper, 2007). As a Guidance Document should always reflect recent changes in the science, Appendix F points to areas for future research that would substantially enhance our future understanding of traffic noise on birds. **ORG6-125**

Second, this Guidance Document suggests *interim* compliance guidelines and a science-based approach, using human and avian data from both the laboratory and the field, to address potential impacts of noise on bird species. In areas such as hearing and masking of sounds as a result of noise, rigorous data are available from a wide range of species so that it is reasonable to extrapolate the effects on federally listed species. Such guidelines are done in coordination and consultation with compliance protocols for the federal Endangered Species Act.

C. Analysis of United States Fish and Wildlife Service (2006) Report

On July 26, 2006, the Arcata Fish and Wildlife Service Office (AFWO) of the U. S. Fish and Wildlife Service (FWS) issued guidance for estimating the effects of auditory and visual disturbance to northern spotted owls (*Strix occidentalis caurina*) and marbled murrelets (*Brachyramphu marmoratus*) in Northwestern California (AFWO, 2006).[2] These two species live

[2] http://goo.gl/3FLFCA

a rather solitary lifestyle and are expected to be particularly sensitive to noise disturbance. The purpose of the FWS guidance was to promote consistent and reasonable determinations of potential effects on either species that could result from elevated human-generated sounds or human activities in close proximity to nests during the breeding season. FWS acknowledged that its report is to be viewed as a living document subject to continued, ongoing revision, and improvement as additional data and experience are acquired.

The FWS document provides excellent guidance as to how a person in the field should make determinations with regard to the potential effects of construction and traffic noise on these two avian species, especially with regard to harassment.[3] This guidance is particularly valuable because it takes into consideration critical variables and tries to integrate them into a simple practical model. These variables include those listed below.

- Types of sound sources.
- Distances from the sound sources to the birds.
- Level of ambient noise in the environment.
- Levels of anthropogenic (human-generated) noise in the environment.
- Sound-modifying features in the environment.
- Visual cues correlated with the noise.
- The hearing sensitivity of the bird.

The FWS report provides a worthwhile potential strategy for estimating particular kinds of noise effects on these birds; however, the report has several limitations in terms of its applicability to other species. First, it is based on two relatively non-social species and does not address the kinds of effects that may be relevant for more gregarious species that flock and engage in continuous vocal communication with conspecifics. **ORG6-125**

Second, as discussed below, there are substantial differences between species in the ability to hear in noisy environments. As a consequence, one noise level is not likely to affect all species in the same way since some species will hear a particular level of sound and others will not due to their overall hearing sensitivity.

Third, how a bird responds to and integrates acoustic and visual stimuli in different contexts (e.g., breeding season or brooding) is likely to have a profound effect on whether harassment occurs. For example, very low level sounds bearing some resemblance to the sounds of a natural predator are likely to be far more important to the bird than other sounds of equal sound level but with no history of signaling danger. Such experiential factors will undoubtedly vary significantly by species.

Finally, the noise levels discussed in the FWS guidance are geared toward those that result in harassment or flushing from the roost or nest. There are other effects, such as masking of communication signals, that are also very important for species that must learn their vocalizations

[3] The Act's implementing regulations further define harass as "… an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding or sheltering" [50 CFR §17.3]. (Taken verbatim from p.4 of FWS (2006) report.)

and are engaged in continuous vocal communication with conspecifics throughout their lifetime, that are not considered in the FWS document.

Despite these caveats, the FWS report, together with information reviewed in this Guidance Document, may have value in helping reach a decision metric on possible effects of traffic and construction noise on birds. Moreover, the specific recommendations made in the FWS guidance report, while not fully applicable to situations involving continuous traffic and construction noise, represent a thoughtful approach to identifying and quantifying some of major variables for consideration.

D. Literature Surveyed in this Guidance Document

The material presented in this Guidance Document is based on a careful evaluation of technical reports and peer-reviewed articles, much of which is discussed in Section 4. The scientific approach and analysis used in each study differs, and so extrapolation between the studies, and especially those done in different locations or by different groups of investigators, is difficult and must be done with considerable caution.

In addition to primary peer-reviewed literature, this Guidance Document also cites a number of reviews covering various aspects of the issues considered here. These reviews, even if they have gone through appropriate peer review, often reflect the opinions and biases of the authors based on their analysis of the original material from peer-reviewed research articles.

Finally, wherever possible, this Guidance Document incorporates new material that has been produced since the authors' original review (Dooling and Popper, 2007). Taken together, the previously reviewed literature (see Appendix E) and the more recent literature significantly inform the conclusions and recommendations in this Guidance Document. **ORG6-125**

E. Metrics and Terminology

This Guidance Document contains a number of acoustic and biological terms. To facilitate understanding of terminology, most of the terms are defined in the glossary in Appendix A. Appendix D discusses fundamentals of traffic noise.[4] Those unfamiliar with fundamental concepts relating to traffic noise are advised to review information published by the California Department of Transportation (Caltrans) on the topic of highway traffic noise. This includes the Caltrans Traffic Noise Analysis Protocol (Protocol) (Caltrans, 2011),[5] the Technical Noise Supplement to Protocol (Caltrans 2013), and Caltrans online noise training.[6]

It is also important to define what is meant by "behavior" in this Guidance Document because the word is used for a wide range of activities, and usage also varies between different authors. For example, the term may be used to refer to the complex interaction of signals and rituals that animals use during mating or may also be used to refer to the movements of animals from one feeding

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[4] Material in Appendix D was prepared by Caltrans and not by the authors of this report.

[5] http://www.dot.ca.gov/hq/env/noise/pub/ca_tnap_may2011.pdf

[6] http://www.dot.ca.gov/hq/env/noise/training_license.htm.

ground to another. In the context of this Guidance Document, "behavior" is used in its broadest possible sense unless otherwise qualified

F. Typical Roadway Operational and Construction Noise Levels

Traffic noise produced by vehicles traveling on a highway is a function of the traffic volume, vehicle mix, vehicle speed, and pavement type. For example, Table 1 summarizes typical traffic conditions for several typical highway configurations.

Table 1. Typical Highway Conditions

Number of Lanes	Highway Type	Worst Hour Traffic Volume	Speed	Heavy Truck %[!]
2	Highway	3,000	55 mph	2%
4	Highway	6,000	65 mph	2%
6	Freeway	12,000	65 mph	6%
8	Freeway	16,000	65 mph	8%

[!] Truck percentages can vary widely depending on the proximity of a roadway to commercial uses and truck routes. The truck percentages shown here are generally conservative for the roadway construction shown.

A considerable amount of work has enabled traffic engineers to model noise levels expected under various traffic conditions, road types, and vehicle speeds. Figure 1 shows traffic noise levels at various distances (in feet) from the roadway as predicted by the Federal Highway Administration (FHWA) Traffic Noise Model[7] (TNM) version 2.5 for each traffic condition in Table 1. Neutral atmospheric conditions (no inversion, moderate temperature, and wind speed less than 11 miles per hour [mph]) and soft ground surface (lawn) assumptions as recommended by FHWA were used. Additional assumptions included that the roadway was undivided, had no median lanes, was the typical 12 foot (3.6 meters) wide, and had average pavement, dry conditions, and moderate temperatures, with wind speed below 11 mph (17.7 kilometers per hour [km/h]). ORG6-125

With multiple lanes and a large number of vehicles, free-flowing traffic on a roadway acts like a line source. Geometric attenuation for a line source is 3 dB per doubling of distance. Additional attenuation resulting from ground absorption can add attenuation of about 1.5 dB per doubling of distance. Excess attenuation from ground effects, atmospheric absorption, wind, and temperature gradient effects, etc., are highly complex and can add attenuation over 5–10 dB per 100 m depending on the environment (e.g., Marten and Marler, 1977).

In contrast to the continuous noise produced by large volumes of traffic, noise produced by construction equipment is likely to be intermittent and impulsive (with very short rise-times), such as impact noise from a pile driver. Noise produced by construction equipment is a function of the type of equipment. Table 2 summarizes typical maximum noise levels at 50 feet (15.2 m) produced by typical construction equipment (see FHWA, 2006)[8]). In contrast to traffic noise, equipment used in roadway construction acts like a point source and will typically off at a rate of 6 dB per doubling of distance, although there is also likely to be additional attenuation that varies with the environment. Moreover, these are maximum noise levels which are not typically sustained over

[7] http://www.fhwa.dot.gov/environment/noise/construction_noise/rcnm/rcnm.pdf
[8] http://www.fhwa.dot.gov/environment/noise/construction_noise/rcnm/rcnm.pdf

long periods of time. Energy average sound levels can be developed based on utilization factors (FHWA, 2006).

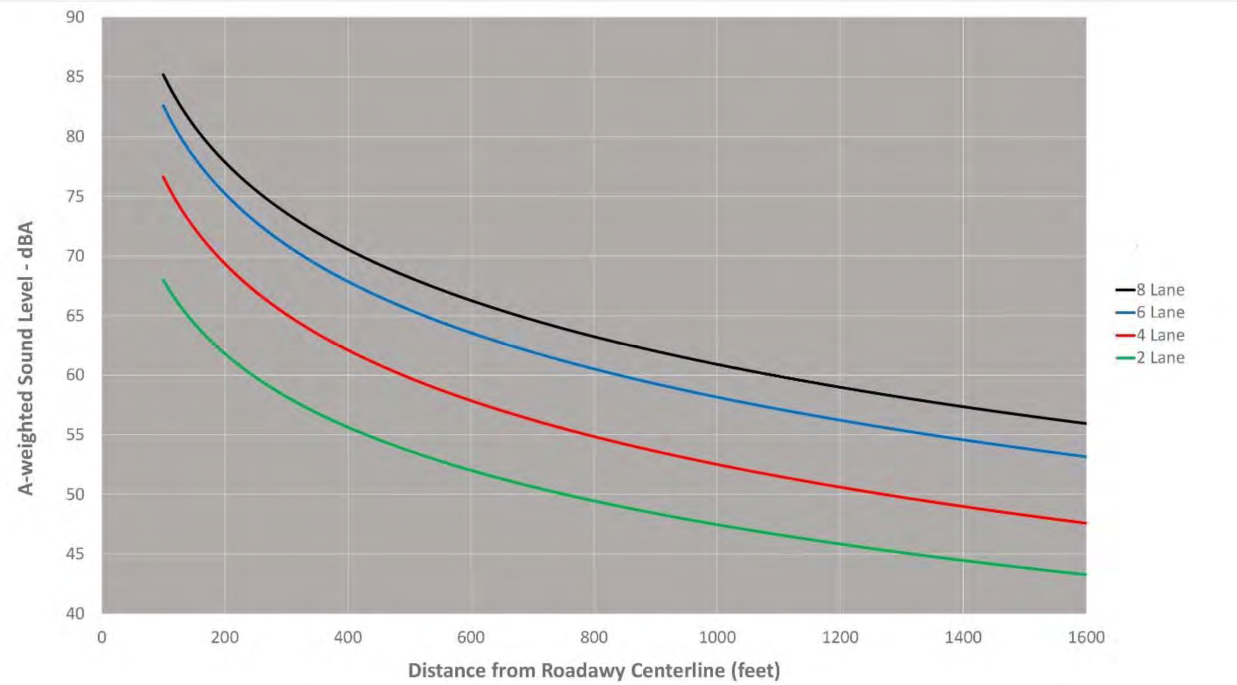

Figure 1. Typical Roadway Noise Levels as a Function of Distance
Data based on traffic conditions listed in Table 1
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G. Relation between A-Weighted Sound Level in and Spectrum Level[9]

The noise levels described in Section 1.F for both traffic noise and construction noise are given in dBA[10] (see Appendix G for discussion of history of dBA for bird studies). The dBA scale for measuring sound levels takes into account the equal loudness contours of human hearing—that sounds at low frequencies and high frequencies presented at the same sound pressure level as intermediate frequencies are judged as softer than the sounds at intermediate frequencies. This scale is incorporated in most sound level meters and is thus convenient for the person doing the measurements. It may not always the most accurate measure for determining the effects of noise on bird hearing, however, because birds are even less sensitive to sound below 1 kHz than are humans, and birds have extremely poor hearing at frequencies about 10 kHz. Thus, the most relevant measure of noise for estimating the masking effects of noise on bird hearing is the spectrum level (the intensity level of a sound within a 1 hertz (Hz) band) in the frequency region where birds vocalize most and hear best—typically around 2–5 kHz.

Traffic noise and non-impact construction noise often show a sloping spectrum (Figure 2) with less energy in the region of 2–4 kHz than at lower frequencies. Thus, estimating the spectrum level

[9] Note that this Guidance Document does not include a direct discussion of the idea of 60 dBA that has been found in much of the earlier literature. A history of the use of 60 dBA is found in Appendix G.
[10] For a detailed discussion of dBA see: https://en.wikipedia.org/wiki/A-weighting

in the region of 2–4 kHz from an overall dBA level could overestimate the energy in the region of 2–4 kHz. On the other hand, traffic noise still has a considerable amount of energy around 1 kHz, and this band of energy contributes significantly to the overall dBA level actually resulting in a significant underestimate of the noise level actually in the 2–4 kHz bands that contain most bird vocalizations. Thus, in many cases, the overall level of the noise measured as dBA does not provide an accurate estimate of the noise level in the frequency region where birds communicate. Depending on the overall spectrum of the noise, it could underestimate, or more often overestimate, the masking effects of traffic noise on hearing and vocal communication in birds. In Figure 2, for instance, the overall level of noise is 84 dB (83 dB measured on the A scale) and this value is almost entirely accounted for by the energy in the octave band around 1 kHz. The level of noise in the frequency region that birds use for acoustic communication is much less, at around 60–65 dB.

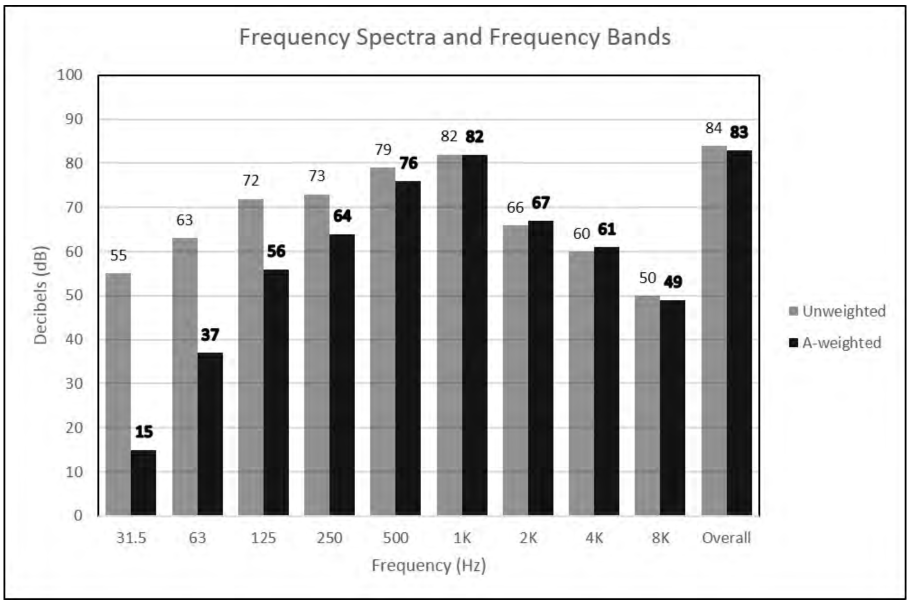

Figure 2: Caltrans Traffic Noise Spectra Showing Differences in Unweighted and Weighted Spectra and Overall Levels[11]

For traffic and construction noises, measuring overall sound levels in in dBA is likely to overestimate the effects of traffic and construction noise on communication in birds. A more accurate estimate would be obtained with measures of the sound pressure level in the octave bands at 2 kHz and 4 kHz From these two measurements, given the characteristics of traffic and construction noise, reasonably accurate estimates of spectrum levels can be obtained for the critical frequency range in which birds communicate and from these spectrum levels, decisions can be made about whether the noise will interfere with vocal communication. At 2.0 kHz, the spectrum level is roughly 33 dB less than the octave band level; at 4.0 kHz, the spectrum level is about 36 dB less than the octave band level.

2. The Bird Ear and Hearing

[11] Figure from: http://www.dot.ca.gov/hq/env/noise/online_training_module1/slides/slide50.htm

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In order to appreciate the potential effects of traffic and construction noise on bird hearing, it is important to have some understanding of the bird ear and the basic hearing capabilities of birds both in quiet and in high noise settings (Dooling *et al.*, 2000a). It is also worthwhile to appreciate why birds, or any animals (including humans) hear, and why hearing may have evolved. In the case of many animals, especially birds and humans, hearing is closely related to acoustic communication (Dooling, 1982; Dooling *et al.*, 1992). Indeed, birds, more than most any vertebrate group other than primates, make use of a rich array of sounds for communicating, finding mates, expressing territorial occupation, and numerous other social behaviors.

Table 2: Construction Equipment Noise Emission Levels (greatest-to-least)[12]

Equipment	Typical L_{max} at 50 feet (15.2 m) from Source (dBA, Slow)
Pile Driver (Impact)	95
Vibratory Pile Driver	95
Rock Drill	85
Paver	85
Scraper	85
Crane	85
Jack Hammer	85
Concrete Mixer Truck	85
Dozer	85
Grader	85
Jackhammer	85
Pneumatic Tool	85
Crane	85
Chain Saw	85
Roller	85
Tractor	84
Concrete Pump Truck	82
Generator	82
Compactor (ground)	80
Compressor (Air)	80
Backhoe	80
Vibratory Concrete Mixer	80
Pumps	77

Source: Federal Highway Administration 2006. Table 1. http://goo.gl/PXltyy

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Birds, as with humans and other animals, also use hearing to learn about their overall environments. Bregman (1990) refers to this as the "acoustic scene." This acoustic scene is the array of sounds in the environment, not just vocalizations, which may arise from biological or non-biological sources, such as predators moving through the environment or the wind moving through trees. This acoustic scene covers an area all around an animal, and it is just as rich at night as

[12] http://www.fhwa.dot.gov/environment/noise/construction_noise/rcnm/rcnm00.cfm

during the day when animals can use vision. The acoustic scene tells an animal a great deal about its extended environment. So, while this Guidance Document focus on the effect of noise on communication signals, it is important to also realize that other aspects of the animal's acoustic scene are also affected.

The bird ear and bird hearing has been well described over the years (e.g., Dooling *et al.*, 2000a; Gleich and Manley, 2000; Saunders *et al.*, 2000; Saunders and Henry, 2014). It consists of an external membrane (tympanic membrane), a middle ear (Saunders *et al.*, 2000; Saunders and Henry, 2014), and an inner ear (Gleich and Manley, 2000; Saunders and Henry, 2014). There is no external structure that resembles the mammalian outer ear flap, or pinna (except in owls). Instead, the tympanic membrane is the outermost covering of the middle ear.

The avian inner ear is similar to that of most vertebrates in that is has three semicircular canals to determine angular acceleration of the head and three otolith organs to detect motions of the head relative to gravity. In addition, birds have a cochlear duct that contains a basilar papilla upon which sit the sensitive sensory hair cells used for hearing. However, the basilar papilla is shorter and rather different in structure than that found in mammals (Tanaka and Smith, 1978; Smith, 1985; Gleich and Manley, 2000; Manley, 2000) and the differences may, to a degree, account for the much narrower range of frequencies detected by birds as compared to mammals.

Another factor that probably limits the frequency range over which birds hear is the presence of a single-bone middle ear rather than the three-bone middle ears (malleus, incus, stapes) that are characteristic of mammals (Manley, 2010). It has been suggested that the single columella in place of the three ear bones found in mammals is what limits hearing in most avian species to not much more than 10 kHz (Saunders *et al.*, 2000; Manley, 2010). **ORG6-125**

A. Behavioral Measures of Avian Hearing—the Audiogram

The minimum sound pressure that can be detected at frequencies throughout an animal's range of hearing defines the audiogram, or audibility curve.[13] This is the most basic measure of hearing and one most people are familiar with from having their own hearing tested. Over the past 50 years, behavioral audibility curves have been collected for about 39 species of birds, and this database can be extended by another 10 species of birds by including data from physiological recordings (Appendix B, also see Fay, 1988). These data are fit with a polynomial function to provide a continuous curve describing the minimum audible sound pressure over the range of hearing for a particular species.

Figure 3 shows the median audiogram based on the species in Appendix B. For animals, and sometimes for humans, the audiogram is measured in a sound attenuated room (an audiometric test chamber) so that the background noise is minimized and there is no interference by other sounds (i.e., masking). Thus the audiogram represents an ideal detection threshold that is rarely, if ever, attained in the real world, which always has some measurable amount of background noise.

[13] This is a measure of hearing "threshold." It should be noted that the threshold (the lowest sound detectable at a given frequency) is not a fixed value. There are slight variations from animal to animal and larger differences across species. Testing conditions and context can also play a role. Typically, the "threshold" is a statistical measure indicating the lowest sound pressure level that an animal can detect 50% of the time.

Audiograms are often described and compared on several features, such as the softest sound that can be heard (often referred to as best sensitivity or lowest intensity), the frequency at which hearing is best (best frequency—the frequency at which the subject can hear the softest sound), the bandwidth (the width of the audiogram to the point where it is raised by 30 dB on either side of the best frequency), lowest intensity (at the best frequency), and the low and high frequency limits of hearing (the frequencies at which thresholds are 30 dB above the best intensity) for both birds and humans. Interestingly, compared to species in other vertebrate groups, there is not wide variation in hearing sensitivity between different bird species. This suggests that the recommendations in this Guidance Document apply to most birds.

Generally, birds hear best at frequencies between about 1 and 5 kHz (Figure 3), with absolute (best) sensitivity often approaching 0–10 dB SPL[14] at the most sensitive frequency, which is usually in the region of 2–4 kHz (Dooling, 1980; 1982; 1992; Dooling *et al.*, 2000b). Nocturnal predators, such as most owls, can generally detect much softer sounds than can either Passeriformes (e.g., songbirds, such as sparrows, canaries, starlings, finches) or other non-Passeriformes (e.g., chickens, turkeys, pigeons, parrots, owls) over their entire range of hearing, sometimes with levels as low as -10 to -15 dB SPL. Passeriformes also tend to have better hearing at high frequencies than non-Passeriformes, while non-Passeriformes can detect softer signals at low frequencies than do Passeriformes. This difference is usually on the order of 5 to 10 dB. A recent correlative study of hearing characteristics (using the database in Appendix B) with several biological parameters confirms significant correlations among body weight, inner ear anatomy, and low- and high-frequency hearing in birds, with the exception of owls (Gleich *et al.*, 2005). Simply put, large birds hear better at low frequencies and small birds hear better at high frequencies. On average, however, the frequency range available to the typical bird for long distance vocal communication extends, at best, from about 1 to 4 kHz, the region of best sensitivity. **ORG6-125**

B. The Hearing Range and Vocalization Spectrum of Birds

Almost all avian species rely heavily on acoustic communication for species and individual recognition, mate selection, territorial defense, and other social activities. Studies of bird hearing have long shown a strong correlation between the range of hearing in birds and the frequency spectrum of bird vocalizations (Konishi, 1969; Dooling, 1980; 1982). That is, with the exception of some nocturnal predators such as barn owls, birds typically hear best in the spectral region of their species-specific vocalizations. Barn owls hear better at higher frequencies than do most other bird species because they have evolved to use high frequency cues to localize their prey in darkness. The importance of the general observation of a close match between hearing thresholds and vocalizations is that concerns over the effects of masking or hearing damage from noise should focus attention on the critical frequency region of about 1–6 kHz—the spectral region used for acoustic communication in birds (Dooling, 1982).

[14] SPL, or sound pressure level, is a widely used expression of the sound pressure using the decibel (dB) scale and the standard reference pressures 20 μPa for air.

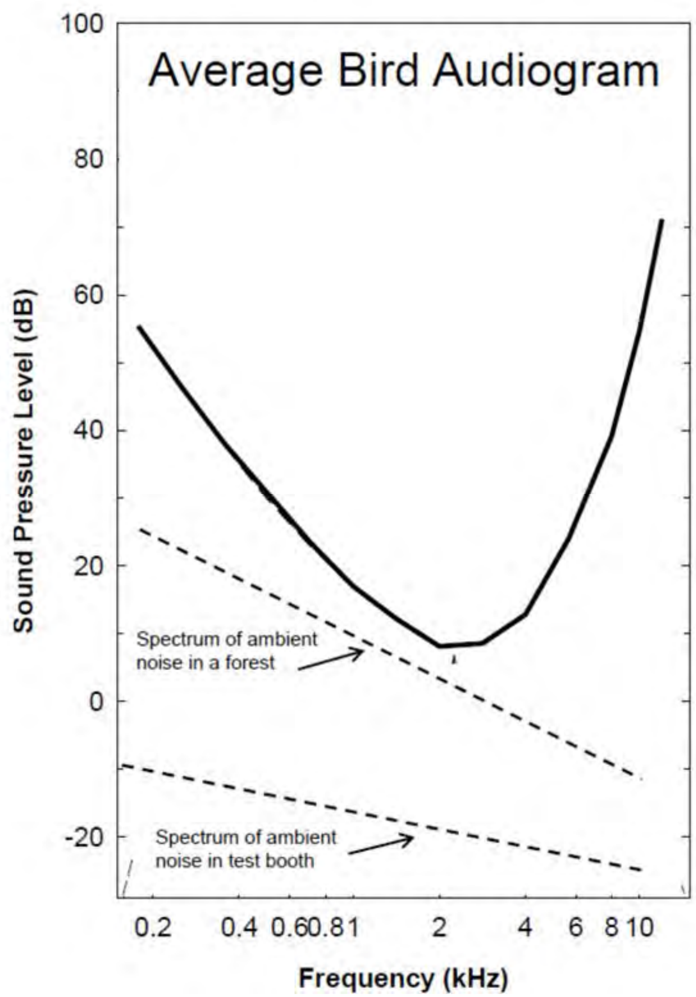

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Figure 3: Bird Hearing Thresholds

Median bird hearing thresholds from 49 bird species (Appendix B measured behaviorally and physiologically in the free field in the quiet (solid line). The typical bird hears less well than humans and over a narrower bandwidth. Dotted lines show typical spectrum levels of the background noise in a double-walled acoustic isolation testing chamber and the spectrum level of ambient noise that a bird might encounter in a typical forest environment. An ambient noise spectrum level at least 20 dB below the audiogram will have no effect on hearing thresholds (i.e., no masking). An ambient noise level less than 20 dB below the audiogram thresholds, which is the case in almost all natural environments, will raise the animal's thresholds (i.e., cause masking).

C. The Hearing Capabilities of Nestlings

Less is known about hearing in nestlings and young birds as compared to sexually mature birds. However, a limited amount of data from young songbirds and parrots suggest that the auditory system of altricial birds (i.e., birds that are in an undeveloped stage at hatching in the nest and require care and feeding from parents[15]) does not function well at hatching. Auditory Brainstem Response (ABR, a type of physiological recording) studies of budgerigars[16] (*Melopsittacus undulatus*) and canaries (*Serinus canaria domestica*) indicate that hearing thresholds during the

[15] Altricial birds include all Passeriformes (songbirds). Altricial birds hatch with their eyes closed and with few, if any, feathers. In contract, precocial birds hatch with eyes open and are generally ready to leave the nest within two days of hatching—see: http://www.stanford.edu/group/stanfordbirds/text/essays/Precocial_and_Altricial.html

[16] Also known as a parakeet.

first two weeks after hatching of altricial birds are 30–40 dB higher than hearing thresholds of adults By the time nestlings are 20–30 days old and just getting ready to leave the nest; however, hearing thresholds as measured by the ABR approach adult levels of sensitivity (Brittan-Powell and Dooling, 2004).

Hearing thresholds in young birds and nestlings in the presence of noise have not yet been measured. While it is unlikely that nestlings can hear better in noise than adults, the fact that this is a critical stage in vocal development means that any additional noise, as from construction or traffic, may affect a bird's ability to acquire and develop its species-typical vocalizations. Recent laboratory work in zebra finches has now confirmed this suspicion (Potvin and MacDougall-Shackleton, 2015).

3. General Principles of the Effects of Noise on Birds

There are four general overlapping categories of construction and traffic noise effects on birds: permanent threshold shift (PTS—permanent hearing loss), temporary threshold shift (TTS—temporary hearing loss which recovers over a period of minutes to days from the end of noise exposure), masking, and other physiological and behavioral responses. The actual auditory effect that is encountered depends upon the level of noise arriving at the bird's ear, which is highly correlated with the proximity of the bird(s) to the noise source (Figure 4, Table 3).The existing scientific literature provides a considerable amount of data that can be used to define the boundaries between these categories of effects e.g., Dooling *et al.*, 2008; Salvi *et al.*, 2008; Saunders and Salvi, 2008).

Based on Figure 4, it is possible to generalize on the potential effects of highway and construction noise on birds, depending on their distance from the source. The distance of each zone is arbitrary and depends on the level of the source. Thus, if the level of the source is very high, each zone will be large, whereas if the sound level at the source is low, the distances between the zones will be smaller. Regardless, as is shown, these zones no doubt overlap with regard to potential effects. ORG6-125

a. Zone 1: If a bird is in this region, it is close to the noise source such that traffic and construction noise can *potentially* result in all four effects—permanent threshold shift, temporary threshold shift, masking, and other behavioral and/or physiological effects. Laboratory evidence shows that continuous noise levels above 110 dBA SPL lasting over 12–24 hours, or a single impulsive noise over 140 dB SPL (125 dB SPL for multiple blasts), can cause damage and loss of inner ear sensory hair cells resulting in a large initial threshold shift, followed by a small (~10–15 dB) lingering threshold shift even after all hair cells have been regenerated (Saunders and Dooling, 1974; Dooling and Saunders, 1975; Dooling *et al.*, 2008).

b. Zone 2: At greater distances from the roadway, starting where the received noise levels fall below 110 dBA continuous exposure, hearing loss and permanent threshold shift are unlikely to occur. However, continuous traffic and construction noise above 93 dBA SPL might still temporarily elevate a bird's threshold, mask important communication signals, and possibly lead to other behavioral and/or physiological effects.

c. Zone 3: At even greater distances from the roadway, where the spectrum level of the noise is still at or above the natural ambient noise level, masking of communication signals from this added noise may occur. This, in turn, may also result in other behavioral and/or physiological effects.

d. Zone 4: Once the level of traffic and construction noise falls below ambient noise levels in the critical frequencies for communication, masking of communication signals is no longer an issue. However, faintly heard sounds, such as the low rumble of a truck, or an alarm from a construction site, may still lead to a chronic state of increased arousal and, thus, lead to other behavioral and/or physiological effects.

e. Beyond Zone 4: At this boundary, the energy in traffic noise and construction noise at all frequencies is completely inaudible (i.e., falls below the level of the ambient noise). The bird cannot hear this noise and, thus, the noise has no effects of any kind on the bird.

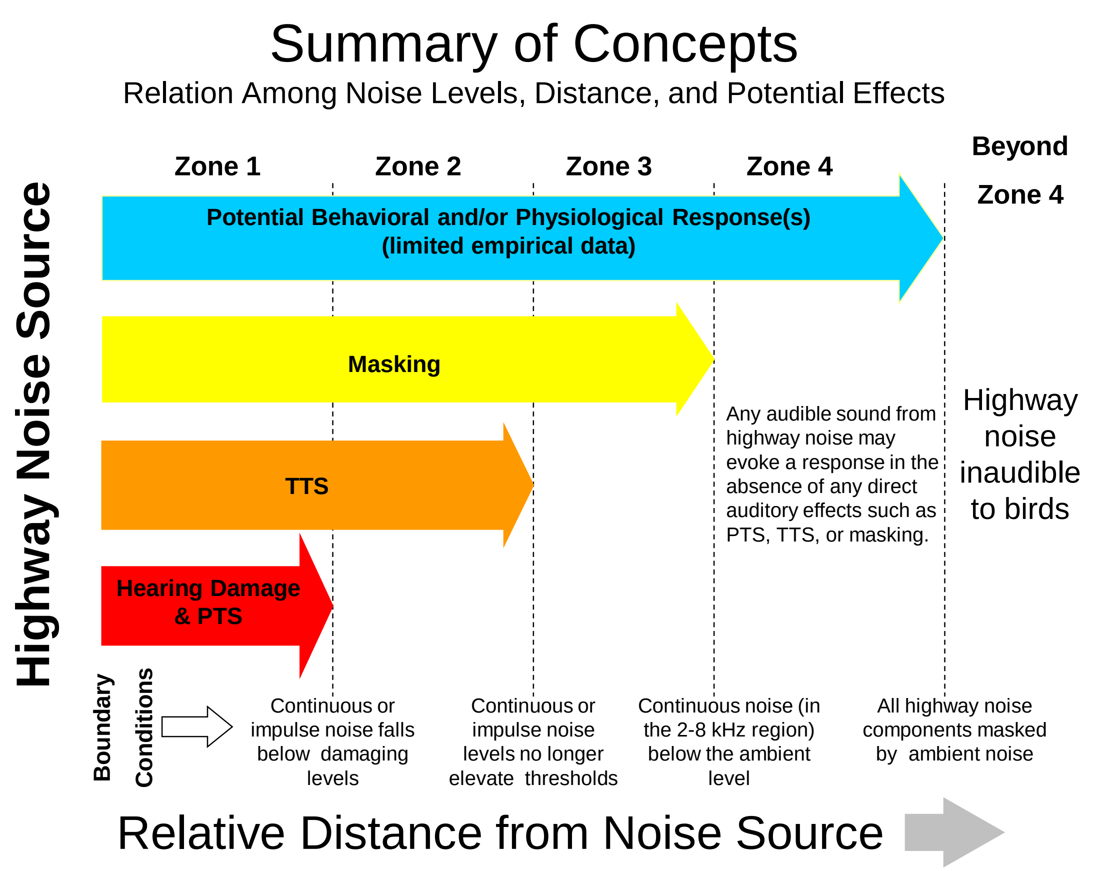

Figure 4: Potential Effects of Traffic and Construction Noise on Birds
Categories of traffic and construction noise effects on birds with distance from the source. Zone 1 is closest to the source while Zone 4 is furthest away. Sound level decreases further from the source. Note that the actual distances for the Zones ae not given since that would depend on the source sound level, hearing sensitivity of the receiver, and the propagation distance from the source to the receiver. See text for detailed discussion.

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e. Beyond Zone 4: At this boundary, the energy in traffic noise and construction noise at all frequencies is completely inaudible (i.e., falls below the level of the ambient noise). The bird cannot hear this noise and, thus, the noise has no effects of any kind on the bird.

Before considering the effects on the auditory system of birds from traffic and construction noise, it is important to understand three facts about potential behavioral and physiological effects of traffic and construction noise. One is that these effects can occur alone or in combination with effects on the auditory system of birds. Second, behavioral and physiological effects may be less dependent on noise level and more dependent on environmental context and the salience of the traffic and construction noise component(s) to the bird. Third, in contrast to the effects of noise on the bird auditory system, there are fewer empirical data available on behavioral and physiological effects, and especially for those effects that occur alone, as in Zone

Table 3: Recommended Interim Guidelines for Potential Effects from Different Noise Sources				
Noise Source Type	**Hearing Damage**	**TTS**	**Masking**	**Potential Behavioral/ Physiological Effects**
Single Impulse (e.g., starter's pistol 6" from the ear	140 dBA[1]	NA[3]	NA[5]	Any audible component of traffic and construction noise has the potential of causing behavioral and/or physiological effects independent of any direct effects on the auditory system of PTS, TTS, or masking
Multiple Impulse (e.g., jack hammer, pile driver)	125 dBA[1]	NA[3]	ambient dBA[6]	
Non-Strike Continuos (e.g., construction noise)	None[2]	93 dBA[4]	ambient dBA[6]	
Traffic and Construction Noise	None[2]	93 dBA[4]	ambient dBA[6]	
Alarms (97 dB/100 ft)	None[2]	NA[2]	NA[6]	

[1] Estimates based on bird data from Hashino et al. (1988) and other impulse noise exposure studies in small mammals.
[2] Noise levels from these sources do not reach levels capable of causing auditory damage and/or permanent threshold shift based on empirical data on hearing loss in birds from the laboratory.
[3] No data available on TTS in birds caused by impulsive sounds.
[4] Estimates based on study of TTS by continuous noise in the budgerigar and similar studies in small mammals.
[5] Cannot have masking to a single impulse.
[6] Conservative estimate based on addition of two uncorrelated noises. Above ambient noise levels, critical ratio data from 14 bird species, well documented short term behavioral adaptation strategies, and a background of ambient noise typical of a quiet suburban area would suggest noise guidelines in the range of 50–60 dBA.
[7] Alarms are non-continuous and therefore unlikely to cause masking effects.

A. Effects of Noise on Hearing in Birds—Threshold Shift

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Birds (as well as humans and other animals) show a shift in hearing sensitivity in response to sounds that are sufficiently long and/or intense. There are several recent reviews of the effects of trauma to the auditory system of birds (Dooling *et al.*, 2008; Salvi *et al.*, 2008; Saunders and Salvi, 2008). Taken together, the data show that birds can tolerate continuous (i.e., up to 72 hours) exposure to noises of up to received levels of 110 dBA without experiencing hearing damage or a significant permanent threshold shift.

Permanent Threshold Shift: A PTS occurs if the intensity and duration of the noise is sufficient to damage or kill the inner ear sensory hair cells or other structures in the inner ear. In birds, thee specific damage to sensory hair cells depends on the type, intensity, and duration of the acoustic trauma (reviewed in Cotanche, 1998). Since hearing depends on the function of these hair cells, their permanent loss in mammals, including humans, results in permanent hearing loss. However, since birds can regenerate damaged or destroyed sensory hair cells usually within a month, there can be substantial recovery of hearing, although there is often still a small, insignificant 10 dB threshold shift that remains permanent (Dooling and Saunders, 1974; Saunders and Dooling, 1974).

A number of comparative studies on hearing loss in birds are instructive in understanding important sources of variation on the effects of sound exposure on birds. For example, Japanese quail (*Coturnix coturnix japonica*) exposed to a 1.5 kHz octave band noise at 116 dB SPL for four hours showed hearing loss of up to 50 dB immediately following exposure (Niemiec *et al.*, 1994). Hearing loss was most severe at frequencies at and above 1.0 kHz, although there was considerable variation between subjects. Hearing loss was accompanied by a significant loss of sensory hair cells in the basilar papilla. Nevertheless, hearing improved rapidly within the first week following exposure, and recovered to pre-exposure levels within 8–10 days. Damaged hair cells were observed up to 2 weeks post exposure, but there was little evidence of damage to hair cells at 5 weeks post-exposure. Similar patterns of threshold shifts and recoveries were seen after repeated exposures to noise, although recovery times increased with increasing exposure duration. The authors found there can be a return to normal sensitivity prior to complete regeneration of the sensory hair cells (Bennett *et al.*, 1994) suggesting birds do not need a full complement of hair cells for normal hearing.

Ryals and colleagues (1999) found that the amount of hearing loss and the time course of recovery varied considerably among different bird species, even with identical exposure and test conditions. In one study, Japanese quail and budgerigars were exposed to pure tones of 112–118 dB SPL for 12 hours, with the frequency of the sounds centered in the region of best hearing of each species. Quail showed much greater susceptibility to acoustic trauma than did budgerigars, and showed significantly larger threshold shifts and hair cell loss. Quail showed a threshold shift of 70 dB at 2.86 kHz at one day following over-exposure, and this hearing loss remained virtually unchanged for 8–9 days after exposure. Hearing began to improve by about 1 dB/day until recovery at day 50, at which time recovery reached asymptote. This left the quail with a permanent threshold shift of approximately 20 dB, which remained even 1 year following exposure. In contrast, budgerigars showed a threshold shift of about 35–40 dB and a much faster recovery than the quail. By thee days after exposure, budgerigars' thresholds had improved to within 10 dB of normal. In human hearing, elevated thresholds of 10 dB are still considered within the normal range.

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In another experiment, budgerigars, canaries, and zebra finches were exposed to the same band pass noise (2–6 kHz) at 120 dBA SPL for 24 hours. Thresholds at 1.0 kHz were initially elevated by 10–30 dB but returned to within normal limits by about 10 days after exposure in all three species. Moreover, at 2.86 kHz, the center of the exposure band, all three species showed a 50 dB threshold shift. Recovery began immediately after the noise was terminated for canaries, while zebra finches recovered to within 10 dB of normal by about 30 days after exposure. However, thresholds remained elevated for 10 days before recovery begin to occur in budgerigars. By 50 days after exposure, thresholds for budgerigars still only recovered to about 20 dB above normal. Thus, in this experiment, there was significantly more rapid recovery in canaries and zebra finches than in budgerigars.

These comparative studies, and especially those by Ryals and her colleagues (Ryals and Rubel, 1985a, b; Ryals *et al.*, 1999), are important for understanding the effects of intense noise on hearing in birds. The Ryals et al. (1999) study showed that different species, tested under identical noise exposure and test conditions, all showed resistance to hearing damage from noise. In addition, these studies show that there is considerable variation among species in the amount of damage and the time-course of loss and recovery from acoustic trauma. Thus, concern over the effects of loud sounds on the ear and hearing is quite reasonable (McFadden and Saunders, 1989; Saunders *et al.*, 1991; Adler *et al.*, 1992; Adler *et al.*, 1993; Pugliano *et al.*, 1993; Saunders and Salvi, 1993). These studies suggest that, for birds, permanent hearing loss from traffic noise or construction noise is probably not a significant concern.

Temporary Threshold Shift: At continuous noise levels below 110 dBA down to about 93 dBA, birds may experience a temporary threshold shift (TTS) which lasts from seconds to days, depending on the intensity and duration of the noise to which the animal was exposed. In contrast to a PTS, hearing recovers completely from TTS to the level that it was before the exposure. Nevertheless, during this period of TTS the bird's hearing is temporarily impaired and this could affect a variety of auditory and vocal communication behaviors, including detection of predators, communication with young, auditory feedback, etc. There have been a number of studies quantifying the relation between noise exposure and temporary threshold shift in birds. Several of the most relevant studies are described below.

Budgerigars exposed to a narrow band of noise centered at 2 kHz for 72 hours at levels of 76–106 dB SPL showed maximum hearing losses at 2 kHz with a TTS ranging from 10–40 dB depending on the level of the noise to which the birds were exposed (Saunders and Dooling, 1974; Dooling, 1980) (Figure 5). Importantly, a PTS of 7–10 dB was observed only with the 106 dB exposure (Dooling, 1980). A 72-hour continuous exposure to a narrowband of noise at 106 dB would result in severe and permanent hearing loss in humans due to irrevocable damage to the sensory cells of the inner ear. TTSs in these birds also lasted less time than typically seen in mammals and were also restricted to a narrower range of frequencies (e.g., Luz and Hodge, 1971; Dooling, 1980; Henderson and Hamernik, 1986). The maximum threshold shift in budgerigars occurred at the exposure frequency (rather than at higher frequencies in mammals) and showed much less spread of threshold shift to other frequencies.

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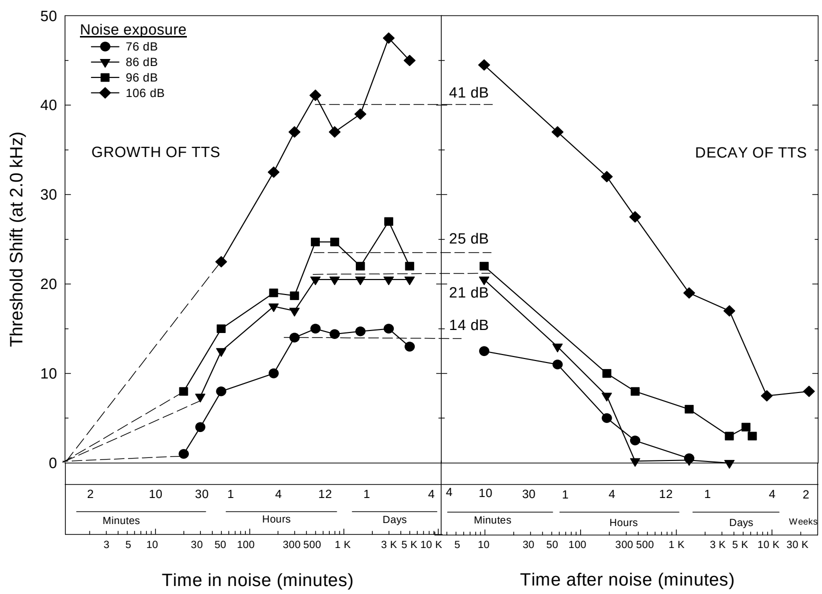

Figure 5: Threshold Shift in Birds Exposed to Noise
The growth and decay of threshold shift in four budgerigars exposed to four different levels of a one-third octave band of noise for 72 hours. Threshold shift reaches an asymptote (horizontal dashed line) after 12–24 hours regardless of the exposure level. Exposure to a 76 dB noise results in a threshold shift of 14 dB which recovers within a few hours following the termination of the noise. Exposure to a 106 dB noise, however, leads to longer recovery time and a permanent threshold due to damage to the inner ear (Dooling, 1982).

Finally, all the experiments described above were conducted with continuous noise, much as would be expected with dense traffic or continuous construction noise (Table 1, Figure 1). Impulse noises, such as those produced by single pieces of construction equipment, are short, intermittent, high intensity, and have very fast rise times (Table 2).

Much less is known about the effects on avian hearing resulting from high-level impulse sounds as might be experienced in close proximity to construction equipment as compared to lower level, continuous noise as from traffic. There is a single report in the literature that exposed budgerigars to four 169 dB SPL blast impulses produced by starter pistol shots in close proximity (20 cm) to the bird. In contrast to results from a continuous noise exposure, this impulsive exposure initially caused more low frequency (~60 dB) than high frequency (~40 dB) hearing loss (Hashino *et al.*, 1988). Even from this extremely intense exposure, however, thresholds at 1 and 4 kHz (the frequencies at which budgerigars sing and hear best) returned to almost normal within 20 days following the exposure. At 500 Hz, there remained a permanent threshold shift of about 20 dB even 40 days after exposure. These results confirm that birds are resistant to permanent auditory damage and hearing loss from noise exposure, even following extraordinarily exposure to intense impulse noise.

B. Masking and the Characteristics of Noise

Masking is the interference of the detection of one sound by another. For example, two people in a room talking at a comfortable level can easily hear one another because the level of the speech signal arriving at the ear is sufficiently greater than the background noise. If the people are having the same conversation in a noisy restaurant, it may be much harder for them to hear one another because the level of the background noise approaches the level of the speech signal from their companion. This is an example of the masking of speech by speech. Moreover, masking can also occur from other kinds of noises that also have energy in the spectral region of speech (e.g., noisy fans, air conditioners, traffic noise). **ORG6-125**

The simplest kind of masking experiment is to measure the sound detection thresholds for pure tones (the signal) in the presence of a broadband noise (see Appendix A). The noise in such an experiment is usually described in terms of a spectrum level (i.e., sound energy per Hz) rather than the overall sound pressure level. The signal level in the case of a pure tone is, of course, simply the level of the tone in dB. Experiments on masking in birds (and other animals) show that at low- to mid-levels, it is the noise in the frequency region of a signal that is most important in masking the signal—not noise at more distant frequency regions (Dooling *et al.*, 2000b). It could be the case that if the masker energy is at a low to moderate level in a frequency range that does not overlap with that of the pure tone, there may be no change in threshold for the pure tone.[17]

Masking of signals by noises in the same frequency range is an important phenomenon to keep in mind when estimating the effects of different kinds of noises on hearing. Common experience shows that acoustic communication can be severely constrained if background noise is of a sufficient level.[18] Such noise decreases signal-to-noise-ratios and thereby restricts the range over which a signal produced by a bird can be heard by another bird. In simple terms, background noise

[17] The amount of masking depends primarily on the amount of energy in the masker in the frequency region surrounding the pure tone. This band of frequencies around the pure tone in which masking will still occur is called the “critical band.”
[18] The exact level depends on many factors, including masker level and the hearing sensitivity of the species of concern.

makes it harder for an animal (including humans) to hear sounds of conspecifics or other sounds that may be biologically relevant. Otherwise said, it limits the organism's active acoustic space.

The masking case described above with a pure tone and broad band noise is very simple. In a natural setting, the situation is usually much more complex. The signal is rarely a pure tone, and the masker is rarely flat, broadband noise. Moreover, human work shows that it has been difficult to come up with a broadly acceptable definition of noise because of extreme variations in both the physical properties of noise and the perceptual preferences of listeners.[19] For humans, perhaps the broadest, most universally accepted definition is that noise is simply unwanted sound. This definition, however, is not useful in trying to predict the effects of masking on animal communication.

To make matters even more complex, noises can be continuous or intermittent, broadband or narrowband, or predictable or unpredictable in time or space. These noise characteristics determine the strategies that birds might employ to minimize the effects of noise on acoustic communication. Most laboratory studies measuring the effects of noise on signal detection (as described above) use continuous noises with precisely defined bandwidths, intensities, and spectral shapes. Because traffic noise on heavily traveled roads can approximate some of these features (e.g., relatively continuous, relatively constant spectrum and intensity), it increases the validity of using laboratory results to make predictions about how far away two birds can be in a natural setting and still hear one another in a background of traffic noise. In fact, for this purpose, laboratory masking studies define the worst case estimate of communication distance in the natural setting. This is because the animal being tested in the laboratory is in a fixed location with respect to the loudspeaker that is producing both the noise and the signal and head movement is restricted. Whenever these two conditions are not met, as is usually the case in a natural setting, the amount of masking from traffic noise is likely to be less, and sometimes considerably less, than predicted from signal-to-noise ratios measured in the laboratory. ORG6-125

C. Comparative Masking Effects in Birds—Critical Ratio

The ratio between the power in a pure tone at threshold and the power per Hz (the spectrum level) of the background noise is called the *critical ratio* (Fletcher, 1940). The masking principles discussed above that govern the critical ratio are shown schematically in Figure 6 (see also Figure 7). The critical ratio (left panel of Figure 6) is defined as the sound pressure level of a tone (when it is just masked) minus the spectrum level of the noise. In this case, the spectrum level of the noise is 40 dB SPL, and the level of a 3 kHz pure tone that can just be heard is 60 dB SPL, resulting in a critical ratio of 20 dB. Since it is noise in the spectral region of the tone that contributes most to the masking of the tone, measuring overall noise level over a very wide band of frequencies is not very useful unless the noise is flat and one can accurately estimate the level of noise around the signal. For a flat noise with an overall noise level of about 80 dBA, when measured across the whole band of noise, would have a spectrum level of 40 dB across the whole spectrum and in the region of the pure tone. When the noise is not flat, it is hard to calculate the spectrum level in the frequency region around 2–6 kHz—the frequency region that contains most of the energy in bird vocalizations.

[19] What is "noise" to one listener may be music to another, and vice versa.

Critical ratio data have now been obtained behaviorally for 14 species of birds, including songbirds (e.g., canary, sparrows, etc.), non-songbirds (e.g., budgerigars, pigeons), and some nocturnal predators (e.g., barn owl) (Dooling *et al.*, 2000b). Figure 7 shows the median critical ratio functions for the 14 species of birds (see Appendix C for these data) with corresponding values from the literature on tone masking by noise in human. There is species variation in bird critical ratios, with some birds approaching human levels of sensitivity and others being much worse than the median curve. However, the median function shows the typical pattern of approximately a 2–3 dB/octave increase in signal-to-noise ratio that has come to be characteristic of these functions in mammals, including humans (roughly a 3 dB/octave slope). The correlation between the increase in masking effectiveness and frequency is thought to be related to the mechanics of the peripheral auditory system (von Békésy, 1960; Greenwood, 1961a; b; Klump *et al.*, 1995).

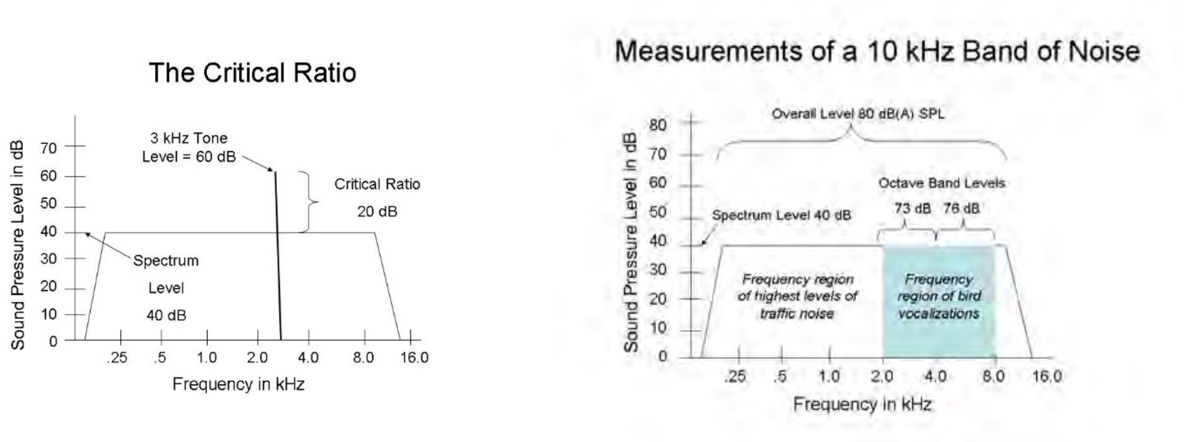

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Figure 6: Avian Critical Ratios
(Left) Schematic representation of the critical ratio. A 60 dB tone at 3 kHz is just masked by a broad band noise with a spectrum level of 40 dB. The critical ratio is defined as the level of the tone minus the spectrum level of the noise. (Right) The relationship for overall sound pressure level, spectrum level, and octave band levels between 2 and 8 kHz for a flat broad band noise. The overall level of noise of 80 dBA is greater than the amount of noise falling in the octave band of 2–4 kHz (73 dB) and 4–8 kHz (76 dB). Much of the energy in traffic and construction noise falls in lower frequencies, while bird vocalizations fall in mid- to higher frequencies. Measuring noise that is in the spectral region of bird vocalizations is critical to understanding whether masking occurs because it is predominantly the noise in this spectral region that contributes to the masking.

In practical terms, this critical ratio curve describes the level in decibels above the spectrum level of the background noise that a sound (usually a pure tone or other narrow band sound) must be in order to be heard. For the typical bird, a pure tone (or tonal vocalization) in the region of 3 kHz must be at about 27 dB (± 3dB) above the spectrum level of noise in order to be detected. In fact, birds vary in their critical ratios from about 21 dB (budgerigar) to about 32 dB (canary) at 3 kHz. For the human, the same pure tone need only be about 21 dB above the spectrum level of noise to be heard—a difference of about 6 dB from the typical bird (Dooling and Popper, 2000).

These data raise two important issues. First, there is little variation in how humans with normal hearing are able to detect signals in noise. The same is true of animals within a species. However, there is considerable variation across species in how well organisms can hear in noise, including among different species of birds. As is the case with susceptibility to auditory damage from noise exposure, there is no way to tell from a bird's vocalizations, physical appearance, or behavior, whether it hears well or less well in noise. Thus any complete model for predicting masking for a given species should use the species' critical ratio. The next best solution is to use the average or median values of all bird critical ratios.

Second, the difference in masked thresholds of 6 dB between humans and a "representative" bird with median masking thresholds for the 14 avian species studied has important implications for the detection of a point source of sound (e.g., a single vehicle, a piece of construction equipment, a bird singing, etc.) in a natural setting. Recall that sound pressure level decreases about 6 dB for a point source with every doubling of distance (by the inverse square law). What this means is that if a human listener can barely hear the sound of an automobile or a piece of construction equipment at 100 meters from the highway because of background ambient noise, the typical bird could not hear it at all. The bird would have to move twice as close to the highway (i.e., 50 meters) to barely hear the sound of an automobile. For a line source (e.g., a stream of traffic) which deceases at 3 dB/doubling of distance, this difference between birds and humans is a factor of 4.

Generally, since human auditory thresholds in quiet and in noise are about 6 dB better than that of the typical bird, this leads to the following two facts when conclusion on assessing the effect of noise on birds:

(1) When estimating whether a bird might be disturbed by hearing traffic or construction noise from a distant site, this 6 dB difference in masked thresholds means that if a human can barely hear traffic or construction noise from a distant site, a bird certainly cannot hear the noise and therefore can't be disturbed by it. The rule that "if a human can't hear it, a bird can't either" thus proves a handy rule of thumb for estimate whether a distant noise from construction equipment might be disturbing. ORG6-125

(2) However, when trying to estimate whether two birds can acoustically communicate against a background of traffic or construction noise, this 6 dB difference also means that the typical bird must be much closer to a singing bird to be able to hear it than does a human. So, if a human can barely hear a singing bird in the distance, the typical bird would not be able to hear it. In fact the bird would have to be even closer (i.e., half the distance) in order to hear the singing bird. In this case, human perceptual experience provides a dangerously poor estimate of whether two birds can hear one another against a background of traffic noise. It underestimates the effect of noise on communicating birds by over estimating the distance over which birds can communicate.

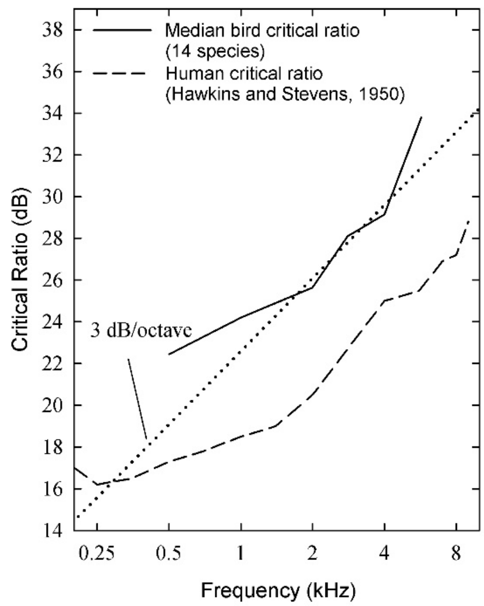

Figure 7: Critical Ratios in Birds and Humans

Median critical ratios for 14 birds (solid line) and the human (dashed line). Dotted line is a slope of 3 dB/octave. The critical ratio (s/n ratio) at threshold is about 6 dB greater in the typical bird compared to humans over the frequency range of 1–5 kHz (Dooling *et al.*, 2000b). These median critical ratios for birds represent the best available science of how birds hear in noise and can be used to predict how well birds can communicate in noise.

D. Understanding the Implications of Masking and Hearing in Noise

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As discussed earlier, the audiogram represents the lowest sound pressure level (in dB) of pure tones throughout the range of hearing that can be detected in the quiet background of a test booth (see Figure 2). But since all hearing in natural settings is against a background of noise, the pure tone audiogram is not very useful for estimating what a bird can hear in a natural setting. In other words, in all environments, other than a quiet background of a test booth, ambient noise in the background has a large effect on what can be heard (i.e., the critical ratio). Therefore, the critical ratio (Figure 6) provides the metric for estimating the effects of noise on the audiogram because it shows the level (in dB) that a pure tone must be above the spectrum level of noise in order to be heard.

The realization that all hearing in natural settings are masked thresholds and that a signal, in order to be heard, must be a certain level above the noise, provides a way to estimate the effect a particular continuous noise on the hearing of the typical bird. In the case of the 84 dBA traffic noise illustrated in Figure 8, there is a large masking effect from traffic noise at low and mid frequencies of the bird audiogram but less at high frequencies. Birds living in city environments tend to have higher pitched vocalizations than their rural counterparts because there is less masking from traffic noise at higher frequencies in rural environments.

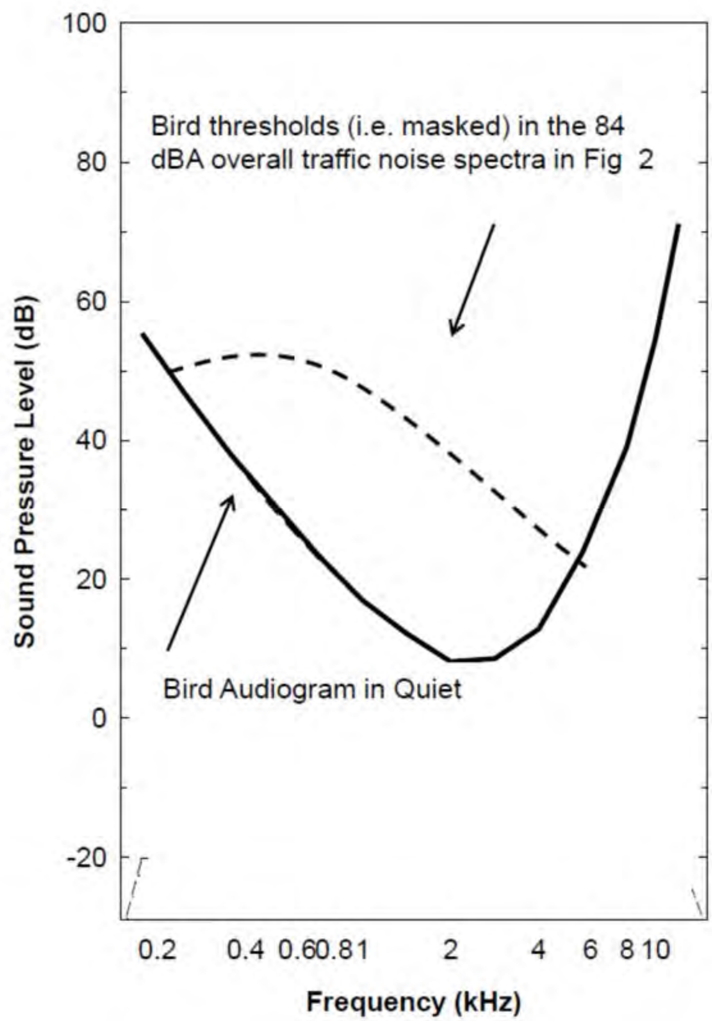

Figure 8: The Effects of Traffic Noise of 84 dBA on Hearing Thresholds of the Typical Bird
The effects of traffic noise illustrated earlier in Figure 2 raises a bird's threshold. The solid line shows the auditory thresholds (audiogram) in the quiet. The dashed line above the audiogram shows elevated thresholds due to masking by traffic noise at a level of 84 dBA. Thresholds are considerably elevated at low- to mid-frequencies.

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4. Effects of Traffic and Construction Noise on Birds—A Review of Relevant Literature

A. Overview

Reviewing effects of traffic noise on birds has been challenging in several ways as; it is difficult to find an effective way to evaluate information from very diverse perspectives to arrive at a useful predictive tool. One challenge is separating the effects of noise on birds from the effects of other variables (usually visual, but possibly vibratory or olfactory) that may occur along with the noise. Another challenge is in is applying findings from well-controlled laboratory studies involving a few species to the effects of noise exposure on birds in their natural environments. Under controlled circumstances in the laboratory, hearing capabilities can be measured to a precise degree. As mentioned above, these measures, when taken to the field, represent a worst case in terms of predicting the effects of noise on birds. This is because in laboratory studies, the noise is presented continuously, the signal and the noise are coming from the same location, and any other environmental cues ordinarily associated with the signal (e.g., visual cues) or the noise that might aid auditory perception of important biological signals in a natural setting are not present. Wild animals use an array of short term and long term strategies for counteracting the effects of noise in more natural environments, as described later. These are similar to the behaviors that humans employ in trying to hear and communicate in a noisy environment such as turning the head, raising the voice, moving closer to the source, etc.

Studies and reviews of the effects of traffic and construction noise on birds are often included in a broader literature on the effects on birds of other noise sources, most notably those produced by aircraft (airplane or helicopter) over-flight (e.g., Brown, 1990). Such studies sometimes provide insight into the effects of noise on breeding biology (e.g., Bunnell *et al.*, 1981), survival of eggs and young birds (Burger, 1983; Leonard and Horn, 2008), and non-auditory physiological effects. A number of these papers might also serve as more controlled experimental studies where the effects of noise on birds could be isolated and understood, and such studies may provide guidance for the type(s) of studies that are needed in order to better understand the effects of traffic and construction noise on birds.

At the same time, the characteristics of noise from aircraft is sufficiently different from that produced by traffic that extrapolation from one set of response data to the other is very difficult (Stansfeld *et al.*, 2005; Murphy and King, 2014) and perhaps should not be done at all. These differences include sound level and temporal distribution. Generally, at similar distances from the source, aircraft noise is far more intense than noise from roadways. Moreover, exposure to aircraft noise is almost always intermittent, whereas traffic noise can often be characterized and modeled as a continuous, lower level noise source. Birds respond to such differences in sounds in different ways; therefore, it becomes questionable whether it is possible to extrapolate between sound sources in trying to assess the effects of traffic noise on birds. **ORG6-125**

There is considerable evidence that road noise can contribute to stress and alter human physiology in many ways (Miller, 1974; Öhrström and Rylander, 1982; Öhrström and Björkman, 1983; Ouis, 2001; Le Prell *et al.*, 2012; Murphy and King, 2014). While caution should rule in the extrapolation of data from humans to birds or other animals, the many similarities in physiology between humans and birds, and the reliance of both on sound for communication, suggests the possibility that stress and physiological effects on humans may be paralleled in birds (and other terrestrial vertebrates).

B. Birds and Traffic and Construction Noise

As pointed out at the beginning of this Guidance Document, the world is becoming a noisier place and the cost of chronic noise exposure for terrestrial organisms could become significant (Barber *et al.*, 2010; Pijanowski *et al.*, 2011a., b; Luther and Magnotti, 2014; Merchant *et al.*, 2015). When the original 2007 report (Dooling and Popper, 2007) was written, there were relative few well-controlled studies on the effects of traffic noise on birds and a considerable amount of grey literature consisting of uncontrolled studies and anecdotal observations studies all suggesting the possibility of negative effects of traffic noise on birds. For instance, at that time there were reports from several investigators, later confirmed and published, suggesting that there may be differences in vocalizations between city birds and country birds, with city birds generally singing at a higher pitch presumably due to greater amounts of low frequency noise from urbanization, including traffic noise (Nemeth and Brumm, 2009; Nemeth and Brumm, 2010a; Slabbekoorn *et al.*, 2012). However, these studies in aggregate also led to two other inescapable conclusions: there were likely to be large species differences in susceptibility to increased noise, and there is an enormous challenge ahead in pinpointing the precise effects of traffic and construction noise on birds.

However, in the past eight years, there has been a number of more refined laboratory and experimental field research and observations published in peer-reviewed journals that has clarified some of the outstanding issues that were identified in earlier work. There is now a body of scientific literature which allows much stronger statements regarding the effects of noise on birds and the strategies birds use to adapt to increasing noise levels. While there are still numerous questions, especially with regard to species differences, it is overwhelmingly clear that many species of birds do respond to traffic noise (though no studies have focused on construction noise). However, it is also becoming apparent, as also discussed below, that many bird species successfully use the same kinds of strategies that humans and other animals use to hear and communicate in a noisy environment such as that created by traffic noise.

Results up to 2007: Many of the key issues involving the effects of traffic noise on birds were raised in the earlier literature, as were suggestions for future research. More recent findings have relied on this earlier work, and there is now a growing body of data that resolve some of the earlier issues. This Guidance Document focuses a review on this more recent data. For a complete review of the earlier work, please refer to the original report (attached as Appendix

Many of these earlier studies were in a very real sense pioneering. They also in many cases revealed considerable species variation and often did not have sufficient control of critical variables; therefore, these studies could not isolate the potential effects of highway noise on birds or provide general guidance (Clark and Karr, 1979; Ferris, 1979; Van der Zande *et al.*, 1980; Reijnen and Foppen, 1994; 1995; Reijnen *et al.*, 1995; Lee and Fleming, 1996; Llacuna *et al.*, 1996; Kuitunen *et al.*, 1998; Reijnen *et al.*, 1998; Clench-Aas *et al.*, 2000; Stone, 2000; Fernández-juricic, 2001; Forman *et al.*, 2002; Peris and Pescador, 2004). This literature has been reviewed several times in recent years (e.g., Sarigul-Klijn *et al.*, 1997; Kaseloo, 2005; Warren *et al.*, 2006; van der Ree *et al.*, 2011; Ortega, 2012; Slabbekoorn *et al.*, 2012; Merchant *et al.*, 2015); therefore, it will not be re-reviewed here. Instead, issues arising from this earlier work are listed below as a framework in which to understand the more recent, and generally more scientifically rigorous, work that has followed. **ORG6-125**

1) What evidence is there to suggest that results from one species or set of conditions can be generalized to all bird species?
2) Which aspects of a bird's behavior are likely to be affected by traffic noise?
3) How can one be sure that the effects of traffic noise on a bird is due to noise and not to other accompanying visual (i.e., moving vehicles) or olfactory (i.e., exhaust emissions, or tactile (i.e., vibration) stimuli?
4) Most studies are of adult birds. What are the effects of traffic noise on birds that must learn their vocalizations from auditory information?
5) Laboratory masking studies typically use white noise. Do the general masking principles emerging likely to hold for other anthropogenic noises?

Studies Since 2007: Many of the more recent studies discussed below add more high-quality information to the growing body of literature on this topic. Other studies are aimed specifically at some of the lingering questions from the last review and now allow conclusions on these questions, leading to an overall better understanding of how construction and traffic noise could impact birds.

Regarding the prevalence of noise effects on birds, a within-genera comparison of singing in 529 bird species within 109 genera has recently showed that species occurring in urban environments generally vocalize at higher frequencies than non-urban congeneric species without differing in body size or the vegetation density of their natural habitats (Hu and Cardoso, 2009, 2010). For example, white-crowned sparrow (*Zonotrichia leucophrys*) song increased in minimum frequency from 1969 to 2005 in San Francisco, and male birds responded more strongly to current songs than to earlier songs indicating current songs are most effective in the noisier environment (Luther and Baptista, 2010a; Luther and Derryberry, 2012; Luther and Magnotti, 2014).

For some species, it is clear that the whole communication process is affected and not just by the level of noise but by the actual signal-to-noise ratio. European robins (*Erithacus rubecula*) were presented with two playback songs, one with noise, one without; the male birds responded to the song in noise with increased minimum frequency and decreased song complexity and song duration (McMullen *et al.*, 2014).

In another study, low frequency traffic noise reduced female canary responsiveness to low-frequency, more attractive songs but did not affect responsiveness to high-frequency songs (Huet des Aunay *et al.*, 2014). In the great tit (*Parus major*), low frequency songs by males are related to female fertility and sexual fidelity. Urban noise impairs male-female communications shifting communication to higher frequency songs (Halfwerk *et al.*, 2011). Interestingly, artificial noise in nest boxes shows that female great tits can steer male singing behavior under noisy conditions, making males sing closer to the nest boxes even though males were not themselves exposed to noise (Halfwerk *et al.*, 2012). In another study, great tits were 6 dB better at detecting high frequency songs than low frequency songs in urban noise, but not in woodland noise. Moreover, discrimination between low frequency variants of song was less efficient than discriminating high frequency variants. High frequency elements were used by birds in urban noise, while all song elements were used in discriminating between songs in woodland noise (Pohl *et al.*, 2012).

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A great deal of research has also examined the relation between the increase in vocal intensity and the increase in vocalization frequency and whether there is a cause-effect relationship between these changes or if they occur independently (reviewed in (Zollinger *et al.*, 2012). Some birds adjust both loudness and peak frequency in their songs to compensate for traffic noise rather than simply adjusting loudness with a correlated frequency shift (Cardoso and Atwell, 2011). Other species vary multiple parameters. With increasing noise levels, plumbeous vireos (*Vireo plumbeus*) sang shorter songs with higher minimum frequencies while grey vireos (*Vireo vicinior*) sang longer songs with higher maximum frequencies suggesting that vocal plasticity may help some species occupy noisy areas (Francis *et al.*, 2011a, b). But the results are likely environmentally determined. The common blackbird (*Turdus merula*) preferentially sang higher frequency songs elements that can be produced at higher intensities and, at the same time, are less masked by low frequency traffic noise (Nemeth *et al.*, 2013b).

But it was also shown that for the common blackbird and the great tit, increasing frequency (song pitch) was less effective at increasing communication distance in noisy environments than was increasing vocal amplitude (Nemeth and Brumm, 2010a). Silvereyes (*Zosterops lateralis*) exposed to low and high frequency noise lowered the minimum frequency of their calls, and this shift was independent of amplitude which increased in all noises. Thus, silvereyes are clearly capable of flexible adjustments of call frequency, amplitude, and duration to maximize signal-to-noise ratio in noisy environments (Potvin and Mulder, 2013).

The variation noted in the earlier literature is still a leading finding. There are substantial species differences in which song features are adjusted. In the house wren (*Troglodytes aedon*), anthropogenic noise reduced bandwidth, increased trill rate, and increased minimum frequency (Redondo *et al.*, 2013). On the other hand, both northern cardinals (*Cardinalis cardinalis*) and American robins (*Turdus migratorius*) increased frequency range as noise increased but did not change song length or singing rate (Seger-Fullam *et al.*, 2011). A study in house sparrows (*Passer domesticus*) revealed that chronic noise exposure reduced fitness by masking parent-offspring communication rather than male-female communication (Schroeder *et al.*, 2012). Moreover, black-capped chickadees (*Poecile atricapillus*) use shorter, higher frequency vocalizations when traffic noise is high, and longer, lower frequency songs when noise abates (Proppe *et al.*, 2011). The same species sing at higher pitches with elevated anthropogenic noise but not with decreasing canopy cover, suggesting noise is the main factor, and not vegetation, that leads to increased song pitch (Proppe *et al.*, 2012). Finally, a pattern seen among seven songbird species is that noise contributes to declines in urban diversity by reducing the abundance of select species in noisy areas, especially species with low frequency songs (Proppe *et al.*, 2013).

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Noise effects are complex, usually related to level, and can be both short- and long term. Serins (*Serinus serinus*), a small European songbird related to canaries, responded to increasing levels of anthropogenic noise by increasing song activity up to noise levels of about 70 dBA, after which singing activity decreased with further increases in noise level (Díaz *et al.*, 2011). Male cardinals gave stronger responses to songs of average frequency than to songs with shifted frequency at low levels of background noise, but the difference disappeared at high noise levels, suggesting that frequency shifted songs were not advantageous in terms of communication at higher noise levels (Luther and Magnotti, 2014). Red-winged blackbirds (*Agelaius phoeniceus*) increased song tonality when temporarily exposed to low frequency white noise, and birds living in noisier environments showed increased tonality when singing in quiet, suggesting both short-term and long-term effects (Hanna *et al.*, 2011). On the other hand, male red buntings (*Emberiza bruniceps*) adjusted their songs immediately in response to noise singing at higher frequency and a lower rate when noise level were high, suggesting short-term, rather than long-term, adaptations (Kane *et al.*, 2010).

The effects of noise on bird songs are usually, but not always, negative. The female American kestrel (*Falco sparverius*) had higher cortisol levels and abandoned nests more frequently near busy roads and developed areas (Strasser and Heath, 2013). In a study of a number of bird species in northwestern New Mexico, noise alone decreased nesting species richness and this led to different communities of birds with less interaction with one another. But, unexpectedly, this same noise indirectly facilitated reproductive success of individuals nesting in noisy areas as a result of disruption of predator–prey relationships (Francis *et al.*, 2009). Experimental noise exposure data in six European songbird species revealed a noise-related earlier start of dawn singing for two out of six species but revealed no impact on four species with more variable starting times for dawn singing (Arroyo-Solís *et al.*, 2013).

Another study of six different American songbird species also found that the effects of urban noise on song were mixed. Minimum song frequency increased with noise level for two species, with those species singing in lower frequencies being most affected. On the other hand, maximum frequency and frequency range decreased for two species, with increasing urban noise at quiet sites (Dowling *et al.*, 2011). A recent paper examined the effects of noise on a bird's ability to discriminate between various levels of song degradation—a cue used by birds to gauge the distance from other singing birds. The great tit's overall responses in a noisy dawn chorus were, unexpectedly, very similar to their performance in silence.

Finally, Ware et al. (2015) conducted a well-controlled and designed study that separated the effects of traffic noise from the other sensory effects that accompany traffic noise such as exhaust (i.e., olfactory) and vehicular traffic (i.e., visual) by creating a "phantom road." Results across species were decidedly mixed. Some species avoided the noisy area, and some lost weight, while others did not. It's possible that presenting traffic noise without the attendant visual (e.g., moving vehicles), olfactory (i.e., exhaust emissions), and tactile (i.e., vibration) cues is itself stressful to some birds because these cues all normally occur together. Results from these recent studies confirm that the effects of traffic noise remain complicated and are highly likely to vary by species and other conditions (see also Merchant *et al.*, 2015).

Recent studies with young birds and nestlings, add even more complexity to the mixed effects described above. Young birds would not be expected to have had experience with noisy objects, such as vehicles, in their environment and, thus, the effects of noise alone might be easier to gauge. Crino et al (2013) showed nestling white crowned sparrows (*Zonotrichia leucophrys*) exposed to traffic noise had lower glucocorticoid levels and improved condition relative to control nests. Nestling Eastern bluebirds, young enough to be constrained to the nestling box were recorded in their natural habitat at various locations from quiet to near highways, parking lots, and other noisy environments. Birds did not increase the amplitude or structural characteristics of the begging calls in response to increasing noise levels (Swaddle *et al.*, 2012). On the other hand, a recent study on zebra finches by Potvin and MacCougall-Shackleton (2015) showed that chronic, long-term exposure to traffic noise in an experimental setting had both immediate and long-term effects on song but not in a way that would reduce masking. Moreover, the noise exposure resulted in a decrease in corticosterone suggesting reduced stress.

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Finally, a recent study examined the effects of traffic noise played to juvenile free-living house sparrows (*Passer domesticus*) and showed that exposed birds had shorter telomeres (chromosome ends) than birds not exposed, although the experimental and control birds were identical in all other ways, including health (Meillère *et al.*, 2015). Telomeres decrease in size with aging, and it is generally accepted that there is a correlation between telomere length and longevity. Thus, these results, though the first of their kind and only for single species, suggest a new mechanism by which traffic noise might affect birds.

The emerging picture from the latest research on the effects of noise on birds is one of more careful data collection and focused research designs but with complex outcomes still occurring and large species differences still the rule. Finally, extreme noise events may also have more extreme effects.

Using weather radar technology, it was documented that thousands of birds take flight following evening fireworks displays lasting 45 min. The peak densities of fleeing birds extended to altitudes of at least 500 feet (Shamoun-Baranes *et al.*, 2011). While this is the only report of its kind, it may have implications for the effects of short-term, high-level construction noise, especially when it occurs at night.

Summary of Recent Studies on Effects of Traffic Noise on Birds: The overall picture that emerges from the research since 2007 is still one of considerable complexity and variation. It is now abundantly clear that noise has a widespread effect on many species of birds. However, this is not to say that it is any easier to predict the specific effects of traffic noise on any particular species in its natural habitat. The recent literature also shows that the same noise can affect different species sometimes in the same way but often in different ways. And it is still the case that there are clear examples where traffic noise actually benefits a species rather than causing harm.

Nevertheless, it is difficult to argue with the notions that the world is an increasingly noisy place and noise affects birds and interferes with their acoustic communication. It follows that there should be an effort made to monitor anthropogenic noise and decrease noise levels where possible. The challenge in pinpointing specific effects of noise or finding invariant noise levels that cause harm across conditions should not be surprising. The same lack of specificity is true of humans living and communicating in noisy environments. Personal experiences (e.g., conversing in a noisy restaurant) make it clear that humans can and do employ a plethora of both short-term and long-term adaptive strategies for communicating effectively in noise, which makes it impossible to determine that a particular type or level of noise is accurately predictive. It is evermore clear from field studies and well-controlled laboratory studies that birds can and do use human-like strategies, described below, for counteracting the effects of an increasingly noisy environment. And, as with humans, it is possible from laboratory studies on birds to define a level of noise that would represent a "worst case" scenario in terms of interfering with acoustic communication. In other words, there is a precise signal-to-noise ratio at the ears below which communication is impossible without employing short term adaptation strategies (i.e., those typically available to freely moving birds in their natural habitat). That signal-to-noise value comes from laboratory studies and is the critical ratio. **ORG6-125**

C. Short-Term Adaptations to Noise Masking

A critical question is how birds, or any animal, including humans, adapt to noise (traffic) masking in the short term. Based on both highly controlled laboratory and field studies, it is apparent that in natural settings, birds can use many strategies to maximize their hearing in noise. For one, birds are able to adjust the characteristics of their vocalizations in response to temporary changes in the background noise. There is now a considerable amount of literature demonstrating that birds can adjust the amplitude of their vocalizations in response to increased noise by a phenomenon first referred to in humans as the Lombard effect. A number of species of birds have been shown to raise the level of their vocal output by as much as 10 dB in the presence of moderate background noise that is loud enough affect the bird's perception of its own vocalizations (Potash, 1972; Cynx *et al.*, 1998; Manabe *et al.*, 1998; Brumm and Todt, 2002; 2003; Hu and Cardoso, 2010; Nemeth *et al.*, 2013a).

The ability of birds to adjust vocalization in the presence of noise has now been demonstrated by studying behaving birds trained to wear headphones while vocalizing (Osmanski and Dooling, 2006). In these experiments, presenting noise through headphones caused the bird to raise the amplitude of vocal output by as much as 10 dB. These highly controlled laboratory studies are now complemented by a variety of field studies such as a study showing that males of the common nightingale (*Luscinia megarhynchos*) sing louder in noisier territories, and birds in urban areas sing louder on working days than on weekend days when noise levels are reduced (Brumm, 2004).

Paralleling what is known from humans communicating in noise, there is limited evidence that at least some birds use repetition rate or increases in call duration to increase the efficiency of signal transmission. Japanese quail increase the number of call syllables per call series in noise (Potash, 1972) and king penguins (*Aptenodytes patagonicus*) respond to increasing levels of background noise due to wind by increasing the number of syllables in their calls (Lengagne *et al.*, 1999).

Birds are also capable of making short term alterations in the spectrum of their vocalizations (Hultsch and Todt, 1996; Manabe, 1997). The basic mechanisms for this was more recently examined in budgerigars trained to produce vocalizations while wearing headphones. Such birds can be induced to pitch-shift their vocalizations in real time. Artificially shifting the pitch of auditory feedback of the bird's own vocalizations resulted in the bird compensating by shifting the pitch of its vocalization in the opposite direction (Osmanski and Dooling, 2009). These experiments demonstrate that birds have some short-term control over the pitch of their vocalizations and may use this ability to maximize information transfer in a noisy environment.

Clearly, humans can choose to communicate when noise levels are low and limit communication when noise levels are so high as to make communication impossible. It is also well known that birds can adjust the timing of their vocalizations to avoid competition for acoustic space with other species or to coincide with low noise periods to prevent auditory masking (Cody and Brown, 1969; Wasserman, 1977; Ficken *et al.*, 1985; Popp *et al.*, 1985; Popp and Ficken, 1987; Evans, 1991; Luther and Baptista, 2010b; Nemeth and Brumm, 2010b). **ORG6-125**

Birds (both senders and receivers) can also behaviorally counteract the effects of masking noise on acoustic communication by changing their location. One strategy that can improve signal-to-noise ratio is to move to a position in the habitat in which the transmission pathway is better for the signal than the noise (Brumm and Slabbekoorn, 2005). Thus, moving higher up into the canopy of the vegetation is another response that will improve the signal-to-noise ratio (Mathevon *et al.*, 1996; Holland *et al.*, 1998). With European blackbirds *(Turdus merula)*, it is estimated that moving up from the ground to a perch at about 9 meters (29.5 feet) high would result in an increase in audibility that is comparable to the receiver moving 90 meters (295 feet) closer to the sender horizontally (Dabelsteen *et al.*, 1993).

Birds (like humans and other binaural animals) enjoy a "spatial release" from masking when the noise source is spatially separated from the signal source. That is, when the signal to be detected comes from a different location in space than the noise, having two ears leads to an improvement in signal detection (Popper and Fay, 2005). In human hearing, this can represent a large effect, but there were some questions whether birds, with their closely spaced ears, would enjoy a similar benefit (Dent *et al.*, 1997). A Laboratory study with budgerigars under controlled conditions has shown that the amount of this masking release is can be as much as 10–15 dB when the noise and the signal arrive at the bird's ears from 90 degrees apart (Dent *et al.*, 1997) paralleling the advantage gained by humans when they scan the environment using head movements to hear a weak acoustic signal. Recalling that sound pressure decreases roughly 6 dB with each doubling of distance, this could translate into a quadrupling of distance over which two birds could communicate if they position themselves optimally with regards the noise source (i.e., at 90 degrees).

D. Long-Term Adaptations to Noise Masking

Even without human-generated noise, natural habitats have particular patterns of ambient noise (the acoustic scene) resulting from, among other things, wind, animal and insect sounds, and other noise-producing environmental factors such as a streams, waterfalls, etc. Biologists have long suspected that such noise has exerted a selection pressure on the evolution of acoustic signals, especially in birds (e.g., Morton, 1975; Brenowitz, 1982; Wiley and Richards, 1982; Ryan and Brenowitz, 1985; Slabbekoorn, 2004; Smith *et al.*, 2008, 2013). Brumm and Slabbekoorn (2005) reported that the large-billed leaf-warbler (*Phylloscopus magnirostris*), which lives close to river torrents in the Himalayas, evade masking of their territorial songs by producing high-pitched notes in narrow frequency bands around 6 kHz (Dubois and Martens, 1984). In fact, differences in song or call structure based on differences in habitat have been reported, or suspected, in a number of avian species (Douglas and Conner, 1999; Slabbekoorn and Smith, 2002; Slabbekoorn and Peet, 2003), such as for the songs of little greenbuls *(Andropadus virens)*. It remains an intense area of study as to whether a given vocalization is adapted to environmental noise by evolutionary or ontogenetic changes or both.

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E. Estimating Maximum Communication Distance between Two Birds Using Laboratory Masking Data

The question of whether noise affects vocalization structure raises a parallel question of how much noise is too much. In other words, how loud does a noise have to be before the bird must begin to alter the structure of its vocalizations in order to communicate? To address this question with quantitative rigor, Lohr *et al*. (2003) examined the effects of masking on the detection and discrimination of species-specific vocalizations in zebra finch and the budgerigar using two different types of continuous noise—one a flat, broadband noise and the other shaped like traffic noise with more energy at low frequencies and less at high frequencies**.**

Lohr and his colleagues used both budgerigar vocalizations (narrow band and tonal) and zebra finch vocalizations (broadband and harmonic) and measured both detection and discrimination because being able to detect a sound is not the same as being able to discriminate effectively between sounds or to recognize a particular sound. Results show exactly this for —it requires slightly better signal-to-noise ratio for birds to discriminate between two sounds in noise than to detect the sounds in noise at equivalent levels of performance. This is much like the case of perceiving speech in human listeners where hearing or detecting speech is not the same as actually hearing it well enough to understand what is being said.

These results enabled the investigators to estimate the theoretical maximum communication distance (d_{mc}) by solving the following equation adopted from Marten and Marler (Marten and Marler, 1977) and Dooling (Dooling, 1982):

$$\text{Drop} = 20 \cdot \log \left(\frac{d_{mc}}{d_o} + \frac{EA \cdot d_{mc}}{100} \right)$$

- Drop: the amount of signal attenuation from source intensity to that at threshold;
- d_{mc}: the maximum communication distance;
- d_o: the distance at which source intensity is measured; and
- EA: the amount of excess attenuation (linear attenuation, not due to spherical spreading).

Solving the above equation for both detection and discrimination of each species calls in both types of noise, and it is possible to generate a series of curves to describe maximum effective communication distances for a given level of background noise (Lohr *et al.*, 2003). In this analysis, a source intensity level of 95 dB SPL at 1 meter was assumed, as was an excess attenuation of 5 dB/100 meters (appropriate for an open area) (Lohr *et al.*, 2003). These values fall within the range of those measured in the field but are near the high end for source intensity (Brackenbury, 1979a, b) and the low end for excess attenuation (Marten and Marler, 1977; Brenowitz, 1982).

Such an approach provides a way to estimate maximum communication distance under fairly good conditions from the perspective of a receiver and revealed both species differences and vocalization differences. ORG6-125 The results demonstrate that it is easier for birds to hear vocalizations in traffic noise than flat noise. A bird can detect and discriminate budgerigar calls at longer distances than it can zebra finch calls. Budgerigars do better than zebra finches. And the distances over which signals may be discriminated are shorter than distances at which those same signals may be detected. These predictive distances from the laboratory masking data do not take into account any gains from short term adaptation strategies animals are able to use in their natural habitats. So, the distances obtained from this model represent the worst case scenario.

F. Putting It All Together—Predicting the Effects of Noise on Bird Acoustic Communication

It is clear that acoustic communication can be constrained if background noise is of a sufficient level, and can become impossible in very high noise levels. These effects occur because the noise decreases signal-to-noise ratios, thereby limiting the acoustic space of a sound. Noises can be continuous or intermittent, broadband or narrowband, and predictable or unpredictable in time or space. Background noise makes it harder for an animal (including humans) to detect sounds that may be biologically relevant, to discriminate among these sounds, to recognize these sounds, and to communicate easily.

Since the early studies by Lohr *et al*. (2003), more recent work (Dooling and Blumenrath, 2014) has elaborated on predicting communication distance in noise by considering not just detection and discrimination, but other meanings of hearing, including recognition and comfortable communication. It is now clear that signal discrimination requires a higher signal-to-noise ratio than detection; that recognition in both humans and birds requires an even higher signal-to-noise ratio than discrimination; and comfortable communication requires an even higher signal-to-noise ratio (Lohr *et al.*, 2003; Freyaldenhoven *et al.*, 2006). Interestingly, there is about a 3 dB difference in signal to noise ratio required between detection (i.e., the critical ratio) and discrimination, and between discrimination and recognition for both birds and humans. It is not possible to measure comfortable communication in a bird, but in humans a signal-to-noise ratio of about 15 dB is required. The similarity between birds and humans on the different signal-to-noise ratios required for detection, discrimination, and recognition strongly suggest that the 15 dB signal-to-noise ratio required for comfortable communication can probably also be applied to birds.

The approach developed from the above discussion integrates the spectrum level of the masking noise, how well the bird hears in noise (i.e., the critical ratio), the level at which the bird sings (Brackenbury, 1979b), as well as some simple acoustic characteristics of the environment. The model is based on the spectrum and the level of both the noise and the signaler's vocalization at the receiver's ear. These values for spectrum and level of noise and signal can either be measured directly or they can be estimated by applying signal attenuation algorithms to both the noise source and the signal source. The model is particularly relevant because it incorporates the notion that different auditory behaviors from detection (i.e., the critical ratio) to communicating comfortably (i.e., 15 dB greater signal-to-noise ratio than the detection threshold). For the listening bird, the model provides distances corresponding to the human perceptual experience of communicating comfortably versus just being able to detect that something was said.

Figure 9 shows the effects of anthropogenic traffic noise on four different auditory behaviors based on the median bird critical ratio function (see Figure 7 and discussion of masking). The specific case illustrated is for a background noise level at the listening bird of 60 dBA—a level that is typical of traffic noise measured roughly 300 meters (984 feet) from a busy 6 lane roadway. This example assumes the calling bird is vocalizing at a peak SPL of 100 dB (as measured 1 meter (3.3 feet) from the bird) through an open area and that the vocalization is affected by excess attenuation, in addition to the loss due to spherical spreading, of 5 dB/100 meters (328 feet). **ORG6-125**

In this noise, a comfortable level of communication between two birds requires a distance between them of less than 60 meters (197 feet). Recognition of a bird vocalization by the receiver can still occur at greater inter-bird distances up to about 220 meters (722 feet). Discrimination between two vocalizations is possible at inter-bird distances up to 270 meters (886 feet). And finally, simple detection of another bird's vocalization can occur at distances up to 345 meters (1,132 feet) in this noise. These findings can be plotted in terms of a bird's active auditory space as in shown in Figure 10 as a set of concentric circles with a listening bird in the center and a calling bird located at various distances from the listener representing the kind of auditory behavior that is possible at that distance.

G. Defining Guidelines for Effects

The model described above (Lohr *et al.*, 2003; Dooling *et al.*, 2009; Dooling and Blumenrath, 2014) incorporates many factors that should be considered when establishing guidelines for the effects of traffic and construction noise on birds. Based on psychophysical thresholds measured in a laboratory setting, it shows maximum communication distance for a typical bird in a natural setting based on the intensity with which the bird vocalizes and the transmission loss from the environment due to the excess attenuation. The threshold for effect would also have to take into account what is known about the spectral characteristics of vocalizations, the distance over which conspecific acoustic communication (e.g., the territory size) normally occurs, and the existing levels of ambient noise. Noise levels that limit the maximum communication distances to a distance that is less than the diameter of the bird's territory size (or known communication distances in ambient noise) may have serious biological consequences. The level of natural ambient noise already present in the bird's environment is a key factor in determining whether additional noise from traffic and construction would have any effect. Traffic or construction noise below ambient noise levels would not affect communication.

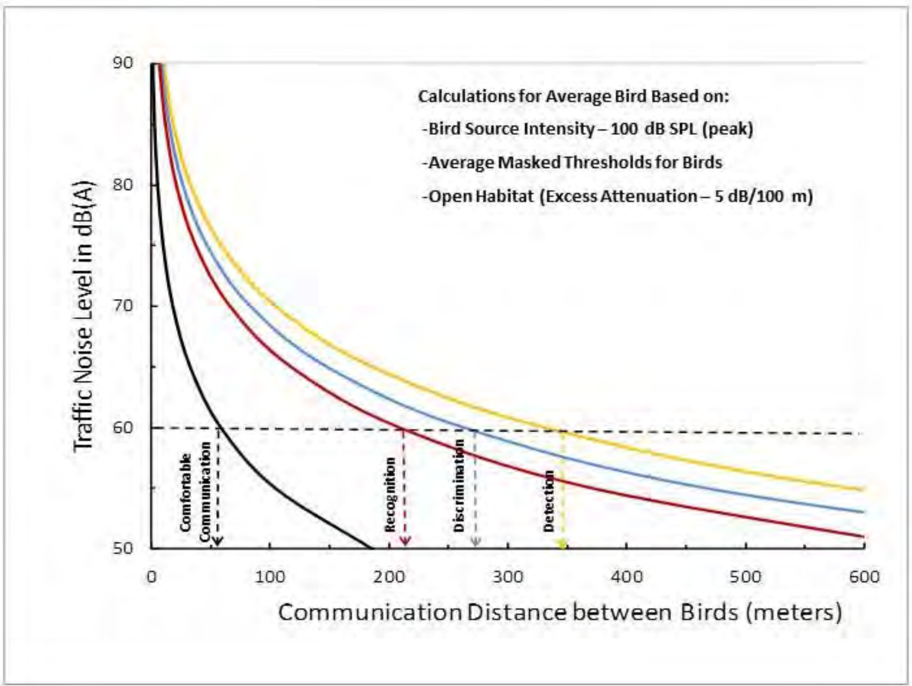

Figure 9: The Effects of Anthropogenic Traffic Noise on Four Different Behaviors Based on the Average Bird Critical Ratio Function

Based on the traffic noise spectrum shown in Figure 2 at a level of 60 dBA, comfortable communication occurs up to 60 meters; recognition of a vocalization can occur up to about 110 meters; discrimination between two vocalizations at about 270 meters, and detection at about 340 meters. Beyond this distance, a bird is not likely to detect the signal. This is based on laboratory critical ratio data and, thus, defines a worst case scenario. In a natural setting, birds would be expected to use their demonstrated short-term adaptation strategies for communicating in noise.

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Clearly, variation in territory size, the size of the critical ratio among birds, and natural ambient noise levels are key variables that make it impossible to use a single noise level as a one-level-fits-all level in terms of estimating whether traffic and/or construction noise is limiting communication distance by causing additional masking. In fact, species differences and habitat differences can make rather large differences in the distance. There are species differences in critical ratios and therefore these plots would look different for different species. Because budgerigars hear better in noise (smaller critical ratios) than, for instance, canaries, under the same conditions of an open habitat canaries would a much smaller active vocal space than do budgerigars in the same amount of noise. The model used here is successful in predicting communication distance in a variety of environments and a variety of species. When this model is combined with commercial software (e.g., SoundPlan[20]) for predicting noise characteristics at different distances from a highway, a map can be made describing the bird's communication difficulty at any location from the highway.

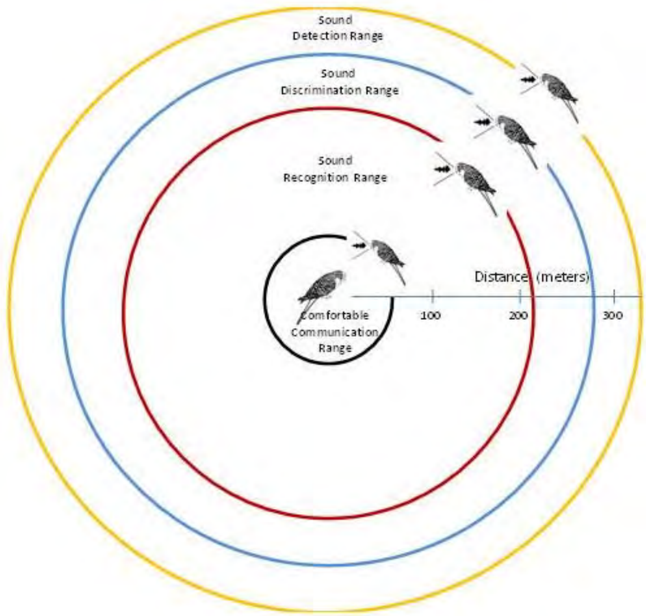

Figure 10: Diagrammatic Representation of Bird Communication

A diagrammatic representation of data in Figure 9 showing the quality of hearing for a bird in noise located at different distances from a sound-emitting bird. A bird can just hear a vocalizations (i.e., detect it) at a much greater distance than is required for comfortable communication. This represents the worst case scenario based on critical ratio data from the laboratory and does not include short-term adaptation strategies described earlier, which would improve communication.

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Based on laboratory data, this Guidance Document recommends several guidelines—two dealing with hearing damage and threshold shift, one dealing with masking, and a fourth dealing with stress and annoyance. As illustrated in Figure 3, these guidelines are as follows.

(1) Received noise levels less than 110 dBA SPL continuous are extremely unlikely to cause hearing damage or permanent threshold shift in birds.
(2) Received continuous noise levels below 93 dBA SPL are unlikely to cause even temporary threshold shifts in birds. This value, based solely on bird studies, is in harmony with much of the literature on human hearing. Consider, for example, that OSHA standards require hearing conservation procedures only when noise levels in the workplace reach continuous levels of 85 dBA for 8 hours.
(3) At further distances from the highway, once the received level of traffic and construction noise falls below the ambient noise level (particularly in the region of 2-4 kHz), there is little or no additional masking of communication signals beyond what already occurs from natural ambient noise.
(4) In the absence of empirical data from birds, received levels of traffic and construction noise known to annoy humans provide a useful interim guideline for the potential to cause

[20] http://www.soundplan.eu/english/soundplan-acoustics/

physiological stress and behavioral disturbance in birds. Generally, construction noise, because it is both short term and more intermittent, is likely to have less of an effect that traffic noise. This is expected except in rare in cases where birds may remain in close proximity to very high level impulsive noise as from pile driving.

Two common sense guidelines also arise from review of the data on masking. First, the typical human listener can hear traffic and construction noise at distances 2–4 times greater than can the typical bird. It follows that traffic and construction noise from either traffic or construction activity that is just barely audible to humans at any given distance, almost certainly cannot be heard by birds at the same distance. Second, the converse is also true, if a human listener can barely hear a bird singing against a background of traffic and construction noise, masking data suggest that another bird would have to half again as close to singing bird in order to hear it. In this case, using human hearing as a guide underestimates the effects of noise on bird communication.

5. Summary and Overview of the Effects of Traffic Noise on Birds

1) Stress and physiological effects:
   a) There are no studies definitively identifying traffic noise as the critical variable affect bird behavior near roadways and highways.
   b) There are well-documented adverse effects of sustained traffic noise on humans, including stress, physiological and sleep disturbances, and changes in feelings of well-being that may be applicable, when viewed with care, to birds.
   c) Traffic/construction noise below the bird's masked threshold has no effect. ORG6-125

2) Acoustic over-exposure:
   a) Birds are more resistant to both temporary and permanent hearing loss or to hearing damage from acoustic overexposure than are humans and other animals that have been tested.
   b) Birds can regenerate the sensory hair cells of the inner ear, thereby providing a mechanism for recovering from intense acoustic over-exposure, a capability not found in mammals.
   c) The studies of acoustic over-exposure in birds have considerable relevance for estimating hearing damage effects of traffic noise, non-continuous construction noise, and for impulsive-type construction noise such as pile drivers.

3) Masking:
   a) Continuous noise of sufficient intensity in the frequency region of bird hearing can have a detrimental effect on the detection and discrimination of vocal signals by birds.
   b) Noise in the spectral region of the vocalizations has a greater masking affect than noises outside this range. Thus, traffic noise will cause less masking than other environmental noises of equal overall level but that contain energy in a higher spectral region around 2–4 kHz (e.g., insects, vocalizations of other birds).
   c) Generally, human auditory thresholds in quiet and in noise are better than that of the typical bird, which leads to the following conclusions:
      (1) The typical human will be able to hear single vehicle, traffic noise, and construction noise at a much greater distance from the roadway than will the typical bird, thereby providing a valuable, common sense, easy-to-apply, risk criterion.

(2) However, the typical human will also be able to hear a bird vocalizing in a noisy environment at twice the distance that a typical bird, meaning that relying on human hearing underestimates the effects of noise on bird communication.

d) From knowledge of: (i) bird hearing in quiet and noise, (ii) the Inverse Square Law, (iii) Excess Attenuation in a particular environment, and (iv) species-specific acoustic characteristics of vocalizations, reasonable predictions can be made about possible maximum communication distances between two birds in continuous noise.

e) The amount of masking of vocalizations can be predicted from the peak in the total power spectrum of the vocalization and the bird's critical ratio (i.e., signal-to-noise ratio) at that frequency of peak energy.

f) Birds, like humans and other animals, employ a range of short-term behavioral strategies, or adaptations, for communicating in noise, resulting in a doubling to quadrupling of the efficiency of hearing in noise.

4) Dynamic behavioral and population effects:

a) Any components of traffic noise that are audible to birds may have effects independent of and beyond the effects listed above. At distances from the roadway where traffic noise levels fall below ambient noise levels in the spectral region for vocal communication (i.e., 2–8 kHz), low level but audible sound in non-communication frequencies (e.g., the rumbling of a truck) can potentially cause may cause physiological or behavioral responses). Beyond effects due specifically to traffic noise, since the more recent literature points to noise as possibly having wide ranging effects on birds, consideration must be given to the additive effects of traffic noise and environmental noise.

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5) Extrapolation of data from humans and birds to other species:

a) Since there is substantial variation in bird hearing and behavior, considerable care must be taken when trying to extrapolate data between species, and particularly when the species have different hearing capabilities and acoustic behaviors.

b) Data from humans has relevance to understanding effects of sound in birds. In particular, data on physiological effects in humans may have implications for birds, but additional study is needed.

6) Much more data are needed on:

a) Physiological effects of sound on birds.

b) How responses vary between species with regard to masking, hearing loss, and hearing recovery.

c) Hearing in young animals and how this compares to that in adults.

d) Additional, and carefully selected, species so there is a large enough database from which to allow extrapolation between species, and broader generalizations on effects of noise on birds.

e) A broader range of studies, as discussed in detail in Appendix F.

6. Estimating Effects of Traffic Noise on Birds, Rationale, and *Interim* Guidelines

This Guidance Document has reviewed three classes of potential effects of traffic noise on birds. The basis of the guidelines for each class of effects differs. Table 3 and Figure 3 provide specific *interim* criteria.

1. *Behavioral and/or physiological effects*: There are no definitive studies showing that traffic noise exclusively (as opposed to correlated variables) has an adverse effect on birds. While a wealth of human data and experience suggest traffic noise could have a number of adverse effects, there are several studies (e.g., Awbrey *et al.*, 1995) showing that birds (as well as other animals) adapt quite well, and even appear sometimes to prefer, environments that include high levels of traffic noise. Given the lack of empirical data on this point, it is recommended using subjective human experience with the noise in question as an *interim* guideline to estimate acceptable noise levels for avoiding stress and physiological effects. Noise types and levels that appear to increase stress and adverse physiological reactions in humans may also have similar consequences in birds.

2. *Damage to hearing from acoustic overexposure*: In contrast to the above, there are many definitive studies showing the effects of intense noise on bird hearing and auditory structures. These extensive data show that birds are much more resistant to hearing loss and auditory damage from acoustic overexposure than are humans and other mammals. Traffic and construction noise, even at extreme levels, is unlikely to cause threshold shift, hearing loss, auditory damage, or damage to other organ systems in birds and, therefore, *interim* guidelines for hearing damage from traffic and construction noise are probably not needed. Construction noise, such as impulse noise from pile driving, does reach high levels and may be capable of causing damage to auditory structures in birds. **ORG6-125**

3. *Masking of communication signals and other biologically relevant sounds*: Many laboratory masking studies show precisely the effects of continuous noise (including traffic noise) on sound detection in over a dozen species of birds. These studies describe a sort of worst case scenario because the noise is continuous and the myriad of short-term adaptive behavioral responses for mitigating the effects of noise are not available to the bird in a laboratory test situation. These masking studies led to an overall noise level guideline of around 60 dBA for continuous noise. Since this 60 dBA criterion was developed, however, controlled laboratory and field studies have extended the range of species differences in signal-to-noise ratios as well as the gain in signal-to-noise ratio that occurs with various short-term, adaptive behavioral responses that birds might use in natural environments. Critical ratios vary across species as much as 10 dB, strongly suggesting that acoustic communication in some species might be affected by an overall traffic and construction noise level even less than 60 dBA, while others would not. For some other species, communication between individuals, especially if they can employ short-term behavioral strategies for hearing in noise, might be unaffected at even higher levels of noise perhaps approaching 70 dBA. These short term behavioral adaptations include scanning (head turning), raising vocal output, and changing singing location. Each of these strategies alone can result in a significant gain in signal level or signal-to-noise ratio of about 10 dB (under masking conditions), and birds can employ all three strategies simultaneously.

4. *Practical guidelines arising from masking studies*: There is a common sense, extremely practical guideline that emerges from basic hearing knowledge of birds and humans. Specifically, the 6 dB difference in masking (critical ratio) functions between the typical bird and human listeners with normal hearing provide two common sense guidelines: (1) Humans can hear traffic noise, in a natural environment, at twice the distance from the roadway/highway than can birds. In other words, if in a natural environment, distant traffic noise is barely audible to humans, it is certainly inaudible to birds, and will have no effect on any aspect of their acoustic behavior. (2) Humans can hear a bird singing against a background of noise at twice the distance than can the typical bird. This provides an informal estimate of maximum communication distance between two birds vocalizing against a background of continuous traffic noise. This works not only for the typical bird, but it is probably also valid for most species.

These recommended guidelines for estimating effects that traffic noise has on masking in birds are *interim* guidelines for several reasons.

1. The *interim* guidelines are based on median data from masking studies from a limited number of the thousands of bird species. Thus, they represent the typical bird, based on the species studied. However, it is important to recall that bird species can vary considerably in how they hear in the presence of noise; some have masked thresholds that approach those of humans, while others have masked thresholds that are 3–4 dB worse than thresholds for the typical bird presented here. Therefore, final noise guidelines will require testing more species with appropriate experimental adjustment for the species in question.

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2. Traffic noise characteristics are influenced by transmission through the environment, as are the spectral, temporal, and intensive aspects of bird vocalizations through differences in excess attenuation. **ORG6-125**

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Appendix A: Glossary

Altricial: Species that are in an undeveloped state at hatching or birth and require care and feeding from parents.

Audiogram: A measure of hearing sensitivity, or threshold, at each frequency in the hearing range of an animal or human.

Auditory brainstem response (ABR): A physiological method to determine hearing bandwidth and sensitivity of animals without training. Electrodes (wires) are placed on the head of the animal just outside of the base of the brain (brainstem) to record electrical signals (emitted by the brain) in response to sounds that are detected by the ear. These signals are averaged and used to determine if the animal has detected the sound. It is possible to determine auditory thresholds for fishes using this method. The same method is used for numerous other species, including measurement of hearing capabilities of newborn human babies.

Auditory threshold: The lowest detectable sound, generally at a specific frequency. Most often, thresholds are the level at which a signal is detected some per cent of the time—often 50% or 70%. Absolute thresholds are the lowest level of signal that is detectable when there is no background (masking) noise.

Bandwidth: The range of frequencies over which a sound is produced or received.

Basilar papilla: The auditory region of the inner ear of birds. The basilar papilla referred to as the avian cochlea since it may be evolutionarily related to the mammalian hearing organ, the cochlea. ORG6-125

Broadband: Defined as noise that covers a wide range of frequencies relative to which the ear is sensitive. In contrast, narrowband noise covers only a limited number of (contiguous) frequencies. In relation to bird or human hearing, for instance, a broadband noise might contain sound energy from 100 to 10,000 Hz, whereas a narrowband noise may contain sound energy from 500 to 550 Hz.

Critical ratio: Defined as the ratio of the intensity of a pure tone to the intensity per hertz of a noise (i.e., the spectrum level) at a listener's threshold. For example, if a listener can just hear a 60 dB pure tone against a background of noise whose spectrum level is 40 dB, the listener's critical ratio is said to be 20 dB. In fact, the human critical ratio at 2 kHz is approximately 20 dB.

Conspecific: A member of the same species.

Decibel (dB): A customary scale most commonly used (in various ways) for reporting levels of sound. A difference of 10 dB corresponds to a factor of 10 in sound power. The actual sound measurement is compared to a fixed reference level and the decibel value is defined to be $10 \log_{10}$, (actual/reference), where (actual/reference) is a power ratio. Because sound power is usually proportional to sound pressure squared, the decibel value for sound pressure is $20\log_{10}$ (actual pressure/reference pressure). As noted above, the standard reference for underwater sound pressure is 1 micro Pascal (µPa). The dB symbol is followed by a second symbol identifying the specific reference value (i.e., re 1 µPa).

Effects: In this document, we have defined *effect* to mean any response by birds to traffic and construction noise. Our definition does not invoke or imply regulatory definitions of *effect*, as found in any law or regulation affecting birds.

Frequency spectrum: See *Spectrum*.

Hertz (Hz): The units of frequency where 1 hertz = 1 cycle per second.

Impulse sound: Transient sound produced by a rapid release of energy, usually electrical or chemical such as circuit breakers or explosives. Impulse sound has extremely short duration and extremely high peak sound pressure.

KiloHertz (kHz): A unit of frequency representing 1,000 Hz.

Noise: Generally an unwanted sound. Noise is often in the "ear of the beholder" in that a signal may be an important sound to one listener and unwanted "noise" to another.

Noise level: The noise power, usually relative to a reference level. Noise level is usually measured in decibels (dB) for relative power or picowatts for absolute power. Levels are represented in dB to denote specific aspects of the measurement and to also indicate the reference base or specific aspects of the measurement. Most frequently, sound levels for birds are referenced in terms of dB or weighted as dBA. **ORG6-125**

Octave: An octave is any band where the highest included frequency is exactly two times the lowest included frequency. For example, the frequency band that covers all frequencies between 707 Hz and 1,414 Hz is an octave band. The next octave band would be 1,414 to 2,828.

Ontogenetic: Development of an organism, usually from time of fertilization until it reaches its mature form.

Otolithic organs: The end organs in the vertebrate ear (saccule, utricle, lagena) associated with determination of head position relative to gravity. Along with the semicircular canals, these make up the vertebrate vestibular system.

Passeriformes: Song birds.

Permanent threshold shift (PTS): A permanent loss of hearing caused by some kind of acoustic or drug trauma. PTS results in irreversible damage to the sensory hair cells of the ear, and thus a permanent loss of hearing.

Power spectrum: "For a given signal, the power spectrum gives a plot of the portion of a signal's power (energy per unit time) falling within given frequency bins. The most common way of generating a power spectrum is by using a discrete Fourier transform, but other techniques such as the maximum entropy method can also be used."[21]

Semicircular canals: Three canals in the vertebrate ear that are mutually perpendicular to one another. They are involved in the detection of angular acceleration of the head, and provide the brain with information about movement of the head (and body). They are critically important to help maintain fixed gaze of the eyes on an object, even as the head moves. The semicircular canals and the otolithic organs make up the vestibular part of the ear.

Sensory hair cells: The cells in the basilar papilla and other end organs of the ear that are responsible for converting (transducing) mechanical energy of sound to signals that can stimulate the nerve from the ear to the brain (eighth cranial nerve).

Sound pressure level (SPL): The sound pressure level or SPL is an expression of the sound pressure using the decibel (dB) scale and the standard reference pressures 20 µPa for air and other gases.

Spectrum level: The intensity level of a sound within a 1 Hz band.

Spectrum (Spectra): A graphical display of the contribution of each frequency component contained in a sound.

Temporary threshold shift (TTS): Temporary loss of hearing as a result of exposure to sound over time. Exposure to high levels of sound over relatively short time periods will cause the same amount of TTS as exposure to lower levels of sound over longer time periods. The mechanisms underlying TTS are not well understood, but there may be some temporary damage to the sensory hair cells. The duration of TTS varies depending on the nature of the stimulus, but there is generally recovery of full hearing over time.

Threshold: The threshold generally represents the lowest signal level an animal will detect in some statistically predetermined percent of presentations of a signal. Most often, the threshold is the level at which an animal will indicate detection 50% of the time. Auditory thresholds are the lowest sound levels detected by an animal at the 50% level.

Weighting: An electronic filter which has a frequency response corresponding approximately to that of human hearing. Human hearing is most sensitive to sounds from about 500 Hz to 4000 Hz, and less sensitive at lower and higher frequencies. The overall level of a sound is usually expressed in terms of dBA and this is generally measured using a sound level meter with an "A-weighting" filter. The level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

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[21] From: http://mathworld.wolfram.com/PowerSpectrum.html

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Appendix B: Complete Table of all Behavioral Studies of Hearing in Birds

Order	Common Name	Genus and Species	References
Anseriformes	mallard duck	*Anas platyrhynchos*	(Trainer, 1946)
Apodiformes	Australian grey swiftlet	*Collocalia Spodiopygia*	(Coles *et al.*, 1987)
Caprimulgiformes	oilbird	*Steatornis caripensis*	(Konishi and Knudsen, 1979)
Casuariiformes	emu	*Dromaius novaehollandiae*	(Manley *et al.*, 1997)
Charadriiformes	plains wanderer	*Pedionomus torquatus*	(Pettigrew *et al.*, 1990)
Columbiformes	pigeon	*Columbia livia*	(Trainer, 1946; Heise, 1953; Hienz *et al.*, 1977)
Falconiformes	American kestrel	*Falco sparverius*	(Trainer, 1946)
Falconiformes	European sparrowhawk	*Accipiter nisus*	(Trainer, 1946; Klump *et al.*, 1986)
Galliformes	bobwhite quail	*Colinus virgianus*	(Barton *et al.*, 1984)
Galliformes	chicken	*Gallus*	(Gray and Rubel, 1985; Saunders and Salvi, 1993)
Galliformes	Japanese quail	*Coturnix japonica*	(Niemiec *et al.*, 1994)
Galliformes	turkey	*Meleagris gallopavo*	(Maiorana and Schleidt, 1972)
Passeriformes	American robin	*Turdus migratorius*	(Konishi, 1970)
	blue jay	*Cyanocitta cristata*	(Cohen *et al.*, 1978)
	brown-headed cowbird	*Molothrus ater*	(Hienz *et al.*, 1977)
	bullfinch	*Pyrrhula*	(Schwartzkopff, 1949)
	chipping sparrow	*Spizella passerina*	(Konishi, 1970)
	common canary	*Serinus canarius*	(Okanoya and Dooling, 1987)
	common crow	*Corvus brachyrhynchos*	(Trainer, 1946)
	European starling	*Sturnus vulgaris*	(Trainer, 1946; Konishi, 1970; Kuhn *et al.*, 1982; Dooling *et al.*, 1986)
	field sparrow	*Spizella pusilla*	(Dooling *et al.*, 1979)
	fire finch	*Lagonosticta senegala*	(Dooling *et al.*, 2000b)
	great tit	*Parus major*	(Klump *et al.*, 1986; Langemann *et al.*, 1998)
	house finch	*Carpodacus mexicanus*	(Dooling *et al.*, 1978)
	house sparrow	*Passer domesticus*	(Konishi, 1970; Aleksandrov and Dmitrieva, 1992)
	pied flycatcher	*Ficedula hypolueca*	(Aleksandrov and Dmitrieva, 1992)
	red-winged blackbird	*Agelaius phoeniceus*	(Hienz *et al.*, 1977)
	slate-colored junco	*Junco hyemalis*	(Konishi, 1970)
	song sparrow	*Melospiza melodia*	(Okanoya and Dooling, 1987; 1988)
	swamp sparrow	*Melospiza georgiana*	(Okanoya and Dooling, 1987; 1988)
	western meadowlark	*Sturnella neglecta*	(Konishi, 1970)
	zebra finch	*Taeniopygia guttata*	(Okanoya and Dooling, 1987; Hashino and Okanoya, 1989)
Psittaciformes	Bourke's parrot	*Neophema bourkii*	Dooling et al. Unpublished Data
	budgerigar	*Melopsittacus undulatus*	(Dooling and Saunders, 1974; 1975; Saunders *et al.*, 1979; Saunders and Pallone, 1980; Okanoya and Dooling, 1987; Hashino *et al.*, 1988)
	cockatiel	*Nymphicus hollandicus*	(Okanoya and Dooling, 1987)
	orange-fronted conureq	Aratinga canicularis	(Wright *et al.*, 2003)
Strigiformes	African wood owl	*Strix woodfordii*	(Nieboer and Van der Paardt, 1976)
	barn owl	*Tyto alba*	(Konishi, 1970; 1973; Dyson *et al.*, 1998)
	brown fish owl	*Ketupa zeylonensis*	(Van Dijk, 1972)
	eagle owl	*Bubo*	

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Order	Common Name	Genus and Species	References
	forest eagle owl	*Bubo nipalensis*	
	great horned owl	*Bubo virginianus*	(Trainer, 1946)
	long eared owl	*Asio otus*	(Van Dijk, 1972)
	mottled owl	*Strix virgata*	
	scops owl	*Otus scops*	
	snowy owl	*Nyctea scandiaca*	
	spotted wood owl	*Strix seloputo*	
	tawny owl	*Strix aluco*	
	white-faced scops owl	*Otus leucotis*	

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Appendix C: Complete Table of all Behavioral Studies of Critical Ratios in Birds

Order	**Common Name**	**Genus and Species**	**References**
Columbiformes	pigeon	*Columbia livia*	(Hienz and Sachs, 1987)
Passeriformes	brown-headed cowbird	*Molothrus ater*	(Hienz and Sachs, 1987)
	common canary	*Serinus canarius*	(Okanoya and Dooling, 1987)
	European starling	*Sturnus vulgaris*	(Okanoya and Dooling, 1987)
	fire finch	*Lagonosticta senegala*	(Lohr *et al.*, 2004)
	great tit	*Parus major*	(Langemann *et al.*, 1998)
	red-winged blackbird	*Agelaius phoeniceus*	(Hienz and Sachs, 1987)
	song sparrow	*Melospiza melodia*	(Okanoya and Dooling, 1987)
	swamp sparrow	*Melospiza georgiana*	
	zebra finch	*Taeniopygia guttata*	
Psittaciformes	budgerigar	*Melopsittacus undulatus*	(Dooling and Saunders, 1975; Dooling *et al.*, 1979; Saunders *et al.*, 1979; Okanoya and Dooling, 1987; Hashino *et al.*, 1988; Hashino and Okanoya, 1989)
	cockatiel	*Nymphicus hollandicus*	(Okanoya and Dooling, 1987)
	orange-fronted conure	*Aratinga canicularis*	(Wright *et al.*, 2003)
Strigiformes	barn owl	*Tyto alba*	(Konishi, 1973; Dyson *et al.*, 1998)

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Appendix D: Fundamentals of Highway Traffic Noise

(Provided by Caltrans)

Fundamentals of Traffic Noise

The following is a brief discussion of fundamental traffic-noise concepts. For a detailed discussion, please refer to the *Technical Noise Supplement* (Caltrans 2013) available on the Caltrans Web site (http://www.dot.ca.gov/hq/env/noise).[22]

Sound, Noise, and Acoustics

Sound is a disturbance that is created by a moving or vibrating source in a gaseous or liquid medium or the elastic stage of a solid and that is capable of being detected by the hearing organs. Sound can be described as the mechanical energy of a vibrating object transmitted by pressure waves through a medium to a hearing organ, such as a human ear. For traffic sound, the medium of concern is air. *Noise* is defined as loud, unpleasant, unexpected, or undesired sound.

Sound is actually a process that consists of three components: the sound source, the sound path, and the sound receiver. All three components must be present for sound to exist. Without a source to produce sound or a medium to transmit sound-pressure waves, there is no sound. Sound must also be received; a hearing organ, sensor, or object must be present to perceive, register, or be affected by sound or noise. In most situations, there are many different sound sources, paths, and receivers, not only one of each. *Acoustics* is the field of science that deals with the production, propagation, reception, effects, and control of sound.

Frequency and Hertz

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A continuous sound can be described by its *frequency* (pitch) and its *amplitude* (loudness). Frequency relates to the number of pressure oscillations per second. Low-frequency sounds are low in pitch, like the low notes on a piano, whereas high-frequency sounds are high in pitch, like the high notes on a piano. Frequency is expressed in terms of oscillations, or cycles, per second. Cycles per second are commonly referred to as Hertz (Hz) (e.g., a frequency of 250 cycles per second is referred to as 250 Hz). High frequencies are sometimes more conveniently expressed in kilo-Hertz (kHz), or thousands of Hertz. The extreme range of frequencies that can be heard by the healthiest human ears spans from 16–20 Hz on the low end to about 20,000 Hz (20 kHz) on the high end.

Sound-Pressure Levels and Decibels

The *amplitude* of a sound determines its loudness. Loudness of sound increases and decreases with increasing and decreasing amplitude. Sound-pressure amplitude is measured in units of micro-Newtons per square meter (N/m^2) , also called micro-Pascals (µPa). One µPa is approximately one-hundred billionth (0.00000000001) of normal atmospheric pressure. The pressure of a very loud sound may be 200 million ΦPa, or 10 million times the pressure of the weakest audible sound (20 µPa). Because expressing sound levels in terms of ΦPa would be cumbersome, *sound-pressure level* (SPL) is used to describe in logarithmic units the ratio of actual sound pressures to a reference pressure squared. These units are called bels, named after Alexander Graham Bell. To provide finer resolution, a bel is divided into 10 decibels (dB).

[22] http://www.dot.ca.gov/hq/env/noise/pub/TeNS_Sept_2013B.pdf

Addition of Decibels

Because decibels are logarithmic units, SPL cannot be added or subtracted by ordinary arithmetic means. For example, if 1 automobile produces an SPL of 70 dB when it passes an observer, 2 cars passing simultaneously would not produce 140 dB; rather, they would combine to produce 73 dB. When two sounds of equal SPL are combined, they produce a combined SPL 3 dB greater than the original individual SPL. In other words, sound energy must be doubled to produce a 3-dB increase. If two sound levels differ by 10 dB or more, the combined SPL is equal to the higher SPL; the lower sound level would not increase the higher sound level.

A-Weighted Decibels

SPL alone is not a reliable indicator of loudness. The frequency of a sound also has a substantial effect on how humans respond. Although the intensity (energy per unit area) of the sound is a purely physical quantity, the loudness or human response is determined by the characteristics of the human ear.

Human hearing is limited in the range of audible frequencies as well as in the way it perceives the SPL in that range. In general, the healthy human ear is most sensitive to sounds from 1,000–5,000 Hz and perceives a sound within that range as being more intense than a sound of higher or lower frequency with the same magnitude. To approximate the frequency response of the human ear, a series of SPL adjustments is usually applied to the sound measured by a sound level meter. The adjustments, referred to as a *weighting network*, are frequency-dependent.

The A-scale weighting network approximates the frequency response of the average young ear when listening to most ordinary sounds. When people make judgments of the relative loudness or annoyance of a sound, their judgments correlate well with the A-scale sound levels of those sounds. Other weighting networks have been devised to address high noise levels or other special problems (e.g., B-, C-, and D-scales), but these scales are rarely used in conjunction with highway-traffic noise. Noise levels for traffic-noise reports are typically reported in terms of A-weighted decibels (dBA). In environmental noise studies, A-weighted SPLs are commonly referred to as noise levels. Table D1 shows typical A-weighted noise levels. **ORG6-125**

Human Response to Changes in Noise Levels

Under controlled conditions in an acoustics laboratory, the trained, healthy human ear is able to discern 1-dB changes in sound levels when exposed to steady, single-frequency ("pure-tone") signals in the mid-frequency range. Outside such controlled conditions, the trained ear can detect 2-dB changes in normal environmental noise. However, it is widely accepted that the average healthy ear can barely perceive 3-dB noise level changes A 5-dB change is readily perceptible, and a 10-dB change is perceived as being twice or half as loud. As discussed above, doubling sound energy results in a 3-dB increase in sound; therefore, doubling sound energy (e.g., doubling the volume of traffic on a highway) would result in a barely perceptible change in sound level.

Table D1. Typical Noise Levels

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	— 110 —	Rock band concert
Jet flyover at 300 meters (1,000 feet)		
	— 100 —	
Gas lawn mower at 1 meter (3 feet)		
	— 90 —	
Diesel truck at 15 meters (50 feet) at 80 kilometers per hour (50 miles per hour)		Food blender at 1 meter (3 feet)
	— 80 —	Garbage disposal at 1 meter (3 feet)
Noisy urban area, daytime		
Gas lawn mower, 30 meters (100 feet)	**— 70 —**	Vacuum cleaner at 3 meters (10 feet)
Commercial area		Normal speech at 1 meter (3 feet)
Heavy traffic at 90 meters (300 feet)	**— 60 —**	
		Large business office
Quiet urban daytime	**— 50 —**	Dishwasher next room
Quiet urban nighttime	**— 40 —**	Theater, large conference room (background)
Quiet suburban nighttime		
	— 30 —	Library
Quiet rural nighttime		Bedroom at night
	— 20 —	
		Broadcast/recording studio
	— 10 —	
Lowest threshold of human hearing	**— 0 —**	Lowest threshold of human hearing

Source: Caltrans 2013.

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Noise Descriptors

Noise in our daily environment fluctuates over time. Some fluctuations are minor, but some are substantial. Some noise levels occur in regular patterns, but others are random. Some noise levels fluctuate rapidly, but others slowly. Some noise levels vary widely, but others are relatively constant. Various noise descriptors have been developed to describe time-varying noise levels. The following are the noise descriptors most commonly used in traffic-noise analysis.

- *Equivalent Sound Level (L_{eq})*: L_{eq} represents an average of the sound energy occurring over a specified period. In effect, L_{eq} is the steady-state sound level that in a stated period would contain the same acoustical energy as the time-varying sound that actually occurs during the same period. The 1-hour A-weighted equivalent sound level (L_{eq}[h]), is the energy average of the A-weighted sound levels occurring during a 1-hour period and is the basis for noise-abatement criteria (NAC) used by Caltrans and the FHWA.

- *Percentile-Exceeded Sound Level (L_x)*: L_x represents the sound level exceeded for a given percentage of a specified period (e.g., L_{10} is the sound level exceeded 10% of the time, L_{90} is the sound level exceeded 90% of the time).

- *Maximum Sound Level (L_{max})*: L_{max} is the highest instantaneous sound level measured during a specified period.

- *Day-Night Level (L_{dn})*: L_{dn} is the energy average of the A-weighted sound levels occurring during a 24-hour period with 10 dB added to the A-weighted sound levels occurring between 10 p.m. and 7 a.m.

- *Community Noise Equivalent Level (CNEL)*: CNEL is the energy average of the A-weighted sound levels occurring during a 24-hour period with 10 dB added to the A-weighted sound levels occurring between 10 p.m. and 7 a.m. and 5 dB added to the A-weighted sound levels occurring between 7 p.m. and 10 p.m.

Sound Propagation

When sound propagates over a distance, it changes in level and frequency content. The manner in which noise reduces with distance depends on the following factors.

- *Geometric spreading:* Sound from a small, localized source (i.e., a point source) radiates uniformly outward as it travels away from the source in a spherical pattern. The sound level attenuates (or drops off) at a rate of 6 dBA for each doubling of distance. Traffic and construction noise is not a single, stationary point source of sound. The movement of the vehicles on a highway makes the source of the sound appear to emanate from a line (i.e., a line source) rather than a point. This line source results in cylindrical spreading rather than the spherical spreading that results from a point source. The change in sound level from a line source is 3 dBA per doubling of distance. ORG6-125

- *Ground absorption*: The noise path between the highway and the observer is usually very close to the ground. Noise attenuation from ground absorption and reflective-wave canceling adds to the attenuation associated with geometric spreading. Traditionally, the excess attenuation has also been expressed in terms of attenuation per doubling of distance. This approximation is done for simplification only because prediction results based on this scheme are sufficiently accurate for distances of less than 60 meters (200 feet). For acoustically hard sites (i.e., those sites with a reflective surface, such as a parking lot or a smooth body of water, between the source and the receiver), no excess ground attenuation is assumed. For acoustically absorptive or soft sites (i.e., those sites with an absorptive ground surface, such as soft dirt, grass, or scattered bushes and trees, between the source and the receiver), an excess ground-attenuation value of 1.5 dBA per doubling of distance is normally assumed. When added to the geometric spreading, the excess ground attenuation results in an overall drop-off rate of 4.5 dBA per doubling of distance for a line source and 7.5 dBA per doubling of distance for a point source.

- *Atmospheric effects*: Research by Caltrans and others has shown that atmospheric conditions can have a significant effect on noise levels within 60 meters (200 feet) of a highway. Wind has been shown to be the most important meteorological factor within approximately 150 meters (500 feet) of the source, whereas vertical air-temperature gradients are more important for greater distances. Other factors such as air temperature, humidity, and turbulence also have significant effects. Receptors located downwind from a source can be exposed to increased noise levels relative to calm conditions, whereas locations upwind can have lower noise levels. Increased sound levels can also occur as a result of temperature inversion conditions (i.e., increasing temperature with elevation).

- *Shielding by natural or human-made features*: A large object or barrier in the path between a noise source and a receiver can substantially attenuate noise levels at the receiver. The amount of attenuation provided by this shielding depends on the size of the object and the frequency content of the noise source. Natural terrain features (e.g., hills and dense woods) and human-made features (e.g., buildings and walls) can substantially reduce noise levels. Walls are often constructed between a source and a receiver specifically to reduce noise. A barrier that breaks the line of sight between a source and a receiver will typically result in at least 5 dB of noise reduction. A taller barrier may provide as much as 20 dB of noise reduction.

D. Federal and State Regulations, Standards, and Policies

Federal and state regulations, standards, and policies relating to traffic noise are discussed in detail in the Protocol. A transportation project affected by the Protocol is referred to as type 1 project, which is defined in 23 CFR 772 as a proposed federal or federal-aid highway project for construction of a highway on a new location or the physical alteration of an existing highway that significantly changes the horizontal or vertical alignment or increases the number of through traffic lanes. The FHWA has clarified its interpretation of type 1 projects by stating that a type 1 project is any project that has the potential to increase noise levels at adjacent receivers. This includes projects to add interchange, ramp, auxiliary, or truck-climbing lanes to an existing highway. A project to widen an existing ramp by a full lane width is also considered to be a type 1 project. Caltrans extends this definition to include state-funded highway projects. The project alternatives evaluated in this report are considered to be a Type 1 project because they involve federal funding and adding lanes to the existing mainline highway.

Applicable federal and state regulations, standards, and policies are discussed below.

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National Environmental Policy Act

NEPA is a federal law that establishes environmental policy for the nation, provides an interdisciplinary framework for federal agencies to prevent environmental damage, and contains action-forcing procedures to ensure that federal agency decision-makers take environmental factors into account. Under NEPA, impacts and measures to mitigate adverse impacts must be identified, including impacts for which no mitigation or only partial mitigation is available. The FHWA regulations discussed below constitute the federal noise standard. Projects complying with this standard are also in compliance with the requirements stemming from NEPA.

Federal Highway Administration Regulations

23 CFR 772 provides procedures for conducting highway-project noise studies and implementing noise-abatement measures to help protect the public health and welfare, supply NAC, and establish requirements for information to be given to local officials for use in planning and designing highways. Under this regulation, noise abatement must be considered for a type 1 project if the project is predicted to result in a traffic-noise impact. A traffic-noise impact is considered to occur when the project results in a *substantial noise increase* or when the predicted noise levels *approach or exceed* NAC specified in the regulation. 23 CFR 772 does not specifically define what constitutes a substantial increase or the term approach; rather, it leaves interpretation of these terms to the states.

Noise-abatement measures that are *reasonable* and *feasible* and likely to be incorporated into the project, as well as noise impacts for which no apparent solution is available, must be identified before adoption of the final environmental document for the project. Table D2 summarizes the FHWA's NAC.

Table D2. Activity Categories and Noise Abatement Criteria

Activity Category	Activity $L_{eq}[h]$[1]	Evaluation Location	Description of Activities
A	57	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[2]	67	Exterior	Residential.
C[2]	67	Exterior	Active sport areas, amphitheaters, auditoriums, campgrou cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrour public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation area Section 4(f) sites, schools, television studios, trails, and tra crossings.
D	52	Interior	Auditoriums, day care centers, hospitals, libraries, medica facilities, places of worship, public meeting rooms, public nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E	72	Exterior	Hotels, motels, offices, restaurants/bars, and other develop lands, properties, or activities not included in A–D or F.
F			Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (wat resources, water treatment, electrical), and warehousing.
G			Undeveloped lands that are not permitted.

[1] The $L_{eq}(h)$ activity criteria values are for impact determination only and are not design standards for noise abatement measures. All values are A-weighted decibels (dBA).

[2] Includes undeveloped lands permitted for this activity category.

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Primary consideration is given to exterior areas. In situations where no exterior activities are affected by traffic noise the interior criterion (activity category E) is used as the basis for noise abatement consideration.

California Environmental Quality Act

CEQA is the foundation of environmental law and policy in California. The main objectives of CEQA are to disclose to decision-makers and the public the significant environmental effects of proposed activities and to identify ways to avoid or reduce those effects by requiring implementation of feasible alternatives or mitigation measures. Under CEQA, a substantial noise increase may result in a significant adverse environmental effect; if so, the noise increase must be mitigated or identified as a noise impact for which it is likely that only partial (or no) mitigation measures are available. Specific economic, social, environmental, legal, and technological conditions can make mitigation measures for noise infeasible.

Traffic-Noise Analysis Protocol for New Highway Construction and Reconstruction Projects

The Protocol specifies the policies, procedures, and practices to be used by agencies that sponsor new construction or reconstruction projects. NAC specified in the Protocol are the same as those specified in 23 CFR 772. This report defines a noise increase as substantial when the predicted noise levels with project implementation exceed existing noise levels by 12 dBA -L_{eq} (h). The Protocol also states that a sound level is considered to approach an NAC level when the sound level is within 1 dB of the NAC identified in 23 CFR 772. For example, a sound level of 66 dBA is considered to approach the NAC of 67 dBA, but 65 dBA is not.

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Appendix E: Review of Pre-2007 Literature on Effects of Traffic Noise on Birds

From (Dooling and Popper, 2007)

The literature on the actual effects of traffic noise on birds is limited and the methodology is often insufficient to provide a clear correlation between traffic noise and any effects on bird physiology and/or behavior. One particular concern is that whereas there is indirect evidence that traffic noise may affect birds (e.g., Reijnen and Foppen, 1994; 1995; Reijnen *et al.*, 1995; Forman *et al.*, 2002), there are also correlated variables that could have impact such as visual stimuli, air pollution produced by autos and trucks (e.g., Llacuna *et al.*, 1996; Clench-Aas *et al.*, 2000), and changes in the physical environment around the roadways (e.g., Ferris, 1979). Differentiating among these and other variables is often difficult or impossible. While there is statistical evidence (debated by some, see below) to suggest that noise may affect birds in some way (e.g., Reijnen and Foppen, 1994; 1995; Reijnen *et al.*, 1995), there have yet to be definitive experiments that clearly isolate noise as an exclusive source of disturbance. Even when noise is implicated as a contributing factor, there are still are many variables which are poorly understood, such as noise levels at the birds (received levels), effects of frequency of disturbances (e.g., how many cars/trucks come by a bird in some time interval – (Forman *et al.*, 2002), and species. Complicating this picture even further are substantial species differences in the way that birds respond to noise and how readily they may acclimate or habituate to various disturbances (e.g., Ferris, 1979; Kuitunen *et al.*, 1998; Fernández-juricic, 2001; Slabbekoorn and Ripmeester, 2008; Slabbekoorn *et al.*, 2012).

The overall literature has been critically reviewed several times in recent years (e.g., Sarigul-Klijn *et al.*, 1997; Kaseloo, 2005; Warren *et al.*, 2006; van der Ree *et al.*, 2011; Ortega, 2012). These reviews suggest that a good portion of the literature is not relevant to the issues at hand since the literature often does not take into consideration all appropriate variables (e.g., variables other than sound) or that the publications have problems with data analysis and/or interpretation. **ORG6-125**

In one analyses, Warren *et al.* (2006) evaluated data suggesting that noise could affect bird behavior. However, the authors pointed out that while the data could be interpreted as indicating that noise may affect birds, none of the earlier work can clearly be used to reach any firm conclusions about any one species, or all species. Indeed, Warren *et al.* (2006) point out the need for very specific and highly controlled laboratory and field studies to assess how highway (or any other) noise will affect birds. Such experiments are very difficult (and expensive) to design and execute, and all other variables must be taken into consideration in design of these experiments.

The four major sets of studies considered by Warren *et al.* (2006) are helpful to understanding the issues. In one series of papers, Reijnen and colleagues (Foppen and Reijnen, 1994; Reijnen and Foppen, 1994; 1995; Reijnen *et al.*, 1995) reviewed in (Reijnen *et al.*, 1998) examined the effects of motorway traffic on breeding bird populations in the Netherlands. The investigators concluded that traffic noise has an impact on birds within several hundred meters of the road and that roadway noise lowers the extent of bird breeding near highways. The study by Reijnen and colleagues showed that when traffic noise level was constant, there was no discernable effect from visual disturbance. But when visual disturbance was kept constant, bird distribution patterns were statistically correlated with traffic noise. Furthermore the authors noted that visual disturbance and vehicular pollutants extended outward only a short distance from the roadway, whereas both traffic noise and reduced bird densities extended outward much further. This differential effect distance approach suggests that if it is appropriately integrated into the experimental designs of future studies, it could provide more tractable means for isolating the effects of the confounding variables and better extracting focused information on noise-specific impacts.

While the data from Reijnen et al. are interesting and possibly instructive, the work has been severely criticized for poor statistical analysis and poor controls, and for lack of analysis of individual bird species (Sarigul-Klijn *et al.*, 1997) which concluded that the number of birds studied was too low for reliable statistical measures and that levels of significance used varied between study years. Sarigul-Klijn *et al*. (1997) also concluded that Reijnen et al., in reaching their conclusions, also did not consider construction as another potential point of impact on birds.

Most importantly, the Transportation Noise Control Center study (Sarigul-Klijn *et al.*, 1997) points out that Reijnen and colleagues pooled all of their data so that they presented a possible effect on all species, rather than determine whether there are species-specific effects. The importance of the species variability in response to noise (and other factors) has been emphasized in several other studies which have shown variability in whether different species respond to noise or not (e.g., Clark and Karr, 1979; Ferris, 1979; Van der Zande *et al.*, 1980; Kuitunen *et al.*, 1998; Fernández-juricic, 2001; Peris and Pescador, 2004). Indeed, lack of consideration of species variability in life style is also the basis for the poor generality of the FWS (2006) recommended procedures for analysis of the effects of sounds on spotted owls and marbled murrelets. **ORG6-125**

In another study, Stone (2000) did transects to determine bird populations over a wide range of land use types. The results led to the suggestion that there is a marked decrease in bird populations in noisier areas, despite the specific land use. However, Warren *et al.*, (2006) criticized the Stone (2000) study and pointed out that while noise was one variable that could have affected bird populations in some types of land use and not in others, Stone (Stone, 2000) did not do a multi-factor analysis to determine if other habitat issues, such as whether there were also differences ground surface, vegetative type, or other variables that could have altered a bird's behavior.

A more convincing case that traffic noise may affect birds is a study by Forman et al. (Forman *et al.*, 2002) which looked at the presence of five species of grassland bird populations at different distances from roadways in and around Boston. The authors argue that there is an effect on density of species studied by roadway noise, but that the extent of the effect, in terms of decreased populations at different distances, varied depending upon the level of traffic on the road. They found that when traffic was less than 8,000 vehicles/day there was no effect on grassland bird populations. In areas with from 8,000-15,000 vehicles per day, there was no effect on population levels per se, but there were fewer breeding birds up to 400 m from the road. Bird presence and breeding was decreased at up to 700 m from the roadway when there were from 15,000-30,000 vehicles per day, whereas this distance increased to 1,200 m for more than 30,000 vehicles per day (a multilane highway). While the authors conclude that noise may be the major factor affecting these grassland species, but that other environmental variables such as visual signals, air pollutants, and lack of prey near the roadways may help explain the decline in bird populations. Clearly, direct experimental evidence of effects of increased chronic noise of different levels and sound spectra (Lee and Fleming, 1996) is needed to confirm this hypothesis (also see Warren *et al.*, 2006).

Still, it is important to recognize that the results from Forman *et al.* (2002) may not be applicable to all species, or in all situations. For example, Peris and Pescador (2004) examined the effects of low, medium, and high traffic volumes on bird populations of 20 passerine species in pasture-woodland environments near several roads in western central Spain. While it is hard to specifically compare results between the two studies since Peris and Pescador (2004) did not define road density in terms of actual number of vehicles/day, the different results are instructive. In contrast to Forman et al. (Forman *et al.*, 2002), Peris and Pescador (2004) provided sound level measures at distances of 50-100 m from the roadways. They reported that the high traffic volume area had sound levels of 69±5 dB, medium density 46±3 dB, and low density at 36±2 dB (it was not indicated if this was dB SPL or dBA). Peris and Pescador (2004) showed that there were differences between the number of birds and the extent of breeding populations in each of the three areas, but the differences varied by species. In effect, no one pattern of bird presence was appropriate for all of the species studied over the two year period.

For example, corn bunting (*Miliaria calandra*), rock sparrow (*Petronia petronia*), and house sparrow (*Passer domesticus*) had a higher breeding density in the high traffic (noisier) environment than they did in the low traffic volume areas. In contrast, breeding density was higher for wheatear (*Oenanthe* sp.) in low and moderate traffic areas (quieter) than in high traffic areas. The authors concluded that 55% of the species did not show any difference in breeding density between the three noise level sites, whereas other birds did show statistically significant differences. The authors suggest that the differences in responses of the various species may depend on hearing sensitivity of the species, with birds that have more sensitive hearing showing greater avoidance of road noise than birds with poorer hearing. **ORG6-125**

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Appendix F: Recommendations for Research to Refine Future Guidance

The three classes of potential effects of traffic noise on birds: (1) behavioral and/or physiological effects; (2) damage to hearing from acoustic over-exposure; and (3) masking of communication signals. All of these can cause dynamic behavioral, and population effects. These three classes of potential effects lead to separate, *but overlapping*, recommendations for future work (see Table F1 and Table F2). Some of this work is at high priority while other work is of lower priority depending on the criteria for making decisions. High priority could be to go for those issues that can be tackled by efficiency of data collection and the precision of the results (e.g., noise exposure studies in the laboratory), or, at by taking on the problem that extends the furthest from the roadway (e.g., field studies of stress and disturbance effects at distances far beyond those at which hearing damage and masking from traffic noise might occur). Or highest priority could be assigned to some combination of studies which give the greatest potential value for moving us forward to better and more useful *interim* guidelines. Experiments that can quickly improve the *interim* guidelines are given a higher priority than longer-term (and often more difficult) experiments that may not refine the *interim* guidelines efficiently. It should be noted that while not always stated explicitly, all studies should be done on several species.

7) Stress and physiological effects:[23]
   a) Obtain a definitive answer to the question of whether traffic noise alone can cause stress, physiological reactions, and disturbances in social behavior in birds by using artificial traffic noises broadcast in large areas while birds (preferably captive) are monitored for stress indices (low priority).
   b) Conduct studies comparatively to determine if stress effects are species specific (low priority). ORG6-125
   c) Conduct studies on birds of different ages and with different degrees of experience with loud noises to determine if experience is a factor in stress-related impacts (low priority).

8) Acoustic over-exposure effects:
   a) Conduct lab experiments to definitively rule out the possibility that continuous loud traffic noise can damage avian hearing (low priority).
   b) Examine effects of different levels of continuous noise on temporary and permanent hearing loss in different bird species (high priority).
   c) Examine effects of impulsive noise such as that produced by construction equipment and pile driving on hearing loss in different bird species. Consider a range of variables including: the intensity of the noise, the number of impulses, inter-pulse interval, and effects of different "rest periods" between pulses on hearing loss. Also include combinations of continuous traffic noise and impulse noises since some mammalian data suggest a synergistic effect (high priority).

9) Masking effects:
   a) Extend what is known about masking effectiveness of traffic noise on the vocalizations of birds by conducting behavioral tests with a wider range of individual and species

[23] It should be noted that precise definition of the questions and issues of the effects of traffic noise on birds should be developed with the guidance of individuals who are expert on avian endocrinology and the literature on this topic.

vocalizations, different types and levels of traffic noise, traffic noises filtered through various habitats, and recorded at various distances from the roadway (high priority)

b) Assemble current data or generate new data on vocalizations of endangered species including types, levels, preferred singing location preferences, habitat characteristics, territory size, effects of habitat characteristics on vocalization and noise transmission. This will allow precise modeling of the masking effects of traffic noise acoustic communication (high priority).
c) Obtain ABR measures of hearing (audiogram) and masking (critical ratios) in endangered species to determine how well they conform to the emerging model of masking of vocalizations by noise which, to date, is based primarily on laboratory species of birds (high priority).
d) Develop a generalized quantitative model for estimating communication distance based on masking data, habitat characteristics, territory size, the bird's singing position preferences, and different traffic noise profiles (high priority).

10) Dynamic behavioral effects[24]

a) Evaluate population dynamic shifts (i.e., population range, predator prey relationships, etc.) based on increases in ambient traffic noise and construction related activities.
b) Evaluate any secondary effects of implementing adaptations in order to avoid masking. How does this interact with other life-cycle activities such as mate attraction, prey identification, territory size, etc.
c) Understand behavioral indicators of harassment or stress such as flushing from a nest, territorial behaviors, etc. associated with noise.

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The recommendations are summarized in Tables F1 and F2. Table F1 presents the data in terms of examining the effects in terms of specific sound types.

Table F1: Research recommendations based on interim guidelines

Noise Source Type	Hearing Damage	Masking	Behavioral/ Physiological
Single Impulse (e.g., Blast)	Expose multiple species to impulsive noises (at different levels/distances) and measure hearing loss & recovery.	Not applicable	Examine animals post exposure for signs of stress (e.g., droppings, etc.)
Multiple Impulse (e.g., jackhammer, pile driver)	Expose multiple species to multiple strikes (at different levels/distances/intervals) and measure hearing loss and recovery.	In multiple species, examine masking by low level noises from multiple strikes to compare with results from continuous noise masking(Lab study)	Examine animals post exposure for signs of stress (e.g., droppings, etc.)
Non-Strike Continuous (e.g., construction noise)	Not applicable	In multiple species, examine masking by low level noises from multiple strikes to compare with results from continuous noise masking(Lab study)	Examine animals post exposure for signs of stress (e.g., droppings, etc.)
Traffic and Construction Noise	Not applicable	In multiple species, examine masking by low level traffic and construction noises to compare with results from continuous noise masking(Lab study)	Examine animals post exposure for signs of stress (e.g., droppings, etc.)
Alarms (97 dB/100 ft)	NA	NA	Future research

[24] Get input from experts in behavioral ecology on the types of population effects that might be expected.

Table F2: Additions to basic science data to inform decisions on interim guidelines and future analyses	
Topic	**Method**
Audiograms in Birds	Measure hearing thresholds in a variety of species using the ABR(lab & field)
Masked Thresholds in Birds	Measure masked thresholds and critical ratios in a variety of (endangered) species using the ABR(lab & field)
Vocalization & Communication Distance	Review literature for description of vocalizations, territory size, and communication range, young learning songs, female choice in breeding
Acoustic Communication Model	Develop a model that combines habitat characteristics (e.g., sound transmission), vocalization characteristics (e.g., spectrum, intensity, etc.) and masked thresholds to refine estimates of the effects of masking by noise on communication.
Attenuation/Avoidance/Minimization/Mitigation Methods	Evaluate ways which may inform decisions regarding equipment use, attenuation methods, avoidance, minimization/mitigation methods.

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Appendix G: A History of the 60 dBA Criterion

In 1987, a biologist, John Rieger, developed a criterion for a California highway project by measuring noise levels at the nests of birds along a highway. On average, these levels approximated 60 dBA (Barrett, 1996). According to Barrett, Rieger assumed that if birds were successfully breeding, then this noise level is, by definition, not detrimental to the birds. Unaware of this work, and completely independently, Dooling also provided the California Fish and Wildlife Service with a noise level of 60 dBA for traffic noise that would begin to raise concerns about potential masking of communication sounds between birds by traffic noise. Barret's number came from actual observations of birds nesting in noisy areas near a highway. Dooling's number came from an auditory model that calculated whether noise levels from traffic rose above ambient noise levels enough to affect acoustic communication between two birds. In neither case was this number intended to set a precedent or become a standard for noise-impact mitigation. The level of 60 dBA for traffic noise only applies, at best, under a narrow range of specific conditions having to with the sound-affecting aspects of the habitat, the species life style and dependence on acoustic communication, the level of ambient noise without any traffic noise, as well as whether the species' predators use acoustic signals to locate their prey. The use of one number like 60 dBA provides only a crude and probably conservative estimate. A precise answer would require the information just discussed as well as information about the level and spectrum of the ambient noise, of the traffic noise, and of the bird's vocalizations.

Nevertheless, it appears that the 60 dBA criterion has been inappropriately used in many reports over the past 25 years as a hard and fast rule regarding the effects of highway and other anthropogenic noise on birds. The evidence today clearly shows that the application of this criterion to construction noise is likely to be far too conservative and unnecessarily restrictive. There are several reasons for this conclusion: (1) birds do not hear as well as humans at low frequencies which contain the bulk of energy in traffic noise; (2) bird vocalizations are at higher frequencies than traffic noise; (3) the use of the A scale on the sound level meter which mirrors human hearing, as opposed to bird hearing, overestimates the effects of traffic noise on bird hearing because traffic and construction noises are predominantly low frequency; and (4) birds, like humans, can and do employ a number of short term behavioral strategies for hearing in noise such as turning their heads, changing height or location, raising their voice, and timing their communication to coincide with periods of low noise. ORG6-125

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Amanda, matrix can say "Exhibit K: [Description of attachment]"

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EXHIBIT K

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GENERATOR BASICS: SOUND ATTENUATION

GENERATOR NOISE

Understandably, kW output and fuel type are major considerations when choosing an industrial generator for your facility. However, generator noise quickly becomes the next major factor in deciding which industrial generator is best. A 50kW diesel generator set can typically produce around 85 dB(A) –as loud as city traffic. A 1500kW engine can be as loud as, if not louder than a jet engine 1000 feet above our heads (105 dB(A)). This can be an annoyance to neighbors but can pose actual health risks to those working in close proximity.

ENGINE IMPROVEMENTS

Most major industrial generator manufacturers have made great strides in reducing overall generator noise by making advancements in fuel injection technology, turbocharging and internal combustion control measures. Larger engines produce more power strokes per revolution (RPM), smoothing out overall power flow, and like V-8 configurations, internally balancing the unit to reduce vibrations that lead to noise.

BROWSE USED GENERATORS

SOUND ATTENUATION

Many industrial generator manufacturers also produce sound attenuating enclosures. These are usually built from 12 to 14-gauge steel or even aluminum. These specially designed generator housings effectively provide a Noise Control Barrier; reducing noise by up to 40 dB(A) as well as providing some weather resistance. Other effective tools for noise reduction include; exhaust silencers, acoustic insulating materials, and isolation mounts. Any combination of the listed sound reducing measures will benefit you, the end user, and your community.

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NOISE ORDINANCES

The majority of noise ordinances are based upon decibel readings taken at the property line. Simply choosing a location as far as possible from neighbors can effectively solve noise ordinance problems. However, OSHA has set guidelines to protect workers from noise pollution. These require facility management teams to do everything possible to suppress dangerous decibel levels from heavy equipment.

MORE INFORMATION

For more guidance on how noise pollution can affect your generator purchasing decisions, and answers to many more of your generator questions, simply give us a call.

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Amanda: Matrix can say "Exhibit L: [Title of Attachment"]

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EXHIBIT L

International Journal of
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Review

WHO Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Effects on Sleep

Mathias Basner * and **Sarah McGuire**

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Abstract: To evaluate the quality of available evidence on the effects of environmental noise exposure on sleep a systematic review was conducted. The databases PSYCINFO, PubMed, Science Direct, Scopus, Web of Science and the TNO Repository were searched for non-laboratory studies on the effects of environmental noise on sleep with measured or predicted noise levels and published in or after the year 2000. The quality of the evidence was assessed using GRADE criteria. Seventy four studies predominately conducted between 2000 and 2015 were included in the review. A meta-analysis of surveys linking road, rail, and aircraft noise exposure to self-reports of sleep disturbance was conducted. The odds ratio for the percent highly sleep disturbed for a 10 dB increase in L_{night} was significant for aircraft (1.94; 95% CI 1.61–2.3), road (2.13; 95% CI 1.82–2.48), and rail (3.06; 95% CI 2.38–3.93) noise when the question referred to noise, but non-significant for aircraft (1.17; 95% CI 0.54–2.53), road (1.09; 95% CI 0.94–1.27), and rail (1.27; 95% CI 0.89–1.81) noise when the question did not refer to noise. A pooled analysis of polysomnographic studies on the acute effects of transportation noise on sleep was also conducted and the unadjusted odds ratio for the probability of awakening for a 10 dBA increase in the indoor L_{max} was significant for aircraft (1.35; 95% CI 1.22–1.50), road (1.36; 95% CI 1.19–1.55), and rail (1.35; 95% CI 1.21–1.52) noise. Due to a limited number of studies and the use of different outcome measures, a narrative review only was conducted for motility, cardiac and blood pressure outcomes, and for children's sleep. The effect of wind turbine and hospital noise on sleep was also assessed. Based on the available evidence, transportation noise affects objectively measured sleep physiology and subjectively assessed sleep disturbance in adults. For other outcome measures and noise sources the examined evidence was conflicting or only emerging. According to GRADE criteria, the quality of the evidence was moderate for cortical awakenings and self-reported sleep disturbance (for questions that referred to noise) induced by traffic noise, low for motility measures of traffic noise induced sleep disturbance, and very low for all other noise sources and investigated sleep outcomes.

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Keywords: sleep; transportation noise; wind turbine noise; hospital noise

1. Introduction

Sleep is a biological imperative and a very active process that serves several vital functions [1]. Undisturbed sleep of sufficient length is essential for daytime alertness and performance, quality of life, and health [2]. Noise has been shown to fragment sleep, reduce sleep continuity, and reduce total sleep time [3,4]. Numerous experimental studies have demonstrated that sleep restriction causes, among others, changes in glucose metabolism and appetite regulation, an attenuated immune response to vaccination, impaired memory consolidation, and dysfunction of blood vessels [5–10]. These are precursors for manifest diseases like obesity, diabetes, high blood pressure, and probably also dementia [11,12]. The epidemiologic evidence that chronically disturbed or curtailed sleep is associated with the negative health outcomes mentioned above is overwhelming [1,13]. For these reasons, noise-induced sleep disturbance is considered one of the most important non-auditory effects of environmental noise exposure [14].

Sleep and the effects of noise on sleep can be measured in multiple ways [15]. The gold standard for measuring sleep is polysomnography, which is the simultaneous measurement of (at least) brain electrical potentials (electroencephalogram, EEG), eye movements (electrooculogram, EOG), and muscle tone (electromyogram, EMG). The night is usually divided into 30-s epochs and a sleep stage (or awake) is assigned to each epoch based on typical patterns in the EEG, EOG, and EMG and according to standard criteria [16,17]. Rapid eye movement (or REM) sleep is differentiated from non-REM stages S1 through S4 (or N1 through N3 according to the newer AASM criteria [17]). Stages S3 and S4 (or N3) are also called deep or slow wave sleep (SWS). Continuous bouts of SWS and REM sleep are important for memory consolidation and sleep recuperation, while superficial sleep stage S1 and wake time do not relevantly contribute to sleep recuperation [18]. Polysomnography is currently the only methodology that provides detailed information on sleep stages, sleep structure, and shorter cortical arousals. However, it is somewhat invasive, and trained personnel are needed to attach and detach electrodes and to visually score sleep stages (with known inter-rater variability [19]). This restricts the sample size and generalizability of polysomnographic studies. Simpler methods with similar informative value compared to polysomnography are needed to increase generalizability of noise-effects studies [20].

Other less invasive but typically less sensitive methods include actigraphy and signaled awakenings. Actigraphy infers sleep or wake from wrist movements measured with a watch-like device that is usually worn for 24 h [21]. These devices have been introduced to the consumer market and have become more and more popular over the past years, with potential avenues for future noise-effects research. In studies using signaled awakenings, participants are asked to push a button whenever they wake up during the night, which requires both waking consciousness and the motivation of the subject to push the button, which explains the low sensitivity of this methodology. Finally, questionnaires may be used to ask about awakenings, sleep latency and other aspects of sleep quality. They can refer to the last night or to longer time periods. As humans are unconscious for most of the sleep period, subjective assessments of sleep may not agree with objective measurements, and misattributions are possible (e.g., a subject wakes up spontaneously, regains consciousness, and then perceives a noise event). Also, the subject may use his/her answer to make a political statement if the question explicitly asks about the effect of a noise source. Regardless of the limitations outlined above, self-assessments of sleep disturbance are nevertheless important endpoints for studies on the effects of noise on sleep, and they have been used successfully to describe exposure-response relationships and inform analyses on the burden of environmental noise on disease [14,22]. The different methods for measuring sleep are discussed in greater detail in Basner et al. [15].

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The auditory system has a watchman function and constantly scans the environment for potential threats. Humans perceive, evaluate and react to environmental sounds even while asleep [23]. At the same sound pressure level, meaningful noise events are therefore more likely to cause arousals from sleep than less meaningful events. During the night, noise can often be described as intermittent (i.e., discrete noise events rather than a constant background noise level). In this case, the effects on sleep are primarily determined by the number and acoustical properties (e.g., maximum SPL, spectral composition) of single noise events (Figure 1). Noise may be accompanied by vibrations (e.g., rail noise), and the combination of noise and vibration induces higher degrees of sleep disturbance than noise alone [24]. Whether or not noise will disturb sleep also depends on situational (e.g., depth of sleep phase [25], background noise level [26]) and individual (e.g., noise sensitivity) moderators [23]. Repeated noise-induced arousals impair sleep quality and recuperation through changes in sleep structure including reduced sleep continuity [27], delayed sleep onset and early awakenings, less deep and REM sleep, and more time spent awake and in superficial sleep stages (Figure 1) [25,28]. Noise may also prevent a subject from falling asleep again after a spontaneous or noise-induced awakening. Deep and REM sleep have been shown to be important for sleep recuperation in general and memory consolidation specifically [10].

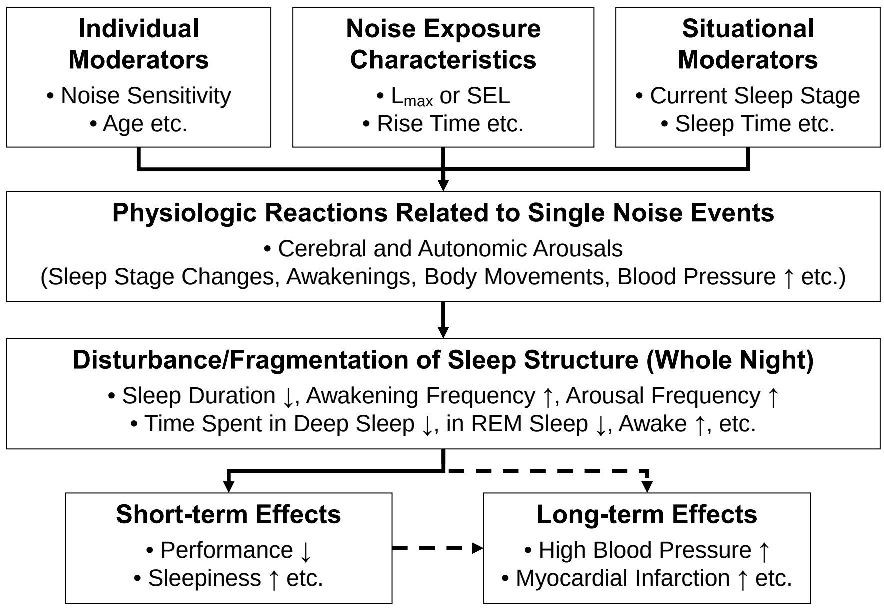

Figure 1. Effects of noise on sleep. It is hypothesized that health consequences will develop if sleep is relevantly disturbed by noise over long time periods (dashed lines; figure reproduced from Basner et al. [25]).

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Non-acoustic factors can also affect sleep: external (e.g., high temperature and humidity) and internal (e.g., sleep disorders, nightmares) factors may induce arousals from sleep, complicating the unequivocal attribution of arousals from sleep to noise [29]. At the same time, classical indicators of fragmented sleep (e.g., awakenings, body movements) are part of the physiological sleep process and occur multiple times throughout the night in healthy sleepers and environments without external stressors, with no pathologic consequences. For example, a healthy adult briefly awakens ca. 20 times during an 8 h bed period (most of these awakenings are too short to be remembered the next morning) [30]. It is currently unclear how many additional noise-induced awakenings are acceptable and without consequences for sleep recuperation and health, especially given the large inter-individual differences in the susceptibility to noise. Although compensatory mechanisms have been observed [28], it is unclear at what point these mechanisms are exhausted or what biological cost they carry. In typical noise scenarios, noise-induced sleep-disturbance is usually less severe than, e.g., that observed in clinical sleep disorders like obstructive sleep apnea [31].

Short-term effects of noise-induced sleep disturbance include impaired mood, subjectively and objectively increased daytime sleepiness, and impaired cognitive performance [32,33]. It is hypothesized that noise-induced sleep disturbance contributes to the increased risk of cardiovascular disease if individuals are exposed to relevant noise levels over months and years (dashed lines in Figure 1). Recent epidemiologic studies indicate that nocturnal noise exposure may be more relevant for the genesis of long-term health outcomes like cardiovascular disease than daytime noise exposure, probably also due to the fact that people more consistently are at home during the night than during the day [34]. Given the many vital biological functions of sleep, and the fact that acutely curtailed or fragmented sleep has immediate consequences for next day alertness and performance, the effects of noise on sleep should not solely be judged based on long-term health consequences. Sleeping satisfies a basic need and is pleasurable if undisturbed and of sufficient length (very much like eating when hungry). Sufficient sleep increases, among others, alertness, mood, productivity, and creativity [2].

Therefore, sleep disturbance (induced by noise or other external or internal factors) needs to be minimized even without clearly established links to long-term health consequences.

One of the main goals of noise effects research is to derive exposure-response functions that can then be used for health impact assessments and ultimately to inform political decision making [3]. Numerous studies have associated several transportation noise sources (e.g., road, rail, and aircraft noise) with awakenings, briefer brain activations, and vegetative arousals (e.g., increases in heart rate and blood pressure) in both laboratory and field settings [25]. Unfortunately, sample sizes and response rates of the studies that are the basis for exposure-response functions were usually low, which restricts generalizability of the latter. These functions are usually sigmoidal (s-shaped) and show monotonically increasing reaction probabilities with increasing maximum sound pressure levels (SPL) or sound exposure levels (SEL). Maximum SPLs as low as 33 dBA induce physiological reactions during sleep, i.e., once the organism is able to differentiate a noise event from the background, physiologic reactions can be expected (albeit with a low probability at low noise levels) [35]. This reaction threshold should not be confused with limit values used in legislative and policy settings, which are usually considerably higher. As exposure-response functions are typically without a clearly discernible sudden increase in sleep disturbance at a specific noise level and because of individual variation in noise sensitivity, defining limit values is not a straightforward task. It usually involves expert judgement of the existing evidence (e.g., Night Noise Guidelines [36]), and political weighing of negative health consequences of noise and societal benefits of the noise source.

Equivalent noise levels are often used in surveys and epidemiologic studies as long-term average exposure metrics, and are therefore also often found in legislative and policy contexts. For example, the Night Noise Guidelines for Europe of the World Health Organization (WHO) define effects of nocturnal noise based on annual average outdoor L_{night} ranges [36]. The value of equivalent noise levels in describing the effects of noise on sleep is more limited, as different noise scenarios may calculate to the same equivalent noise level, but differ substantially in their sleep disturbing properties [25]. There is general agreement that the number and acoustical properties of single noise events better reflect the actual degree of nocturnal sleep disturbance in a single night [35]. It is thus questionable whether L_{night} can be used as the only indicator for predicting the effects of noise on sleep and the consequences of noise-induced sleep disturbance, or whether supplemental noise indicators are needed [25]. **ORG6-127 cont.**

Subjects exposed to noise usually habituate. For example, the probability that noise causes physiologic reactions is in general higher during the first nights of a laboratory experiment compared to the last nights [28], and exposure-response relationships derived in the field (where subjects have often been exposed to the noise for many years) are usually much shallower than those derived in laboratory settings, which often include exposure to unfamiliar noise events in an unfamiliar environment [35,37]. Habituation is a reasonable mechanism that preserves energy resources. However, habituation is not complete, i.e., subjects continue to react to noise events even after several years of noise exposure. Unfortunately, little is known about individual differences in the ability to habituate to noise and potential predictors. Importantly, activations of the vegetative nervous system habituate to a much lesser degree to noise compared to cortical arousals. They provide biologic plausibility for the observed association between long-term noise exposure and cardiovascular disease [28,38,39]. It is also possible that exposed subjects become more sensitive to the effects of noise on sleep. This sensitization may be related to, e.g., individual changes (like aging, new incident disease), changes in noise exposure, or changes in media coverage. However, scientific knowledge about noise sensitization is currently very limited.

Sensitivity to nocturnal noise exposure varies considerably between individuals. Little is known about characteristics that predict someone's sensitivity to nocturnal noise-exposure. Men were found to be more sensitive to traffic noise than women [28], and specific features in the electric potentials generated by the brain (so-called sleep spindles) were associated with resiliance to noise-induced sleep disturbance [23]. The elderly, children, shift-workers, and patients with pre-existing (sleep) disorders are considered risk groups for noise-induced sleep disturbance [4]. Hospitals are often required to have additional sound insulation to reflect the increased sensitivity of the patient population.

In conclusion, undisturbed sleep is a prerequisite for high daytime performance, well-being and health. Environmental noise can disturb sleep and impair sleep recuperation. Reliable and up-to-date exposure-response relationships between environmental noise exposure and sleep disturbance are needed to inform political decision making and to help mitigate the effects of environmental noise on sleep. To provide updated recommendations since the last guidelines, we performed a systematic review of the literature on the effects of noise on sleep published in or after the year 2000. We performed a meta-analysis of surveys linking environmental noise exposure to self-reports of troubles falling asleep, awakening during the night, and sleep disturbance, and derived exposure-response relationships. We also performed a pooled analysis of studies on the acute effects of road, rail, and aircraft noise on sleep, and derived exposure-response functions between the maximum sound pressure level of individual noise events and the probability to wake up.

2. Methods

2.1. Mapping of Identified Reviews

A search for reviews on the effects of environmental noise on sleep was completed by WHO during spring 2014. The purpose was to determine if there were existing systematic reviews that could be used to provide evidence on noise and sleep outcome measures. In the literature search, sixteen reviews were identified. The quality of reviews was evaluated using the AMSTAR criteria [40]. Nine of the reviews were excluded as they did not have an a priori design, did not include a comprehensive literature review, or were on a topic irrelevant for this evidence review [41–49]. Of the seven remaining reviews, two examined the effects of noise on sleep in specific geographic regions only [50,51], one review only included studies in which there was a change in noise level [52] (a topic covered within the intervention evidence review), and 1 review only included studies that examined the relationship between sleep outcomes and noise sensitivity not the association with noise level [53]. The three remaining reviews were broader in content and examined the effects of aircraft [54], ambient [55], and wind turbine noise on sleep [56]. Data from individual studies were not pooled in any of the reviews; results from individual studies were presented qualitatively only. Therefore, it was determined that for all sleep outcome measures an updated search and review of individual studies would need to be conducted.

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2.2. Search for Individual Studies

A search for individual studies was conducted by WHO which resulted in a total of 1159 hits. This search was not restricted by the year of publication. The titles and abstracts of these papers were reviewed by two independent reviewers and 51 were determined to be on relevant topics. The search terms included the study design (prospective, retrospective, cohort, longitudinal, cross-sectional, case control, ecological), type of noise source (environmental, community, traffic, railway, wind, aircraft, leisure, hospital) and outcome measure (insomnia, sleep, cortical awakening and arousal, autonomic arousal). After conducting this initial search, it was determined that several key papers in the field were not identified. Therefore, a second literature search was conducted using the same terms as provided by WHO, except terms that referred to study design were removed as they are not always applicable to studies on the effects of noise on sleep (the exact search term can be found in Section S6 of the supplement). The second literature search resulted in 10,029 hits and 216 additional papers were identified after reviewing titles and abstracts. The databases searched included PSYCINFO, PubMed, Science Direct, Scopus, Web of Science and the TNO Repository. A total of 69 additional papers which were mentioned in the identified literature reviews and in the meta-analysis by Miedema and Vos (2007) [22] were also included. Therefore, the literature search resulted in a total of 336 identified papers. The search also included gray literature, ICBEN and INCE conference proceedings were searched. The two literature searches were conducted in 2014. Additional searches were conducted on 30 July 2015 and 1 December 2015 to identify any additional studies while finalizing this review, two additional reports on transportation noise, one on hospital noise, and three on wind turbine noise were included based on these final searches.

2.3. Inclusion and Exclusion Criteria

Not all of the individual studies identified in the literature search were included in this evidence review. For all noise sources, studies conducted in the laboratory or those studies in which sounds were played back artificially were excluded due to low ecological validity. Studies conducted in the laboratory or studies that play back artificial sounds have typically found a higher probability of awakening to noise events than field studies [37,57,58]. Intervention studies (except for hospital noise) were excluded as they were covered in the intervention evidence reviews. Also, studies on sleep medication use were not covered in this review, as they initially were supposed to be covered in the mental health evidence review. However, the latter does not specifically cover sleep medication use. This is a limitation of this review, as sleep medication use can be an important indicator for noise-induced sleep disturbance. Sleep medication use is covered in the Night Noise Guidelines for Europe [36], and the reader is referred to those for a relatively recent review. In addition, for road, rail, and aircraft noise, only those studies published in the year 2000 or later were included, as this review is meant to be an update since the last guidelines. All studies on hospital noise were included though as this topic was not covered in detail in the previous guidelines. To be included in the review, studies must also have included measured or predicted noise levels for the participant's home; those that only included subjective evaluations of the noise or distance to the noise source were excluded. Studies that included noise levels not specific to the participant's home address were also excluded. Also studies had to have at least 2 different noise level categories examined in the study. In total 74 studies contributed to this review. Studies that did not meet the inclusion criteria and were excluded from the qualitative and quantitative analysis are listed in section S7 of the Supplement. A flow diagram of the selection and elimination of studies is shown in Figure 2.

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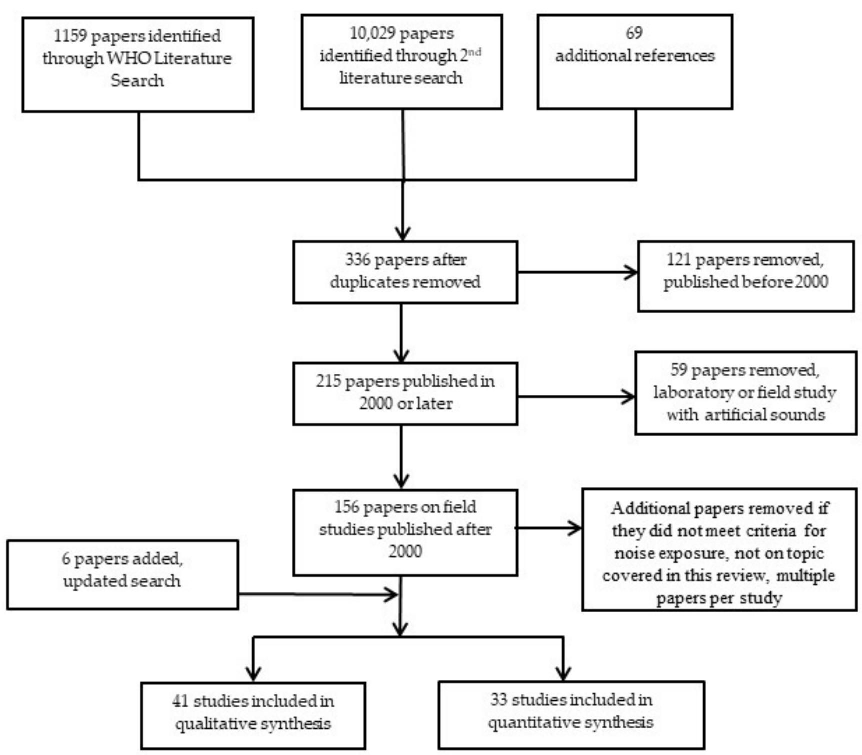

Figure 2. Flow of study selection.

2.4. Risk of Bias and Quality Assessment

Socio-economic status, age and gender were considered important confounders (i.e., variables associated both with the exposure and the outcome), but the use of these variables for adjustment was variable, so we did not exclude studies based on whether or not they adjusted for confounding by these variables.

The risk of bias in the studies reviewed is primarily a consequence of (a) the methodology used to measure sleep and noise-induced sleep disturbance and (b) the willingness of subjects to participate in a study on the effects of noise on sleep. Unfortunately, (a) and (b) are inversely related in such a way that less biased measurement techniques are associated with a higher selection bias and vice versa.

Information bias: Those studies that used polysomnography, or made continuous heart rate and blood pressure measurements during the sleep period were considered to have the lowest risk of information bias. Polysomnography, the simultaneous measurement of the electroencephalogram (EEG—brain activity), electrooculogram (EOG—eye movement), and electromyogram (EMG—skeletal muscle tone), is considered the gold standard for measuring sleep, and evaluating sleep fragmentation and sleep structure. However, electrodes cause some discomfort, may influence sleep (especially during the first measurement night), and thus introduce bias. Heart rate and blood pressure during the night will increase when an individual has brief autonomic or cortical arousals and therefore these measurements also provide a sensitive measure of sleep fragmentation [20].

The risk of information bias for studies that measured motility was considered moderate. Motility is measured typically using wrist worn devices (i.e., actigraphs). While awakenings or arousals during the night often occur together, individuals can be awake without moving which results in misclassification. Comparison studies between awakenings identified using actigraphy and polysomnography have found high sensitivity in identifying sleep epochs during the night but a low specificity (below 0.40) in identifying wake epochs [59]. **ORG6-127 cont.**

Studies in which self-reported measures of sleep were used were considered to have a high risk of information bias. Subjects are not aware of themselves and their surroundings for most of the night, and relevant physiologic reactions are often not consciously perceived and remembered in the morning. Also, misattributions are possible (e.g., a subject wakes up spontaneously, regains consciousness, and then perceives a noise event). When studies specifically ask about how a particular noise source affects sleep, an individual's response may (at least partially) reflect his or her attitude or feelings toward nighttime noise rather than disrupted sleep itself.

Information bias could occur not only due to sleep measurement methods, but also could arise from the methods used to quantify environmental noise. Due to variability in traffic across days, noise measurements should be made over a sufficient time period (minimally 1 week). For noise predictions, at a minimum data that is representative of the current traffic patterns should be used in the calculations for a study to have low risk of bias.

Selection bias: While studies using polysomnography for the measurement of sleep may have low information bias, they suffer from high selection bias. These studies often only include healthy individuals without sleep disorders. Due to the high methodological expense, sample sizes are typically low. Therefore the results may not be representative of the effects of noise on sleep in the general population. In addition, response rates for taking part in these studies are low as the instrumentation for measuring sleep requires trained personal to go to participant's home each night and morning to apply and remove the electrodes, and the equipment that needs to be worn induces discomfort. Compared to studies using PSG, studies relying on self-reported sleep, in which participants are asked to fill out a questionnaire or complete an interview, have in general lower selection bias, higher response rates, and larger sample sizes. The results may therefore be more representative of the general population. However, this methodology also suffers from the highest information bias.

Publication bias: Publication bias refers to the fact that studies with positive findings are more often both submitted to and accepted by scientific journals. This likely biases the published studies to positive findings. It is, however, difficult to assess the consequences of publication bias.

3. Polysomnography Measured Cortical Awakenings for Road, Rail, and Aircraft Noise

As described in detail in Section 1, polysomnography is considered the gold standard for measuring sleep, its structure, and related events. Sleep structure varies systematically over the course of the night, with deep sleep (stages 3 or 4, or N3 according to the new classification) dominating the first half of the night and REM sleep and superficial sleep stages 1 and 2 (or N1 and N2) dominating the second half of the night. Field studies (including the four studies discussed in detail below [35,60–62]) typically allow subjects to adhere to their normal bed times. Sleep duration thus varies systematically both between subjects but also within subjects (if a subject is measured for multiple nights). This within- and between-subject variability in sleep duration complicates the assessment of the effects of noise on sleep duration and whole night sleep parameters, and introduces substantial non-noise variance to the data. Even sleep architecture (i.e., the distribution of sleep stages) will be affected by fluctuations in sleep period duration (regardless of whether sleep stages are expressed in minutes or % of sleep period time), as sleep stages are not evenly distributed over the course of the night. For these reasons, we concentrated our analysis on the effects of traffic noise on sleep on the reaction of the sleeper to single noise events. Spontaneous and noise-induced awakenings also increase with increasing sleep period time, but it is relatively easy to account for the latter in single event analyses. Furthermore, relationships between whole-night noise exposure descriptors (i.e., L_{night}) and single event metric outcomes (i.e., awakenings) have been previously described, and the reader is referred to these [25].

Four studies were identified on study selection for which the effects of road, rail, or aircraft noise on polysomnographically measured sleep was evaluated. Two studies identified in the literature review but not included in the re-analysis include one road traffic and rail noise study and one aircraft noise study. Aasvang et al. [61] conducted a field study examining the effect of railway and road traffic noise on sleep in Oslo, Norway. Twenty of the subjects were exposed to railway noise and twenty to road traffic noise. The subjects participated for two consecutive nights. Several sleep variables were examined in relation to the maximum noise level inside the bedroom for the entire night due to road traffic or rail noise. Wake after sleep onset (WASO) was found to increase with the maximum noise level of train noise with a 30 min increase in WASO found for those subjects exposed to noise levels above 50 dBA compared to those exposed to levels less than 50 dBA. Also a decrease in REM sleep with noise level was found with rail noise, however no significant changes in any sleep parameter was found for road traffic noise. The data from the study by Aasvang et al. [61] was not included in the re-analysis because single transportation noise events and associated awakenings had not been scored. Flindell et al. [62] conducted a study on the effects of aircraft noise around Manchester airport. Eighteen subjects took part for 5 consecutive nights. All subjects were between the ages of 30 to 40 years old. Noise levels were recorded within the bedroom. There was no significant change in sleep between a high noise and a low noise area, but the indoor noise exposure in both areas was similar. The study found increases in the number of awakenings, total durations of stage 1 sleep, number of REM sleep periods and changes in the frequency content of the EEG associated with higher numbers of ANEs occurring during the sleep period. The data from the Flindell et al. [62] study was not available for inclusion in the re-analysis.

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Single event based analysis was completed in two studies conducted by the German Aerospace Center (DLR), both of which used similar methodology and were included in the re-analysis. The STRAIN study was conducted to investigate the effect of aircraft noise on sleep [35]. The study was conducted between September 2001 and November 2002 and included 64 residents between the ages of 18 to 61 years (average age 38 years, 55% female) who lived around Cologne-Bonn Airport. The DEUFRAKO study was conducted to investigate the effect of rail noise on polysomnographically measured sleep [60]. The study was conducted between February 2008 and July 2009 and included 33 individuals between the ages of 22 and 68 years (average age 36 years, 67% female) who lived near Cologne and Bonn close to railway lines. In both studies, subjects participated for nine consecutive nights and indoor noise levels were recorded in the bedroom. Physiological reactions to road traffic noise were also measured. The raw data for these two datasets were obtained from DLR and used to derive exposure-response relationships for the probability of a sleep stage change to wake or S1; the STRAIN dataset was used for aircraft noise, the DEUFRAKO dataset was used for train noise, and the STRAIN and DEUFRAKO data were combined for road traffic noise.

3.1. Event-Related Analysis

For both studies, sleep stages were scored according to the standard criteria of Rechtschaffen and Kales using 30-s epochs [16]. Epochs scored as Movement Time were re-classified as wake. Individuals who visually scored the polysomnography data were blinded to the occurrence of noise events. For the STRAIN study, data from 61 of the 64 participants contributed to the analysis, two were excluded due to constant snoring and one was excluded due to an intrinsic sleep disorder.

Road, rail, and aircraft events were identified by listening to indoor sound recordings and the start and end of each noise event was scored. For each noise event, the first sleep stage affected by a noise event (first noise epoch) was defined as the first epoch that contained more than 15 s of the event [35]. If the subject was asleep in the epoch prior to the first noise epoch (Stages 2, 3, 4, or REM sleep) then the next three epochs (90 s) were screened for a transition to wake or Stage S1.

During a road, rail, or aircraft event, additional outdoor or indoor noises can occur. In this analysis a noise event was considered 'undisturbed' if the following criteria were met: (1) only events from the same noise source could occur one minute before (e.g., the end of a prior noise event) and 1.5 min after the start of the event and (2) sounds made by the subject such as turning over in bed were allowed before and during the noise event of interest as they could be reactions to the noise. Events defined as 'disturbed' consisted of those in which any other noise event occurred 60 s prior or up to 1.5 min after the start of the first noise epoch.

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3.2. Statistical Analysis

For the analysis, each noise event was annotated with its maximum sound pressure level ($L_{AS,max}$), the age and gender of the exposed subject, the day of the week (weekday/weekend), and time from sleep onset. The primary outcome is binary and reflects an awakening or sleep stage change to stage 1 (1) or no such change in sleep structure (0). Random subject effect logistic regression models with the maximum indoor noise level ($L_{AS,max}$) as the only predictor were performed with the NLMIXED procedure in SAS (version 9.3, SAS institute, Cary, NC, USA), based on the event-related data. The non-liner models were calculated to reflect the clustered nature of the data (i.e., that each subject was exposed to multiple noise events). Both unadjusted models and models adjusted for age, gender, weekday, and time from sleep onset were calculated. Point estimates and 95% confidence intervals were generated with estimate statements in Proc NLMIXED. Unadjusted models were used to derive the exposure-response relationships. While additional factors such as prior sleep stage, time of night, duration of the event, age, gender have been found to be important effect moderators [35,60], assumptions have to be made for the values of these parameters when deriving exposure-response relationships between noise level and probability of awakening. Therefore, only the noise level of the event was included when deriving these models.

430 subject nights of data from the STRAIN study and 277 subject nights from the DEUFRAKO study contributed to the analysis. Exposure-response relationships for all transportation modes, for only undisturbed events and both disturbed and undisturbed events were calculated and the results are shown in Figure 3. This analysis was completed to examine the potential bias in the exposure-response curves when including or excluding specific noise events. The exposure-response functions are for the probability of a transition to wake and Stage 1 because in the DEUFRAKO study more Stage 1 sleep was scored than in the STRAIN dataset (23.3 min versus 16.6 min), which may be due to inter-rater variability in scoring.

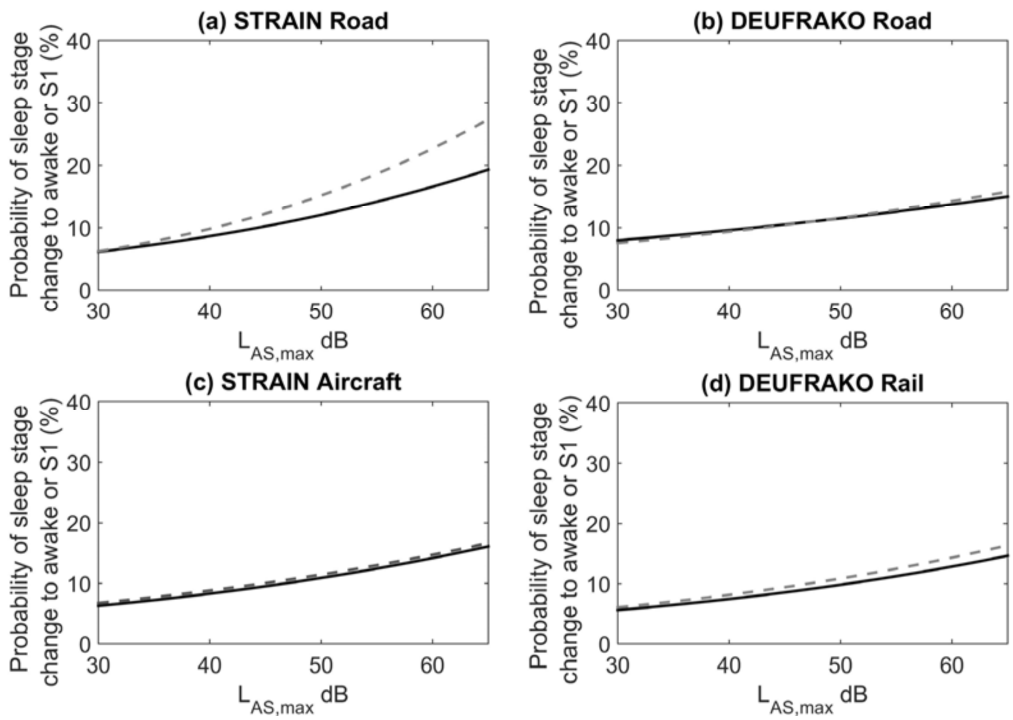

Figure 3. Probability of a sleep stage change to awake or S1 in a 90 second time window following noise event onset depending on the maximum indoor sound pressure level ($L_{AS,max}$) for (**a**) STRAIN road traffic (*N* = 61 subjects); (**b**) DEUFRAKO road traffic (*N* = 33); (**c**) STRAIN aircraft (*N* = 61); and (**d**) DEUFRAKO rail noise events (*N* = 33). Undisturbed events only (black), all events including disturbed and undisturbed events (gray dotted line).

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When all events were included in the analysis there was a higher probability of transitions to wake and S1 for road traffic noise in the STRAIN study compared to the probability for transitions for undisturbed noise events. This may be due to simultaneous aircraft noise events that increase awakening probability. However, this was not found for the DEUFRAKO study. For the other noise sources there were only small non-significant changes in the exposure-response relationships when including disturbed noise events. Due to the difference for road traffic noise, however, for the remaining analysis only the undisturbed events were used. The number of noise events contributing to the analysis was 10,546 aircraft events, 7631 train events (including both passenger and freight trains), and 7101 road traffic events in the STRAIN study and 4407 events in the DEUFRAKO study. The road traffic events consisted primarily of single car or truck passings, 843 events consisted of multiple vehicles.

The three exposure-response curves for the undisturbed events are shown in Figure 4 for the slow weighted maximum noise level. The road noise data from the STRAIN and DEUFRAKO study were combined as estimates did not differ significantly between studies (OR per 10 dBA 1.45; 95% CI 1.22–1.73 for STRAIN and OR per 10 dBA 1.22; 95% CI 0.98–1.51 for DEUFRAKO, $p = 0.09$). The data for both passenger and freight trains in the DEUFRAKO study were combined as well (OR per 10 dBA 1.40; 95% CI 1.22–1.61 for freight trains and OR per 10 dBA 1.21; 95% CI 0.98–1.50 for passenger trains, $p = 0.31$). While the slow A-weighting is typically used for aircraft noise metrics, the fast weighting is often used for road and rail noise due to the faster temporal profile of the sounds. While not available for the STRAIN study, $L_{AF,max}$ levels were available for the DEUFRAKO study. The mean absolute difference between $L_{AF,max}$ and $L_{AS,max}$ levels was 0.86 dB (2.5–97.5% Range: 0–3.5 dBA) for road traffic, and 0.72 dB (2.5–97.5% Range: 0.0–4.0 dBA) for rail traffic. Overall the average difference in levels was less than 1 dBA and therefore all results are presented using $L_{AS,max}$ levels.

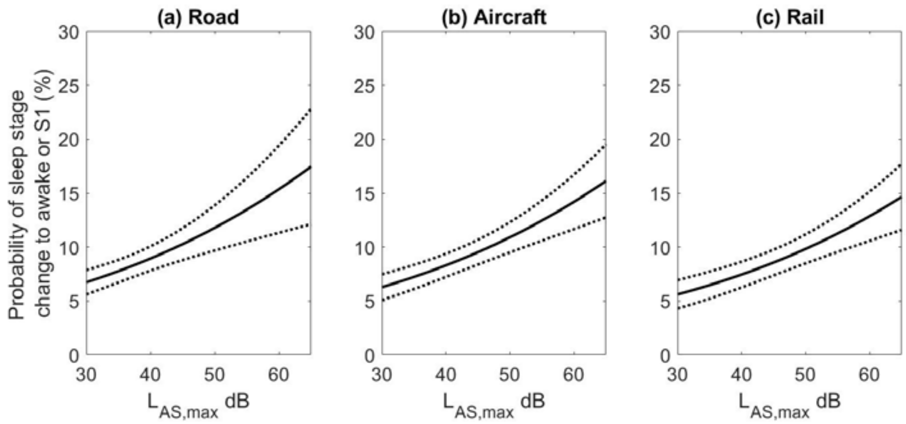

Figure 4. Probability of a sleep stage change to awake or S1 in a 90 s time window following noise event onset depending on the maximum indoor sound pressure level ($L_{AS,max}$) for (**a**) road (STRAIN and DEUFRAKO, N = 94 subjects); (**b**) aircraft (STRAIN, N = 61); and (**c**) rail noise (DEUFRAKO, N = 33). 95% confidence intervals (dashed lines). Results are for the unadjusted model.

The distribution of indoor noise levels and the timing of events relative to sleep onset for each noise source are shown in Figure 5. The unadjusted odds ratio for sleep stage transitions to wake or Stage 1 for a 10 dBA increase in the slow weighted indoor maximum noise level ($L_{AS,max}$) for all three transportation modes was calculated and the results are shown in Table 1. All odds ratios were statistically significant and differed only marginally between traffic modes. Odds ratios adjusted for age and gender, and odds ratios adjusted for age, gender, day of the week (weekend or weekday), and time from sleep onset were also calculated. Adjusting only marginally reduced the odds ratios, and all estimates were still significantly different from 1. Data for additional confounding variables were not available.

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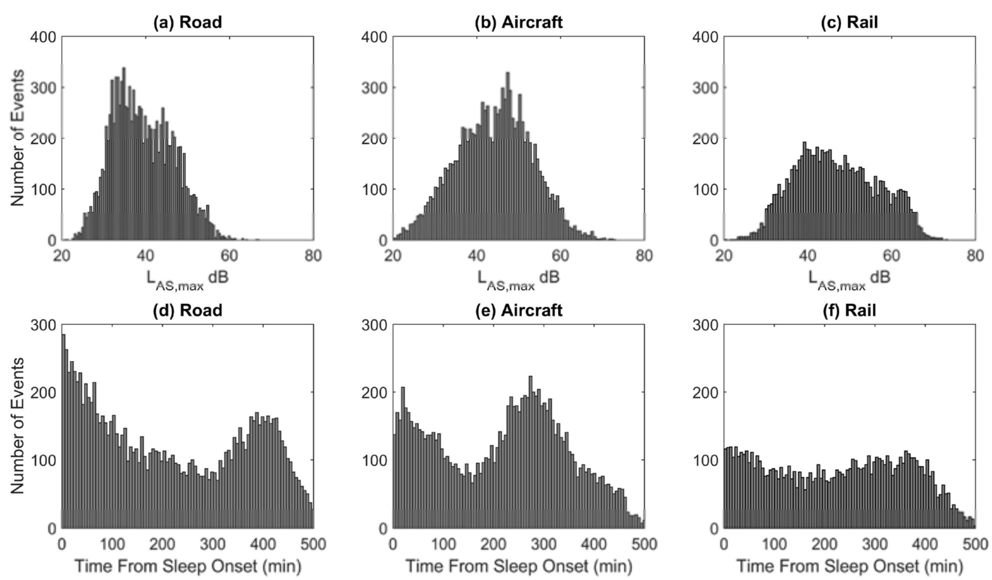

Figure 5. Distribution of indoor noise levels and the time of events relative to sleep onset for (**a**,**d**) road; (**b**,**e**) aircraft; and (**c**,**f**) rail events (all undisturbed noise events from the STRAIN and DEUFRAKO studies used for analysis).

Table 1. Odds Ratios and 95% confidence intervals for sleep stage transitions to awake or Stage 1 for road, rail, and aircraft noise for a 10 dBA increase in the indoor maximum noise level ($L_{AS,max}$). Number of subjects contributing to the analysis: Road = 94, Aircraft = 61, Rail = 33.

Odds Ratio per 10 dBA ($L_{AS,max}$)	Road (STRAIN and DEUFRAKO)	Aircraft (STRAIN)	Rail (DEUFRAKO)	Combined Estimate (Based on Road, Rail, and Aircraft)
Unadjusted	1.36 (1.19–1.55)	1.35 (1.22–1.50)	1.35 (1.21–1.52)	1.35 (1.25–1.45)
Adjusted for Age and Gender	1.36 (1.19–1.55)	1.35 (1.21–1.50)	1.34 (1.19–1.50)	1.28 (1.21–1.36)
Adjusted for Age, Gender, Day of the Week, and Time From Sleep Onset	1.32 (1.15–1.50)	1.32 (1.19–1.47)	1.34 (1.19–1.51)	1.29 (1.21–1.36)

Individuals will not only awaken during the night due to noise events but also spontaneously. It is because of these spontaneous reactions that in Figure 4, even for low noise levels the probability of sleep stage transitions to wake or S1 is greater than 5.0%. The probability of spontaneously awakening during the night was calculated separately for all three transportation sources using virtual events [57]. As each subject was investigated for several nights, the other study nights could be used to determine spontaneous awakening probability. For example, if a noise event occurred in study night #2 two hours after sleep onset, study nights #3–#9 were screened for spontaneous awakenings at the same time from sleep onset as the noise event if this time interval was determined to be free from transportation noise (night #1 was always discarded from the analysis due to a possible first-night effect [63]). The spontaneous awakening rates that were calculated were 6.1% for rail, 7.7% for aircraft, and 8.2% for road noise (all for 90-s intervals relative to onset of the virtual noise event). Three different rates of spontaneous awakening probability were calculated as the value is dependent on the time noise events occurred (as shown in Figure 5d–f the distribution of events during the night varied by noise source). In addition, different spontaneous rates were calculated because for each transportation mode the results are based on data from different subjects. **ORG6-127 cont.**

The spontaneous awakening probabilities were subtracted from the exposure-response curves, by including the value in the logistic regression equation when deriving the point estimates, to obtain the probability of having an additional awakening attributable to the noise event. Second order polynomials were fit to obtain exposure-response relationships. The exposure-response relationships obtained are shown in Figure 6.

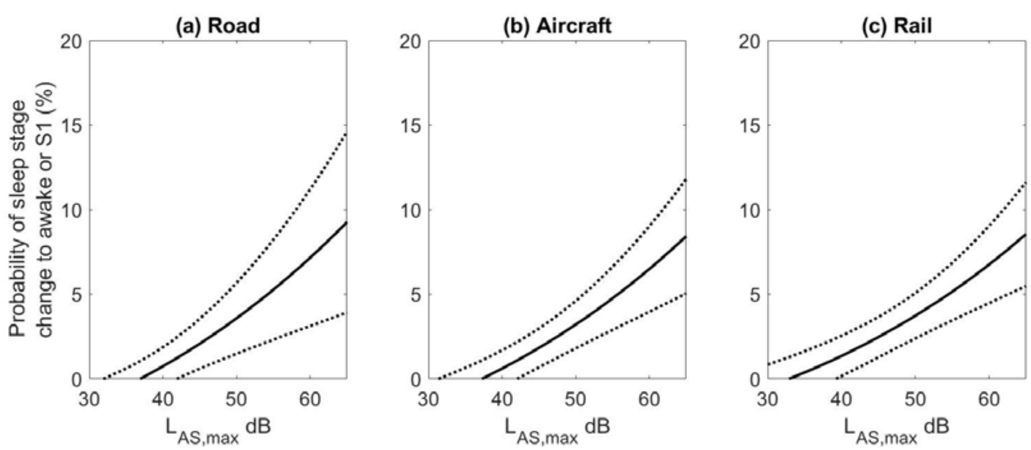

Figure 6. Probability of additional sleep stage changes to awake or S1 in a 90 s time window following noise event onset depending on the maximum indoor sound pressure level ($L_{AS,max}$) for (**a**) road (STRAIN and DEUFRAKO, N = 94 subjects); (**b**) aircraft (STRAIN, N = 61); and (**c**) rail noise (DEUFRAKO, N = 33). 95% confidence intervals (dashed lines). Results are for the three unadjusted models.

The equations for the probability of additional awakenings due to road, rail, and aircraft noise are:

$$\text{Road: Prob. of Wake or S1} = -3.3188 - 0.0478 * L_{AS,max} + 0.0037 * (L_{AS,max})^2 \quad (1)$$

$$\text{Aircraft: Prob. of Wake or S1} = -3.0918 - 0.0449 * L_{AS,max} + 0.0034 * (L_{AS,max})^2 \quad (2)$$

$$\text{Rail: Prob. of Wake or S1} = -1.7768 - 0.0529 * L_{AS,max} + 0.0033 * (L_{AS,max})^2 \quad (3)$$

3.3. Conclusions

In the re-analysis conducted, for all transportation modes a significant positive association was found between indoor maximum noise levels of single events and the probability of sleep stage transitions to wake or Stage 1. The noise levels at which the probability of an additional awakening was nonzero varied between transportation modes but was between 33–38 dBA, which is consistent with previous findings [35,64]. While for road traffic noise the odds ratio for awakenings was greater in the STRAIN study than in the DEUFRAKO study, no significant differences were found between the three transportation modes. This finding is in contradiction to the results of a laboratory study conducted by Basner et al. [28] in which road and rail traffic noise resulted in a greater probability of awakening than aircraft noise for events of the same noise level. Also these results are in contradiction to those of Aasvang et al. [61] who found that train noise had a greater effect on sleep than road traffic noise. However, the DEUFRAKO and STRAIN studies were not designed to specifically examine the effect of road traffic noise on sleep. A difference was also not found in awakening probability between train and aircraft noise. However, this comparison was conducted across studies. While polysomnography is a sensitive and objective measure of sleep, sleep stage scoring is performed visually and there can be both high intra- and inter-rater variability in the scoring [65]. Therefore, further studies are still needed in order to determine whether in the field setting the three types of transportation modes have a different effect on awakening probability.

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In terms of the applicability of these results to the general population, all four of the studies identified in the review suffer from selection bias. Subjects in these studies were physically healthy and free of intrinsic sleep disorders. The effect of transportation noise on sleep in those with preexisting medical conditions is unknown; the results presented may underestimate the effect of noise on sleep in the general population. We were able to adjust odds ratios for the confounders age and gender, time from sleep onset, and day of the week but did not have access to a more comprehensive set of confounders. The exposure-response functions are based on unadjusted models that contained the maximum sound pressure level as the only predictor. Although the number of noise events that contributed to the exposure-response relationships was large, the latter are nevertheless based on data from a total of $N = 94$ subjects only and these subjects lived in geographically circumscribed regions in Germany. Thus, although the best data set currently available, it is unclear how the exposure-response relationships translate to other populations and regions. More studies with a higher degree in diversity of populations and regions are needed to inform future exposure-response functions.

Finally, it is unclear how the results from single event analyses translate to changes in sleep structure across the whole night, as time in bed is rarely fixed in field studies on the effects of noise on sleep and sleep stages are not evenly distributed across the night (see Section 3 for a discussion). Some research has shown that the body engages in compensatory mechanisms to keep the level of sleep fragmentation low [28]. However, noise-induced awakenings may come at a greater biological cost for recuperation than spontaneous awakenings that are part of the physiologic sleep process [29]. The two studies that did provide whole night sleep estimates also allowed variable individual bed times [61,62]. The limited evidence derived from these two studies does, however, support the notion that nocturnal traffic noise exposure contributes to sleep disturbance on the whole night level.

4. Self-Reported Sleep Outcomes for Road, Rail, and Aircraft Noise

After reviewing individual studies in which the effect of road, rail, or aircraft noise on self-reported sleep outcomes was measured, the decision was made to focus on the 3 most common outcomes, the definitions of which are:

- Awakenings from sleep, which refers to the period after sleep onset and before the final awakening. They are defined as events where a subject wakes up from sleep, regains consciousness, and recalls the awakening in the next morning.
- The process of falling asleep, which is defined as the transition from wakefulness into sleep.
- Sleep disturbance refers to internal/external interference with sleep onset or sleep continuity (sleep maintenance).

Results from surveys that contained general questions about sleep and surveys that included questions specifically on how noise affects sleep were included in the review. The results for self-reported sleep disturbance were not reported in the literature in a consistent manner; therefore in order to conduct a meta-analysis, the authors of the individual papers reviewed were contacted in order to obtain the number of participants who reported each response alternative for 5 dB noise categories. This information was obtained for 30 studies, which were used to derive exposure-response relationships for the percent highly sleep disturbed for the different sleep outcome measures. We were unable to obtain data from five studies. Data for confounding variables was not obtained for any of the studies. The number of participants in these studies and sleep questions used are listed in Tables 2–4.

4.1. Statistical Analysis

For the meta-analysis, the noise metric used was the average outdoor A-weighted noise level (L_{night}). All studies used this metric (although relative to different time periods), except for Bodin et al. (2015) who reported the average 24 h noise level ($L_{Aeq,24hr}$) [66]. The $L_{Aeq,24hr}$ was converted to L_{night} using linear equations between the two metrics that were derived based on the Swiss transportation noise map (sonBase). The equations used for road traffic and railway noise are: **ORG6-127 cont.**

$$\text{Road Traffic: } L_{night} = L_{Aeq,24h} - 6.0 \text{ dB} \tag{4}$$

$$\text{Railway: } L_{night} = L_{Aeq,24h} - 0.9 \text{ dB} \tag{5}$$

For most studies the noise metric was predicted or measured at the most exposed façade of the dwelling, not the bedroom. The L_{night} levels assigned for all studies were the midpoint of the 5 dB categories. For open-ended noise exposure categories (e.g., <50 or >50) the noise level assigned was 2.5 dB above or below the category, for example for <50 dB the assigned value would be 47.5 dB.

The approach used in this meta-analysis is not the same as the approach used by Miedema and Vos (2007) [22], who previously developed exposure-response models relating the percent highly sleep disturbed for road, rail, and aircraft noise based on survey response data. In their analysis, the survey response data used was available at the individual response level. The response scales for the questions on sleep disturbance varied between the studies used in their analysis. In order to derive a combined model, they translated the response categories for each question to a scale of 0 to 100 by dividing 100 by the number of response choices and multiplying by the rank of the response choice. They modeled a cumulative distribution function based on the assigned scores and then calculated the percent of the population that was estimated to have a score of 72% or higher, which was the cutoff point they defined as highly sleep disturbed, for different L_{night} levels.

For this analysis, data was not obtained at the individual level, results were not always obtained for all response categories, and questions were included in which the frequency or the severity of sleep disturbance was reported. Therefore instead of modeling sleep disturbance as a continuous function, the probability of being highly sleep disturbed was modeled. A binary variable was created for highly sleep disturbed. Following previous conventions used for the ICBEN annoyance scale, for questions that used a 5 point or 11 point scale, and referred to the severity of sleep disturbance the top two and top three categories, respectively, were defined as highly sleep disturbed. For the few questions that referred to the frequency of symptoms, such as Halonen et al. (2010) [67], response alternatives for symptoms occurring three times or more per week were considered highly sleep disturbed. This criterion was used, as having difficulty sleeping at least three times per week for at least one month is considered a diagnostic criterion of insomnia [68]. For other response scales, the response alternatives that were considered highly sleep disturbed are highlighted in the tables.

Table 2. Studies on aircraft noise and self-reported sleep disturbance (* general health survey, + noise survey). Studies modeled the noise levels except where indicated. Response alternatives contributing to the calculation of the percent Highly Sleep Disturbed are in bold.

Study	*N*	Country	Sleep Disturbance Questions	Noise Metric (Range for Obtained Data)
Falling Asleep (Total *N* = 6368)				
+ Nguyen et al. (2015) [69]	1095	Hanoi, Vietnam	In daily life, when an airplane passes by, at what degree are you disturbed in the following cases: When it makes it difficult for you to fall asleep? Not at all, Slightly, Moderately, **Very, Extremely**	L_{night}, 22:00–6:00, measured (1 week) (37.5–57.5)
+ Yano et al. (2015) [70]	780	Hanoi, Vietnam		L_{night}, 22:00–6:00, measured (1 week) (37.5–57.5)
+ Nguyen et al. (2012) [71]	512	Da Nang City, Vietnam		L_{night}, 22:00–6:00, measured (1 week) (37.5–52.5)
+ Nguyen et al. (2010) [72] Nguyen et al. (2011) [73]	805	Hanoi, Vietnam		L_{night}, 22:00–6:00, measured (1 week) (37.5–52.5)
+ Nguyen et al. (2009) [74]	868	Ho Chi Minh City, Vietnam		L_{night}, 22:00–6:00, measured (1 week) (42.5–62.5)
+ Schreckenberg et al. (2009) [75]	2308	Germany	How much has aircraft noise in the last 12 months disturbed falling asleep? Not at all, Slightly, Moderately, **Very, Extremely**.	L_{night}, 22:00–6:00 (37.5–57.5)
Awakenings (Total *N* = 4054)				
+ Nguyen et al. (2015) [69]	1093	Hanoi, Vietnam	In daily life, when an airplane passes by, to what degree are you disturbed in the following cases: When you are awakened in your sleep? Not at all, Slightly, Moderately, **Very, Extremely**.	L_{night}, 22:00–6:00, measured (1 week) (37.5–57.5)
+ Yano et al. (2015) [70]	776	Hanoi, Vietnam		L_{night}, 22:00–6:00, measured (1 week) (37.5–57.5)
+ Nguyen et al. (2012) [71]	511	Da Nang City, Vietnam		L_{night}, 22:00–6:00, measured (1 week) (37.5–52.5)
+ Nguyen et al. (2010) [72] Nguyen et al. (2011) [73]	804	Hanoi, Vietnam		L_{night}, 22:00–6:00, measured (1 week) (37.5–52.5)
+ Nguyen et al. (2009) [74]	870	Ho Chi Minh City, Vietnam		L_{night}, 22:00–6:00, measured (1 week) (42.5–62.5)
Sleep Disturbance (Total *N* = 2309)				
+ Schreckenberg et al. (2009) [75]	2309	Germany	How much has aircraft noise in the last 12 months disturbed sleeping during the night? Not at all, Slightly, Moderately, **Very, Extremely**.	L_{night}, 22:00–6:00 (37.5–57.5)
Falling Asleep-Noise source not specified in sleep questions (Total *N* = 2978)				
+ Brink et al. (2005) [76] 2001 Study	1528	Switzerland	How often do you have the following symptoms: Problems falling asleep? Never, Rarely, Sometimes, Often, **Very Often, Always**	L_{night}, 22:00–6:00 (27.5–62.5)
+ Brink et al. (2005) [76] 2003 Study	1450			L_{night}, 22:00–6:00 (27.5–62.5)

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Table 2. *Cont.*

Study	*N*	Country	Sleep Disturbance Questions	Noise Metric (Range for Obtained Data)
Awakenings-Noise source not specified in sleep questions (Total *N* = 2978)				
+ Brink et al. (2005) [76] 2001 Study	1528	Switzerland	How often do you have the following symptoms: Problems with sleeping through? Never, Rarely, Sometimes, Often, **Very Often, Always**	L_{night}, 22:00–6:00 (27.5–62.5)
+ Brink et al. (2005) [76] 2003 Study	1450			L_{night}, 22:00–6:00 (27.5–62.5)
Sleep Disturbance-Noise source not specified in sleep questions (Total *N* = 195)				
* Brink (2011) [77]	195	Switzerland	During the last 4 weeks, have you suffered from any of the following disorders or health problems? Difficulty in sleeping or insomnia? Not at all, Somewhat, **Very Much**.	L_{night}, 22:00–6:00 (32.5–52.5)
				L_{night}, 22:00–6:00 (32.5–52.5)

Table 3. Studies on road noise and self-reported sleep disturbance (* general health survey, + noise survey). Studies modeled the noise levels except where indicated. Response alternatives contributing to calculation of the percent Highly Sleep Disturbed are in bold.

Study	*N*	Country	Sleep Disturbance Questions	Noise Metric (Range for Obtained Data)
Falling Asleep (Total *N* = 10,212)				
+ Bodin et al. (2015) [66]	2444	Sweden	Do you experience any of the following because of road traffic noise? Difficulties falling asleep. Never, Sometimes, **Often**.	L_{Aeq}, 24 h (37.5–62.5)
+ Sato et al. (2002) [78]	1302	Gothenburg, Sweden	Does the road traffic noise cause the following conditions? Difficulty to fall asleep? No, Little Disturbed, Rather Disturbed, **Very Disturbed**.	L_{night}, 22:00–7:00, measured (1 night) (42.5–72.5)
	814	Kumamoto, Japan		L_{night}, 22:00–7:00, measured (1 night) (47.5–77.5)
	779	Sapporo, Japan		L_{night}, 22:00–7:00, measured (1 night) (52.5–67.5)
+ Phan et al. (2010) [79] Shimoyama et al. (2014) [80]	1471	Hanoi, Vietnam	How much are you disturbed in falling asleep by road traffic? Not at all, Slightly, Moderately, **Very, Extremely**.	L_{night}, 22:00–6:00, measured (1 night) (62.5–77.5)
	1458	Ho Chi Minh City, Vietnam		L_{night}, 22:00–6:00, measured (1 night) (67.5–77.5)
	481	Da Nang, Vietnam		L_{night}, 22:00–6:00, measured (1 night) (57.5–67.5)
	682	Hue, Vietnam		L_{night}, 22:00–6:00, measured (1 night) (52.5–72.5)
	781	Thai Nguyen, Vietnam		L_{night}, 22:00–6:00, measured (1 night) (52.5–67.5)

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Table 3. *Cont.*

Study	*N*	Country	Sleep Disturbance Questions	Noise Metric (Range for Obtained Data)
Awakenings (Total *N* = 10177)				
+ Bodin et al. (2015) [66]	2438	Sweden	Do you experience any of the following because of road traffic noise? You wake up? Never, Sometimes, **Often**.	L_{Aeq}, 24 h (37.5–62.5)
+ Sato et al. (2002) [78]	1291	Gothenburg, Sweden	Does the road traffic noise cause the following conditions? Awakening? No, Little Disturbed, Rather Disturbed, **Very Disturbed**.	L_{night}, 22:00–7:00, measured (1 night) (42.5–72.5)
	819	Kumamoto, Japan		L_{night}, 22:00–7:00, measured (1 night) (47.5–77.5)
	779	Sapporo, Japan		L_{night}, 22:00–7:00, measured (1 night) (52.5–67.5)
+ Phan et al. (2010) [79] Shimoyama et al. (2014) [80]	1454	Hanoi, Vietnam	How much are you disturbed by awakening during nighttime by road traffic? Not at all, Slightly, Moderately, **Very, Extremely**.	L_{night}, 22:00–6:00, measured (1 night) (62.5–77.5)
	1460	Ho Chi Minh City, Vietnam		L_{night}, 22:00–6:00, measured (1 night) (67.5–77.5)
	479	Da Nang, Vietnam		L_{night}, 22:00–6:00, measured (1 night) (57.5–67.5)
	680	Hue, Vietnam		L_{night}, 22:00–6:00, measured (1 night) (52.5–72.5)
	777	Thai Nguyen, Vietnam		L_{night}, 22:00–6:00, measured (1 night) (52.5–67.5)
Sleep Disturbance (Total *N* = 9901)				
+ Brown et al. (2015) [81]	8841	Hong Kong	How much is your sleep disturbed by road traffic noise? 11 point scale used from 0 (not disturbed at all) to 10 (extremely disturbed) **(8, 9, 10 HSD)**	L_{night} (42.5–67.5)
+ Hong et al. (2010) [82]	550	Korea	How much have you been disturbed in your sleep by road traffic noise at night when you are sleeping in your house over the last 12 months? 11 point scale used from 0 (not disturbed at all) to 10 (extremely disturbed) **(8, 9, 10 HSD)**	L_{night}, 22:00–7:00 (50.0–73.0)
+ Ristovska et al. (2009) [83]	510	Macedonia	Do you think that your sleep was disturbed due to night-time noise or noise events during the night in the last twelve months and more? Not at all, Very little, Moderate, **High, Very High**.	L_{night}, 23:00–7:00, measured (2 nights) (42.5–62.5)
Falling Asleep–Noise source not specified in sleep questions (*N* = 10,545)				
+ Bodin et al. (2015) [66]	2520	Sweden	Do you have problems falling asleep? Rarely/never, A few times per month, A few times a week, **Almost every day**	L_{Aeq}, 24 h (37.5–62.5)
* Halonen et al. (2012) [67]	6793	Finland	How many times during the past 4 weeks have you had the following symptoms? Difficulty falling asleep? Never, 1 per month, 1 per week, **2–4 per week, 5–6 per week, Nearly every night**.	L_{night}, 22:00–7:00 (42.5–57.5)
* Frei et al. (2014) [84]	1232	Switzerland	How often does it happen, that you cannot fall asleep well? Never, Rarely, Sometimes, **Often**.	L_{night}, 22:00–6:00 (27.5–62.5)

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Table 3. *Cont.*

Study	N	Country	Sleep Disturbance Questions	Noise Metric (Range for Obtained Data)
Awakenings–Noise source not specified in sleep questions (N = 10,603)				
+ Bodin et al. (2015) [66]	2519	Sweden	Do you wake up at night? Rarely/never, A few times per month, A few times a week, **Almost every day**	L_{Aeq}, 24 h (37.5–62.5)
* Halonen et al. (2012) [67]	6853	Finland	How many times during the past 4 weeks have you had the following symptoms? Frequently waking up during the night. Never, 1 per month, 1 per week, **2–4 per week, 5–6 per week, nearly every night.**	L_{night}, 22:00–7:00 (42.5–57.5)
* Frei et al. (2014) [84]	1231	Switzerland	How often does it happen, that you wake up at night multiple times? Never, Rarely, Sometimes, **Often**.	L_{night}, 22:00–6:00 (27.5–62.5)
Sleep Disturbance-Noise Source not specified in sleep questions (N = 9474)				
* Brink (2011) [77]	8245	Switzerland	During the last 4 weeks, have you suffered from any of the following disorders or health problems? Difficulty in sleeping, or insomnia? Not at all, Somewhat, **Very Much**	L_{night}, 22:00–6:00 (32.5–77.5)
* Frei et al. (2014) [84]	1229	Switzerland	How often does it happen that your sleep is restless? Never, Rarely, Sometimes, **Often**	L_{night}, 22:00–6:00 (27.5–62.5)

Table 4. Studies on railway noise and self-reported sleep disturbance (* general health survey, + noise survey). Studies modeled the noise levels except where indicated. Response alternatives contributing to calculation of the percent Highly Sleep Disturbed are in bold.

Study	N	Country	Sleep Disturbance Questions	Noise Metric (Range for Obtained Data)
Falling Asleep (Total N = 6520)				
+ Bodin et al. (2015) [66]	2342	Sweden	Do you experience any of the following because of railway noise? Difficulties falling asleep? Never, Sometimes, **Often**	L_{Aeq}, 24h (37.5–62.5)
+ Sato et al. (2004) [85]	1418	Hokkaido, Japan	How much are you disturbed in falling asleep by train passing? Not at all, Slightly, Moderately, **Very, Extremely**.	L_{night}, 22:00–7:00, measured (27.5–62.5)
	1562	Kyushu, Japan		L_{night}, 22:00-7:00, measured (27.5-72.5)
+ Schreckenberg (2013) [86]	1198	Germany	To what extent have the following outcomes of railway noise occurred in the past 12 months? Railway noise disturbs when falling asleep. Not at all, Slightly, Moderately, **Very, Extremely**.	L_{night}, 22:00–6:00 (42.5-82.5)
Awakenings (Total N = 5311)				
+ Bodin et al. (2015) [66]	2344	Sweden	Do you experience any of the following because of railway noise? You wake up? Never, Sometimes, **Often**	L_{Aeq}, 24h (37.5–62.5)
+ Sato et al. (2004) [85]	1418	Hokkaido, Japan	How much are you disturbed by awakening during nighttime by train passing? Not at all, Slightly, Moderately, **Very, Extremely**.	L_{night}, 22:00–7:00, measured (27.5–62.5)
	1549	Kyushu, Japan		L_{night}, 22:00–7:00, measured (27.5–72.5)
Sleep Disturbance (Total N = 1809)				
+ Hong et al. (2010) [82]	610	Korea	How much have you been disturbed in your sleep by railway noise at night when you are sleeping in your house over the last 12 months? 11 point scale used from 0 (not disturbed at all) to 10 (extremely disturbed) **(HSD 8, 9, 10)**	L_{night}, 22:00–7:00 (47.1–70)
+ Schreckenberg (2013) [86]	1199	Germany	To what extent have the following outcomes of railway noise occurred in the past 12 months? Railway disturbs when sleeping during the night. Not at all, Slightly, Moderately, **Very, Extremely**.	L_{night}, 22:00–6:00 (42.5–82.5)

ORG6-127 cont.

Table 4. *Cont.*

Study	*N*	Country	Sleep Disturbance Questions	Noise Metric (Range for Obtained Data)
Falling Asleep- Noise source not specified in sleep questions (Total *N* = 3808)				
+ Bodin et al. (2015) [66]	2576	Sweden	Do you have problems falling asleep? Rarely/never, A few times per month, A few times a week, **Almost every day**	L_{Aeq}, 24 h (37.5–62.5)
* Frei et al. (2014) [84]	1232	Switzerland	How often does it happen, that you cannot fall asleep well? Never, Rarely, Sometimes, **Often**.	L_{night}, 22:00–6:00 (27.5–57.5)
Awakening-Noise source not specified in sleep questions (Total *N* = 3806)				
+ Bodin et al. (2015) [66]	2575	Sweden	Do you wake up at night? Rarely/never, A few times per month, A few times a week, **Almost every day**	L_{Aeq}, 24 h (37.5–62.5)
* Frei et al. (2014) [84]	1231	Switzerland	How often does it happen, that you wake up at night multiple times? Never, Rarely, Sometimes, **Often**.	L_{night}, 22:00–6:00 (27.5–57.5)
Sleep Disturbance-Noise source not specified in sleep questions (*N* = 5914)				
* Brink (2011) [77]	4685	Switzerland	During the last 4 weeks, have you suffered from any of the following disorders or health problems? Difficulty in sleeping, or insomnia? Not at all, Somewhat, **Very Much**	L_{night}, 22:00–6:00 (32.5–77.5)
* Frei et al. (2014) [84]	1229	Switzerland	How often does it happen that your sleep is restless? Never, Rarely, Sometimes, **Often**	L_{night}, 22:00–6:00 (27.5–57.5)

One line of data was created for each study respondent. For example, if a study had 1000 respondents in the noise category with a 47.5 dB L_{night} midpoint, and 20% were classified as highly sleep disturbed, we generated 800 data lines with non-highly sleep disturbed respondents (binary outcome = 0) and 200 data lines with highly-sleep disturbed respondents (binary outcome = 1). Each data line also carried the mid-point of the 5 dB-wide L_{night} exposure category (data were requested from study PIs that way) and a unique identifier for each study. Random study effect logistic regression models with L_{night} as the only explanatory continuous variable were performed with the NLMIXED procedure in SAS (version 9.3, SAS Institute, Cary, NC, USA). This approach takes into account that respondents were clustered within studies, and the weight of a study increases with its sample size and thus precision. The fixed effect estimates reflect the average study (for a detailed discussion of differences in subject specific and population average modeling approaches see Section S3). The models are based on L_{night} levels between 40 and 65 dBA only. The reason for setting a lower limit of 40 dB is due to inaccuracies of predicting lower noise levels, and 65 dB was chosen for comparability between sources as aircraft noise levels did not exceed this level. Point estimates and 95% confidence intervals were generated with estimate statements in Proc NLMIXED. Analyses were performed separately for each noise source, type of sleep disruption, and whether the question referred specifically to how noise affects sleep. The odds ratios for all outcome measures and noise sources are in Tables 5 and 6. We also calculated a combined estimate of high sleep disturbance across the different survey outcomes (falling asleep, awakenings, sleep disturbance). If a study asked questions on two or three of these outcomes, we averaged the results across outcomes within a study to prevent each subject contributing more than once to the analysis.

ORG6-127 cont.

Table 5. Unadjusted Odds Ratio for the percent highly sleep disturbed for road, rail, and aircraft noise for questions on falling asleep, awakenings, and sleep disturbance for a 10 dBA increase in L_{night}. L_{night} was treated as a continuous variable from 40 to 65 dBA. Results are for questions that asked how noise affects sleep. Bold font reflects statistically significant results at $p < 0.05$. The combined estimate is based on all sleep questions. The number of subjects contributing to the analyses can be found in Tables 2–4.

	Number of Studies	Odds Ratio per 10 dBA	95% Confidence Interval
Aircraft Noise			
Falling Asleep	6	**2.00**	**1.68–2.41**
Awakenings	5	**1.72**	**1.31–2.27**
Sleep Disturbance	1	**2.05**	**1.64–2.56**
Combined Estimate	6	**1.94**	**1.61–2.33**
Road Noise			
Falling Asleep	8	**2.63**	**1.86–3.73**
Awakening	8	**1.75**	**1.24–2.47**
Sleep Disturbance	3	**2.21**	**1.52–3.20**
Combined Estimate	12	**2.13**	**1.82–2.48**
Rail Noise			
Falling Asleep	4	**2.57**	**1.87–3.53**
Awakening	3	**2.54**	**1.49–4.33**
Sleep Disturbance	2	4.10	0.69–24.41
Combined Estimate	5	**3.06**	**2.38–3.93**

ORG6-127 cont.

Table 6. Unadjusted Odds Ratio for the percent highly sleep disturbed for road, rail, and aircraft noise for questions on falling asleep, awakenings, and sleep disturbance for a 10 dBA increase in L_{night}. L_{night} was treated as a continuous variable from 40 to 65 dBA. Results are for questions that did not refer to noise in the questions. Bold font reflects statistically significant results at $p < 0.05$. The combined estimate is based on all sleep questions. The number of subjects contributing to the analyses can be found in Tables 2–4.

	Number of Studies	Odds Ratio per 10 dBA	95% Confidence Interval
Aircraft Noise			
Falling Asleep	2	1.10	0.73–1.57
Awakenings	2	0.89	0.66–1.22
Sleep Disturbance	1	4.70	0.41–53.62
Combined Estimate	3	1.17	0.54–2.53
Road Noise			
Falling Asleep	3	1.03	0.77–1.38
Awakenings	3	1.01	0.81–1.25
Sleep Disturbance	2	1.43	0.36–5.59
Combined Estimate	4	1.09	0.94–1.27
Rail Noise			
Falling Asleep	2	**2.02**	**1.44–2.83**
Awakenings	2	1.12	0.90–1.39
Sleep Disturbance	2	1.23	0.85–1.80
Combined Estimate	3	1.27	0.89–1.81

The exposure-response relationships for falling asleep and awakenings for studies that asked about how noise affects sleep are shown in Figure 7. The relationships are not shown individually for questions on sleep disturbance due to the low number of studies. The percent highly sleep disturbed for questions on difficulty falling asleep were higher than the percent highly sleep disturbed calculated based on questions on awakenings. Results for all questions were averaged within each study, and the exposure-response relationships for the combined estimates are shown in Figure 8. For comparison the Miedema and Vos [22] sleep disturbance exposure-response relationships are also shown in Figure 8. For road and rail noise, the percent of the population that was estimated to be highly sleep disturbed was approximately 2% for L_{night} levels of 40 dB. However for aircraft noise 10% of the population was estimated to be highly sleep disturbed for the same noise level. Janssen and Vos [87] derived an updated exposure response curve for the percent highly sleep disturbed for aircraft noise only. This update included studies used by Miedema and Vos that were conducted in the year 1996 or later, and 4 additional studies, two of which are included in this analysis, Brink et al. [76] and Schreckenberg et al. [75]. The aircraft noise exposure-response relationship developed in this analysis and the one derived by Janssen and Vos [87] is shown in Figure 9.

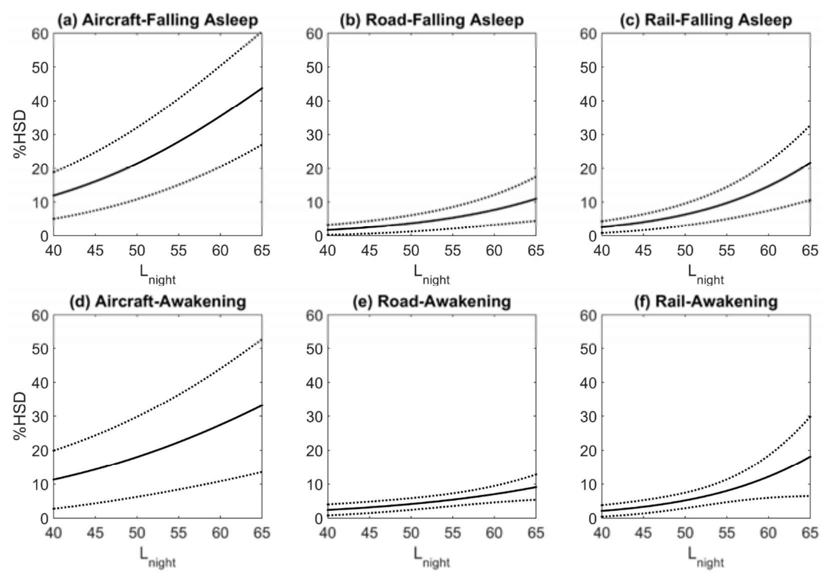

Figure 7. The percent highly sleep disturbed (HSD) based on responses to questions on awakenings or difficulty falling asleep for road, rail, and aircraft noise and for studies that asked about how noise affects sleep (black dashed lines: 95% confidence intervals). The number of studies and subjects contributing to the analyses can be found in Tables 2–4.

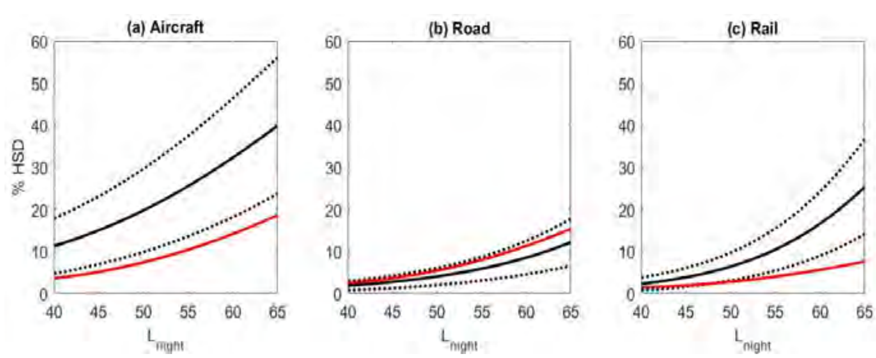

Figure 8. The percent highly sleep disturbed (HSD) based on responses to questions on awakenings, difficulty falling asleep, and sleep disturbance for road, rail, and aircraft noise (black dashed lines: 95% confidence intervals). The number of studies and subjects contributing to the analyses can be found in Tables 2–4. Red: Miedema and Vos (2007) [22] highly sleep disturbed exposure-response curves.

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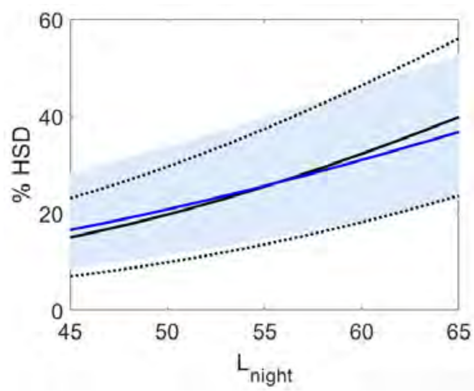

Figure 9. The percent highly sleep disturbed (HSD) based on responses to questions on awakenings, difficulty falling asleep, and sleep disturbance for aircraft noise (black dashed lines: 95% confidence intervals). The number of studies and subjects contributing to the analyses can be found in Table 2. Blue: Janssen and Vos (2009) [87] highly sleep disturbed exposure-response curve.

Second order polynomials were calculated based on the point estimates for the exposure-response relationships for awakenings, difficulty falling asleep, and the combined estimates for questions that asked about the noise source. The equations obtained are as follows (valid for an L_{night} range of 40–65 dB):

For questions on difficulty falling asleep:

$$\text{Aircraft \%HSD} = 16.3369 - 0.9663 * L_{night} + 0.0214 * \left(L_{night}\right)^2 \quad (6)$$

$$\text{Road \%HSD} = 19.3767 - 0.9263 * L_{night} + 0.0122 * (L_{night})^2 \quad (7)$$

$$\text{Train \%HSD} = 44.4836 - 2.1324 * L_{night} + 0.0273 * (L_{night})^2 \quad (8)$$

For questions on awakenings:

$$\text{Aircraft \%HSD} = 12.0411 - 0.5646 * L_{night} + 0.0137 * (L_{night})^2 \quad (9)$$

$$\text{Road \%HSD} = 8.8986 - 0.4209 * L_{night} + 0.0065 * (L_{night})^2 \quad (10)$$

$$\text{Train \%HSD} = 38.5819 - 1.8376 * L_{night} + 0.0234 * (L_{night})^2 \quad (11)$$

For the combined estimates:

$$\text{Aircraft \%HSD} = 16.7885 - 0.9293 * L_{night} + 0.0198 * (L_{night})^2 \quad (12)$$

$$\text{Road \%HSD} = 19.4312 - 0.9336 * L_{night} + 0.0126 * (L_{night})^2 \quad (13)$$

$$\text{Train \%HSD} = 67.5406 - 3.1852 * L_{night} + 0.0391 * (L_{night})^2 \quad (14)$$

In addition to the analyses based on individual response data presented above, we also calculated the unadjusted odds ratio per 10 dBA increase in L_{night} for each individual study (using the combined estimate) and derived pooled estimates across studies for each transportation mode with the Review Manager Software (RevMan, Version 5.3, Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014). L_{night} was treated as a continuous variable and its range was not restricted for calculating individual study estimates. The purpose of this analysis was primarily to assess the heterogeneity of the studies. The results are shown in Figures 10–12. The small differences between pooled estimates provided in Tables 5 and 6 and Figures 10–12 are expected due to the different

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underlying methodological approaches (random study effect model estimate based on individual response data versus pooled estimate across individual study estimates).

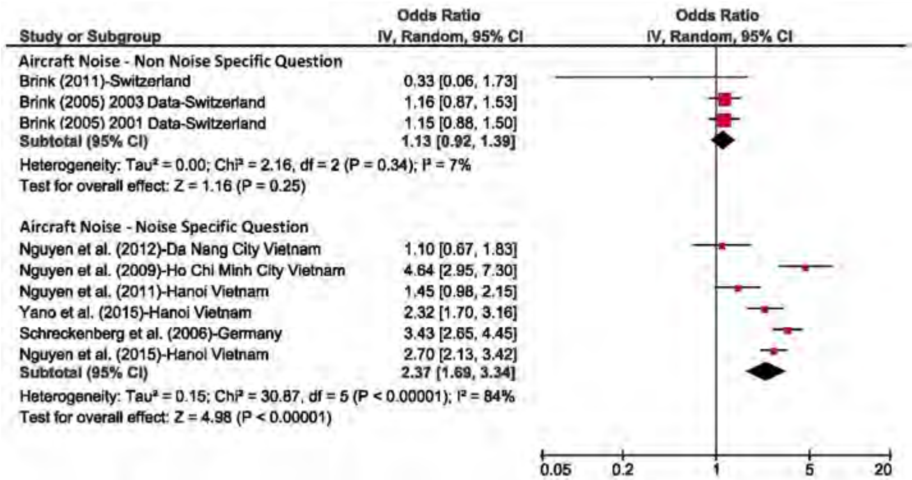

Figure 10. Meta-analysis on the effects of aircraft noise on self-reported sleep disturbance (combined estimate) based on Odds Ratios for a 10 dBA increase in L_{night} level for aircraft noise. The number of studies and subjects contributing to the analyses can be found in Table 2.

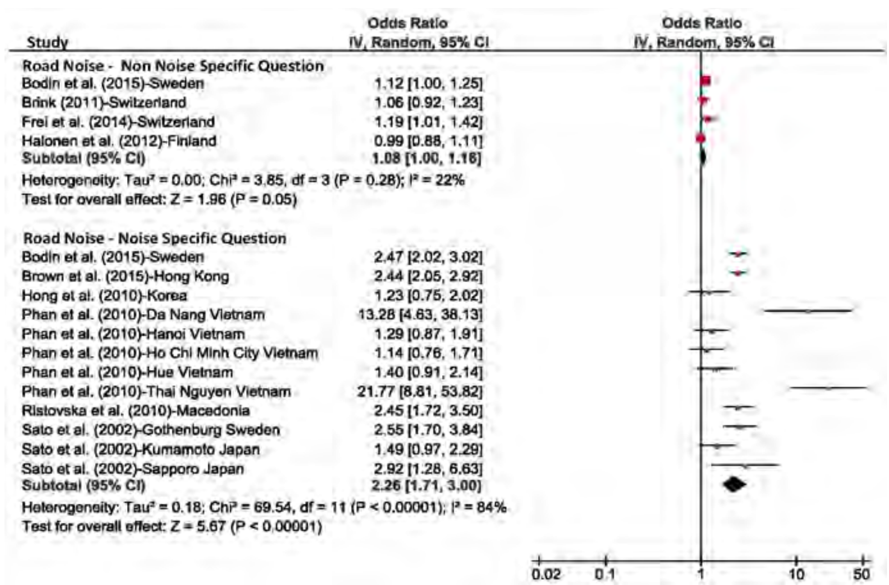

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Figure 11. Meta-analysis on the effects of road noise on self-reported sleep disturbance (combined estimate) based on Odds Ratios for a 10 dBA increase in L_{night} level for road noise. The number of studies and subjects contributing to the analyses can be found in Table 3.

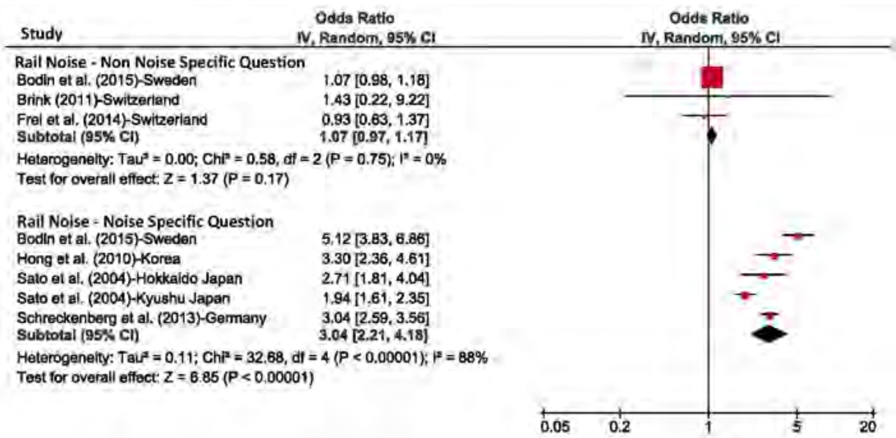

Figure 12. Meta-analysis on the effects of rail noise on self-reported sleep disturbance (combined estimate) based on Odds Ratios for a 10 dBA increase in L_{night} level for rail noise. The number of studies and subjects contributing to the analyses can be found in Table 4.

The I^2 values, a measure of variance across studies, was 84% for road and aircraft noise studies that mentioned the noise source in the sleep question, and was 88% for train noise which indicates there was high heterogeneity between studies. In contrast, for studies that did not refer to the noise source, the I^2 values were 22% or lower, however the number of studies for these meta-analyses were low.

ORG6-127 cont.

4.2. Additional Studies

Results from studies that were not included in the meta-analysis are listed in Table S1. The reason for exclusion of these studies include: the aggregated response data was not available and that the sleep question used had only a binary response choice. Our meta-analysis without these studies is unlikely to be biased in showing a positive association between noise level and percent highly sleep disturbed as only one study by Ohrström et al. (2010) [88] found no association between self-reported sleep disturbance and train noise. However if these studies were included in the meta-analysis they may have affected the magnitude of the effect that was found.

4.3. Conclusions

Noise is only one reason for sleep disturbance. There are many other external (e.g., temperature, humidity, light levels) and internal (e.g., sleep disorders, health conditions, bad dreams) causes. For this reason, odds ratios for sleep disturbance were calculated separately for those studies that did and did not ask about sleep disturbance, awakenings, or problems falling asleep relative to a specific noise-source. The odds ratios calculated for all noise sources and sleep outcomes were greater than 1 but not statistically significant when the noise source was not specifically mentioned in the question except in one case. However, odds ratios were much higher and mostly statistically significantly different from 1 when the noise source was mentioned in the question. This difference could be due to lack of adjustment for confounding factors in the analysis, such as age, gender, socio-economic status, and pre-existing sleep or health conditions. However, the context and wording of the questions can also bias the results.

The surveys included in this meta-analysis consisted of both noise surveys and general health surveys which contained questions on sleep. Bodin et al. [89] examined whether response to questions on the effects of road traffic and train noise was dependent on the context of the survey, whether the survey was presented as a noise and health survey. The question on sleep asked how often sleep was disturbed. The percent of the population providing response alternatives at the end of the scale (i.e., "Every day" and "Never") was the same when the questions were presented as a noise survey and when they were presented as a more general survey.

In the studies examined in this meta-analysis the type of questions asked were also different, with some studies referring specifically to how noise affects sleep while other studies contained more general sleep questions. Barker and Tarnopolsky (1978) [90] examined the difference in response to noise specific and non-noise specific questions in two groups of people exposed to high and low levels of aircraft noise. They asked two questions in their study, one question asked if participants had been nervous and irritable and the other asked if aircraft noise made them feel nervous or irritable. When the question did not refer to noise the percent reporting symptoms was not significantly different between the high noise and low noise exposure group. However there was a significant difference between the two exposure groups when the question referred to noise, which is consistent with the findings of our meta-analyses. For the studies used in this review, even when questions referred to the noise source and the same sleep outcome measure, there were additional differences in the specific wording, reference time frame, and response format of the sleep questions. For example, some studies referred to sleep disturbance during the past 12 months, others during the past month, and a few studies referred to single events or no time period at all. These differences could have all contributed to the high heterogeneity found between studies.

Despite the differences in sleep questions used, results were averaged across questions within studies to obtain combined estimates. These estimates were compared to the previous models developed by Miedema and Vos (2007) [22]. In contrast to their analysis our meta-analysis found that the percent highly sleep disturbed was greater for railway noise than for road noise. In addition, for both rail and aircraft noise the percent highly sleep disturbed was higher in this analysis than Miedema and Vos's. This difference could be due to different methodologies used to derive the model. Also many of the studies included in this meta-analysis were conducted in Japan and Vietnam where the noise exposure and attitude towards noise may be different than in European countries. In addition, in Miedema and Vos's analysis the questions referred to annoyance that occurred due to sleep disturbance for several of the studies, while in this analysis the questions were on the severity or frequency of sleep disturbance. Also, in the studies included on train noise in this analysis, more nighttime events were reported than in previous studies [86]. **ORG6-127 cont.**

Another potential difference for the findings in this analysis and Miedema and Vos's is that this analysis only contained studies published in the year 2000 or later. Recent updates to annoyance exposure-response curves have found an increase in annoyance although only for aircraft noise [91]. The higher reported sleep disturbance found in this analysis is also consistent with the updated exposure-response curve reported by Janssen and Vos [87] for aircraft noise which only included studies conducted in 1996 or later.

Limitations of the current meta-analysis include that L_{night} was predicted or measured at the most exposed façade only, and thus noise levels at the bedroom façade were unknown. The potential effect on the results is likely dependent on the noise source, and could be more important for the results for road and train noise but less for aircraft noise due to the directionality of the noise. Ultimately, this misclassification could result in a shift in the exposure-response curves for road and rail noise to the left, as noise levels in the bedroom are on average likely lower compared to the most exposed façade. Also two of the studies included in the meta-analysis did occur after a change in noise level. The Nguyen et al. [69] aircraft study occurred after the opening of a new terminal building. The average nighttime noise levels did increase for 9 of the 11 sites. However the mean increase in L_{night} was 2 dB; in addition there was a non-significant difference in the Odds Ratio when compared to the results from the Yano et al. [70] study that was conducted before the new terminal was opened. Therefore we included the data in the analysis. Brink et al. [76] conducted 2 surveys before and after a change in operations at Zurich airport, the results from both studies were included in the evidence review as the odds ratios for an increase in sleep disturbance for the two studies were not significantly different.

5. Wind Turbine Noise and Self-Reported and Actigraphy Measured Sleep Outcomes

5.1. Literature Review

Six studies were identified in the literature review in which the association between predicted A-weighted sound pressure levels of wind-turbine noise and self-reported measures of sleep disturbance were assessed. For three of the studies the questions asked how noise affects sleep. Two of the studies were conducted in Sweden [92,93] and one in the Netherlands [94]. For the two studies conducted in Sweden sleep disturbance was assessed using a binary question which asked whether sleep was disturbed by any noise source, while the study conducted in the Netherlands asked how often sleep was disturbed by any noise source with a frequency of at least once a month considered sleep disturbance. The odds ratios for sleep disturbance per 1 dB increase in the predicted A-weighted sound pressure level for all three studies was reported in Pedersen 2011 [48], the values transformed for a 10 dBA increase in noise level can be found in Table 7. For two of the studies a significant association was found between wind turbine noise levels and sleep disturbance. In addition, the Dutch study by Bakker et al. (2012) [94] reported a significant Odds Ratio for sleep disturbance when comparing individuals exposed to noise levels above 45 dBA to those exposed to noise levels less than 30 dBA (2.98, 95% CI: 1.35–6.60). However, in their structural equation model, they found that annoyance was the only factor that predicted sleep disturbance.

For the three remaining studies the effect of wind turbine noise on sleep was evaluated using questions that did not refer to noise. Pawlaczyk-Luszcynsa et al. [95] conducted a study in 2011 in Poland which included questions on different aspects of sleep including difficulty falling asleep. They found that the proportion of individuals reporting that they suffer from sleep disturbance at least a few times per week was significantly higher in individuals exposed to wind turbine noise levels of 40–45 dBA compared to those exposed to levels of 35–40 dBA (26% vs. 10.2%, $p < 0.05$). Kuwano et al. [96] examined self-reported insomnia in a study conducted in Japan. This study included both a noise exposed and control group. Insomnia was defined as having difficulty falling asleep, maintaining sleep, prematurely awakening, or having light sleep at least 3 times a week for any reason. The insomnia prevalence rate in the study was low, with 3.1% of participants exposed to 41–45 dB L_{night} and 2.7% of participants exposed to an L_{night} of greater than 45 dB reporting insomnia. Kuwano et al. also stratified their data according to those individuals who were noise sensitive or not noise sensitive and a significant association between insomnia and L_{night} was only found in the noise sensitive population, though this analysis is limited due to the very low insomnia prevalence rate in the study. Also in contradiction to this finding, Pedersen and Persson-Waye [92] found no association between noise sensitivity and reported sleep disturbance. Michaud [97] assessed subjective and objective measures of sleep for those exposed to predicted wind turbine noise levels of up to 46 dB in Canada. In total 1238 households completed subjective assessments which included the Pittsburgh Sleep Quality Index. No association was found between the mean value of PSQI and wind turbine noise levels or between the percent of participants with a score of 5 or higher and the noise levels. Michaud also evaluated whether individuals were highly sleep disturbed, and found no significant association with wind turbine noise levels.

ORG6-127 cont.

A meta-analysis was conducted for five of the six studies based on the odds ratios for sleep disturbance for a 10 dBA increase in outdoor predicted SPL levels. The results are shown in Figure 13. The analysis was performed separately for questions that did and did not mention noise in the questions on sleep. The pooled odds ratio was 1.60 (95% CI: 0.86–2.94) which was statistically non-significant, there was also high heterogeneity between studies with an I^2 value of 86%.

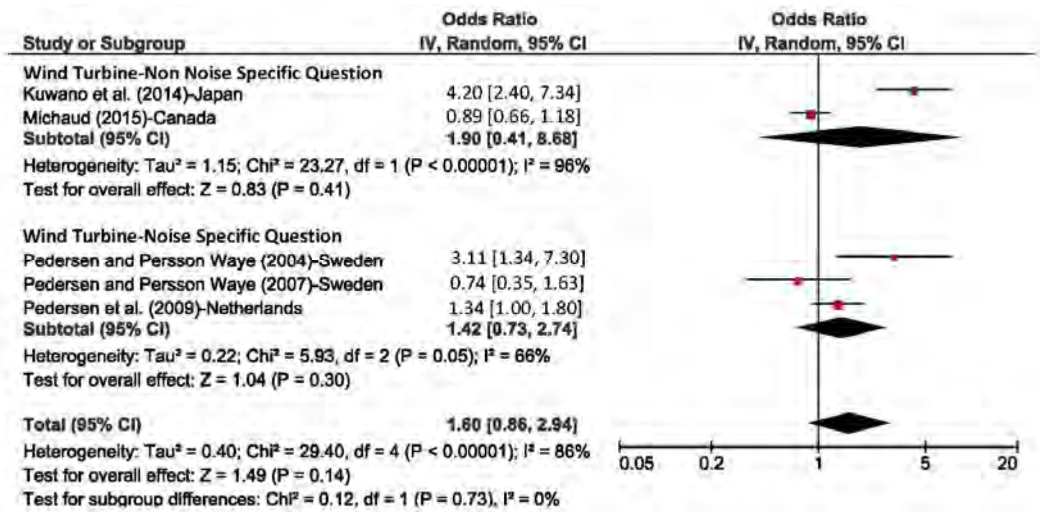

Figure 13. Meta-analysis on the effects of wind turbine noise on self-reported sleep disturbance based on Odds Ratios for a 10 dBA increase in A-weighted SPL level for wind turbine noise. The number of subjects contributing to the analyses can be found in Table 7.

5.2. Conclusions

The results of the six identified studies that measured self-reported sleep disturbance are consistent, four of the studies found an association between wind turbine noise levels and increased sleep disturbance. However the evidence that wind turbine noise affects sleep is still limited. This finding is supported by other recent reviews on wind turbine noise and sleep disturbance [56,98,99]. Three of the studies referred to noise specifically in the questions which could have led to a bias in the results. Also while the results from four out of the six studies suggest that sleep disturbance due to wind turbine may occur when noise levels are above 40 or 45 dBA, for two of the studies less than ten percent of the participants were exposed to these higher noise levels. Therefore, it is difficult to make conclusions on populations exposed to these higher levels. In addition, noise levels were calculated using different methods and different noise metrics were reported in the studies. Pawlaczyk-Luszcynsa et al. [95] reported L_{den} levels which were obtained by adding a +4.7 dBA correction to the predicted sound pressure levels. In the Kuwano et al. [96] study wind turbine noise was measured at select locations, and then a logarithmic regression was performed between the measured noise levels and distance from the wind turbines. Noise levels for each participant were estimated based on the regression which could have led to misclassification. While noise level measurements were made to confirm noise predictions in a few studies, noise levels were never measured inside participant's bedrooms. The audibility of wind turbine noise in bedrooms particularly when windows are closed is unknown. In the study by Pedersen and Persson Waye [92] all but two of 20 subjects that reported sleep disturbance slept with open windows.

ORG6-127 cont.

Evidence is also limited as five of the six studies only obtained self-reported measures of sleep disturbance. There have been two studies which used actigraphy to evaluate sleep due to wind turbine noise. In a study by Lane [100] 13 individuals slept for five consecutive nights while wearing actigraphy devices. The sample size was too small to draw significant conclusions. Actigraphy was also used to evaluate sleep for multiple nights in a subsample of 654 participants in a study by Michaud [97]. They found no significant association between wind turbine noise levels and actigraphy measured outcomes, but predicted L_{night} levels did not exceed 46 dBA outside with an arithmetic mean of 35.6 dBA for the study population. Studies using both objective measures of sleep and noise exposure are still needed.

Table 7. Characteristics of studies on self-reported measures of sleep disturbance and wind turbine noise. Odds ratios for sleep disturbance are listed.

Reference	Country	N	N (>40 dBA)	Noise Exposure	Confounding Variables Adjusted for in the Statistical Analysis	Odds Ratio per 10 dBA (95% CI)	Odds Ratio Relative to Reference (95% CI)
Pedersen and Persson Waye (2004) [92]	Sweden	351	25	Predicted A-weighted SPL	Age, gender	3.11 (1.34–7.30)	Reference: <35 dBA >35 dBA: 4.72 (0.27–82.97)
Pedersen and Persson Waye, (2007) [93]	Sweden	754	20	Predicted A-weighted SPL	Age, gender	0.74 (0.35–1.63)	NA
Pedersen et al. (2009) [101] Bakker et al. (2012) [94]	Netherlands	725	159	Predicted A-weighted SPL	Age, gender, economic benefits	1.34 (1.00–1.80)	Reference <30 dBA >45 dBA: 2.98 (1.35–6.60)
Kuwano et al. (2014) [96]	Japan	747 (332 Controls)	260	L_{night} (22:00-6:00)	Age, gender	4.20 (2.40–7.34)	Reference: <35 dBA 41–45 dBA: 5.55 (1.12–27.47) >46 dBA: 4.79 (0.64–35.70)
Michaud (2015) [97]	Canada	1238	234	Predicted A-weighted SPL	None	0.89 (0.66–1.18)	NA
Pawlaczyk-Luszcynsa et al. (2014) [95]	Poland	156	90	L_{den}	None	NA	Reference: 35–40 dBA 40–45 dBA: 2.74 (1.08–6.97)

ORG6-127 cont.

6. Hospital Noise

6.1. Literature Review

Seventeen studies were identified in which the effects of hospital noise on sleep were examined. Five were intervention studies in which quiet hours were implemented to reduce noise. While intervention studies are covered in another review, we included them here due to the low number of studies on hospital noise and sleep that were identified. Also it may be difficult to observe a wide variance in noise levels within a study in the same hospital ward without implementing an intervention. Of the non-intervention studies, nine examined the effect of noise on sleep in adult patients and three studies examined the effect on young children. Characteristics for all studies reviewed are shown in Tables 8–10. The study methodology was too diverse and prohibited us from doing a systematic meta-analysis. Of the studies in adults, four compared arousals measured with polysomnography to peaks in noise level. Aaron et al. (1996) [102] found a significant correlation between arousals and noise events which exceeded 80 dBA ($r = 0.57$, $p = 0.0001$) in a small study of six patients. However, in a study by Elliott et al. (2013) [103] which used a similar methodology but enrolled 53 patients, only a weak non-significant correlation between arousals and noise events was found (daytime measurements: $r = 0.13$; nighttime measurements $r = 0.19$). Freedman et al. (2001) [104] reported that 11.5% $\pm$ 11.8% of arousals in patients were due to noise events. Gabor et al. (2003) [105] examined sleep in both patients and healthy individuals who slept in the Intensive Care Unit and found that while 68.4% of arousals in healthy individuals were related to noise events only 17.5% of arousals in patients were. Three of the studies reviewed used actigraphy to evaluate measures of sleep duration and efficiency. Adachi et al. (2013) [106] found no association between hourly minimum noise levels and sleep duration. Missildine et al. (2010) [107] found no association between sleep efficiency and mean noise levels. However, Yoder et al. (2012) [108] did find that those exposed to the loudest tertile of average nighttime noise levels slept significantly less than those exposed to the quietest tertile. ORG6-127 cont.

Of the three studies identified that examined sleep in children, two of the studies, Corser (1996) [109] and Cureton-Lane and Fontaine (1997) [110], evaluated sleep subjectively using the Patient Sleep Behavior Observation Tool (Echols, 1968) [111] which describes patient behaviors that are related to 4 levels of cortical activity. Corser (1996) [109] found a small correlation between noise levels and observed sleep state ($r = -0.20$, $p < 0.05$) in infants (mean age 23.3 months). The observed sleep state though was more strongly correlated to behavioral indicators of pain ($r = -0.27$, $p < 0.05$) and caregiver activities ($r = -0.30$, $p < 0.05$). Similar results were found by Cureton-Lane and Fontaine [110]. In a probit analysis, noise was a significant predictor of sleep state in children (mean age 4.7 years). However, light levels and caregiver activity were also identified as significant predictors. Kuhn et al. [112,113] used both subjective and objective measures of sleep; the objective measurements included heart rate, blood pressure and respiration rate. They found that respiration rate significantly decreased during quiet sleep in pre-term infants when a noise event exceeded the background level by 10 dBA (-10.0 ± 12.5 breaths/min, $p = 0.002$).

Several of the studies examined whether interventions to reduce noise resulted in improved sleep. Dennis et al. (2010) [114] implemented a two hour quiet period during the day and night in which telephone volumes were decreased, caregiving activities were reduced, visiting hours were limited, and the staff were encouraged to interact quietly. During the day the implementation of quiet hours resulted in a 9 dB reduction in noise level (71.2 dB prior to the intervention, 62.2 dB during the intervention) while at night only a 1.4 dB reduction occurred. Sleep state was determined based on observation every 30 min. A significant Odds Ratio for being asleep was found when the intervention was implemented during the day (4.04, 97.5% CI 2.24–7.30) however, not when it was implemented during the night (0.96, 97.5% CI 0.41–2.24). Gardner et al. (2009) [115] implemented a quiet period during the daytime only and included both an experimental and control group. While they found a significant correlation between noise levels and the number of patients observed to be awake in the experimental group ($r = 0.704$, $p \leq 0.01$) the correlation in the control group was weak ($r = 0.24$, $p < 0.05$).

Therefore, it is unclear whether it was the reduction in noise level that resulted in more of the patients being observed asleep. Walder et al. (2000) [116] found results that were opposite to the previous studies, they found that sleep duration and the number of awakenings was greater after behavioral rules to reduce noise were implemented. However, the same patients did not take part before and after the intervention was implemented, also the number of patients enrolled was small. Contrary to previous studies, Thomas et al. (2012) [117] did not find an improvement in noise levels when sleep promoting measures were put into practice; however the noise levels were low, below 40 dB before the intervention. One intervention study was conducted with children. Duran et al. (2012) [118] conducted a study to examine whether preterm infants that wore earmuffs while in an incubator, which reduced noise levels by 7–12 dBA, had improved heart rate, respiration rate, and blood pressure, and subjective observations of sleep. They found that more infants were observed in a state of rest when wearing the earmuffs (87.5% with ear muffs, 29.4% without earmuffs). However no difference was found in the physiological measurements. Both subjective and objective measurements were recorded once every two hours.

6.2. Conclusions

Sleep quality in hospitals in general is low. Studies have found that sleep primarily consists of Stage 1 and 2 sleep with low or absent amounts of REM and slow-wave sleep [104,119]. In addition average sleep bouts of 20 min duration or less have been measured [107]. Sleep disturbance in hospitals can be caused by many factors including pain, medication, desynchrony with ventilation, care-giving activities, stress, unfamiliar environment, in addition to environmental factors such as light and noise levels. While noise is just one component, the average noise levels in the studies reviewed were high, with L_{day}, L_{night}, and $L_{eq,24hr}$ primarily above 50 dBA [103,105,110], with several reporting noise levels exceeding 60 dBA [115,120,121].

ORG6-127 cont.

Despite the high noise levels the quality of the evidence on the effect of noise on sleep is low. The results of 14 studies do indicate that noise is among the factors contributing to sleep disturbance in hospitals. The results from the four studies that used polysomnography indicate there is a weak correlation between EEG arousals and events of high noise level and that 10–20% of all arousals maybe associated with noise events. The results from studies using actigraphy measures of sleep however were contradictory with only one study finding a significant association between noise and sleep duration. In children, the study by Kuhn et al. [112,113] did find that increases in noise level affected physiological measures of pre-term infants. Also in two of the four studies, implementing quiet hours in adults, lower noise levels and improved sleep were found. The relationship between noise levels or signal-to-noise ratios and the likelihood of having a physiological reaction to the noise events though is unclear based on the studies reviewed.

Another limitation of the studies reviewed is that several only examined correlations and confounding factors were not adequately examined. A study by Park et al. (2014) [120] though did include several important confounders in their analysis. They measured subjective sleep quality using the Pittsburgh Sleep Quality Index [122] and found that sleep disturbance scores increased with mean daytime and nighttime noise levels even after controlling for age, gender, severity of disease, medication, and room-type. Additional factors that should be examined include mechanical ventilation and time in unit. The length of time spent in the hospital could be examined as a confounding variable or as an outcome measure as it may increase when there are higher noise levels.

Table 8. Characteristics of studies on hospital noise and sleep in adults.

Reference	N	Age	Hospital Unit	Noise Measurement	Subjective Measure	Objective Measure	Outcome
Aaron et al. 1996 [102]	6	66.8 ± 2.8 years	Intensive and Intermediate Respiratory Care Unit	SPL every minute	NA	Polysomnography	Correlation (r = 0.57, p = 0.0001) between number of arousals (between 22:00–6:00) and SPL peaks ≥ 80 dB
Adachi et al. 2013 [106]	118	65.0 ± 11.6 years	General Medicine	Hourly L_{min}, L_{eq}, L_{max}	Karolinska Sleep Log	Actigraphy	Multivariate linear and logistic regressions: No significant association between L_{min} tertiles and sleep duration, Karolinska Sleep Quality, or noise complaints
Elliott et al. 2013 [103]	53	60.1 ± 20.0 years	Intensive Care Unit	L_{Aeq} and L_{Cpeak} levels logged every second	Richards Campbell Sleep Questionnaire	Polysomnography	Weak correlation between arousal indices and number of sound peaks > 80 dB (day r = 0.13, night r = 0.19)
Gabor et al. 2003 [105]	13 Patients: 7 Control: 6	Patients: 56. 7± 19.2 years Controls: 23–65 years	Intensive Care Unit	SPL	NA	Polysomnography	17.5 ± 11.2% (Patients) and 68.4 ± 11.1% (Control Subjects) of arousals were associated with a sound event greater than 10 dB over background
Freedman et al. 2001 [104]	22	61 ± 16 years	Intensive Care Unit	SPL every minute	NA	Polysomnography	11.5 ± 11.8% of arousals and 26.2 ± 24.8% of awakenings was due to environmental noise
Hsu et al. 2010 [121]	40	54. 5± 14.5 years	Cardiac Surgical Unit	SPL every second	Questions on insomnia	Heart rate and blood pressure every 5 min	Correlation between insomnia and noise level, L_{eq} (r = 0.09), L_{max} (r = 0.24), L_{min} (r = −0.03).
Missildine et al. 2010 [107]	48	79 years	Medical Unit	SPL levels (23:00–7:00)	Richards Campbell Sleep Questionnaire	Actigraphy	For those subjects with less than 300 minof sleep, 59% were exposed to nighttime noise levels ≥ 40 dBA. In a multiple regression for sleep efficiency, the coefficient for median noise level was not significant (β = −0.671, p = 0.836).
Park et al. 2014 [120]	103	60 ± 14.8 years	Internal Medicine	Leq	Pittsburgh Sleep Quality Index	NA	Sleep disturbance scores increased with mean daytime and nighttime levels (β = 0.2; 95% CI = 0.09–0.53 for daytime; β = 0.12; 95% CI = 0.07–0.36 for nighttime). Controlled for age, gender, severity of disease, medication, and room type.
Yoder et al. 2012 [108]	106	66.0 ± 12 years	General Medicine	L_{min}, L_{eq}, L_{max}	Pittsburgh Sleep Quality Index	Actigraphy	Patients exposed to the loudest tertile of average nighttime noise levels slept significantly less (−76 min, 95% CI −134 to −18 min, p = 0.01) than patients exposed to the lowest tertile of noise.

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Table 9. Characteristics of studies on hospital noise and sleep in children.

Study	N	Age	Hospital Unit	Measure of Noise	Subjective Measure	Objective Measure	Outcome
Corser 1996 [109]	12	23.3 ± 6.1 months	Pediatric Intensive Care Unit	SPL every 5 min	Patient Sleep Behavior Observation Tool used to identify sleep state every 5 min 19:00–7:00	NA	Correlation between observed sleep state and noise ($r = -0.2043$, $p < 0.05$).
Cureton-Lane and Fontaine 1997 [110]	9	4.7 ± 3.5 years	Pediatric Intensive Care Unit	SPL every 5 min	Patient Sleep Behavior Observation Tool used to identify sleep stage every 5 min from 20:00–6:00	NA	Noise was a significant predictor of sleep state in probit analysis ($p < 0.001$). Light levels and contact with staff were also significant predictors.
Kuhn et al. 2013 [112] Kuhn et al. 2012 [113]	26	28 weeks (median)	Neonatal Intensive Care Unit	Classified sound peaks: those exceeding the previous level by more than 5 dBA	Prechtl's observational rating system for defining arousal states.	Heart Rate, Respiratory Rate and SaO_2	Average percent awakened due to classified sound peaks was 33.8% (95% CI: 24–37%). For control periods without sound peaks average percent awakened was 11.7% (95% CI: 6.2–17.1%). For sound peaks 10–15 dBA above background a significant decrease in respiration rate (-10 ± 12.5 breath/min, $p = 0.002$) during quiet sleep was found.

ORG6-127 cont.

Table 10. Characteristics of intervention studies on hospital noise and sleep in adults and children.

Study	N	Age	Hospital Unit	Invention	Measure of Noise	Subjective Measure	Objective Measure	Outcome
Dennis et al. 2010 [114]	50 Day: 35 Night: 15	Day: 55.5 ± 14.4 years Night: 52.9 ± 16.3 years	Neuro-Intensive Care Unit	Implemented 2 h quiet period during the day and night	SPL collected 6 times a day over a period of 5 s before, after and during the quiet time hours	Sleep Observation Tool: seven observations made per subject	NA	Odds Ratio (97.5% CI) observed asleep: Day: 4.04 (2.24–7.30) Night: 0.96 (0.41–2.24)
Duran et al. 2012 [118]	20	30.0 ± 2.2 weeks	Neonatal Intensive Care Unit	Infants wore earmuffs that decreased noise levels by 7–12 dBA for 2 days	Measurements made every 2 h during an 8 h period	Anderson Behavioral State Scoring System. Measurements made every 2 h during an 8 h period	Blood pressure, heart rate, respiration rate, body temperature, and oxygen saturation. Measurements made every 2 h during an 8 h period	For the two conditions (with and without earmuffs): No difference was observed in physiological measures. 87.5% of infants with earmuffs observed asleep, 29.4% of infants without earmuffs observed asleep
Gardner et al. 2009 [115]	293 Experimental: 137 Control Group: 156	Experimental Group: 56.4 ± 19.1 years Control Group: 50.5 ± 19.4 years	Orthopedic Unit	Implemented quiet hours	Daily SPL	Observed Sleep State	NA	Correlation between mean SPL levels and patients found to be awake: Experimental: (r = 0.704, p < 0.01) Control group: r = 0.243, p < 0.05)
Thomas et al. 2012 [117]	95 Phase 1: 32 Phase 2: 33 Phase 3: 30	Phase 1: 49 ± 1 years Phase 2: 43 ± 3 years Phase 3: 46 ± 3 years	Neurological Unit	Study had 3 phases with measured noise levels Phase 2: Sleep promoting rules	SPL between 20:00–8:00	Questions on sleep quality, sleep quantity	NA	Intervention did not result in a reduction in noise level. The median noise levels were: Phase 1: 38.6 dB, Phase 2: 40.6 dB, Phase 3: 43.5 dB
Walder et al. 2000 [116]	17 Before Guidelines: 9 After Guidelines: 8	Before Guidelines: 62.5 ±16.5 years After Guidelines: 57.8 ±15.9 years	Surgical Intensive Care Unit	Implemented behavioral rules	SPL, every 1 s between 23:00–5:00.	Nurses estimated the patient's sleep duration and the number of awakenings.	NA	Sleep duration was shorter, and the number of awakenings higher when the behavioral rules were implemented.

ORG6-127 cont.

7. Additional Sleep Outcome Measures

7.1. Cardiac and Blood Pressure Outcome Measures during Sleep in Adults

In this review, while several studies were identified in which electrocardiogram (ECG) measurements were performed [35,60–62] only two studies were identified in which the results on the effects of transportation noise on cardiac measures and blood pressure were reported. Haralabidis et al. (2008) [123] examined the effect of road and aircraft noise on heart rate and blood pressure measurements as part of the HYENA study. 140 subjects underwent 24 h ambulatory blood pressure measurements with heart rate, measurements were recorded every 15 min. Noise levels within the bedroom were also recorded. When aircraft events occurred a small but significant increase in both systolic and diastolic blood pressure was found for a 5 dB increase in indoor maximum noise level (systolic: 0.66 mmHg, 95% CI 0.33–0.98 and diastolic: 0.64 mmHg, 95% CI 0.37–0.90). For road traffic noise a small but significant increase in blood pressure was also found (systolic: 0.81 mmHg, 95% CI 0.46–1.16 and diastolic: 0.55 mmHg, 95% CI 0.26–0.83). Graham et al. (2009) [124] examined respiratory sinus arrhythmia and pre-ejection period in 36 subjects exposed to road and rail noise. Respiratory sinus arrhythmia was considered an index for cardiac parasympathetic tone and pre-ejection period was considered an index of cardiac sympathetic tone. No significant association was found between pre-ejection period and the average indoor noise level during the sleep period. A significant decrease of the log of respiratory sinus arrhythmia with noise level was found, with age as a significant covariate. This finding suggests that noise exposure may lead to decreased parasympathetic tone.

7.2. Motility Measured Sleep Outcomes in Adults

Eight studies were identified in which motility was measured (see Table 11). Four of the studies examined the probability of having a motility reaction due to single noise events. In a study by Passchier-Vermeer et al. (2002) [64] 418 individuals that lived near Schiphol airport wore actigraphs continuously for 11 days. They found a significant increase in motility reaction with the indoor maximum noise level ($L_{AS,max}$) of aircraft events. The estimated probability of a motility reaction was less than 1% for events of 40 dB, and was greater than 4% for events of 60 dB. In 2007, Passchier-Vermeer et al. conducted a second study to examine the effect of road and rail noise on measures of motility. The study included 262 participants who wore actigraphs for 5 consecutive nights. They found that motility and motility onset increased with noise level, and that railway noise did not have a greater effect on motility than road traffic noise. Hong et al. (2006) [125] also used actigraphs to evaluate sleep in 12 subjects exposed to railway noise. They found slightly higher probability of reaction then found in the Passchier-Vermeer et al. [64] study. Lercher et al. (2010) [126] used seismosomnography [127] to measure movement in individuals exposed to rail noise. In a linear regression, for the probability of motility, the coefficient for L_{Amax} was significant (0.04 per dB, 95% CI 0.01–0.07, $p < 0.01$). ORG6-127 cont.

For the remaining 4 studies, actigraphy derived sleep parameters for the entire night were compared to average noise levels. Ohrström et al. (2006) [128] conducted a study using actigraphy in both children and their parents. No clear exposure-response relationship was found between mean activity, wake episodes, and sleep latency and predicted $L_{Aeq,24hr}$ for the parents. Frei et al. (2014) [84] did not find a significant decrease in sleep duration with predicted outdoor L_{night} levels. However, sleep efficiency was found to decrease with L_{night} even after adjusting for several confounding variables including gender, age, education, and body mass index. Unlike the two previous studies Pirrera et al. (2014) [129] recorded noise levels within the bedroom of participants. The study consisted of two groups, 23 individuals that lived in an area with high levels of road traffic and 22 individuals that lived in a more quiet area. There was a 10 dB difference in the mean outdoor L_{Aeq} (measured during the participant's time in bed period) between the high and low noise group, however there was not a significant difference in the indoor L_{Aeq} levels between the two groups. Therefore although individuals in the high noise group spent less time in bed (high noise group: 433 min, quiet group: 451 min), there was no significant difference found in sleep onset latency, wake after sleep onset, or sleep efficiency. Griefahn et al. (2000) [130], similar to the other studies mentioned, found no association between road and rail noise levels and motility. The results from motility studies are therefore conflicting in that there is evidence from 4 of the 8 studies that for single-events there is an increase in movement. On the other hand, there is not consistent evidence that sleep parameters descriptive of the entire night are affected by noise.

Table 11. Characteristics of studies that evaluated sleep based on measures of motility.

Reference	*N*	Noise Source	Noise Metric	Outcome
Hong et al. (2006) [125]	12	Rail	L_{Amax} indoor	Exposure-response between probability of motility and indoor L_{Amax}. A higher probability of motility than in previous aircraft noise studies was found.
Frei et al. (2014) [84]	119	Road	L_{night}, 22:00–6:00, outdoor, most exposed facade	Decrease in sleep efficiency (percent) with outdoor L_{night}. Coefficients for random subject intercept linear regression: 30–40 dB: 0.20 (95% CI −1.21, 1.60), 40–55 dB: −0.85 (95% CI −2.42, 0.71), >55 dB: −4.06 (−6.78, −1.35)
Griefahn et al. (2000) [130]	377	Road and Rail	Indoor and outdoor whole night and individual event noise levels	No significant effect of noise on sleep parameters found.
Lercher et al. (2010) [126]	8	Rail	L_{Amax} indoor	Coefficient for L_{Amax}, in a linear regression for the probability of motility reaction was significant. (0.04, 95% CI 0.01–0.07, $p < 0.01$)
Ohrström et al. (2006) [128]	79	Road	$L_{Aeq,24hr}$ outdoor, most exposed facade	No significant effect of noise on sleep parameters was found.
Passchier-Vermeer et al. (2002) [64]	418	Aircraft	L_{Amax} indoor	Exposure-response relationship between motility and indoor L_{Amax}.
Passchier-Vermeer et al. (2007) [131]	262	Road and Rail	L_{Amax} indoor	Significant noise metric coefficient when comparing probability of motility reaction to an estimated indoor L_{Amax} level. Motility reaction was greater when there was higher levels of background noise.
Pirrera et al. (2014) [129]	45	Road	L_{Aeq} indoor	No significant difference in indoor average noise levels was found despite differences in outdoor noise level. No significant difference in time in bed, total sleep time, sleep latency, wake after sleep onset, or sleep efficiency was found.

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7.3. Sleep Disturbance in Children

The results from sleep studies in children have suggested that they are less likely to awaken to noise events than adults, with a difference in sensitivity of approximately 10 dBA [132]. However, despite being less sensitive, children are still considered a vulnerable group due to their developmental state and also because of the difference in their sleep patterns. Children have earlier bedtimes and longer sleep durations than adults, which may overlap with periods of high traffic not accounted for by metrics such as L_{night}.

Five studies on the effects of road, rail, and aircraft noise on sleep in children published since 2000 were identified as part of this review (see Table 12). Ohrström et al. (2006) [128] conducted a study to examine the effect of road traffic noise on sleep in both adults and children. They conducted a main study which included a questionnaire and a more detailed study in which subjects filled out sleep logs and wore actigraphs for 4 days. The children in the study were between the ages of 9–12 years. In the main study a small yet significant decrease in self-reported sleep quality with increasing predicted outdoor $L_{Aeq,24hr}$ levels was found. However, no relationship between outdoor noise levels and actigraphy measured sleep parameters was found. Lercher et al. (2013) [133] found a small but significant relationship between road and rail noise (L_{den}) and a sleep disturbance index which was based on responses to questions on sleep onset, maintaining sleep, and tiredness in 3rd and 4th grade students. The variance explained by the models though was small. Ising and Ising (2002) [134] obtained self-reported measures of sleep for 56 children between the ages of 7–13. Noise levels were measured in the children's bedroom. They found that those children exposed to higher C-weighted maximum noise levels were more likely to report problems sleeping. Tiesler et al. (2013) [135] examined the relationship between predicted noise levels and self-reported sleep disturbance in children that were part of a population-based birth-cohort study called LISAplus. Data on sleep was available for 287 children and the mean age of children in the cohort studies was 10 years. They found a significant relationship between noise levels (L_{night}) at the least exposed façade and sleeping problems (OR 1.79, 95% CI 1.10–2.92) and difficulty falling asleep (OR 1.96, 95% CI 1.16–3.32) after controlling for a number of confounding variables including gender, age, and parental education. However, a significant relationship was not found for noise levels at the most exposed façade. They also found that those children reporting sleep problems were more likely to report emotional symptoms although this was not significantly related to noise level. Stansfeld et al. (2010) [136] examined whether self-reported sleep disturbance in children in the Munich study mediated the relationship between aircraft noise and cognitive performance. However, they did not find an effect.

Table 12. Characteristics of studies that evaluated sleep in children.

Reference	Age	*N*	Confounding Variables Adjusted for in the Statistical Analysis	Noise Source	Noise Metric	Outcome
Ising and Ising (2002) [134]	7–13 years	56	Age, gender, social status	Road	L_{Cmax} Indoors	Significant correlation between L_{Cmax} and awakenings during sleep and problems to fall asleep
Lercher et al. (2013) [133]	8–11 years	1251	Gender, health status, and mother's education	Road and Rail	L_{den} Outdoor most exposed facade	L_{den} was a significant predictor of self-reported sleep, but not when adjusted for sound perception score
Ohrström et al. (2006) [128]	Mean 10.9 years (range 9–12.9)	160 (survey) 79 (actigraphy)	None	Road	$L_{Aeq,24h}$ Outdoor most exposed facade	Decrease in self-reported mean sleep quality (0–10) < 55 dB: 8.6, 55–59 dB: 8.2, 60–64 dB: 8.2, >64 dB: 8.1. No association between actigraphy measured sleep parameters and noise level
Tiesler et al. (2013) [135]	10.1 ± 2.2 years	287	Gender, age, parental education level, mother's age at birth, television/computer usage, single parent status, sleeping alone, and orientation of the window	Road	L_{night} Outdoors, least exposed facade	Reporting any sleep problems: OR: 1.79 (95% CI 1.10–2.92) Reporting problems falling asleep: OR 1.96 (95% CI 1.16–3.32)

ORG6-127 cont.

The results of four of the studies suggest that noise may lead to poorer self-reported sleep in children. Additional studies are needed though to determine the effect of noise on both subjective and objective measures of sleep in children. Also more studies are needed to examine whether nighttime noise exposure may contribute to attention deficits, emotional or behavioral problems, or reduced cognitive performance.

8. Summary of Available Evidence

A summary of the evidence for different noise sources and sleep outcome measures is shown in Table 13. For road, rail, and aircraft noise the focus of this review was to conduct a re-analysis for polysomnography measured awakenings and a meta-analysis for self-reported sleep outcome measures. The quality of the evidence that transportation noise causes cortical awakenings is moderate. The two studies reviewed were conducted using a similar methodology and exposure-response relationships were developed for all three transportation modes. The results from the analysis consistently indicate that a 10 dBA increase in the indoor maximum noise level is associated with an Odds Ratio for awakenings or sleep stage changes to Stage 1 of 1.3 or higher.

Table 13. Summary of findings.

Sleep Outcomes	Noise Source	Number of Participants (Studies)	Quality of Evidence	Noise Metric	Odds Ratio per 10 dBA Increase (95% CI)
Cortical Awakenings in Adults	Road	94 (2)	⊕⊕⊕O Moderate There was evidence of dose-response	Indoor $L_{AS,max}$	1.36 (1.19–1.55)
	Rail	33 (1)	⊕⊕⊕O Moderate There was evidence of dose-response	Indoor $L_{AS,max}$	1.35 (1.21–1.52)
	Aircraft	61 (1)	⊕⊕⊕O Moderate There was evidence of dose-response	Indoor $L_{AS,max}$	1.35 (1.22–1.50)
Self-Reported Sleep Disturbance in Adults (Noise Source Specified)	Road	20,120 (12)	⊕⊕⊕O Moderate There was evidence of dose-response	Outdoor L_{night}	2.13 (1.82–2.48)
	Rail	7133 (5)	⊕⊕⊕O Moderate There was evidence of dose-response	Outdoor L_{night}	3.06 (2.38–3.93)
	Aircraft	6371 (6)	⊕⊕⊕O Moderate There was evidence of dose-response	Outdoor L_{night}	1.94 (1.61–2.33)
Self-Reported Sleep Disturbance in Adults (Noise Source Not Specified)	Road	18,850 (4)	⊕OOO Very Low Confounding factors not accounted for in analysis, Imprecision low number of studies	Outdoor L_{night}	1.09 (0.94–1.27)
	Rail	8493 (3)	⊕OOO Very Low Confounding factors not accounted for in analysis, Imprecision low number of studies	Outdoor L_{night}	1.27 (0.89–1.81)
	Aircraft	3173 (3)	⊕OOO Very Low Confounding factors not accounted for in analysis, Imprecision low number of studies	Outdoor L_{night}	1.17 (0.54–2.53)
Motility Measures of Sleep in Adults	Road, Rail, Aircraft	1320 (8)	⊕⊕OO Low Single event analysis indicates dose-response	L_{Amax} and L_{Aeq}	Not estimated
Self-Report and Motility Measured Sleep Disturbance in Children	Road, Rail, Aircraft	1754 (4)	⊕OOO Very Low Inconsistency in results, small number of studies	Varied across studies	Not estimated
Self-Reported Sleep Disturbance in Adults	Wind Turbine Noise	3971 (6)	⊕OOO Very Low Inconsistency in results and imprecision due to small sample sizes at highest noise levels	Outdoor A-weighted SPL	1.60 (0.86–2.94)
All Sleep Outcome Measures	Hospital Noise	964 Adults/67 Children (13 Adults/4 Children)	⊕OOO Very Low Inconsistency in results and imprecision due to small sample sizes	Varied across studies	Not estimated

ORG6-127 cont.

For self-reported sleep outcome measures, the quality of the evidence is dependent on the wording of the questions. When individuals were asked whether road, rail, or aircraft noise affected sleep a significant increase in the odds of being highly sleep disturbed was found for a 10 dBA increase in outdoor L_{night} levels for all sources. However no significant increase was found when the noise source was not mentioned. Because the dose-response relationships between Lnight and percentage highly sleep disturbed were statistically significant and showed Odds Ratios > 2, for both road and rail noise, we upgraded our GRADE assessment from very low to moderate quality for studies using questions that did mention noise as the cause (see Table 13, and Tables S3 and S4). However, we downgraded to very low quality for studies using the respondents' answers to questions that did not mention the noise source, due to inadequate adjustment for confounding and imprecision due to the low number of studies. This suggests that for self-reported measures it is annoyance or attitude to the nighttime noise that may be driving the increase of reported sleep disturbance outcomes with L_{night} level. However, whether or not the question is reflective of sleep disturbance or attitude to nighttime noise both are important endpoints. For the other outcome measures and noise sources, we were not able to derive pooled odds ratios.

9. Conclusions

This review demonstrates effects of traffic noise on objectively measured sleep physiology and on subjectively assessed sleep disturbance (including sleep quality, problems falling asleep, and awakenings during the night). The evidence for other sources of noise (e.g., hospital noise, wind turbine noise) is conflicting or only emerging and did not allow for the derivation of exposure-response functions. There is biologic plausibility that chronic night time exposure to relevant levels of noise can contribute to negative health consequences like cardiovascular disease. Although recent epidemiological studies have shown stronger relationships of nocturnal noise exposure [34] with negative health consequences compared to daytime noise exposure, studies directly investigating the link between acute noise-induced sleep disturbance and long-term health consequences are missing and not an easy undertaking. However, disturbed sleep has immediate next-day consequences (e.g., increased sleepiness, impaired cognitive performance) that may increase the risk for errors and accidents, and thus sleep deserves protection from noise even in the absence of a direct link to long-term health consequences. The exposure-response functions provided in this report can be used to assess the degree of noise-induced sleep disturbance. It is plausible that preventing acute effects of noise on sleep will likely also prevent long-term negative health consequences.

Supplementary Materials: The following are available online at http://www.mdpi.com/1660-4601/15/3/519/s1, Table S1: Characteristics and outcomes of studies not included in the meta-analysis for self-reported sleep outcomes, Table S2: GRADE Table for the quality of evidence of noise from road, rail, and aircraft noise and cortical awakenings in adults, Table S3: GRADE Table for the quality of evidence of noise from road, rail, and aircraft noise and self-reported sleep disturbance in adults (noise source specified), Table S4: GRADE Table for the quality of evidence of noise from road, rail, and aircraft noise and self-reported sleep disturbance in adults (noise source not specified), Table S5: GRADE Table for the quality of evidence of noise from road, rail, and aircraft noise and motility measures of sleep in adults, Table S6: GRADE Table for the quality of evidence of noise from road, rail, and aircraft noise and self-report and motility measured sleep disturbance in children, Table S7: GRADE Table for the quality of evidence of noise from wind turbines associated with effects on sleep, Table S8: GRADE Table for the quality of evidence of noise from hospitals associated with effects on sleep, Table S9: Model coefficients for the random study effect logistic regression model (Mixed) and the GEE model for the percent Highly Sleep Disturbed due to Aircraft noise, Table S10: Model coefficients for the random study effect logistic regression model (Mixed) and the GEE model for the percent Highly Sleep Disturbed due to Road noise, Table S11: Model coefficients for the random study effect logistic regression model (Mixed) and the GEE model for the percent Highly Sleep Disturbed due to Train noise, Table S12: Model coefficients for the random subject effect logistic regression model (Mixed) and the GEE model for the probability of a sleep stage change to wake or S1 for Aircraft noise, Table S13: Model coefficients for the random subject effect logistic regression model (Mixed) and the GEE model for the probability of a sleep stage change to wake or S1 for Road noise, Table S14: Model coefficients for the random subject effect logistic regression model (Mixed) and the GEE model for the probability of a sleep stage change to wake or S1 for Train noise. Table S15: Percent Highly Sleep Disturbed for road, rail, and aircraft noise for the logistic regression models shown in Figure 8. Figure S1: Percent Highly Sleep Disturbed. Random study effect logistic regression (gray) and GEE regression (black) with 95% confidence intervals (dashed lines); Figure S2: Probability of a sleep stage change to wake or S1. Random subject effect logistic regression (gray) and GEE regression (black) with 95% confidence intervals (dashed lines); Table S16: Criteria used to rate the bias of individual studies; Table S17: Bias ratings for studies on noise from road, rail, and aircraft noise and cortical awakenings in adults; Table S18: Bias ratings for studies on road, rail, and aircraft noise and self-report sleep disturbance; Table S19: Bias ratings for studies on wind turbine noise; Table S20: Bias ratings for studies on hospital noise and sleep in adults; Table S21: Bias ratings for studies on hospital noise and sleep in children; Table S22: Bias ratings for studies on hospital noise studies that had interventions; Table S23: Bias ratings for studies on noise from road, rail, and aircraft noise and cardiac and blood pressure outcomes; Table S24: Bias ratings for studies on noise from road, rail, and aircraft noise and actigraphy outcomes; Table S25: Bias ratings for studies on noise from road, rail, and aircraft noise and children's sleep; Table S26: Bias ratings for studies that were not included in the meta-analysis of self-reported sleep outcomes for road, rail, and aircraft noise. ORG6-127 cont.

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From: Dolly Babcock <dbabcock@condorearth.com>
Sent: Thursday, July 30, 2020 3:50 PM
To: Quincy Yaley <QYaley@co.tuolumne.ca.us>
Subject: Terra Vi Lodge & "Glamping" Projects

Good afternoon Quincy,

I'm inquiring on finding out how to go about getting a copy of the draft EIR for the above projects, especially the Terra Vi Lodge project.

Please advise how I can attain a copy of draft EIR's.

ORG7-01

Thank you very much.

Dolly Babcock
MTSI Dispatch Coordinator

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From: John Buckley <johnb@cserc.org>
Sent: Thursday, July 30, 2020 9:41 AM
To: Quincy Yaley <QYaley@co.tuolumne.ca.us>; Natalie Rizzi <NRizzi@co.tuolumne.ca.us>; John Gray <JGray@co.tuolumne.ca.us>; Sherri Brennan <SBrennan@co.tuolumne.ca.us>; Ryan Campbell <RCampbell@co.tuolumne.ca.us>; Anaiah Kirk <AKirk@co.tuolumne.ca.us>
Subject: Terra Vi Lodge DEIR comments from CSERC

Quincy:

Please confirm that you have received and are able to open and read the following attached PDF comments that are submitted on behalf of our Center.

Background for these comments from CSERC

It is with considerable frustration and concern that these comments are submitted on behalf of the members and staff of the Central Sierra Environmental Resource Center.

First, the County unreasonably denied a request by CSERC and similar requests by other concerned citizens for a time extension for the submission of public comments for this massive DEIR and the associated Yosemite Under Canvas DEIR for the property directly adjacent to this site.

Because the County chose to release both the Yosemite Under Canvas DEIR and the Terra Vi Lodge DEIR with overlapping public comment deadlines, CSERC and interested members of the community have been forced to attempt to simultaneously review, analyze, and assess the two extremely lengthy and detailed EIRs – including more than 1,800 pages overall for this DEIR. Combined with the 1,200 pages of associated project materials for the Yosemite Under Canvas project, the public has needed to scrutinize over 3,000 pages of documentation. Given the additional challenges for citizens caused by the COVID-19 situation, it is especially disrespectful for the County to rush through this phase of the planning process with what appears to be disinterest by County leaders in the ability of citizens to become well informed about the proposed action in order to comment most effectively. ORG8-01

Second, CSERC respects that different interests can certainly hold different perspectives. However, professional analysis done for the purpose of meeting CEQA requirements should be neutral, accurate, and without highly slanted bias.

If this matter ends up in court, it is the hope of our staff that that **the many instances described in our comments that point out misinformation and totally illogical judgments made by the DEIR consultants will underscore the failure of the Terra Vi Lodge DEIR to provide accurate information and unbiased conclusions -- as is legally required by CEQA.** ORG8-02

Finally, CSERC respectfully requests that in addition to our formal comments, that all previous CSERC input, including pre-scoping written input submitted to Tuolumne County relative to the Terra Vi Lodge project, all be made a part of the legal record for this planning process. ORG8-03

John Buckley, Executive Director
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July 30, 2020

From John Buckley, executive director
Central Sierra Environmental Resource Center
P.O. Box 396
Twain Harte, CA 95383

Quincy Yaley, Community Development Director
Tuolumne County Community Development Department
2 S. Green Street
Sonora, CA. 95370

RE: Comments for Terra Vi Lodge Yosemite DEIR

To Quincy Yaley, the Tuolumne County Board of Supervisors, and Planning Commissioners:

Executive Summary of Key Comments

1) THE DEIR FAILS TO MEET STATE REQUIREMENTS FOR ACCURACY AND ADEQUACY -- The DEIR is filled with contradictions, misinformation, and inaccurate claims. As the comments below will spell out, the DEIR inarguably fails to comply with clear state requirements. ORG8-04

2) RESPONSIBLE AGENCIES LACK ADEQUATE CAPACITY TO PROVIDE ESSENTIAL PUBLIC SERVICES -- The DEIR acknowledges in detail that the proposed project cannot be effectively served for fire response, law enforcement response, and emergency medical services. The minor mitigation measures proposed by the DEIR to compensate for the lack of public service capability cannot possibly reduce the level of significance for this public safety impact. ORG8-05

3) WILDFIRE RISK IS HIGHLY SIGNIFICANT -- The project both independently and in combination with other proposed projects will put hundreds of people at significant risk due to the potential for a deadly wildfire burning across the project site that already burned severely just 7 years ago. ORG8-06

4) THE PROJECT'S SOLE SOURCE OF WATER SUPPLY IS BOTH CONTAMINATED AND UNPROVEN – The DEIR spells out that the limited 10-day well testing showed levels of contamination that exceed thresholds. One 10-day testing of wells in a normal water year cannot provide any evidence of a long-term, reliable, adequate water supply during future drought periods or critically dry water years. ORG8-07

5) HIGH AMOUNTS OF WASTEWATER POSE RISK TO GROUNDWATER – The cumulative impact of this project combined with the Yosemite Under Canvas project across the street will discharge tens of millions of gallons of black water and gray water (wastewater) onto sites where wells will provide the projects' water supply. Risk of contaminating subsurface water in fractured rock is significant. ORG8-08

6) IMPACTS TO AESTHETICS AND SCENIC VALUES WILL BE SIGNIFICANT – In contradiction to the proposed solution to scenic impacts (which is to plant dense landscaping of trees to block the view of the facilities), fire risk measures will prevent that proposed dense planting of the screening trees. Thus, the impact will be significant. ORG8-09

7) THE CONVERSION OF USE FROM COMMERCIAL FOREST MANAGEMENT IS SIGNIFICANT – The project must obtain a Timberland Conversion Permit. The site is being converted from forest management to a commercial lodging use. This is a Significant Impact that is falsely dismissed with no legitimate rationale by the DEIR authors. ORG8-10

8) THE CREST OF THE HILL AT THE PROJECT LOCATION RESULTS IN TRANSPORTATION SAFETY RISK – Viewing distance constraints and motorists hurrying toward Yosemite or back from Yosemite pose risk not just for vehicles turning in or out of the project site, but the cumulative effects of the project combined with the project across the street intensifies the risk. Pedestrians crossing the busy highway to access the Terra Vi Lodge market from the Yosemite Under Canvas project will also add additional safety risk. ORG8-11

DUE TO THE SITE'S HIGH FIRE RISK AND THE SIGNIFICANT LACK OF PUBLIC WATER, PUBLIC SEWER, AND TIMELY PUBLIC SERVICES, AS WELL AS THE SIGNIFICANT IMPACT OF FOREST CONVERSION, THE POTENTIAL FOR SO MANY SIGNIFICANT IMPACTS THUS LEADS TO THE NEED TO FIND A MORE SUITABLE SITE AT AN ALTERNATIVE LOCATION. ORG8-12

AREAS OF CONCERN THAT ARE DESCRIBED INITIALLY IN THE DEIR

The DEIR starts with a bullet list of 22 issues that are supposedly inclusive of the critical comments of concern that were raised during the scoping process. How an issue is worded can directly determine how the response to that issue can be formulated by the DEIR consultants. In many instances throughout the DEIR, CSERC asserts that the consultants have strategically slanted the wording of an environmental issue (that was raised in comments) or of a definition of what qualifies as a Significant Impact. And by doing so, the DEIR response or analysis to that slanted question or description of the issue ends up skewing what was originally raised as the concern for the key issue. ORG8-13

As our Center shared in our comments for the adjacent Under Canvas project DEIR, **the State has made clear in the CEQA Guidelines that the sample Checklist in Appendix G of the CEQA Guidelines contains questions that "…are (1) broadly worded, (2) highlight environmental issues *commonly* associated with *most* types of new development, and (3) alert lead agencies to environmental issues that might otherwise be overlooked in the project planning and approval process." The Environmental Checklist is described as only being provided as a sample form that can be tailored to address local conditions and project characteristics.**

Thus, the consultant authors of the DEIR cannot narrowly focus the CEQA analysis for purposes of legal significance on simply whether the project will trigger a level of significance for a Checklist question that fails to address the true potential environmental impacts of this specific project on this specific site. CSERC will re-emphasize this point in our comments below.

Adding to that concern is the matter of key issues being overlooked or dismissed inappropriately. The DEIR list of Areas of Concern, for example, does not even mention the issue of **forest conversion from commercial forest management to a recreational lodging operation**. Neither does the list of Areas of Concern identify the frequently raised issue of the **inadequate capacity of available county services to be able to provide essential services to this leapfrog development location**.

ORG8-13 cont.

DEIR SUMMARY OF IMPACTS AND MITIGATION MEASURES

As summarized in Section 1.6, **the DEIR asserts that all impacts would be reduced to a less-than-significant level if mitigation is adopted except for impacts GHG-2.2, GHG 1.2, and NOI-3.1.** That that incorrect judgment is a clear example of the bias and inaccuracy of the DEIR.

In reality, with these comments our Center will show that even if the recommended mitigation measures are adopted, <u>the project will still independently or cumulatively cause potential Significant Impacts for</u>:

- **Aesthetics,**
- **Air Quality,**
- **Hydrology and water quality,**
- **Forestry Resources,**
- **GHG Emissions,**
- **Public Safety,**
- **Land Use and Planning,**
- **Public Services,**
- **Transportation,**
- **Utilities and Service Systems,**
- **Noise, and**
- **Wildfire.**

It would be hard for a court to find another project with a wider range of potential Significant Impacts for which the DEIR consultants so inaccurately dismiss the vast majority of impacts as being Less Than Significant.

ORG8-14

AESTHETICS

AE-3: The project would change and degrade the existing visual character or quality of public views of the site and its surroundings.

AE-5: The proposed project would contribute to significant cumulative aesthetics impacts.

Both of the above Impacts should be shown as "Significant" rather than dismissed as LTS.

For **AE-3**, the project would dramatically change and degrade the existing visual character or quality of public views of the site and its surroundings from a natural forest site (with no currently visible structure, lighting, onsite road system, parking areas, or signage, etc.) to a commercially developed site with all of those visible effects.

The DEIR purports that within 10 years after the project gains approval, fast-growing planted trees will be tall enough and dense enough to screen from view the development for those driving along the highway. That claim is wildly inaccurate.

Even if fast-growing ponderosa pines or incense cedars are planted and watered, it is highly debatable that in 10 years they will actually have grown sufficiently to screen the project from the view of those driving on the adjacent highway. Further, an EIR cannot pre-judge that mitigation that may eventually result in screening for the project at some point in the future can be assured, since planted trees can die from insects, a roadside fire ignition, or other causes. Even if all the projected tree growth occurs, up to the time (12-15 years) that the planted trees may actually take to reach a height sufficient to generally screen the development from motorists' views, **there will still have been more than a decade of a Significant visual impact.** ORG8-15

PIVOTAL POINT OF MISINFORMATION AND BIAS IN THE DEIR FOR AESTHETICS

The DEIR painstakingly provides four viewing sites (as examples) and presents artist-altered photos of the existing views to purportedly show that fast-growing conifers will fully block the view of the lodge, cabins, parking areas, water tank, etc. at 10 years. Such artistic renderings are highly subjective and debatable. Over many years of actual project implementation in the County observed by CSERC staff of planted landscaping at projects, the actual effectiveness and growth of screening is almost always far less than what is envisioned by project applicants to be achieved in a decade of growth.

What is especially misleading is for the DEIR authors to have buried in the text on page 4.1-26 the information that in fact Mitigation Measure WF-2 will prohibit the individual trees (that will make up the screening landscaping) to be installed in such close proximity as depicted in the artistically altered photos in the DEIR due to the fire safety need to keep adequate spacing between bushes and trees so as to reduce the spread of wildfire burning vegetative fuel on the project site.

PUT MOST SIMPLY, FIRE SAFETY REQUIREMENTS WILL CONFLICT WITH THE ABILITY OF LANDSCAPING TO EFFECTIVELY SCREEN THE TERRA VI LODGE FACILITIES, PARKING AREAS, the WATER TANK, EMPLOYEE HOUSING, AND OTHER STRUCTURES FROM THE VIEW OF MORE THAN A MILLION PEOPLE A YEAR DRIVING BY ON THE HIGHWAY.

Yet, on pages 4.1-26-27 the DEIR authors claim that despite the plantings needing to be planted further back from the highway and despite the plantings needing to be more widely spaced than originally envisioned, the plantings "would still fill the visual space and screen the proposed project from Highway 120 and Sawmill Mountain Road." Thus, the DEIR authors assert that there would not be impacts to aesthetics or visual resources.

Even after acknowledging that fire risk requirements will prevent the screening trees from being planted in close proximity, the DEIR consultants still exaggerate the benefits of planted trees for screening purposes on page 4.1-28. They assert that Figures 4.1-8c and 4.1-9c accurately depict that "the proposed project will be almost entirely concealed from Highway 120, except for a view of the resort sign located off of Sawmill Mountain Road.

That claim by the DEIR authors is simply not true and is contradicted by their own admission as to the need to have plantings more widely spaced for wildfire mitigation purposes.

ORG8-15 cont.

CAL FIRE fuel reduction standards and fuel spacing requirements within 100 feet of structures (especially structures that will have up to 570 or more people at one time) will absolutely not allow closely packed-together tree plantings that would visually screen the project facilities from the view of travelers on Highway 120. Scattered screening may reduce to some degree how much of the project is visible at any one spot along the project boundary, but the overall project will certainly be highly visible from Highway 120.

The very fact that the public will be seeing a developed commercial lodge operation rather than undeveloped natural forest inarguably degrades the character of the scenic forest views that visitors to Yosemite Park and the national forest are used to experiencing along this highway corridor.

<u>AE-3</u> should be identified as a <u>Significant Impact</u> because the project <u>would</u> change and degrade the existing visual character or quality of public views of the site and its surroundings.

For AE-5, <u>the proposed project in combination with the Yosemite Under Canvas project across the road will result in new development now being visible on both sides of the highway for an extended area along the road.</u> This inarguably results in a degradation of the natural character at a level of cumulative effects that cannot simply be dismissed as not even needing mitigation.

Both development sites will have signs, new road work, parking areas, visible parking areas with cars and RVs, the fancy glamping tents on the Yosemite Under Canvas property, and the lodge, market, cabins, and employee housing on the Terra Vi Lodge property. A court should find that if the Project is implemented there will inarguably be a Significant degree of change and degradation of the scenic view from the natural forest setting currently visible on both sites.

ORG8-16

AGAIN, SHOULD A COURT CONSIDER THE FACTUAL ADEQUACY OF THIS DEIR, THIS AESTETHICS SECTION IS BUT ONE OF MANY CRITICAL ISSUE AREAS WHERE THE DEIR AUTHORS BLATANTLY DEFY LOGIC IN ORDER TO AVOID ACKNOWLEDGING THE SIGNIFICANT IMPACT OF THE PROJECT.

On page 4.1-31, the authors falsely claim that the Terra Vi Lodge project will be screened from public view because the tree line on the property "will block views from surrounding roadways, residences, and scenic vistas." That is nonsense. Elsewhere in the DEIR the authors admit that most of the trees that survived the Rim Fire on the Terra Vi Lodge site have no lower branches to screen views (which is clearly portrayed in the photos of the four scenic view points). Similarly, the conifers that survived directly across the street on the Yosemite Under Canvas site also suffered the same scorching and the killing back of lower branch foliage. Thus, except for the trunks of the trees, there is almost no visual screening at all that will somehow block views on either the Under Canvas of the Terra Vi Lodge project sites. A large percentage of the Under Canvas project's 99 tented campsites as well as the new kitchen facility, administrative facility, and parking areas would all be highly visible. Our staff visited both project sites again on July 21 and took photos that prove that views from the highway inarguably allow those in passing vehicles to see clearly the areas on both properties where the tent cabins and the Terra Vi Lodge facilities will be constructed. Yet the DEIR authors claim that the "…proposed project would not, in combination with this cumulate project, change the visual character of the site vicinity, impact scenic vistas…. or create a cumulatively significant impact to light and glare." ORG8-16 cont.

That claim by the DEIR authors once again is a completely false judgment that is contrary to fact.

AE-5 should be identified as a Significant Impact.

The cumulative effects of the two projects combined must be fully and correctly analyzed by the FEIR. As now presented, the DEIR fails to carefully consider the scenic viewshed impacts of the two combined projects for whether they would substantially degrade the existing natural visual character of public views of the site and its surroundings. The daytime visual scenic impacts of the two projects will cumulatively exceed the criteria for creating a significant visual impact.

In addition, there is currently zero visible nighttime lighting on the two sites except for a very minor transportation building light that is barely visible. But if both projects are approved their construction and operation will result in a highly significant change – with both sites having lighting that will be in stark contrast to pre-project conditions. For the Under Canvas project, there will be all the lights associated with the kitchen facility, administrative facility, each of the 99 tent structures, as well as lights for the parking area. For the Terra Vi Lodge project, there will be even greater levels of lighting du to the higher number of buildings, occupied guest rooms, the market, the bar, the restaurant, the parking areas, etc. The combined cumulative impact of nighttime lighting from the two projects will be markedly significant compared to the current lack of lighting. Even if the installed lights meet county General Plan standards and are pointed downward, those mitigation measure requirements will primarily reduce a project's upward facing lighting impacts on nighttime raptors and other wildlife, rather than reducing scenic lighting impacts for those traveling past the site in motor vehicles. ORG8-17

Millions of travelers pass each year on the highway directly between the two adjacent development projects. They will be directly affected – both in the daytime and in darkness – if the two projects gain approval and are allowed to become operational.

Implementation of the project would certainly create a new source of substantial light or glare which would adversely affect nighttime views in the area. The project will result in a Significant Impact for Aesthetics.

AIR QUALITY

AQ-3: The project would expose sensitive receptors to substantial pollutant concentrations.

AQ-4: The project could result in other emissions adversely affecting a substantial number of people.

AQ-5: The project would result in combination with past, present, and reasonably foreseeable projects, result in significant impacts regarding air quality.

As described above in the Summary of Impacts, the Terra Vi Lodge DEIR authors assert that the project would not expose a substantial number of people to pollutant concentrations nor result in other impacts regarding air quality. **In reality, the claims for AQ-3, AQ-4, and AQ-5 are incorrect. They should all be shown as resulting in a Significant impact.**

State and federal air quality studies underscore the risk to lungs and public health that can be caused by particulates less than 10 microns in diameter. As identified in the Yosemite Under Canvas DEIR and as identified in various scoping comments for this Terra Vi Lodge project, there is high potential for dense smoke to be generated routinely on the adjacent Yosemite Under Canvas project site on cool evenings or mornings when 99 wood heating stoves are all burning firewood. Yet the Terra Vi Lodge DEIR fails to sufficiently describe and address this important air quality and public health issue that would be directly threaten air quality not just for the clients of the Under Canvas project, but for the hundreds of staff and visitors of the Terra Vi Lodge project as well.

On the Yosemite Under Canvas site across the street, that project openly features the plan to allow 99 wood-burning stoves in addition to the 3 community campfire burn sites on the property. Those particulate-producing source of emissions will be in addition to the Terra Vi Lodge Project's new creation of air quality emissions due to vehicles idling, kitchen functions that will include propane gas burning, and various other sources of cumulative air quality emissions on the two sites. The likely concentrated production of wood smoke from so many sources on the Yosemite Under Canvas project site along with the various air quality emissions from hundreds of vehicles and the operations of the restaurant, bar, lodge, cabins, and employee housing – will all cumulatively result in a Significant amount of substantial pollutant concentration of particulate matter and other emissions that would expose all the occupants of the Terra Vi Lodge facility as well as the occupants of the Yosemite Under Canvas project site. ORG8-18

The total number of people (570+ people) potentially present on the project site and (250+ people) at the Yosemite Under Canvas project site across the street, along with neighbors on parcels north of the Terra Vi Lodge property, all will potentially suffer from inhaling fine particulate matter from the smoke generated by the Under Canvas project's community campfires and the "up to 99" woodstoves all burning at the same time.

A project could have a significant impact on air quality if it would result in emissions adversely effecting a substantial number of people. Given that up to 800 people may be present on the two project sites on any cool evening or morning when up to 99 woodstoves and 3 community campfires are all burning, the resulting production of PM_{10} particulate matter has very high potential to cause significant adverse health effects. That is the opposite of the conclusion by DEIR authors, who incorrectly skew the discussion to dismiss air quality impacts.

The FEIR should correct the failure of the DEIR to identify the 99 woodstoves combined with community fire pits on the Yosemite Under Canvas project site as a source of particulate-laden smoke and air quality emissions that collectively pose health risk for up to 800 people at one time on the two project sites. It is incorrect for the DEIR to dismiss air quality emissions of PM_{10} particulate matter just because there is not a concentration of narrowly defined "sensitive receptors" close to the project site. Instead, there are up to 800 people on or adjacent to the project site who will be the receptors of the smoke, and any number of them could have asthma, lung disease, be elderly, etc. ORG8-18 cont.

Air quality emissions and PM_{10} particulate matter for the two adjacent projects combine to be an issue of high concern for this project.

HYDROLOGY AND WATER QUALITY

HYD-2: The proposed project would substantially decrease groundwater supplies…

HYD-6: The proposed project, in combination with past, present, and reasonably foreseeable projects, would result in Significant impacts with respect to hydrology and water quality.

In the DEIR, the consultants inaccurate claim for HYD-2 and HYD-6 that neither would result in a Significant impact. The two claims are incorrect and need to be revised in the FEIR.

The project does pose potential to substantially decrease water supplies that are valuable and essential to project neighbors who have solely groundwater for their source of water. The project combined with the Yosemite Under Canvas project has high potential to result in a Significant impact with respect to cumulative effects for hydrology and water quality – for multiple reasons described in this section of our comments and our comments related to wastewater.

Tuolumne County's General Plan allows for special commercial type developments to be designed and located on parcels that are not served by public water or public sewer. But such a use is allowed only where a planned project can provide sufficient water supply to fully meet project needs during drought periods and only where appropriate wastewater treatment for the project can be achieved – including during wet periods when snowmelt of rainfall have saturated a site's soils. ORG8-19

In this case, the County and the authors of the EIR cannot assure that either of those water supply and wastewater treatment requirements can be met for this site – which has no public water or public wastewater treatment options available.

Throughout the public scoping and meetings or discussion with planning staff prior to the preparation of the DEIR, concerned members of the public repeatedly raised the issue that limited testing of wells on the project site during a normal water year that followed an exceptionally wet water year would NOT represent subsurface groundwater conditions during either a single dry water year or multiple years of drought. Tuolumne County supervisors and other county staff coordinated with state agencies and local utility district staff during the recent exceptional multi-year drought period when many long-functioning wells in the County faltered or failed. WELLS MAY TEST FINE IN A NORMAL YEAR (AND ESPECIALLY IN A NORMAL YEAR FOLLOWING AN EXCEPTIONALLY WET YEAR. BUT THOSE

WELLS HAVE NO ASSURANCE OF BEING PRODUCTIVE OR EVEN HAVING THE SAME LEVEL OF WATER QUALITY IN A DRY WATER YEAR OR DURING MULTIPLE DRY OR CRITICALLY DRY WATER YEARS.

CSERC raised the issue of well testing as a pivotal issue that should be fully addressed in the DEIR.

But the DEIR simply points to a single 10-day pumping testing period in October 2019 as supposed evidence that there is not only sufficient groundwater to support the proposed project over the long-term, but that the water quality is also supposedly adequate.

THIS IS ONE OF THE MOST IMPORTANT ISSUES IN THE ENTIRE DEIR, AND CSERC STRONGLY ASSERTS THAT THERE IS NEITHER SUFFICIENT EVIDENCE TO SUPPORT THE CLAIM OF SUFFICIENT WATER SUPPLY IN TERMS OF QUANTITY NOR TO SUPPORT THE CLAIM OF ADEQUATE WATER QUALITY.

The DEIR should instead honestly admit that while initial water pumping tests show there may be sufficient water in a normal year following a wet water year, there has been no test done in a dry year or in the midst of multiple dry years when the fractured rock beneath the project site may have far lower levels of groundwater.

ORG8-19 cont.

TIMING OF THE GROUNDWATER TEST WAS INADEQUATE TO SHOW SUPPLY IN DRY YEARS

1) CSERC notes that our understanding of Water Board recommended protocols is that well tests be done during a June-September period so as to overlap with the driest time of the year. Instead, the well test for this project was done outside of that protocol-recommended testing period. ORG8-20

2) As noted previously, the only 10-day well testing on the project site was done in a normal water year following a wet water year. Any well test results cannot reliably be extrapolated to reflect the capacity of fractured rock layers beneath the project site to contain the same level of groundwater in a dry or critically dry water year or during multiple years of drought. ORG8-21

3) There is no map or any other evidence to prove exactly where the groundwater in fractured layers exists beneath the project site. As proposed, the project will supposedly pump 60-80 million gallons of groundwater over 200 days, and a significant portion of that water will then become gray water and black water and be disposed of in leach fields or in landscape watering of the property. That contaminated water has potential to be not fully treated by onsite OWTS operations so that effluent has potential to seep downward to contaminate either the project's wells, the wells of neighbors, or the wells for the Yosemite Under Canvas site. When a project applicant will be discharging many tens of millions of gallons of black and gray wastewater into leach fields on a site and will also be drawing domestic/commercial lodging water supply from groundwater from below the surface on the same site, the potential exists for the project to directly contaminate the subsurface groundwater supply. ORG8-22

4) **The DEIR acknowledges on page 4.10-12 that arsenic, iron, turbidity, and color were detected above drinking water maximum contaminant levels in samples from the on-site pumping wells.** This admission should immediately have caused the DEIR authors to point out that water quality in the tested wells has not been proven to meet assured water quality standards. This undermines the entire premise that groundwater by itself adequately provides high quality water as the supply for the project's enormous water demands. Instead, the DEIR acknowledges that additional water testing must be done, and if arsenic levels remain high in future tests, then onsite treatment must be ORG8-23

devised to remove arsenic and other contaminants above drinking water standards from the groundwater.

In assessing the EIR, Tuolumne County is considering whether to approve a giant lodging operation that would be serving up to 550 guests and staff (or more) – all dependent entirely on groundwater from wells as the water supply. **The limited well tests done to date show contaminant levels of arsenic, iron, turbidity, and color all exceed maximum contaminant levels. Simply for water quality reasons, Tuolumne County should then reject the project application on the grounds that an assured safe and sufficient water supply from the wells has not been established, and future assumptions or hopes for different results are not legal grounds on which to base any project approval.**

ORG8-23 cont.

5) The project could draw up to 80 million gallons of groundwater from below the project site over 200 days of operation each year, based upon the well pumping capacity for the site of up to 26.5 gallons per minute. Even if the actual expectation for groundwater pumping is less than that amount, the total consumption of groundwater by the project would still be enormous.

The criteria for causing a Significant impact defines a situation when a proposed project would substantially decrease groundwater supplies or interfere substantially with groundwater recharge. Given that the Terra Vi Lodge project will remove tens of millions of gallons of groundwater each year, including during dry water years and during multiple dry and critically dry water years, there is no evidence to show that such high levels of groundwater pumping will NOT result in decreased water supplies.

ORG8-24

6) The cumulative groundwater demands from the project and the neighboring Yosemite Under Canvas project are inarguably tremendous. Never in the past 30 years in Tuolumne County have two neighboring projects both proposed the pumping of groundwater at tens of millions of gallons each on a ridge area site with fractured rock groundwater. The cumulative amount of groundwater pumped between the Terra Vi Lodge project and the Yosemite Under Canvas project would combine to be a truly staggering amount. Yet for HYD-6 the DEIR consultants erroneously claim that the "proposed project with reasonably foreseeable projects" (including "Yosemite Under Canvas") would result in less-than-significant cumulative impacts to hydrology and water quality. There is no evidence to support that misleading claim.

Given the fact that both projects will be producing huge amounts of wastewater (both black and gray) and that both projects have no connection to public sewer systems, the discharge of wastewater from the two combined sites is higher than any previously approved lodging-type proposed project in Tuolumne County. The fact that both proposed projects also plan to pump tens of millions of gallons of groundwater from beneath sites where they are discharging tens of millions of gallons of wastewater presents a strong potential for contamination. At the least the DEIR should fully acknowledge that there is uncertainty due to the inability for consultants or the County to map accurately WHERE the subsurface groundwater is flowing in the fractured rock beneath the site and WHERE the discharged water in leach fields will seep down into that same fractured rock system.

ORG8-25

7) On page 4.10-16 of the DEIR, the document supposedly considers risks to Water Quality. Yet other than mentioning pollutants potentially generated during project construction and operation, the cumulative amounts of petroleum byproducts from vehicles on the Terra Vi Lodge and Yosemite

ORG8-26

Under Canvas sites, as well as the total combined wastewater discharge from the two projects, are not even mentioned. ORG8-26 cont.

8) Early on a key Project Objective was to develop a site which has a safe, reliable, and sustainable source of water. Instead, based on the extremely insufficient well testing done to date of only a 10-day test during a fall period in a normal water year, there is no evidence that the groundwater under the project site is "reliable" or "sustainable." Further, even before wastewater discharge has begun on the site, the tested water to date shows that contaminants exceed acceptable levels. That provides the only current well testing evidence for water quality, which means that the water is currently not shown to be "Safe."

CSERC strongly asserts that the County should NOT approve the Terra Vi Lodge project based on well tests for water supply that show evidence of contamination, that were not done during the dry season nor in a dry water year, and that cannot be assured of reflecting groundwater conditions in a drought period or in a single critically dry water year.

Similarly, the FEIR should fully acknowledge that the well tests done to date do not provide any evidence of what well capacity may be in a multiple dry year situation. And the FEIR should also acknowledge that envisioned effective treatment of tens of millions of gallons of wastewater between the project and the neighing Yosemite Under Canvas project will combine to potentially create high risk for subsurface water contamination. ORG8-27

Based upon the clear information provided in the DEIR, the FEIR should admit that:

HYD-2: The proposed project would substantially decrease groundwater supplies… which would result in a Significant impact.

HYD-6: The proposed project, in combination with past, present, and reasonably foreseeable projects, would result in Significant impacts with respect to hydrology and water quality.

UTILITIES AND SERVICE SYSTEMS – ADDITIONAL FLAWS IN THE DEIR

On pages 4.16-3 and 4.16-4, the DEIR accurately informs that most areas served by wells in Tuolumne County are underlain by fractured rock that provides inconsistent groundwater conditions. The DEIR further states that the Tuolumne-Stanislaus Integrated Regional Water Management Plan determined that data is insufficient to quantify available sustainable groundwater supply. "This is not atypical in fractured rock environments such as those that occur throughout the Sierra foothills."

Under **4.16.1.3 IMPACT DISCUSSION** the DEIR defines a project creating a Significant impact if there are not sufficient water supplies available to serve the project and reasonably foreseeable future development during normal, dry, and multiple dry years. ORG8-28

The DEIR then asserts that because the single test period of 10-days in October of 2019 provided pumping levels of 53 gpm combined between the two wells, then supposedly each well can pump safely at a rate of 26.5 gpm or 38,160 gpd. **"Since the water demand for the proposed project would be 16,636 gpd, each well can individually supply the proposed project's demand."**

That DEIR claim is unsupported and unproven for multiple reasons. First, there is no evidence for the assumption that each well is drawing from an independent groundwater source. It is fully possible and likely that the two wells are both drawing from the same subsurface fractured rock water source. Therefore, one well cannot be the backup for the other well, because no matter which well is pumping, water is still being drawn from the same groundwater source.

Second, as these comments repeat for emphasis, there is zero evidence that the groundwater well test period of 10 days in October of 2019 in a normal water year either represents the groundwater conditions that will be present at the height of the summer dry season, nor does that single 10-day test period provide even a clue as to whether or not the groundwater will be adequate during a critically dry water year or multiple dry years during a drought. The fact that there was a multiple dry year drought in the past few years intensifies the potential for such dry periods to dramatically reduce groundwater. Yet the DEIR authors assume that groundwater will always be reliable – based upon the single 10-day test period that was done in October in a normal year following an exceptionally wet water year.

THERE IS ZERO EVIDENCE PROVIDED IN THE DEIR THAT THE WELLS ON THE PROJECT SITE WILL BE PRODUCTIVE ENOUGH TO MEET THE PROJECT'S NEEDS IN A CRITICALLY DRY WATER YEAR OR IN MULTIPLE DRY YEARS.

THERE IS ZERO EVIDENCE THAT THE WELLS ON THE PROJECT SITE AND THE NEARBY WELLS ON THE ADJACENT "YOSEMITE UNDER CANVAS" PROJECT SITE ARE NOT DRAWING FROM THE SAME, POTENTIALLY LIMITED GROUNDWATER SOURCE.

ORG8-28 cont.

THERE IS ZERO EVIDENCE IN THE DEIR THAT THE WELLS ON THE TWO PROPERTIES WILL BE PRODUCTIVE ENOUGH TO MEET THE **CUMULATIVE** WATER DEMANDS OF THE TWO LODGING PROJECTS DURING A CRITICALLY DRY WATER YEAR OR DURING MULTIPLE DRY YEARS.

The DEIR on page 4.16-7 purports to prove that there is no connection between the two projects based on the fact that water levels in wells on the Terra Vi property showed no impact from the only well testing done in October 2019. The DEIR authors then add in the unsupported assumption that the two properties "are on different sides of a watershed boundary and likely are accessing different fracture zones. Based on these results, both properties would be able to meet their water demands during single and/or multiple dry years."

To restate for emphasis, there is zero evidence to back up that conjecture that the two properties' wells are drawing from different fracture zones, nor is there the slightest evidence that groundwater under either property is sufficient to meet water demands in multiple dry water years.

FORESTRY RESOURCES

FOR-2: The project would result in an adverse effect associated with the loss of forest land or conversion of forest land to non-forest use.

FOR-3: The project would involve other changes in the existing environment which, due to their location or nature, could result in conversion of forest land to non-forest use.

Claims made by the DEIR authors denying there would be a Significant Impact for FOR-2 and FOR-3 are highly false and incorrect.

Beyond any argument, the Terra Vi Lodge property site is being converted for commercial forest use to a recreational lodge property.

IT IS A VIOLATION OF PUBLIC TRUST FOR THE COUNTY TO PUT FORWARD A DEIR THAT ATTEMPTS TO CLAIM THAT FOREST CONVERSION WILL NOT OCCUR IF THIS PROJECT IS APPROVED. Forest conversion is obviously occurring. The impact for both FOR-2 and FOR-3 should be defined as Significant.

THIS PROJECT CREATES CONFLICT WITH A WRITTEN CONTRACT WITH THE STATE OF CALIFORNIA BECAUSE PROJECT APPROVAL IS BASED UPON THE PROPERTY BEING GIVEN A TIMBERLAND CONVERSION PERMIT.

TO GAIN APPROVAL FOR THE TERRA VI LODGE DEVELOPMENT, TIMBERLAND CONVERSION IS NEEDED TO REMOVE THE PROPERTY FROM COMMERCIAL FOREST MANAGEMENT. YET IN ORDER TO OBTAIN STATE GRANTS FUNDS FOR FOREST MANAGEMENT PURPOSES, THE PROPERTY OWNER IN 2015 SIGNED A LEGAL AGREEMENT, ASSERTING THAT HE WOULD KEEP THE PROPERTY IN COMMERCIAL FOREST MANAGEMENT FOR AT LEAST 10 YEARS. EXCEPT, NOW HE ISN'T… ORG8-29

10. ***"Participant certifies that the parcel of forestland to which the Forest Improvement Program applies will not be developed for uses incompatible with forest resources management within 10 years following recordation date, as explained below. "***

The excerpt above is directly from the Gregory Robert Manly CFIP Agreement 2015 GGRF Project Number: `4-GHG-CFIP-01-0054 (page 3). The property owner, Mr. Manly, signed a legal agreement committing to not develop the property for uses incompatible with forest resources management for at least 10 years. Yet now a significant portion of the property is being put up for approval for a commercial recreation glamping tent cabin resort project on the Yosemite Under Canvas property on the south side of Highway 120 and the Terra Vi Lodge development is now up for approval on the property on the north side of the highway.

This is a stunning factual violation of a legal agreement that should be underscored by the EIR.

Mr. Manly committed in his written agreement with the State that the grant funds to be applied to the property would be used with the primary goal of reducing greenhouse gases (GHGs). And now the property owner and the project applicant stand to profit if they gain approval for a proposed Terra Vi Lodge development that the DEIR identifies as causing Significant impacts for GHG-1.1 and GHG-1.2.

THAT IS BOTH IRONIC AND A CLEAR CONTRADICTION OF THE JUDGMENT OF THE DEIR AUTHORS.

Is it possible that Tuolumne County is not fully aware that the property owner for the Terra Vi Lodge development project committed in writing to the State of California that he would not develop his property for uses incompatible with forest resources management until at least December of 2025 or later?

The property owner signed a legal agreement with the State -- assuring that the grant funds would be applied to "increase carbon sequestration through tree growth and timberland management" and "avoided GHG emissions resulting from retaining the forest and avoiding conversion to another use."

Yet now the County would be approving a project on the property that increases GHG emissions. This revealing information is truly a game-changer when it comes to the County processing and considering approval for the Terra Vi Lodge project. **CSERC respectfully asserts that the County (or a court) should find that, indeed, the owner of the Terra Vi Lodge property site legally committed to maintain the project property in forest management for at least until the 10-year period has expired.**

Even if the property owner takes advantage of the loophole to escape his legal contract, his current proposed development project should not even be considered for approval until after that time has passed.

Quoted below is the twisted logic used by the DEIR authors to avoid acknowledging the very clear conversion of forest land that is explicitly prohibited by the signed written agreement:

"The owner of the project site entered into a CFIP contract with CAL FIRE in 2015 that preserves the site for forest and timber land uses. The CFIP requires a property owner supply protection, maintenance, and enhancement of a productive and stable forest resource system for the benefit of present and future generations in exchange for providing funds to help complete such improvements and preservation. The proposed project would result in non-compliance with this CFIP contract. However, the agreement expired on December 31, 2019, and the project applicant would be required to refund State funds awarded for the project site, consistent with the request of CAL FIRE. Therefore, the proposed project would not result in the loss or conversion of forest land and impacts would be less than significant." (DEIR page 4.6-5) ORG8-29

THAT CLAIM IN THE DEIR IS SIMPLY FALSE.

IT DOES NOT MATTER WHETHER THE PROPERTY OWNER CAN LEGALLY GET OUT OF THE 2015 SIGNED GRANT AGREEMENT BY PAYING BACK THE GRANT FUNDS. That is not the issue.

The applicant must pay back grant funds to the State because he will be failing to abide by a written commitment to not develop the property for a use incompatible with forest resources management. **He will be paying back the grant funds because he is removing the property from forest resources management and converting the property to a non-forest use.**

The applicant must obtain a Timberland Conversion Permit for this project to be approved. The DEIR criteria for significance explains that the project will create a Significant impact if the project will result in the conversion of forest land to non-forest use. The property owner is getting a permit to do exactly that. There is no debate that this causes a Significant impact.

Yet the DEIR misleadingly asserts that the proposed project would not result in the conversion of forest land. This is not just a debatable judgment where the DEIR authors can be excused for having a questionable perspective. This is a clear example of bias and misinformation -- another example of why the DEIR should be rejected because it is consistently misleading, inaccurate, and biased.

The project will result in forest land be converted to a non-forest use, which is a Significant impact.

Furthermore, the Cumulative Impact caused by the conversion of forest lands is even greater as a Significant Impact due to the additional conversion of forest land by the Yosemite Under Canvas project across the street as well as the on the Terra Vi Lodge project property. Whether or not the properties are formally designated as timberland by Tuolumne County is irrelevant, since the property owner applied for grant funds for continuing commercial forest management. Cleary the State accepted the property as qualifying as commercial forest management.

ORG8-29 cont.

For all of the reasons above, the proposed project would result in a Significant and unavoidable impact due to the conversion of forest land to a non-forest use. The FEIR should correct all of the flaws, false claims, and lack of information related to this topic.

PUBLIC SERVICES AND AGENCIES' INABILITY TO SERVE THE PROJECT SITE

One of the most glaring errors in the DEIR is the unsupported rationalization by the authors to reduce the characterization of the Public Service impacts for the project from Significant for four separate issues of concern to a rating to Less-than-significant for those issues.

In reality, the DEIR shows inarguably that there will be a Significant Impact from the project due to the lack of capacity by Tuolumne County or other responsible agencies for fire response, law enforcement response, and emergency medical/ambulance response when emergencies occur at the project site.

The evidence is so clear, it is truly inappropriate and frustrating for the interested public to see that the DEIR authors have attempted to diminish the significance of this pivotal public safety issue.

ORG8-30

UNCLEAR FIRE RESPONSE IS COMPLETELY UNACCEPTABLE FOR ALL RESPONSIBLE AGENCIES

First, the DEIR makes it clear that the project site is located within a CAL FIRE designated State Responsibility Areas (SRA). While fire protection services are provided through a multi-jurisdictional effort, Tuolumne County has the main responsibility for fire protection services to unincorporated areas of the county, including the project site. "The closest fully staffed fire station is Station 76… located 40.4 miles to the northeast." That means the closest County fire engine is located at least 50 minutes from the project site. Furthermore, a County commissioned study in 2019 determined that there are significant challenges to the ongoing provision of fire and EMS services within the unincorporated areas of the county BEFORE adding in the Under Canvas and Terra Vi Lodge projects' additional demands.

The closest staff CAL FIRE crew is the Groveland Community Service District, which is a 22-minute drive from the project site if there is no traffic and IF that GCSD crew is not already committed to another event or emergency call for the area it serves. The closest actual CAL FIRE station is described as being approximately 28 minutes from the project site.

All of the response times are identified as being substandard to each agency's objectives. The inability of a fire response agency to arrive at the project property within the desired response time is a significant public safety matter.

Yet the DEIR authors skew the question for Significance to the Environmental Checklist question that addresses whether or not the lack of an agency's ability to maintain acceptable service rations, response times, or performance objectives does or doesn't result in the construction of new facilities.

As pointed out earlier in CSERC comments, **the State has made clear in the CEQA Guidelines that the sample Checklist in Appendix G of the CEQA Guidelines contains questions that "…are (1) broadly worded, (2) highlight environmental issues *commonly* associated with *most* types of new development, and (3) alert lead agencies to environmental issues that might otherwise be overlooked in the project planning and approval process." The Environmental Checklist is described as only being provided as a sample form that can be tailored to address local conditions and project characteristics.**

Thus, the consultant authors of the DEIR cannot narrowly focus the CEQA analysis simply as to whether the project will trigger a level of significance for a narrowly worded Checklist question that fails to address the true potential environmental impacts of the project. The question isn't whether or not the County must build a new fire station due to insufficient current capacity. The issue is that the County and other multijurisdictional agencies cannot respond to fire emergencies at the project site in a timely manner in order to protect public safety.

ORG8-30 cont.

Second – **there are errors of fact in the DEIR**. On page 4.14-7 under 4.14.1.3 IMPACT DISCUSSION, the **DEIR discussion claims that the proposed project would have a maximum occupancy of 400 guests.** That same incorrect maximum number of guests is shown on page 4.4-11, again claiming that the project would have a maximum occupancy of 400 guests.

In fact, the PROJECT DESCRIPTION on page 3-8 clearly states that the Hotel Lodge would accommodate a maximum occupancy of 400 guests and that Guest Cabin Rooms would accommodate a maximum occupancy of 156 guests. **That is a total of 556 guests, not 400 guests – a major difference**. That difference plays in to the subsequent calculations for demand for services.

ORG8-31

LAW ENFORCEMENT SERVICES ARE EVEN MORE UNRELIABLE AND BEYOND CAPACITY

Third – Even with errors and omissions, the DEIR determines that the Project would result in a Significant impact for law enforcement services due to the fact that the Tuolumne County Sheriff Departments provides law enforcement service to the project site, but the headquarters is located in Sonora – roughly an hour from the project site.

ORG8-32

The Groveland substation is 15 miles west (not "east" as described in the DEIR) of the project site, but the Groveland substation is not permanently staffed with a full-time sworn-in officer. "It does not meet the current demands for police services in the part of the county which it serves.." ORG8-32 cont.

Thus, there is inadequate law enforcement service to the project site with no clear solution on how such service will be provided. Furthermore, the same is true for Emergency Medical Services and the extremely limited ambulance service that is already determined to be insufficient for demands when there are multiple overlapping calls.

The DEIR determines that the project would cause a Significant impact due to impacts from the project and other cumulative projects. Similarly, the DEIR has identified that the project along with other projects will cumulatively result in a Significant impact for the delayed response to fire services.

"Despite the fire resistant and suppression physical features, non-physical features, and training program, the proposed project would still exacerbate existing fire protection service response time deficiencies in the region due to an increase in visitors and employees on the project site. …the proposed project would have a *significant* impact regarding fire protection services." (page 4.14-8)

Those are factual and correct judgments, but then the DEIR authors without valid evidence wildly exaggerate the benefits of having the project incorporate features to aim to prevent fires, have on-site water storage, do fire prevention preparedness, etc. The DEIR does not acknowledge that nearly all businesses attempt to minimize fire risk and yet fires nevertheless still happen (both from ignitions onsite or from fires spreading onto the site from surrounding wildlands). ORG8-33

But the DEIR authors incorrectly point to the mitigation that the project commits to have staff to be trained to meet volunteer fire service standards and that the project will commit to provide personal protect equipment and and communication equipment for all "emergency staff.". It is truly nonsense to claim that magically those unprofessional, unexperienced but newly trained staff will somehow have the ability to fight a wildfire with no fire engine, no depth of experience, etc.

Since CSERC staff has years of experience fighting severe wildland fires, our Center asserts that it is completely unreasonable to drop the level of Significance for fire risk and fire response to Less than Significant based on having two unexperienced volunteer-level employees on staff and on site. To say that is a wildly inaccurate judgment is a great understatement.

Similarly, for POLICE SERVICES, the lack of having any Groveland substation staffed for law enforcement is deemed on page 4.14-11 to be Significant, yet once again the DEIR authors then ignore the facts and assume that the lack of law enforcement will drop to Less Than Significant if the project commits to have a private security personnel on staff (Manager on Duty).

AT THE VERY LEAST, THE PROJECT IN COMBINATION WITH THE YOSEMITE UNDER CANVAS PROJECT, THE BERKELEY-TUOLUMNE CAMP, AND THE THOUSAND TRAILS RV RESORT EXPANSION PROJECT WILL INARGUABLY ADD A MAJOR ADDITIONAL CUMULATIVE AMOUNT OF LAW ENFORCEMENT DEMAND OVER EACH YEAR DESPITE THE FACT THAT TUOLUMNE COUNTY ALREADY POINTS OUT THAT IT IS BEYOND CAPACITY FOR MEETING ÅEXISTING LAW ENFORCEMENT DEMAND. ORG8-34

THE DEIR IS INVALID AND SIMPLY WRONG to suggest that having a trained private security person on the staff will somehow make up for the lack of response capacity by professional, experienced law enforcement personnel from the Tuolumne County Sheriff's Department.

To suggest that the good intention to have a private security person available on staff can somehow be sufficient (to deal with the wide range of minor to major law enforcement matters that have potential to arise at any time of day or night over years of the project's operation) is a unrealistic, unvalidated claim, and the County should not accept that misinformation in the final EIR.

BASED ON BOTH PUBLIC INPUT IN PROJECT COMMENTS AS WELL AS THE INFORMATION MADE AVAILABLE IN THE PUBLIC SERVICES SECTION OF THE DEIR, THE PROJECT INARGUABLY WILL FAIL TO HAVE ADEQUATE PUBLIC SERVICES FOR NECESSARY FIRE RESPONSE, LAW ENFORCEMENT RESPONSE, AND EMS SERVICES. THE DEIR SHOULD HAVE SOLIDLY DEFINED THOSE DEFICIENCIES AS EACH BEING A SIGNIFICANT IMPACT – that makes the project unsafe and a public risk.

ORG8-34 cont.

WILDFIRE THREAT IS SIGNIFICANT - MORE THAN DESCRIBED

Similar to the proposed development project that is located across the highway from the project site, the Terra Vi Lodge property does not currently have even a single residence on the property. It was nevertheless classified back in 2007 as being a Very High Fire Hazard Severity Zone by CAL FIRE, as identified in the DEIR. That designation was made by the State prior to the 2013 Rim Fire burning across the site with varying degrees of fire intensity. Based upon fuel loading, slope, fire weather, and other relevant factors, this site was ranked in 2007 as very high fire risk. That was proven to be accurate as the Rim Fire proved.

Now, for commercial lodging purposes, the Terra Vi Lodge project applicants desire to place up to 576 people at one time on this high-fire-risk site during the busy tourist season, which extends throughout the summer/fall fire season. Those 550+ people in combination with the possibly 250 or more additional people who could be present on the Yosemite Under Cnavas project site directly across the highway could result in an overall total of perhaps 800 people -- guests, workers, market customers, or visitors -- present on the two Very High Fire Hazard risk properties during the height of the summer/fall fire season.

ORG8-35

As these comments have already addressed in relationship to inadequate public services, there are multiple reasons why the danger of placing customers on the Terra Vi Lodge and Under Canvas sites is made even worse by the site's remote location from emergency services - far from the nearest county fire station, from a CAL FIRE station, and even from a staffed Forest Service engine crew (since the Buck Meadows engine crew is often unavailable and is frequently not staffed except for daytime hours).

The DEIR fails to discuss that the wildfire risk is a public concern that has been raised to the highest level by a wide range of community interests, including in comments from the Rush Creek Lodge, CSERC, area property owners, Audubon, the Sierra Club, and the Groveland Community Service District. Many concerned citizens have raised concerns in previously submitted comments about the adequacy and availability of fire and other emergency services for this project site and the Yosemite Under Canvas project site across the street. Once again, those concerns about the adequacy of fire and other emergency service responses are inadequately analyzed in the DEIR and are a glaring defect of the DEIR.

The DEIR spells out on page 4.17-20 that **a project would have a significant impact if it would expose project occupants to the uncontrolled spread of a wildfire or expose people or structures to significant risks. That is straightforward and fully accurate criteria for significance for this high hazard project site.** That criteria is reflective of a reasonable approach to assessing fire risk under CEQA.

Yet instead of the DEIR authors acknowledging that the truthful reality is that the Terra Vi Lodge project and the Yosemite Under Canvas project both separately and cumulatively WOULD INDEED create a significant impact by exposing project occupants to the risk of an uncontrolled spread of wildfire, the DEIR consultants instead dismiss any significant risk on the grounds that the property would have various treatments done to reduce hazardous fuel -- as if fuel reduction treatments magically make fire risk disappear for a forest site to disappear. The DEIR asserts that project landscaping will be fire resistant, which is completely at odds with the claim that planted trees with dense foliage will screen the view of the project site from passing vehicles. ORG8-35 cont.

Even if fuel reduction treatments are implemented to reduce natural vegetation surface and ladder fuels, the Terra Vi Lodge project and the Yosemite Under Canvas project across the street would still be adding flammable fuel – including all of the structures and all of the vehicles proposed to be on the Terra Vi Lodge project site along with the various structural fuels on the Under Canvas property site -- 99 fabric tents and wooden tent support structures, 99 wood heating stoves and stacks of firewood, 3 community campfire rings, a large portable kitchen facility (with gas burning appliances and combustible materials), a portable administrative facility, and more than 100 cars or other vehicles. Mitigation measures to make the additional fuel (added as a result of the project) only create minimal additional risk does not take away the original baseline risk that comes from the two adjacent project sites cumulative creating significant risk by being forested with flammable groundcovers and ladder fuels.

It has already been proven by the Rim Fire that this project site can burn intensely. And whether or not various fuel reduction and dead tree removal actions are taken, due to the forest cover the site will still be rated as being located within a Very High Fire Hazard Severity Zone within a State Responsibility Area.

CSERC emphasizes that occupants of this site will consistently be placed at risk du to wildfire threats – especially during late afternoon periods or early evening periods in the heat of summer – when the site will be filled with guests, staff, over 200 vehicles, and all the new visitor-serving facilities.

During a wildfire threat, at best a fire crew from the Groveland area will be available to respond instead of that crew already being committed to a response call elsewhere). Even then, it will take that fire engine crew 25 minutes or more to reach the project site. Upon arrival, if a spreading wildfire is threatening the site, that fire engine crew will need to decide whether to protect Terra Vi Lodge or the Yosemite Under Canvas facilities, or the newly rebuilt Berkeley-Tuolumne Camp just down the hill, or the Thousand Trails-Yosemite Lakes RV resort project with up to 150 new campsites. In a wind-whipped wildfire, a single fire engine will literally be meaningless when it comes to protecting hundreds of people on any site, let alone needing to protect four sites that are within a high-risk State Responsibility Area. It is also highly conceivable that the closest U.S. Forest Service, ORG8-36

National Park Service, and CAL FIRE/County fire engines will all be assigned to initial attack fire suppression actions at the head of any expanding wildfire or that those engine crews will be already committed to structure protection near the wildfire's ignition site. That realistic scenario leaves no engine or only one engine to protect the Terra Vi Lodge site and three other lodging facilities that would also be facing the wildfire threat.

Accordingly, due to the flammability of the project site and the slow response time for any fire protection crew to arrive, **IT IS INARGUABLE THAT THE PROJECT, IF APPROVED, WOULD EXPOSE PROJECT OCCUPANTS TO THE RISK OF THE UNCONTROLLED SPREAD OF A WILDFIRE**. For years CSERC's Executive Director worked as a Forest Service firefighter and taught wildland fire behavior to Hot Shot fire crews and to other firefighters.

The**re is nothing that minimally-trained Terra Vi Lodge and Yosemite Under Canvas employees with very limited fire suppression equipment could do to effectively suppress a major wildfire or to provide safe refuge on the project site for project occupants if a wind-whipped conflagration blew flames across the property.**

Simply getting people packed and effectively evacuating from the site in the midst of a potential firestorm situation is likely beyond the capacity of a small staff who would be dealing with panicked clients – many who will never have been in a wildfire risk situation previously.

THE PROJECT WILL CLEARLY EXPOSE PROJECT OCCUPANTS TO THE POTENTIAL RISK OF THE UNCONTROLLED SPREAD OF A WILDFIRE. THAT IS A SIGNIFICANT IMPACT OF SUCH IMPORTANCE THAT TUOLUMNE COUNTY PLANNING COMMISSIONERS AND COUNTY SUPERVISORS CANNOT IGNORE WITHOUT BEING RESPONSIBLE FOR FUTURE OUTCOMES.

THE COUNTY OFFICIALS WHO ALLOWED RESIDENTIAL AND COMMERCIAL DEVELOPMENT PROJECTS TO BE APPROVED AND IMPLEMENTED IN WHAT BECAME KNOWN AS THE DEADLY "CAMP FIRE" AREA HOLD CLEAR RESPONSIBILITY FOR THEIR CULPABILITY IN CONTRIBUTING TOWARD THE DEATHS OF 80+ PEOPLE UNDER HORRIFIC CONDITIONS. IT SHOULD BE UNACCEPTABLE FOR TUOLUMNE COUNTY OFFICIALS TO SHRUG OFF THE WILDFIRE RISK AT THIS ALREADY BURNED SITE AND TO CONSIDER GIVING APPROVAL TO A PROJECT (TWO PROJECTS) THAT WOULD RESULT IN HUNDREDS OF PEOPLE BEING ONSITE EACH DAY DURING FIRE SEASON, EVEN THOUGH THERE IS NO CAPACITY FOR FIRE PROTECTION CREWS TO PROVIDE TIMELY RESPONSE TO PROTECT THEM.

ORG8-36 cont.

To further add to the key comments on Wildfire Risk stated above, CSERC notes that despite good intentions that are featured in the DEIR, in reality there is no feasible way that the project managers can effectively ensure that those with smoking habits would only smoke in a designated smoking area. Smokers will vary in terms of their compliance, and over a long fire season, many will not abide by requirements that are not convenient. Furthermore, the project add unusually flammable fuels such as major propane tanks and propane lines on site. In addition, here apparently would be "fire pits located in public areas and operated and maintained by hotel staff only." (page 4.9-19)

ORG8-37

For all of these additional fire hazards or risks created by the project, the DEIR claims there would be Less Than Significant risk, when in fact the project would both independently and cumulatively be creating a Significant risk for Wildfire by exposing people to a significant risk of loss, injury, or death involving wildland fire through inviting them to a high hazard wildfire site in the midst of a broad expanse of forest and surface fuel.

ORG8-38

THE ISSUE IS NOT WHETHER THE PROJECT WOULD TAKE STEPS TO REDUCE RISK OF WILDFIRE. THE LEGAL QUESTION IS WHETHER, DESPITE MITIGATION MEASURES, WILL THERE STILL BE FLAMMABLE VEGETATION, VEHICLES, STRUCTURES, FUELS, AND OTHER FLAMMABLE MATERIALS ON THE PROJECT SITE AND THE ADJACENT "UNDER CANVAS" PROJECT SITE – CUMULATIVELY CREATING A SIGNIFICANT RISK FOR UP TO 800 PEOPLE TO BE EXPOSED TO HIGH FIRE RISK?

The DEIR is often flawed – with misinformation and biased judgments that falsely assume that having some trained staff equipped with fire protective equipment or that planting "fire-resistant landscaping plants" will somehow help protect the project site from a wind-whipped wildfire. During major wildfires, CSERC staff has observed water-filled ice-plant vegetation burn intensely and tires on parked vehicles catch on fire in wind-blown conflagrations, even though those fuels normally cannot be lit with a flame that is held directly against them for an extended period. **ORG8-38 cont.**

This commercial lodging development project is proposed on an extremely risky site surrounded by many square miles of highly flammable vegetation in a location far from the responsible fire response agency's closest engine. Because the project would result in so many people being at risk for wildfire, the impact of the project is SIGNIFICANT.

To resolve the conflicts with public risk and the goals and objectives of the Project, it is imperative to select a different location that can achieve a safer, more positive outcome.

ALTERNATIVES TO THE PROPOSED PROJECT

HOLCOMB PROPERTY IS AN ALTERNATIVE LOCATION WITH FAR LESS IMPACTS

In 2010 Tuolumne County approved the Holcomb Project on agricultural land that lies south of Highway 120 west of the USFS Buck Meadow Station and east of the intersection of Smith Station Road. The site was approved as a large agritourism-based recreational commercial project. Approval currently allows for a specific project that included a major conference center, a 40-room lodge, guest cabins, a store/market, a theater, a swimming pool, and various other visitor serving amenities.

The Holcomb Project site is currently almost completely undeveloped with a single barn/residential use facility and a corral. However, in contrast to the less than scenic or only marginally desirable Big Oak Flat "scar" site which certainly provides one alternative site for consideration, the Holcomb property features large old beautiful oaks, mature conifers, scenic meadows, impressive views, and a flat terrain that is easily developable for the Terra Vi Lodge project. **ORG8-39**

Compared to the current proposed Terra Vi Lodge project site, the Holcomb Project site is many miles closer to emergency services, law enforcement, and fire response agencies. Due to it being at a low point in surrounding hills and vegetation (instead of being on a ridge setting at the current proposed Terra Vi Lodge site), there is a far higher likelihood of a shorter well distance to groundwater. Perhaps most important, due to the open nature of the surrounding lands, while there is absolutely still a level of wildfire risk at this Holcomb property site, the openness of meadows west and north of the property and to some degree to the east of the property would result in far lower wildfire risk for people who occupied the site as guests or staff. AND PERHAPS MOST VITAL, IT IS ALREADY APPROVED FOR USE AS A COMMERCIAL LODGING EVENTS PROJECT SITE.

For all of the reasons listed above and additional reasons, CSERC strongly recommends that the FEIR move past the applicant's and the County's resistance to considering Alternatives to the Project site. CSERC urges the consultants and the project applicant to consider the many benefits and the reduced impacts that would come from shifting from the current proposed project site to the Holcomb property - which is vacant and apparently available.

The DEIR suggests that because that site near Buck Meadows is in another county that it does not need to be carefully analyzed for comparison of environmental impacts. CSERC asserts that the argument is specious and that any reasonable alternative site with fewer environmental impacts cannot be ignored just because the site is outside of the jurisdiction of the decision-making agency. The Holcomb site should be fully considered.

ORG8-39 cont.

ASSESSING OTHER REASONABLE ALTERNATIVES TO THE PROPOSED PROJECT

For purposes of meeting CEQA requirements, the DEIR consideration of alternatives to the proposed project is defective because so many Significant impacts are not appropriately defined under the Issue categories – and thus the reasons to consider an alternative that would lessen impacts are either ignored or minimized. For instance, by repeatedly dismissing any Significant impact for an obvious impact such as Forest Conversion, the DEIR fails to accurately compare the impacts of the project at the current proposed project site with a site where no Forest Conversion would occur. Similar inaccuracies in terms of comparing alternatives to the project occur for the other issue areas where these comments have shown strong evidence of a Significant impact despite the DEIR authors

ORG8-40

ALTERNATE LOCATION ALTERNATIVE DISCUSSION IS MISLEADING

CSERC notes that the DEIR authors have given consideration to "the Scar" property which is vacant, and which has many benefits and reductions for potential project effects if the project was located at that site rather than the currently proposed site. CSERC agrees with the DEIR that the Scar project site is not within the desired 10-mile distance from Yosemite and that there are other visual and locational factors that could make it less marketable for the objectives outlined by the project applicant in the DEIR. However, the DEIR fails to acknowledge that there are other factors such as higher connectivity to the Big Oak Flat and Groveland area communities, closer proximity to a work force, and other assets that could potentially compensate.

In terms of responding to the DEIR, CSERC re-emphasizes the failure of the consultants for the DEIR to provide a balanced, neutral, unbiased analysis. **When comparing the project to alternate locations, the DEIR authors' failure to be unbiased is replete throughout the discussions of the ALTERNATE LOCATION ALTERNATIVE and the REDUCED FOOTPRINT ALTERNATIVE sections.** For example, because the Scar site provides connectivity to both public water and public sewer, the unproven sustainability of the wells on the proposed project site would be avoided, yet that is not even mentioned.

ORG8-41

As another example, for wildfire risk and access to fire response services, the fact that a fire engine could arrive at within 3-5 minutes compared to 22+ minutes (or realistically, far longer) at the proposed project site is mentioned, but not fairly described as a major benefit. Instead, the fact that a marginally feasible emergency helicopter pad is proposed at the current proposed site is described as positive for the current site and negative because the Scar site wouldn't have such a helipad. In

ORG8-42

reality, few fire agencies would EVER consider landing a helicopter on the current proposed project site due to the danger to the copter crew posed by tall trees that will still be left growing on the site along with all the trees on adjacent sites. But if a helipad might have meaningful value, a helipad could be created at the Scar site. ORG8-42 cont.

Likewise, for emergency medical services, the DEIR discussion admits that the Scar site would be far closer to EMS and within a service district, but then the DEIR authors shift to the supposed benefit of having an emergency helipad at the current proposed site. If there are no Terra Vi Lodge or Under Canvas projects at the proposed site due to so many Significant impacts, there would be no benefit for having an emergency helipad – especially due to the unsafe locational hazards of trees. ORG8-43

Most succinctly, the Scar alternate site has many, many key reasons why impacts from a proposed project would be reduced at that location compared to the proposed project site. Yet the DEIR only minimally discusses many of those important differences. Similarly, the DEIR discussion of the REDUCED FOOTPRINT ALTERNATIVE is inadequate by failing to describe the reduced impacts of a smaller overall project. Instead, it spells out the loss of the "indoor-outdoor relationship" that cabins would provide, and it claims that the exclusion of the helipad would deprive the public benefit of that as a new "emergency resource." Again, the authors favor the proposed project instead of reasonably listing that fewer guests would produce less wastewater, would consume less groundwater, would produce less noise, would result in lower GHG emissions, etc. ORG8-44

ENVIRONMENTALLY SUPERIOR ALTERNATIVE

The DEIR accurately describes the No Project Alternative as environmentally superior followed by the Reduced Footprint Alternative. ORG8-45

CLOSING SUMMARY COMMENTS FROM CSERC

In the years leading up to the approval by County supervisors of the revised Tuolumne County General Plan, the board of supervisors, planning commissioners, and supportive interests of the building and development community all stressed the goal to increase development in the County. As a result, the primary objective of the recently approved County General Plan became the goal to provide for development in the County.

Given that strong philosophical view -- seeing new development as highly desirable – it is likely that current county decision-makers will already be leaning towards approval of the project and ignoring the Significant impacts that development at the proposed location would cause if the Terra Vi Lodge and Under Canvas projects are approved. ORG8-46

CSERC cannot change anyone's strongly held perspectives or opinions. What CSERC's comments may hopefully do, however, is to point out facts that are so strong and clear that even pro-development advocates will find them meaningful.

UNSAFE LOCATION

First, this project site is an unsafe location for placing a new lodging development that is intended to have as many as 550+ guests and staff on the property. The next high-severity wildfire along the Highway 120 corridor could potentially sweep upslope from the west, north, or south and burn across this area with wind-whipped intensity. Because county decisionmakers may not have personally experienced being amidst the panic and confusion that the general public can exhibit in such unexpected, stressful situations, it may not be obvious why people make poor choices, or why a Paradise-type conflagration costs so many lives. **This site is an unsafe site due to wildfire risk.** ORG8-47

LACK OF ADEQUATE WATER SUPPLY IN CRITICALLY DRY OR DROUGHT PERIODS

No matter whether the County generally accepts wells as a sole water supply for special commercial type projects, the Terra Vi Lodge project and its adjacent Under Canvas neighboring project cannot assure in any way that wells beneath the site will provide reliable water in drought periods or in a critically dry water year. Further, the inadequate testing done to date shows contamination of wells exceeds acceptable water quality thresholds. There is no assured water supply for multiple dry years or a drought situation. **There is no backup water supply. This is not the right site.** ORG8-48

THE SCALE OF WASTEWATER TREATMENT NEEDED FOR TWO COMBINED ADJACENT LODGING PROJECTS POSES RISK TO GROUNDWATER RESOURCES

Despite good intentions and assurances that an engineered septic system can be designed and constructed for both projects, in fact **the black water and gray water wastewater produced by the two projects has high potential to contaminate groundwater directly beneath those leach fields** or other areas of discharge. Having a total of up to 800 people per day rely solely on fancy septic systems and leach fields positioned above the project's groundwater supply cannot provide assurance that groundwater will be protected and contamination will be totally avoided. ORG8-49

COUNTY CANNOT PROVIDE TIMELY FIRE, EMS, AND LAW ENFORCEMENT SERVICES

Good intentions are not legally sufficient. The DEIR spells out in detail the inability of fire responses to be assured for serving the project site in a timely manner. Law enforcement service capacity is even worse, and the DEIR acknowledges limited EMS capacity despite failing to assess that issue in a thorough manner. Leap-frog development far outside of a service district and many miles from county service ORG8-50 providers results in a Significant legal defect. **Critical services needed for public health and safety cannot be provided at this distant location** for a variety of reasons. **ORG8-50 cont.**

THE PROJECT WOULD CAUSE A SIGNIFICANT IMPACT DUE TO FOREST CONVERSION

The DEIR would fail immediately to pass a legal threshold for adequacy due to its convoluted and false rationale that there will be no Significant impact due to forest conversion. **Changing use from forest management to lodging is inarguable. Again, this is a Significant effect tied to this specific project site.** **ORG8-51**

THE PROJECT WOULD CREATE SIGNIFICANT CUMULATIVE IMPACTS FOR SCENIC VIEWS, GHG EMISSIONS, TRANSPORTATION, AND OTHER KEY ISSUES

The points contained in these comments make clear why the project would create undesirable, Significant negative effects for a wide range of identified issues. **ORG8-52**

The final EIR should correct the extensive number of DEIR flaws, provide accurate analysis, and acknowledge in detail why this project site is not legally appropriate for approval of the proposed project as now designed. **ORG8-53**

John Buckley

Executive Director, CSERC

COMMENT LETTER # ORG9

From: Lee Zimmerman <leez@evergreenlodge.com>
Sent: Thursday, July 30, 2020 5:07 PM
To: Quincy Yaley <QYaley@co.tuolumne.ca.us>; Taryn Vanderpan <TVanderpan@co.tuolumne.ca.us>; Tracie Riggs <TRiggs@co.tuolumne.ca.us>; Jim Junette <jjunette@fs.fed.us>; BOS Members <bosm@co.tuolumne.ca.us>; Kathleen Haff <kathleenhaff2020@gmail.com>
Cc: Brian Anderluh <briana@evergreenlodge.com>
Subject: Terra Vi Draft EIR

Hi Tracie, Quincy, Taryn, Board of Supervisors, Kathleen & Jim,

Attached are our comments on the Terra Vi Draft EIR. Thank you for the opportunity to share our concerns.

Fire and related risks from the development threaten the existence of our lodges, and cumulative impacts of this and other projects in the immediate vicinity, which are not adequately studied or addressed in the draft EIR, need to be before considering review or approval of this project.

ORG9-01

This puts the burden on the County to determine the appropriateness of these projects and mediations and additional resources that would be needed to keep everyone safe and protected and without loss of quality of life and rights due to Terra Vi and the other developments. It also puts the burden on the County to hold them to the same standards as previous full-scale developments, and to not be able to skirt appropriate standards by downplaying what they are proposing and the significant impacts it will have on neighbors, businesses and the broader community.

Thank you very much for doing so,

Lee

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Lee Zimmerman
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Corporation

Evergreen Lodge YOSEMITE EST. 1921

YOSEMITE RUSH CREEK LODGE

July 30, 2020

Dear Quincy & Taryn,

This letter is in reply to your request for comments regarding the Terra Vi EIR related to Site Development Permit SDP18-003 on Assessor's Parcel Numbers: 068-120-060 and 068-120-061.

While Hansji appears to have incorporated many thoughtful elements into their design, numerous core issues are glossed over by them in their EIR recommendations. We summarize below our key concerns regarding significant issues with and impacts of the project that are not adequately assessed, addressed and mitigated in the EIR, and which will require extensive planning, mitigation and additional county resources to resolve.

All of these comments below apply to Terra Vi, and many key items, including fire safety, public services, traffic, infrastructure, neighbor impacts and employee housing, are exacerbated by the contemplated Yosemite Under Canvas (YUC) development across the highway.

If the County is not extremely careful and doesn't make proper investment, create proper requirements, and address timing issues appropriately, it may be inadvertently complicit in our demise, and the goal of increasing the tax base may backfire by putting us and other existing players out of business along with the new developments.

ORG9-02

EXISTENTIAL THREAT

The proposed development, in combination with that contemplated for Yosemite Under Canvas, creates an unjust and existential threat to us and to the neighbors.

- Given the economic and environmental devastation caused by the Rim and Ferguson fires, we are duly very concerned about the concentration of facilities and activities located just a few miles from our lodges and from Yosemite. Wildfire risk in our area will increase dramatically if these developments happen as proposed.

ORG9-03

Evergreen Lodge
33160 Evergreen Road
Groveland, CA 95321
EvergreenLodge.com
(209) 379-2606

Rush Creek Lodge
34001 Highway 120
Groveland, CA 95321
RushCreekLodge.com
(209) 379-2373

- HAZ-7: *"The project would not expose people or structures, either directly or indirectly, to a significant risk of loss, injury, or death involving wildland fires,"* and WF-5: *"The project would not contribute to significant cumulative wildfire impacts,"* are both deemed to have Less Than Significant impact. This is absolutely untrue, speaks to the bias of the EIR and needs to be addressed head-on by the County. **ORG9-04**

- **<u>The proposed projects are directly upwind of Rush Creek, and a fire that escapes Terra Vi or YUC will head straight towards Rush Creek (and potentially Evergreen), quickly arriving at our property</u>.** **ORG9-05**

- There is no fire station or other quick firefighting response for 17 miles from the proposed properties to stop wildfires started there from burning us down. **ORG9-06**

- The project includes guest barbecue areas with hotel provided barbecues, which further heightens fire risk. **ORG9-07**

- Even if our lodges don't burn down, the resultant un-insurability from the fire could literally end our businesses given the current insurance marketplace – see next section below. **ORG9-08**

INSURABILITY

- Bank loans go into default if hospitality properties can't be insured. Due to recent local and other California fires, it has become almost impossible to obtain commercial property insurance coverage in our area. Regular carriers deny coverage, and we've been forced to go to secondary markets to piecemeal minimum bank-required insurance coverage. **ORG9-09**

- **As a result, our cost for property insurance alone** (not liability, auto or other coverages) **has in two years gone from $88,000 to $1,250,000 per year, a 14-fold increase.** **ORG9-10**

- **If fire related risks are perceived to have increased due to these new developments, or if these developments cause any fire related incidents to occur in our area, it will likely become impossible or financially infeasible to secure property coverage, which could result in bank default and bankruptcy for us and other area hospitality operators.** **ORG9-11**

- It is unclear if the developers of Terra Vi and YUC are aware of or have considered the challenging insurance environment faced by hospitality properties in wildfire areas. **ORG9-12**

FIREFIGHTING CAPABILITIES

- **Given the above, any new development, should it be approved to move forward, must be held to the most stringent onsite fire control and prevention requirements for all concerned, including at minimum** (some of which are referenced broadly in the EIR):
    - Fire sprinkler system for all structures
    - Central station alarm monitoring for all structures
    - Large water tank for firefighting water
    - Minimum required fire flow rate & duration
    - Adequate well water supply to quickly refill water tank – unclear how this recharge will be achieved through the mixed recycled, rain and well water system they envision
    - Hydrant and standpipe system to deliver firefighting water throughout the site
    - Construction period fire risk mitigation, including continuous fire watch ORG9-13

- **We are glad to see Terra Vi will train staff in fire service standards. This does not solve the clear need for new, professional firefighting resources, which must be established in the immediate area of the development, to protect us and the neighbors of the developments. A manned station at the property itself seems the most robust and appropriate protection solution.** Counting on firefighting resources from Groveland or Sonora to be onsite in time to stop a fire from spreading beyond the new proposed developments is not acceptable and puts us at unfair risk from the developments. The proposed helipad and fire training are red herrings and not substitutes for what's really needed at the new developments: the addition of true firefighting resources. ORG9-14

- If the developments proceed, firefighting capabilities, including fire watch, should be in place throughout the construction period. ORG9-15

- WF-2 outlines numerous fire risk mitigation measures Terra Vi will perform, and it would be reassuring if there was a clear monitoring/enforcement mechanism around these items. Importantly, these mitigation measures do not lessen the fire risk impact of the development from significant to less than significant as Terra Vi suggests. ORG9-16

- As you will no doubt hear from others as well, **a fire caused by the developments would destroy trees and structures of neighboring parcels, forever unfairly harming the long-time residential neighbors, who should not have been exposed to extensive commercial development at their borders.** ORG9-17

FIRE BUFFER

- NFS Groveland Ranger District Supervisor, Jim Junette, recommends that YUC fund and maintain an extensive fire break (300-500 feet as determined by Cal Fire) in the National Forest perimeter surrounding the property in order to protect fire from escaping YUC's property and causing a wildfire in the national forest that threatens the forest, neighbors and us. **ORG9-18**

- We appreciate Jim's approach in trying to protect all concerned from unintended and disastrous fire consequences from the proposed YUC development, and we **hope a similar extensive fire break approach and requirement will be put in place for the proposed Terra Vi development as well to maximize safety of the surrounding forest, community and businesses.** **ORG9-19**

- Has Cal Fire been contacted to provide comment on the fire risk associated with the project? The only letter we saw from them related to a CFIP cost share grant. **ORG9-20**

COUNTY PUBLIC SERVICES

- **A key consideration in evaluating and allowing the projects to move forward must be that they do not put undue burden on public services and facilities.** **ORG9-21**

- The limited county resources for fire, police & ambulance will not be able to accommodate these two huge projects (let alone when considered with the addition of Berkeley Camp and potential Yosemite Lakes expansion). **ORG9-22**

- We strongly disagree with the conclusion that cumulative impacts on public services, including fire protection, police & ambulance, with the mitigations proposed, would be less than significant. That conclusion is plainly flawed to anyone who understands our area and the limited existing access to services. **ORG9-23**

- As mentioned previously, county firefighting infrastructure and services will definitely need to be expanded to be able to handle potential fire at the new facilities, which could escape and burn to our facility as well. The County has been instrumental in successfully supporting defense of our properties and advocating for resources to ensure our survival during previous fire events. With the contemplated Terra Vi & YUC developments, we have extreme concern about the additional firefighting resources and infrastructure that would need to be added, and need to be funded, to provide continued support at an appropriate level in this essential area to defend us and the new developments. **ORG9-24**

- If Terra Vi and/or YUC are constructed, a rapid response plan and associated firefighting resources need to be in place to stop a fire from moving from these developments to Rush Creek. As mentioned previously, to mitigate fire risk and protect all neighbors, perhaps the County or the developments should help fund an onsite county fire station for quick response and in acknowledgement of the increased risk to neighbors and forest imposed by the new developments. **ORG9-25**

- Services infrastructure – ambulance and police response time to our lodges is already slow due to distances and limited resources. While Terra Vi will have onsite MOD's, which we have as well, more police resources, which are currently located a 45-mile drive from Terra Vi & YUC, will need to be available in Groveland or nearer to the developments to respond to issues that arise at the resort, YUC and Berkeley Camp, as between the three, there will be well over 1000 new guests in the immediate vicinity each night. **ORG9-26**

- Bolstering these resources 'up the hill', and potentially at the project sites, will be key if these additional developments are contemplated, particularly given the cumulative visitor count increases and traffic risk impacts of the projects contemplated. We are glad that GCSD has importantly raised concerns in this regard as well. **ORG9-27**

EXISTING FORESTRY AGREEMENT

- **It appears development such as proposed by Terra Vi and YUC may not be allowed before 2026 given the obligations of the CFIP Agreement the Manly family signed with the CA Department of Forestry and Fire Protection in late 2015.** **ORG9-28**

- Section 13 of the agreement states *"Participant certifies that the parcel of forestland to which the Forest Improvement Program applies will not be developed for uses incompatible with forest resources management within 10 years following recordation date".* **ORG9-29**

- Extensive commercial development as proposed clearly conflicts with the forest resources management requirements of the agreement with the Department of Forestry and Fire Protection and has been called out as such by them. **ORG9-30**

- The EIR discusses returning the money they received to void the expired contract. It is not clear that such action is legal given they are 5 years into the 10-year contract obligation, which they committed to for the 10 years stated in the contract, and for which they have already received financial benefit from Cal Fire. **ORG9-31**

CUMULATIVE IMPACTS

- GEO-7 *"Project impacts are not cumulatively significant with other development projects in the vicinity,"* is concluded to have impacts Less Than Significant. This is absolutely not the case, as their analysis is not accurate, thorough or sound. We encourage the County to hire a truly independent party (at the expense of the developers if needed) to assess the cumulative impacts of the proposed developments. **ORG9-32**

- As the County reviews the EIR and contemplates approval and conditions for this facility, please **include in any impact analysis by the County and other agencies the <u>real combined impact</u> of the two contemplated additions, Terra Vi & YUC, rather than each project individually**. Accepting the current downplayed/understated/unrealistic EIR assumptions of cumulative impacts will miss the true combined effects of the two developments contemplated at this location. **ORG9-33**

- The impact of these two developments also needs to be analyzed in the context of the already approved development in the same area at Berkeley Family Camp and the planned expansion at Yosemite Lakes/NACO and the true scale of the extensive development beyond Terra Vi outlined in Table 4.1. **The cumulative impacts of these large projects, <u>nearly 500 lodging units</u>, would be substantial, would significantly increase public safety and environmental risks, and would significantly expand the need for infrastructure and key public services.** **ORG9-34**

- The Terra Vi EIR discounts and does not appropriately account for these cumulative risks and needs. Given County economics, it is not clear how additional infrastructure, services and protections would be provided to avoid unfairly increasing exposure and risk for neighbors, existing businesses and local community, which need to be avoided at all cost. **ORG9-35**

PURPOSELY UNDERSTATING PROJECT

- In section 2.1, Proposed Project, there is no mention of reception, kitchen, restaurant, bar, event hall gym/locker room or greenhouse facilities and thousands of square feet of other amenities. **ORG9-36**

- The same is done in 3.3, Project Components. These omissions understate the project and associated impacts and staffing needs. Only later under the 'amenities' section are these significant project components mentioned. **ORG9-37**

- Back-of-house and infrastructure needs are underestimated to minimize apparent project impact and staffing. **ORG9-38**

FULL SCALE OF PLANNED DEVELOPMENT

- While Hansji has proposed and analyzed a 126-room development, it is clear that they are designing the property for additional future cabin buildings in a later phase to achieve the originally intended scale of 200+ guest rooms. They should be forthright about this plan so the full scale of development can be fairly assessed now. **ORG9-39**

- Their intent is evident, among other things, as follows: **ORG9-40**

  - All public facilities, such as the kitchen, dining room, bar, event space and reception area are all identically sized to the original 240 room development plan despite the new plan having about ½ of the original room count – a clear indication of future intended scale, particularly given they state that the restaurant and bar are for lodge guests only.

  - The number of parking spaces proposed, 286, remains exactly the same as the original plan, with 74 originally designated for ‘cabins’ just moved to ‘overflow’.

  - Originally planned Phase II cabin buildings were just removed from the site plan with the proposed pathways that weaved around the cabins left in place exactly as originally planned for future addition of the cabins exactly as originally proposed.

- **With this future 2nd phase in mind and clearly being planned for in their design, should the true long-term goal, including the 2nd phase, also be considered when evaluating cumulative impacts and required mitigation and scaling of essential services?** **ORG9-41**

APPROVAL TIMELINE & COVID

- The Groveland hospitality community is facing unparalleled, historic economic impacts from COVID. For example, we will likely take in only 30-40% of budgeted revenue this year, which threatens our very survival. There is no certainty as to when recovery will occur. **ORG9-42**

- **We would hope that, at this time, the County would focus on supporting the survival of existing county businesses that comprise its core tax base rather than trying to push new developments that risk that very tax base.** ORG9-43

PROCESS

- We and others question the decision to issue two massive EIR's of 2000+ pages for 45-day comment period (the shortest possible) with deadlines within 10 days of each other (YUC & Terra Vi). Given that a single project of this scale comes around perhaps every 10 years, we would have expected the County to appropriately stagger the comment periods. ORG9-44

- Such action has raised the question among many in the community about whether the process was done in good faith or designed to limit the ability for thoughtful review and comments, particularly given the scale of the developments and documentation. All is of course exacerbated by current COVID restrictions and demands, which might alone be reason for greater timing flexibility and sensitivity. ORG9-45

POTABLE WATER

- Total expected potable water usage is projected at 16,636 gallons/day. Based on our relevant experience actually running lodging facilities in the area, peak usage will be significantly more than that design volume. Our experience suggests actual daily water usage would be nearly double the projected amount. ORG9-46

- We encourage realistic estimates of water usage and sustained water production to ensure sufficient capacity and so appropriate firewater stores can be consistently maintained. ORG9-47

- The plan to be completely reliant on just 2 wells is naïve and not realistic long-term, especially given actual water usage may be double projected amounts. For comparison, Rush Creek currently has 6 wells and Evergreen has 9. With the Terra Vi design, the loss of a single well pump would halve water production and quickly result in a supply shortage requiring water hauling. ORG9-48

- In addition, Terra Vi's presumption that the wells will continue to produce in the long term at 50% of the 10-day test capacity is unrealistic. Our experience is that wells do not maintain near that level of performance over time, particularly given that tests occurred after record water levels the prior winter. ORG9-49

- It is not clear that sufficient potable water flow has been identified based on realistic estimates and seasonal drought variability, and hauling water on an ongoing basis should not be allowed. **ORG9-50**

- Given the understated water usage projections and likely overstated production volumes, it is unclear if the proposed domestic water tanks have adequate capacity if the tanks are to supply some of the required fire flow water storage (details of fire water storage are not provided). **ORG9-51**

- HYD-2 addresses if *"the proposed project would not substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin."* There is significant uncertainty around this question, as the 10-day pump test done after the wettest season in years does not speak to risks of groundwater recharge and sustainability. **ORG9-52**

- HYD-6 addresses if *"the proposed project, in combination with past, present, and reasonably foreseeable projects, would result in less-than-significant cumulative impacts with respect to hydrology and water quality,"* which they conclude as Less Than Significant. There remains much uncertainty about this, and they have clearly not made the case in this regard. **ORG9-53**

- Pump tests showed significant well draw downs of 25-50+ feet after just 10 days. This is a major concern, as it suggests significant associated risks to ongoing flow rates, water table, neighbors' wells and continuous sufficiency of potable water from ongoing use, especially during drought periods. **ORG9-54**

- It is also not clear that in drought years (unlike when the wells were tested), that the wells at Terra Vi won't significantly impact the local water table and affect the viability of the neighbors' access to potable water via their own nearby wells. In this regard, note that all wells hit initial water at the same 100-foot level. **ORG9-55**

- Given that the projects are to assess cumulative impact, as stated in the YUC EIR, regarding having *"sufficient water supplies available to serve the project and reasonably foreseeable future development during normal, dry and multiple dry years"*, and that this can't be understood from a single short-term testing done after the wettest season in years, should tests be repeated this fall to understand drop in water table and flows in a more normal year to protect neighbors from negative consequences to their water supply? **ORG9-56**

- Since there will be onsite staff for over 6 months, this would make the water system a non-transient, non-community system, which is not addressed. **ORG9-57**

WASTEWATER MANAGEMENT

- Given the scale of development and its proximity to the Tuolumne River and associated watershed, a full waste treatment system should be required for the entire facility, as was the case with Rush Creek. While not totally clear, Terra Vi appears to be calling for a 1.4 acre septic system and to indicate that facilities other than those for the restaurant will be septic systems with leach fields rather than part of a full waste treatment system. **ORG9-58**

- Design wastewater flows from the proposed development are unclear. What is known is that the projected flow of high strength waste from the restaurant is likely very small due to their stated plan to use recyclable flatware & utensils in the restaurant. Could this really be the case for the high-end resort that is contemplated, or are projected flows reduced inappropriately through this assumption? **ORG9-59**

- GEO-5, *"the project would not have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater"*, is called out as Less Than Significant, but it is not clear how this has been determined and if it is correct. **ORG9-60**

- Terra Vi wells hit water at just 100 feet, with similar depth for neighbors' wells also. Neighbors are rightly very concerned about potential wastewater contamination from Terra Vi of well water and the basin at 100 feet that all appear to draw from. Knowing how wastewater flows may travel to confirm they won't migrate to the water basin would provide important reassurance and protection from disastrous consequences for neighbors and the developments. **ORG9-61**

STAFF & HOUSING

- Terra Vi's staffing estimates are unrealistically extremely low and appear targeted at skirting staff housing and other mitigation requirements that would be required were the true employee count known. **ORG9-62**

- Terra Vi calls out a laughable 40 jobs that would be created to run their varied and extensive front desk/reservations, housekeeping, maintenance, food and beverage, event, administrative and retail operations**. For reference, our two lodges, of similar scale, each have 150-200 staff in peak season.** **ORG9-63**

- The unrealistic staff counts are apparently the basis for their conclusion in POP-1 and POP-3, both of which would no doubt result in more significant impact if realistic staff numbers were used. **ORG9-64**

- Underestimating staffing misrepresents the need for onsite housing given the limited labor pool and affordable housing stock in and around Groveland. **ORG9-65**

- It seems key to have year-round onsite employee housing at appropriate scale as a requirement of this project and of YUC, so the County can handle the demand to house employees 'up the hill' near the facilities, and so the developments appropriately bear the burden of the housing demand they are creating. Significant staff housing was required for our lodges and the same should be required for the Terra Vi & YUC developments as well. **ORG9-66**

- **With very limited apartment rental options and affordable housing stock in the Groveland area, not requiring the new developments to provide sufficient onsite housing for employees or requiring appropriate affordable housing offset costs will cause a local shortage and drive prices up, affecting the stability of all moderate wage earners in the area, including trade, hospitality, County, National Park and National Forest Service employees**. **ORG9-67**

- Because our lodges constructed sufficient housing onsite, we can support staff through slow periods where they might otherwise be laid off and become a burden to county services – another reason it's key to require the developments to provide appropriate staff housing and/or housing offsets. **ORG9-68**

- Separately, it is unclear how employee meals will be addressed in the current plan. Are there kitchens in each apartment and associated firefighting protections? How and where are staff who live off-site fed during their shifts? **ORG9-69**

TRAFFIC SAFETY & IMPACT

- Trans-5 draws a key conclusion of Less Than Significant cumulative traffic impact without proper analysis or even suggestion of need for mitigation. **Has there been a complete, objective traffic study performed for the Sawmill Mountain Road and Hardin Flat intersection area that takes into account the cumulative impact of the multiple developments proposed and in process? It seems essential that such a study be completed and mitigating measures be clarified so proper road design, safety and traffic planning occurs.** **ORG9-70**

- The cumulative effect of Terra Vi, YUC, Berkeley Camp & potential Yosemite Lakes expansion will be significant to traffic in the area. A coherent plan is **ORG9-71** essential to ensure that this section of scenic State Highway 120 does not become dangerous and/or congested. **ORG9-71 cont.**

- Turn and merge lanes should be required as appropriate to address highway exit/entrance safety and congestion. Turn areas with limited visibility must be addressed given the speeds of vehicles traveling the highway and Yosemite visitors' lack of knowledge of the local roadways and turnouts. **ORG9-72**

- Between Terra Vi and YUC, 200+ cars will head to Yosemite between 8 and 10am each summer day. That's 100+ trips per hour, not 8.2 as called out in the flawed analysis in Table 4.15-2 that doesn't take traffic timing patterns into account. **ORG9-73**

- Relatedly, Table 4.15-4 uses countywide weekday traffic as its measure, whereas traffic along Hwy 120 near Yosemite between 8-10am and 4-6pm is the relevant measure. **ORG9-74**

- Section 4.15-4 significantly overstates the Yarts benefit and does not in any way adequately analyze the true cumulative impacts, particularly during peak periods, of the cars and guests at the various projects. Note that only about 2% percent of our guests take Yarts each day from Rush Creek, despite us having a Yarts stop onsite and promoting the opportunity aggressively. **ORG9-75**

- The EIR doesn't resolve the dangerous issue that will arise of guests walking across State Highway 120 between the two proposed developments to access retail, F&B and other services, or to just check out the other facilities. It seems important to safely address this issue given highway speeds, hillside locations and guests naïve to the area unused to crossing roads with cars traveling at highway speeds. This is another reason a cumulative impact traffic study is essential. **ORG9-76**

- HAZ-6 relates to emergency evacuation. The aforementioned traffic study should address how emergency evacuation can be accomplished appropriately given the multiple developments at the same junction, and the analysis must include evacuation of the neighbors whose routes will be congested by the guests of the developments who are located nearer to the highway. The developments should not be approved without a safe and comprehensive evacuation plan that protects both guests and neighbors. **ORG9-77**

YOSEMITE IMPACT

- The National Park Service is already limiting park entry due to COVID, and they are generally looking to manage visitation and reduce entry lines, wait times and traffic congestion. Terra Vi and YUC will exacerbate these issues. **ORG9-78**

- There appears no mention of impact on Yosemite visitation of these two large projects, including impact on wait time, the ability of guests to secure Yosemite day passes, etc. **ORG9-79**

- The EIR looks to Yarts as the salvation, which will just not be the case. As we have seen with our guests, due to capacity constraints, convenience, interest and service frequency, only about 2% of our guests use Yarts. **ORG9-80**

- Relying on expanding Yarts to address congestion issues is not a viable approach, as it can only have marginal impact versus the 100's of cars from Terra Vi that will enter and depart the facility and Yosemite each day. **ORG9-81**

NEIGHBOR IMPACTS & LAND USE

- **A key consideration in evaluating/allowing the projects must be their compatibility with other neighboring uses.** It seems abundantly clear that the neighbors would have the peaceful, rural, low density lifestyle they have enjoyed since acquiring their properties significantly and forever altered by the proposed developments. **ORG9-82**

- The effects of a significant change in traffic flow, noise and light in the immediate vicinity of the Terra Vi & YUC neighbors will be extreme and a dramatic departure from the rustic feel that these homesteader families originally sought and have enjoyed through the years. Such a dramatic change is an unfair taking of quality of life and property values for these homeowners. **ORG9-83**

- Is this really an appropriate location for large scale development given the significant effects on and risks to the neighbors who settled the land? In the Overview of Project Alternatives, they mention the 'scar' parcel as an alternate that would allow basically the same development, but they don't highlight the significant benefit of the scar in avoiding dramatically affecting the properties and quality of life of neighbors. **ORG9-84**

- Both construction noise during the multiple years of development and ongoing operational noise will be significant for neighbors, particularly given the elevated and exposed nature of the parcel. **ORG9-85**

- Noise levels from the proposed helipad (NOI-3.1) would have significant impact on neighbors. While stated as for emergency use only, a helipad may over time be used for non-emergency guest access, sightseeing and other activities that **ORG9-86** could further ruin the serenity of the area that neighboring landowners have always enjoyed, also further decreasing the value of their properties. **ORG9-86 cont.**

- If Terra Vi is developed as planned, the neighbors will have to drive through the resort along Sawmill Mountain Road to get to their homes. This is clearly a significant impact that changes the nature of their properties and experience as landowners. **ORG9-87**

- LU-1 speaks to *"if a project would physically divide an established community"*. It is clearly the case that the project itself is dividing the long-time established residential community, and the need to physically pass through the resort to enter neighboring properties is indeed a permanent physical divide created by the development. **ORG9-88**

- FOR-1 states that the project would not conflict with existing zoning for, or cause rezoning of, forestland (as defined in Public Resources Code Section 12220(g)), and states significance as "No Impact", which is disingenuous, as this is forest land (and has an existing Cal Fire agreement confirming so) that is to be specifically converted for this project. **ORG9-89**

- In LU-3, it is stated that the projects would not create land use conflicts within the county. Nothing seems farther from the truth given the dramatic impacts the cumulative projects will have on the residential neighbors and neighborhood. **ORG9-90**

- Did the zoning change pushed through years ago fairly take into account these negative consequences and loss of property value and quality of life to the neighbors who originally settled this land? There certainly seems significant land use inconsistency, not addressed in the EIR, in trying to place this development right in the heart of a well-established homesteader community consisting of over thirty multi-generational RE-2, RE-5 and A10/RR properties. **ORG9-91**

- In the Land Use & Planning Chart, item 1.C.2, Terra Vi wrongly states that the project is consistent with the County's plan as it will not "necessitate additional housing elsewhere, as discussed in Chapter 4.13, Population and Housing." – this is simply false given the limited onsite housing specified vs. the true staffing level required to run a resort of this scale. **ORG9-92**

SCENIC HIGHWAY

- Highway 120 in our area is an officially designated State Scenic Highway, which Cal Trans defines in part by "…the extent to which development intrudes upon the traveler's enjoyment of the view." The development as proposed, with its **ORG9-93** continuous, sprawling complex as shown in the architectural plans, will have an enormous, highly visible presence from Highway 120. This design does not seem in keeping with the nature of the scenic corridor and associated designation. **ORG9-93 cont.**

- AES-2 claims the project would not substantially degrade the view from a Scenic Highway – this is not the case. While the rendering on sheets T0.01 and T0.02 present an extensive array of large, mature trees separating the complex from the highway, there is in fact very little visual break from the highway, and none at all in many areas. The proximity of the development to the highway and the fact that the improvements are uphill from the highway will leave the extensive complex highly visible from the road in both directions. Such a large complex designed parallel to the highway with connected structures with such dramatic visibility from the road will be highly inconsistent with the rest of the scenic corridor. **ORG9-94**

- The graphics created with thick, bushy trees dropped in on pages 102, 103 106 & 107 of the EIR PDF (Figure 4.1-6b & c & 7b & c) are deceptive, do not reflect the density of native conifers, which they state are to be planted, and significantly overstate the blockage newly planted native trees would create. Structures would remain in clear view from the highway well after 5 years. **ORG9-95**

- At Rush Creek Lodge, we were required to set all facilities back and out of direct view from the scenic highway. The same should be required of Terra Vi. **ORG9-96**

- FOR-2 describes taking out 29 pines along Highway 120 for intersection improvements along with others internal to the site. Given the fire damage and the limited number of trees remaining along the frontage, taking out 29 established pines seems a mistake and counter to the goal of blocking views of the uphill facilities from the scenic highway. **ORG9-97**

UTILITIES

- UTIL-12, *"The proposed project would not result in a substantial increase in electrical service demands and would not require new energy supply facilities and transmission infrastructure or capacity enhancing alterations to existing facilities."* is described as Less Than Significant Impact. The UTIL-12 analysis speaks to broad PG&E distribution systems statewide, but doesn't speak to if there is enough capacity along the dead end lines feeding the Sawmill area. Given our directly relevant experience, we would be surprised if new transmission infrastructure would not be required for these two developments. Adding that new infrastructure may have meaningful impacts on neighbors as well. **ORG9-98**

- Whereas projected electrical consumption appears reasonable, proposed propane consumption is only a small fraction of what will likely be required. **ORG9-99**

OTHER

A number of mitigating operational plans proposed don't feel genuine and appear to be included only as proposal marketing tools. It would be great to have formal assurances that what is outlined will be implemented and is not just being used to reduce approval obligations, then abandoned. **ORG9-100**

- Will the market indeed be the only amenity open to the general public, with no outside patrons allowed in the restaurant? Or is this called out to minimize apparent onsite traffic and operating scale impacts and associated requirements?

- Is it really the case given the onsite restaurant that the developers plan to use all recyclable flatware & utensils? Or is this just stated to justify minimizing water and wastewater projections? **ORG9-101**

- The developers use composting as part of their energy efficiency, GHG rationale. Aside from the challenges of managing commercial composting, given bears and associated closed trash container requirements, we can't fathom this is doable. **ORG9-102**

- Given the incredible volume of material provided in the EIR, it seems very strange that draft floor plans aren't included for any of the guest rooms. In seems important to know, in particular, if any type of cooking facilities are intended in units. **ORG9-103**

DEVELOPMENT PACE

- In considering the Hansji & Yosemite Under Canvas developments, in light of Berkeley Camp & Yosemite Lakes, the County should carefully assess pace of development and take into account that the additions of lodging to our corridor have happened incrementally over many years, which has served the County well, allowing each business to stabilize and generate the significant, reliable tax base that has become so important to the County. **ORG9-104**

- For example, we bought the 18 cabin Evergreen Lodge in 2001 and added 48 new rooms there in 2004. We then added 24 more rooms in 2009. Then, 7 years later in 2016, we opened Rush Creek. These stepwise additions over time allowed new inventory to be successfully absorbed into the marketplace, and this disciplined approach has proven out well for the community overall. **ORG9-105**

- This disciplined approach to growth is especially relevant now, given the current economic and health crisis caused by the ongoing global pandemic. We and other businesses are struggling mightily to survive not only the long closure but also the **ORG9-106**

- travel restrictions and associated limited demand for travel to our area now that we have reopened. We are counting on a return of this demand when the pandemic subsides; however, the timeline for a 'return to normalcy' is unclear. International and domestic 'fly to' tourism may not fully come back for years. Given the historically challenging economic environment, is this the best time to push rapid approval of the addition of hundreds of lodging units on our corridor, nearly doubling the lodging supply?

ORG9-106 cont.

- While we know the County is excited about expanding its tax base, which we support, such large scale, nearly simultaneous facilities approvals/additions put the existing tax base at risk, and we encourage the County to be thoughtful about the scale and pace of development along the corridor.

ORG9-107

Given the number of immediate neighbors involved, the scale of what is being proposed and its impact on the Groveland housing, staffing and hospitality markets, along with the other hospitality additions planned in the immediate area which will exacerbate the impact of this development, we encourage discipline, thoughtfulness, and the sincere consideration of all voices in the approval process.

ORG9-108

Thank you for addressing our comments and those of other concerned parties as you assess the appropriateness and viability of the Terra Vi development. We appreciate your critical, methodical review of the significant impacts and risks of this project on the immediate and broader neighbors in the area.

Feel free to call me if we can provide any additional information.

Sincerely,

Lee Zimmerman

cc Tracie Riggs, Board of Supervisors, Kathleen Haff, Jim Junette

TuCARE
Tuolumne County Alliance for Resources and Environment

July 30, 2020

Quincy Yaley
Tuolumne County Community Development Department
2 S. Green Street
Sonora CA 95370

Re: Comments on Terra Vi Lodge Yosemite Project DEIR

Dear Mr. Yaley:

TuCARE is a community based non-profit organization founded in 1988. Our membership is made up of a cross-section of our community including local businesspersons, educators, and those actively engaged in working daily with our natural resources. TuCARE supports the wise use of the many resources on our federal lands. Multiple-use policies allow for everyone to benefit. TuCARE believes that man must play an active role to ensure our resources are available both now and in the future. **ORG10-01**

After reviewing the Terra Vi Lodge Yosemite Project Draft Environmental Impact Report, TuCARE offers the following comments in order to assist you in making the appropriate decision that will benefit local stakeholders and at the same time provide for the long term health and vitality of forest resources.

Property Rights:
A discussion and decision regarding this proposed project must include acknowledgement of the value placed on the rights of property owners to pursue amenable use of their property. Based on the report, the property owners are attempting to follow the guidelines and instructions mandated by Tuolumne County ordinances and regulations. In addition, the property owners have attempted to take into consideration the adjacent properties' environmental values and accepted historical land uses in their project plans. **ORG10-02**

Wildfire, forest health:
Increasing fire frequency in recent years has become the focal point in many land use decisions. As stated in the project report, should the No Project Alternative (#3) be chosen, the existing threat of wildfire will continue. The course of land management described in the project includes fuels reduction, and a Wildfire Mitigation Plan that will be subject to approval by CAL-FIRE and Tuolumne County Fire Department. **ORG10-03**

Project Objectives:
The Project Objectives as outlined in the report (#'s 3-7) align with TuCARE's Mission Statement. Land use compatibility, sustainable land management, the wise use of natural resources, and the economic influx a project like this can have for our communities are addressed in this project.

TuCARE is committed to the wise use of our natural resources. It is our intention to provide comments that will reflect wise use and reasonable solutions to problems shared by all. To that end, we hope you find our comments helpful in your determination of the most appropriate action. **ORG10-04**
Sincerely,

Melinda Fleming

Melinda Fleming, Executive Director
Tuolumne County Alliance for Resources & Environment, Inc.

P. O. Box 1056, Twain Harte, CA 95383 (209) 586-7816 tucare@mlode.com www.tucare.com

ORG11

COMMENT LETTER # ORG11

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September 16, 2020

Via E-Mail

Quincy Yaley
Director, Community Development Dept.
County of Tuolumne
2 South Green Street, Second Floor
Sonora, CA 95370
qyaley@co.tuolumne.ca.us

Re: Draft Environmental Impact Report for the Terra Vi Lodge Yosemite Project – Supplemental Comments

Dear Ms. Yaley:

On behalf of Save Sawmill Mountain, please find attached a report prepared by transportation engineer Neal Liddicoat with Griffin Cove Transportation Consultants, PLLC ("GCTC"), which provides supplemental comments on the Terra Vi Lodge Yosemite Project's Draft Environmental Impact Report ("DEIR"). Given the extensive flaws in the DEIR's transportation impact analysis and the potential for severe impacts pertaining to emergency evacuation and traffic hazards that would accompany the proposed Project, Save Sawmill Mountain believed that it was imperative to retain a transportation engineer to evaluate the DEIR's analysis. Please include the GCTC report in the record for the proposed Project. **ORG11-01**

Very truly yours,

SHUTE, MIHALY & WEINBERGER LLP

Laurel L Impett

Laurel L. Impett, AICP, Urban Planner

Attachment: Griffin Cove Transportation Consulting Report, September 15, 2020.

cc: Ben Gardella, Save Sawmill Mountain

September 15, 2020

Ms. Laurel L. Impett, AICP
Shute, Mihaly & Weinberger LLP
396 Hayes Street
San Francisco, California 94102

Subject: ***Terra Vi Lodge Yosemite Project***
Tuolumne County, California

Dear Ms. Impett:

As requested, Griffin Cove Transportation Consulting, PLLC (GCTC) has completed a review of the transportation analysis completed with respect to the proposed Terra Vi Lodge Yosemite project (Project) in Tuolumne County, California. The proposed project is the subject of a Draft Environmental Impact Report (DEIR) prepared for the County. (Reference: Placeworks, *Terra Vi Lodge Project Draft Environmental Impact Report*, June 2020) The "Transportation" component of the DEIR is largely based on information presented in a traffic study presented in Appendix J1 to the DEIR. (Reference: KD Anderson & Associates, Inc., *Transportation Impact Analysis for Terra Vi Resort*, June 15, 2020) In addition, an analysis of Project-related vehicle-miles-traveled, which was performed by Wood-Rodgers, is included in DEIR Appendix J2. (Reference: Memorandum to Mr. Darin Grossi from Mario Tambellini, PE, TE, *Terra Vi Lodge VMT* Analysis, June 6, 2020.)

Our review focused on the technical adequacy of the transportation analysis presented in the DEIR, including the detailed procedures and conclusions documented in the KD Anderson (KDA) and Wood-Rodgers reports.

BACKGROUND

The proposed Project would be located on the northeast corner of the intersection of State Route 120 (SR 120, also known locally as Big Oak Flat Road) and Forest Route 1S03 (known locally as Sawmill Mountain Road). Vehicular access is proposed via two driveways on Forest Route 1S03. In addition, an emergency-vehicle-only access is proposed on SR 120, a short distance east of the development. **ORG11-01 cont.**

As described in the DEIR Project Description and illustrated on the project site plan, the proposed project would consist of the following components:

- Lodge – 100 guest rooms,
- Cabins – 26 guest rooms in seven buildings,
- Managers' suites – Two units within the lodge to accommodate the Project's managers,
- Public market – 2,800 square feet (SF),
- Employee housing – 5 apartments accommodating 20 employees, and
- Restaurant – 16,787 SF.

For reference, the project site plan is presented as Attachment A. For reasons that are unclear, the proposed restaurant is illustrated on the site plan, but is not included in the Project Description and was not addressed in the transportation analyses. Similarly, the two managers' suites are included in the detailed description of the hotel lodge (DEIR, p. 3-8), but are otherwise ignored in the transportation analyses.

Average lodge occupancy is projected to be 290 guests and the maximum projected occupancy is 400 guests. The 26 cabin guest rooms are expected to have an average of 104 guests, with maximum occupancy of 156 guests. Thus, on an average day, the Project would accommodate 394 guests; 556 guests would be present on a peak day with maximum occupancy. (DEIR, p. 3-8)

ORG11-01 cont.

DRAFT ENVIRONMENTAL IMPACT REPORT REVIEW

Our review of the DEIR revealed several issues affecting the validity of the transportation analysis results. These issues, which are presented below, must be addressed prior to certification of the environmental document and approval of the proposed Project by Tuolumne County.

1. ***Emergency Evacuation*** – The proposed Project is located in a Very High Fire Hazard Severity Zone and the Project site burned as recently as seven years ago in the 2013 Rim Fire. (DEIR, p. 3-23 & 4.9-19) Despite this, insufficient consideration was given in the DEIR to the feasibility of safely evacuating the Project site. This is a particularly critical issue, given that the vast majority of the individuals on the site will be unfamiliar with the area.

   A significant issue for evacuations from the Project is the relative lack of available routes. In short, only SR 120 is available to serve this role for the Project. This significant constraint in the Project-area road system reinforces the need to provide a comprehensive evacuation plan, including detailed analysis of the ability of that system to accommodate the surge of traffic that would occur in the event of a wildland fire.

   Two DEIR significance criteria apply to this critical safety issue. The first, which is designated as HAZ-6, addresses whether the project would "impair implementation of or physically interfere with an adopted emergency response plan or an emergency evacuation plan." This is primarily judged relative to the project's compliance with applicable laws, regulations, and General Plan policies. The DEIR concludes that it does comply, so the impact is less than significant. Such compliance, however, has little bearing on whether the site can be evacuated safely. (DEIR, p. 4.9-18)

   The second criterion, HAZ-7, concerns whether the project would expose people or structures to a significant risk of loss, injury, or death involving wildland fires. The DEIR acknowledges the project's location within a Very High Fire Hazard Severity Zone and the recent fire history, but the only mention of evacuation is a reference to a "project design feature" concerning "an early evacuation protocol." No evacuation plan is presented and no assessment is provided with regard to the feasibility of evacuating the site. This raises obvious questions regarding the validity of the "less than significant" impact finding. (DEIR, pp. 4.9-19)

ORG11-02

   Given the Project site's fire history, the DEIR must address the feasibility of safely implementing an emergency evacuation, including estimates of the amount of time needed to implement a full evacuation of the Project site and whether the evacuation time is acceptable, based on a reasonable standard of safety. Further, an analysis must be conducted to determine the adequacy of the sole vehicular evacuation route, SR 120. Specific issues that must be addressed include:

   - How many Project-related vehicles need to be accommodated during an evacuation? Such an estimate must account for up to 42 employees (including management) and 556 guests, as well as other patrons (at the convenience market, for example) and service people at the resort facilities.

ORG11-03

- How many non-Project vehicles will already be on SR 120 at the time of an evacuation, consuming badly-needed roadway capacity? SR 120 will be the primary evacuation route for areas other than the proposed project, including (as an obvious example) the residents of the existing homes on Forest Service Road 1S03, as well as the residents of the homes on Hardin Flat Road and any service or delivery persons who might also be present in the area. Also, tourists, employees, vendors, and service people in a substantial portion of Yosemite National Park would depend upon SR 120 as their primary evacuation route. The national park is, of course, busiest during the peak fire season of July through October. (Source: www.frontlinewildfire.com/when-california-fire-season/) For example, according to statistics provided on the National Park Service website, in July 2019, the traffic count at the Big Oak Flat entrance on SR 120 at the west entrance to the park totaled 81,448 vehicles. August 2019 traffic counts at that location were a little lower (77,356), but still substantial. Attachment B presents traffic count data for that location from January 1985 through February 2020. ORG11-04

  In addition, a number of other projects are proposed in the vicinity of Terra Vi, which would also affect the feasibility of safely evacuating the area surrounding the proposed Project. Of particular concern is the proposed Yosemite Under Canvas project, which would be located directly across SR 120 from the Project site. In addition to its primary vehicular access point on Hardin Flat Road, that 99-tent campground facility proposes a second, emergency-only access point via Forest Service Road 1S09, which would intersect SR 120 less than 200 feet west of Sawmill Mountain Road (i.e., the Terra Vi access point). The relatively close proximity of these two access points creates the potential for traffic conflicts, particularly during an emergency evacuation when drivers are likely to be distracted and, therefore, careless or otherwise act in unpredictable or erratic ways.

- What is the capacity of SR 120, and how much of that capacity would be available to accommodate evacuating vehicles? This analysis must assess whether the sole available evacuation route from the Project will be able to accommodate a sudden influx of vehicles associated with an emergency evacuation. This analysis must address the specific characteristics of the evacuation route, in this case SR 120. Those characteristics include various parameters reflecting the horizontal and vertical alignment of the road, including the presence of curves, sight distance restrictions, or significant uphill or downhill sections, such as on Priest Grade west of the Project site. ORG11-05

- How much "mobilization time" will be required in connection with an evacuation? Mobilization represents the pre-evacuation notification and preparation period. It is particularly critical with respect to fires that start in close proximity to the proposed project. ORG11-06

- How long will the evacuation itself take, and what will be the travel time to a safe location? ORG11-07

- What will be the effect of sudden surges in SR 120 traffic that would occur during an evacuation? It is extremely unlikely that traffic would be evenly distributed over time in the event of an evacuation. Instead, there will be variable pulses in traffic demand, just as there are in everyday traffic flows. ORG11-08

- How will traffic operations on SR 120 be affected by the following factors, which are likely to prevail during an emergency evacuation due to a wildland fire? ORG11-09

  - The possibility that the road will be obscured by smoke or other fire-related factors, such as visible flames or embers.

- The effects of trucks, recreational vehicles, or vehicles towing trailers in the evacuating traffic stream.
- The emotional state of the evacuees, who will largely be unfamiliar with the area, which could lead to irrational or unpredictable behavior by drivers.

ORG11-09 cont.

In summary, the DEIR completely fails to address the feasibility of safely evacuating the Project site in the event of a wildland fire. No attempt was made to establish whether SR 120, the only evacuation route serving the Project, would have adequate capacity to perform that role and, therefore, to provide a safe means of escape from an approaching wildfire. A comprehensive evacuation plan must be prepared and incorporated into a revised DEIR that must then be recirculated for public review and comment.

ORG11-10

2. ***Proposed SR 120 Improvements*** – The DEIR "Construction" section (DEIR, p. 4.15-15) references project-related improvements proposed along SR 120 near the site – an eastbound left-turn lane, a westbound right-turn lane, and an eastbound receiving lane on SR 120. As it notes:

   These improvements are outside of the project site within the Caltrans right-of-way.

   Those same improvements are included in the discussion of "TRANS-3 - Impacts to SR 120 Based on Access Design." (DEIR, p. 4.15-19) This impact is identified as "significant" based on sight distance deficiencies. Mitigation Measure TRANS-3 calls for construction of the proposed left-turn lane, which:

   . . . will require cutting the hillside and vegetation removal in conformance with Caltrans standards, which will open the line of site [sic] *to an acceptable distance, as determined by Caltrans.*

   This cutting of the hillside will occur in the Caltrans right-of-way, which is beyond the jurisdiction of the Lead Agency (Tuolumne County). Consequently, there is no certainty that the mitigation measure will be accomplished, and this impact should therefore be identified as Significant and Unavoidable. (DEIR, p. 4.15-21)

ORG11-11

3. ***Sight Distance*** – As noted above, Impact TRANS-3 was designated as significant, due to sight distance deficiencies. Although Mitigation Measure TRANS-3 is purported to resolve this issue, the sight distance analysis on which this determination was based is flawed. Specifically, the sight distance analysis was performed relative to the 55 MPH speed limit. To account for vehicles that exceed the speed limit, it is customary to assume a speed that is at least 5 MPH greater than the posted speed limit (unless actual speed data are available, in which case that information should be used). In fact, the DEIR states: (p. 4.15-20):

   Acceptable sight distances are determined by the speed of vehicles on the uncontrolled approaches to the intersection.

   Note the reference to "the speed of vehicles," rather than to the speed limit. It is a commonly-accepted fact that some drivers exceed the posted speed limit. In fact, speed limits are often established based on the "85th-percentile speed," which is defined as the speed at or below which 85 percent of all vehicles are observed to travel; by definition, 15 percent of the observed vehicles exceed this speed.

   The stopping sight distance values employed in the DEIR traffic analysis were taken from "Table 201.1 – Sight Distance Standards" in the Caltrans *Highway Design Manual* (p. 200-2). For ease of reference, that table is presented here as Attachment C. As shown there, the speed column in the table is clearly

ORG11-12

labeled "Design Speed" and not speed limit. The design speed is invariably higher than the speed limit; if it were equal to or less than the speed limit, then vehicles traveling at or even slightly above the speed limit would exceed the physical capabilities of the roadway.

Moreover, a footnote references Topic 101 in the *Highway Design Manual* for more information regarding selection of design speed. Within "Topic 101 – Design Speed" in the *Highway Design Manual*, Index 101.1(2) specifically addresses the selection of an appropriate design speed for use in a sight distance analysis. As it states:

> *Generally the posted speed is a reliable indicator of operating speed although operating speeds frequently exceed posted speeds. . . . For existing limited access highways and conventional highways in rural areas other than Main Streets, the selected design speed for these higher-speed facilities typically is 15 to 20 mph higher than the observed motor vehicle speed (operating speed).*

In other words, according to Caltrans, the appropriate design speed for a roadway such as SR 120 with a posted (or operating) speed of 55 MPH is 70 – 75 MPH. Table 1 below summarizes stopping sight distance information for design speeds ranging from 55 – 75 MPH, as presented in "Table 201.1 – Sight Distance Standards" in the Caltrans *Highway Design Manual*. This information is also presented in DEIR "Table 4.15-6 Sight Distance Standards" (except for the 75 MPH value).

Table 1
Stopping Sight Distance Standards[1]

Design Speed (MPH[2])	Minimum Stopping Sight Distance (Feet)
55	500
60	580
65	660
70	750
75	840

Notes:
[1] Reference: Caltrans, *Highway Design Manual*, 7th Edition, July 1, 2020, "Table 201.1 – Sight Distance Standards," p. 200-1.
[2] Miles per hour.

Mitigation Measure TRANS-3 does not specify the amount of stopping sight distance to be provided at the SR 120/Forest Route 1S03 intersection. To ensure safe operation, a minimum of 580 feet of stopping sight distance must be provided (i.e., the value for 60 MPH) and it would be advisable to provide 660 feet, which would allow safe operation at up to 65 MPH. These values represent the low end of the range of likely design speeds for SR 120 at the Project site. To comply with Caltrans standards, though, as much as 840 feet might be necessary.

Further perspective on the sight distance issue can be gained by referring to the universally-accepted design resource, *A Policy on Geometric Design of Highways and Streets* (Sixth Edition, 2011). This document, which is published by the American Association of State Highway and Transportation Officials (AASHTO), is widely used as the primary source of roadway design parameters. It specifically calls for the use of the design speed, not the speed limit, in determining the required stopping sight distance.

ORG11-12 cont.

According to the AASHTO document (p. 3-4), stopping sight distance (SSD) on a level roadway is calculated using the following formula:

$$SSD = 1.47Vt + (1.075)(V^2/a)\text{, where:}$$

SSD	=	Stopping sight distance (in feet)
V	=	Design speed, MPH
t	=	Brake reaction time (2.5 seconds)
a	=	Deceleration rate (11.2 feet/second^2)

The first portion of this equation computes the "brake reaction distance," which describes how far the vehicle travels while the driver recognizes a need to stop and actually hits the brake pedal. The second element of the equation provides the braking distance (i.e., how long it takes to stop the vehicle after the brakes are applied).

Note the reference to "design speed" in the equation, rather than speed limit.

Further support for our position is provided by referring to the research document that served as the basis for the establishment of the AASHTO stopping sight distance equation: *National Cooperative Highway Research Program Report 400 – Determination of Stopping Sight Distances* (Transportation Research Board, 1997).
Particularly with regard to speed, the NCHRP document states (p. 73):

> *This research and other studies documented in the literature show that many drivers exceed the inferred design speed (design speed calculated using current criteria and existing geometry) of horizontal and vertical curves. The consistency of these results does not support the use of initial speeds less than the roadway's design speed for determining stopping sight distance requirements.*

ORG11-12 cont.

This strongly suggests that vehicles approaching the Project site will, at a minimum, exceed the 55 MPH speed limit and will likely even exceed the design speed. Further, it states that, at minimum, the design speed should be used to derive the safe stopping sight distance. As noted above, the stopping sight distance analysis presented in the DEIR fails to account for vehicle operation above the speed limit.

The inappropriate use of the posted speed limit (instead of the design speed) in determining the required safe stopping sight distance is a substantial flaw in the DEIR. Mitigation Measure TRANS-3 "will require cutting the hillside and vegetation removal," but the quantity of such work is unspecified because it is unknown. This failure to specify the amount of stopping sight distance to be required represents a further flaw in the mitigation measure.

In short, no evidence is provided to support the feasibility of the proposed mitigation measure. If the measure is, in fact, infeasible, the Project would result in a significant safety impact and many drivers approaching the site on SR 120 will be unable to safely avoid any obstructions that might be present in the SR 120/Forest Route 1S03 intersection, as they will be unable to stop before entering the intersection. The result will be additional collisions within the intersection, which will be exacerbated by construction of the Project.

Finally, we note that no assessment has been provided with regard to the secondary impacts that might be incurred in connection with hillside cutting and vegetation removal that are directly associated with

ORG11-12 cont.

implementation of Mitigation Measure TRANS-3. These impacts might be substantial, particularly if Caltrans determines that the appropriate design speed is 70 or 75 MPH.

ORG11-13

4. ***Eastbound Left-Turn Lane*** – The Project proposes to construct an eastbound left-turn lane on SR 120 at Forest Route 1S03 (DEIR, p. 4.15-19), as follows:

> *. . . a new eastbound left turn lane is proposed on SR 120 as part of the proposed Project. The new lane would be about 390 feet long and be proceeded* [sic] *by a 50-foot-long bay taper. While the proposed lane meets Caltrans design standards for left turn lane storage (i.e., minimum 50 feet) and deceleration from 55 mph, the final confirmation of design requirements will be by Caltrans during the encroachment permit review process.*

The design of the proposed left-turn lane is deficient, however.

First, the proposed 50-foot-long bay taper on the approach to the lane is too short. The Caltrans *Highway Design Manual* says (p. 400-34):

> *On rural high-speed highways, a 120-foot length is considered appropriate.*

Second, the 390-foot length of the lane itself is inadequate. Fifty feet of the 390 feet are for storage (i.e., to accommodate vehicles waiting to turn left), leaving 340 feet for deceleration. HDM Table 405.2B (p. 400-35), which is presented here as Attachment D shows the following deceleration lane lengths for various speeds:

- 60 MPH (i.e., 55 MPH speed limit + 5 MPH): 530 feet,
- 55 MPH: 483 feet,
- 50 MPH: 435 feet, and
- 45 MPH: 375 feet.

Thus, the highest speed that be accommodated within the 390-foot left-turn lane (i.e., 50-ft. bay taper + 340 ft. deceleration lane, excluding the 50 ft. storage length) is about 47 MPH.

The HDM does allow partial deceleration in the thru lane prior to entry into the turn lane, but we believe that substantial thru lane deceleration on a high-speed state highway is a bad, unsafe idea.

ORG11-14

5. ***Eastbound SR 120 Receiving Lane*** – The Project proposes to provide an eastbound receiving lane to offset the safety impacts associated with drivers making a left turn from the Project site onto high-speed SR 120. Specifically, the receiving lane is intended to allow drivers to accelerate to match the speed of traffic on SR 120. However, the DEIR acknowledges that the proposed receiving lane is inadequate. The proposed lane would be 150 feet long, when 1,000 feet would be required, according to the DEIR. Despite this significant shortcoming, the DEIR simply shrugs it off (DEIR, p. 4.15-19):

> *It may be that the receiving lane will not be provided if Caltrans requirements exceed the proposed design.*

The failure to identify this as a significant impact suggests that the County is willing to accept an unsafe condition that would be considerably exacerbated by construction of the Project. Moreover, given (1) the uncertainty as to whether the Project will actually implement the proposed mitigating improvement and (2) the fact that, even if implemented, the receiving lane will be inadequate, the impact should have been identified as significant and unavoidable. The extent of this impact is magnified by the high speeds on SR 120, which will substantially increase the forces involved in any resulting collisions, thereby resulting in greater levels of property damage and injury to those involved. **ORG11-14 cont.**

The DEIR needs to be revised to appropriately identify this safety impact and its significant and unavoidable status.

6. ***Project Trip Generation Estimate*** – The Project's trip generation estimate is summarized in DEIR Table 4.15-3 (p. 4.15-13) and KDA Table 7 (p. 21). That estimate was developed using trip generation rates presented in DEIR Table 4.15-2 (p. 4.15-11) and KDA Table 6 (p. 18). We have several comments regarding the trip generation estimate.

<u>Retail Trip Generation</u>

While the general approach to estimating Project-related trips is straightforward, the trip generation estimate for the proposed on-site 2,800 sq. ft. market is unusual. The traffic estimate for that land use is based on the average of trip rates for three very different types of retail uses: variety store, supermarket, and convenience store. It may be noteworthy that in over 40 years of preparing and reviewing traffic impact analyses, we have never seen this averaging approach employed.

According to DEIR Table 4.15-2 and KDA Table 6, those three uses have Saturday daily trip rates ranging from 63.47 trips/1,000 sq. ft. (for a variety store) to 1,084.17 trips/1,000 sq. ft. (for a convenience store). The resulting average is 441.75 trips/1,000 sq. ft., which is well below the more appropriate convenience store rate. Table 2 summarizes a comparison of the trip generation estimates for the proposed retail store using each of the three individual retail types, as well as the average trip rate. The values presented there are gross trip estimates, which do not account for internal or pass-by trips.

ORG11-15

Table 2
Trip Generation Comparison – Saturday[1]
Terra Vi Lodge Retail (2,800 Sq. Ft.)

Retail Type		Saturday Daily Trips	PM Peak Hour of Generator
Variety Store (ITE Land Use Code 814)	Trip Rate[2,3]	63.47	7.42
	Trips	178	21
Supermarket (ITE Land Use Code 850)	Trip Rate	177.62	10.34
	Trips	497	29
Convenience Market (ITE Land Use Code 851)	Trip Rate	1,084.17	79.12
	Trips	3,036	222
Average	Trip Rate	441.75	32.29
	Trips	1,237	90

Notes:
1 KD Anderson & Associates, Inc., *Transportation Impact Analysis for Terra Vi Resort*, June 15, 2020, "Table 6 – Project Trip Generation Rates," p. 18.
2 Trips per 1,000 sq. ft.
3 Reference: Institute of Transportation Engineers (ITE), *Trip Generation Manual*, 10th edition.

As shown, the Saturday daily trip estimates range from 178 (Variety Store) to 3,036 (Convenience Market). In comparison, the average value used in the DEIR is 1,237 daily trips, about 40 percent of the convenience market value. In the peak hour, the values range from as low as 21 trips (Variety Store) to 222 trips (Convenience Market), with an average value of 90 trips.

While it may seem on the surface that use of the Convenience Market trip rates would result in excessively high trip generation estimates, bear in mind that the estimate is substantially reduced to account for internal and pass-by trips. As shown in DEIR Table 4.15-3 and KDA Table 7, those adjustments result in reductions in the Saturday PM peak-hour value from 90 trips to 26 trips, over a 70 percent reduction. Applying that same reduction to the estimated 222 trips associated with use of the Convenience Market rate would result in a net trip estimate of 64 peak-hour trips, which is entirely reasonable, although substantially greater than the value employed in the DEIR traffic analysis

On a daily basis, the DEIR and the KDA report indicate approximately a 69 percent reduction due to internal and pass-by trips. Applying that factor to the 3,036 daily trips estimated using the Convenience Market rate results in a net daily trip generation estimate for the retail land use of 938 trips, which is again completely reasonable for this type of land use in this location, although substantially higher than the 382 trips suggested by the DEIR analysis.

Finally, it is important to understand that in establishing the appropriate ITE trip generation rate to use in any particular situation, a range of factors must be considered. One key consideration is the size of the project compared to the size of the locations included within the ITE trip generation database. In this regard, the ITE *Trip Generation Handbook* (Third Edition, August 2014) specifically says (p. 27): **ORG11-15 cont.**

> *The value of the independent variable* [in this case, square footage] *for the study site must be within the range of data included in the data plot;*

The size of the proposed market is 2,800 sq. ft. In comparison, the average size of the variety stores in the ITE database (9th Edition) is 10,000 sq. ft. and the average size of the supermarkets ranges from 37,000 to 56,000 sq. ft., depending upon what time period is under consideration. The smallest variety store in the ITE database is about 6,800 sq. ft. and the smallest supermarket is about 14,000 sq. ft. These types of stores are obviously much larger than the proposed retail facility, and the Project's convenience market is smaller than any of the ITE data collection sites for the other two types of stores. In other words, the Project store is not included ". . . within the range of data included in the [ITE] data plot."

The average convenience market size for various time periods in the ITE database is 2,000 – 3,000 sq. ft., with individual locations in the database ranging from about 800 sq. ft. to 4,500 sq. ft., which correlates nicely with the proposed Project's retail store.

Clearly, the trip generation estimate for this component of the Project should have been based on the convenience market rate.

<u>Pass-by Trip Rate</u>

DEIR Table 4.15-3 includes adjustments for pass-by trips (i.e., vehicles that are already passing by the site on SR 120, so don't have to be considered as new, Project-generated traffic). Although the DEIR doesn't reveal this, the KDA traffic impact report says that the pass-by adjustment for the retail use was based on information presented in the ITE *Trip Generation Handbook* (Third Edition, August 2014). According to the KDA report (p. 20): **ORG11-16**

> *The average pass-by rate for convenience stores is 61%. While it is likely that the actual pass-by rate of the market could be higher due to the absence of other retail opportunities in the area along SR 120 between the national park and Groveland, this rate has been employed to produce a "worst case" assessment.*

No support is provided for the purported worst case nature of the pass-by rate employed in the analysis or the likelihood that the actual pass-by rate will be higher than the assumed value. We would suggest that it is equally likely that this value will be lower than the assumed percentage.

Although the retail trip generation rates used in the analysis were the average of rates for three very different types of retail uses, the pass-by trip rate is the rate for convenience markets. (Specifically, the analysis employed the pass-by rates for ITE Land Use Code 851 – Convenience Market; those markets do not have gasoline sales). The analysis claims that this rate is 61 percent. Attachment E presents the pertinent page from the 2014 ITE *Trip Generation Handbook*, which is identified as the source for this factor. As shown there, the actual pass-by rate for convenience markets is 51 percent. Further investigation reveals that the 61 percent value was taken from the Second Edition of the ITE *Trip Generation Handbook* (June 2004). Attachment F presents the pertinent page from that obsolete, superseded document. **ORG11-16 cont.**

For comparison, according the Third Edition of the *Trip Generation Handbook,* the pass-by trip rate for variety stores is 34 percent and for supermarkets is 36 percent, so the analysis used the least conservative rate available. If the rates had been averaged (similar to what was done for the trip generation rates), the pass-by rate would have been 40 percent.

In any event, it is clear that the assumed pass-by trip rate is excessive.

<u>Internal Trip Adjustment</u>

The Project trip generation estimate presented in DEIR Table 4.15-3 (p. 4.15-13) and KDA Table 7 (p. 21) includes adjustments to represent internal trips within the Project site; that is, reductions in the estimated Project trip generation to reflect the fact that a certain volume of traffic occurs completely on-site and doesn't impact the off-site roads. Internal trips are projected to occur between the lodging facilities and the convenience market, for example. Other internal trips are associated with the on-site employee housing.

The total number of estimated internal trips is substantial. Subtracting the number of daily "Total External Trips" (1,725) from the daily "Total Gross Trips" (2,309) indicates 584 internal trips on a daily basis. In reality, the table reflects an arithmetic error, in that the total number of gross trips is 2,319, not 2,309 (i.e., 1,032 + 50 + 1,237 = 2,319), so the estimated number of internal trips is 594 (i.e., 2,319 – 1,725 = 594). That number of internal trips represents 26 percent of the Project's estimated daily gross trip generation. **ORG11-17**

No basis is provided for any of the internal trip adjustment percentages employed in developing the Project trip generation estimate, even though the adjustment is substantial. Of particular interest is the adjustment for trips between the lodging facilities and the convenience market. That adjustment is shown as 24 percent, which is equivalent to 252 daily trips according the DEIR, but the source of the 24 percent value is undocumented. Also, the adjustment value of 252 daily trips appears to be in error. Applying the 24 percent factor to the 1,032 gross lodging trips indicates that the adjustment should be 248 trips, not 252 trips. For 252 to be correct, the gross daily total would need to be 1,050, not 1,032.

The DEIR also indicates a 14 percent adjustment for trips between the on-site employee housing and the market (5 daily trips), and a 2 percent internal trip adjustment for travel between the employee housing and the lodging facilities (40 daily trips). Again, the percentages and the trip numbers don't seem to correspond. For example, the two percent trip match between the employee housing and the lodging facilities is shown as 40 daily trips, but two percent of the lodging trips (1,032) is 21 daily trips, not 40.

These differences (2,319 vs. 2,309, 248 vs. 252, 21 vs. 40) might not seem considerable, but the values derived here carry through the remainder of the analysis and, to the extent that they are incorrect, the results of the overall analysis are also wrong. **ORG11-17 cont.**

In summary:

- The sources of the individual internal trip adjustment factors must be revealed,
- The methodology employed in applying the internal trip adjustment factors must be clarified,
- The erroneous values presented in DEIR Table 4.15-3 must be corrected, and
- The traffic analysis must be revised to correct errors in the trip generation calculations.

Restaurant Trip Generation

As noted earlier, the Project site plan is provided in Attachment A. Review of the site plan reveals a 16,787 sq. ft. restaurant. However, that Project element is completely ignored in the traffic analysis. Although the Project proponents may claim that the restaurant will serve only hotel guests, and therefore generate no traffic, that is simply not reasonable or realistic. After all, if the market will generate traffic, it certainly seems that a restaurant would also do so. **ORG11-18**

Summary

The Project's trip generation estimate understates the volume of traffic that will result from its construction because:

- The trip generation for the Project's market was substantially underestimated due to the use of an inappropriate retail trip rate, which was derived from an unusual and invalid methodology.
- The number and percentage of pass-by trips associated with the market was overestimated, due to use of an obsolete, superseded technical reference. Because pass-by trips are deducted from the gross trip generation estimate, this has the effect of understating the number of Project-related trips added to the road network. **ORG11-19**
- The estimated number of internal trips that will occur solely within the site was flawed due to arithmetic errors, as well as the fact that the specific methodology and sources were not described.
- The analysis completely ignored the trips associated with the Project's proposed restaurant.

Therefore, the volume of Project-generated traffic will be considerably greater than the DEIR reveals, and the resulting traffic impacts will be substantially worse than the DEIR discloses.

7. ***Vehicle-Miles-Traveled (VMT) Analysis*** – The DEIR traffic impact analysis is based on consideration of vehicle-miles traveled (VMT), as documented in a memorandum prepared by Wood-Rodgers. (Reference: Memorandum to Mr. Darin Grossi from Mario Tambellini, PE, TE, *Terra Vi Lodge VMT* **ORG11-20**

Analysis, June 6, 2020.) The traditional level of service (LOS) analysis is presented for informational purposes only. This is consistent with the approach required under SB 743.

Unfortunately, our review suggests that the DEIR's VMT analysis is significantly flawed. We should note the potential for confusion, given the fact that the LOS analysis (which constitutes the bulk of the DEIR Transportation section as well as the KDA traffic impact analysis report) addresses Saturday midday conditions, but the VMT analysis considers weekday conditions.

We should also note that our earlier comments regarding flaws in the Project trip generation estimate apply to both analyses, as the weekday trip estimate used in the VMT analysis was developed by applying a factor to the KDA Saturday trip estimate. That "typical weekday vs. peak Saturday" factor, which is the ratio of SR 120 weekday traffic (May 2018) to SR 120 Saturday traffic (June/July 2018), is 0.52. In other words, the analysis is based on the assumption that the project will generate 52 percent as many trips on an average weekday as it does on a peak Saturday. Specifically, under this approach, the project would generate 586 weekday trips compared to 1,127 Saturday trips.

However, this approach is substantially flawed, as there is no connection between Project trip generation and historical traffic volumes on SR 120. That is, just because Saturday background traffic on SR 120 represents 52 percent of the weekday volume, there is absolutely no reason to believe that the Project, or any land use for that matter, will have that same pattern of trip generation.

Based on this flawed approach, the analysis concluded that the lodging portion of the project will generate 385 trips, representing a daily rate of 3.1 trips per room, which is claimed to be reasonable because the Tuolumne County model uses a daily rate of 3.2 trips per room. For comparison, the ITE *Trip Generation Manual* (10th Edition) says a hotel generates trips at a daily rate of 8.36 trips per room. (See DEIR Table 4.15-2 and KDA Table 6.) Clearly, the appropriate interpretation of this is not that the Project trip rate is accurate because it is consistent with the model's trip rate, it's that the model substantially underestimates hotel traffic. **ORG11-20 cont.**

Moreover, the DEIR and the KDA report already show weekday trip rates for the project; those rates should be used to develop the trip generation estimate needed for the VMT analysis. Using the same basic approach as that employed in the DEIR analysis (including erroneously using the average retail rate), we derived a gross weekday trip generation estimate of 1,976 trips for the Project (excluding any adjustments for internal or pass-by trips). This estimate can be compared to the Saturday gross trip estimate of 2,309 in DEIR 4.15-3 and KDA Table 7. Obviously, use of the weekday trip rates presented in the DEIR results in substantially more than 586 trips, even using the faulty approach to convenience market trip generation. This, in turn, will result in a substantially higher estimate of project-related VMT, which would likely alter the conclusions regarding Project significance.

We should note that the Wood-Rodgers VMT analysis memo specifically says that they obtained the KDA trip generation estimates, ". . . in order to maintain consistency between the VMT analysis and other Project traffic analyses." If consistency was truly a goal of the VMT analysis, then it certainly should have incorporated the weekday trip generation information documented in the KDA report.

<u>Average Trip Length</u>

For perspective, we used the VMT analysis results to develop an average trip length for the Project. Specifically, the total Project VMT of 13,091 divided by the claimed weekday trip generation of 586 indicates an average trip length of 22.3 miles per trip. Given that the Yosemite valley is 30 miles away **ORG11-21** and 85 percent of the lodging-related trips will be to/from there (KDA, p. 31), we don't consider this to be a reasonable result.

Consider also that guests checking in and out of the lodging facilities will be oriented to and from locations all over California and beyond. The average trip lengths for that component of the Project's daily traffic will far exceed 22.3 miles. For reference, we used MapQuest to check the travel distance from several California cities to Yosemite valley, as follows:

- San Francisco: 188 miles,
- Los Angeles: 311 miles,
- Stockton: 117 miles, and
- Fresno: 94 miles.

ORG11-21 cont.

Here's further perspective on that question: Based on the above, 327 daily trips will be to/from Yosemite valley. At 30 miles per trip, that's 9,818 VMT. With total VMT of 13,091, that leaves 3,273 non-Yosemite VMT. There will 259 non-Yosemite trips (586 – 327 = 259), which results in an average non-Yosemite trip length of 12.64 miles. This is simply unreasonable, given the location of the Project, the likely origin and destination points of guests that are checking in and out, non-resident employee residence locations, and other factors.

<u>VMT Standard of Significance</u>

As of the time the VMT analysis was prepared and the DEIR published, Tuolumne County had not adopted a standard of significance regarding VMT. Instead, the DEIR says (p. 4.15-17):

> *Tuolumne County is in the process of establishing significance criteria based on VMT thresholds, and alternative criteria are under consideration within the context of OPR* [Office of Planning and Research] *guidance.*

ORG11-22

Three alternative sets of criteria were described, but the DEIR never explicitly states which (if any) of those was used in the analysis.

In any event, if the County has no adopted criteria, how can they credibly determine significance?

8. ***Construction Impacts*** – The DEIR states that (DEIR, p. 4.15-15):

> *The number of trips made by* [construction] *vehicles . . . would not exceed the amount of traffic accessing the site during operation of the project.*

Unfortunately, no support is provided for this statement. A construction traffic volume estimate must be developed to verify the validity of this statement.

ORG11-23

Further, that estimate must identify the volume of heavy-truck traffic that would travel to and from the Project site during the construction period. Trucks have an inordinate adverse impact on traffic operations and safety, due to their size, weight, and reduced operating characteristics, including slower acceleration and longer stopping distances. Traffic operations and safety impacts associated with such vehicles entering and exiting the high-speed traffic stream on SR 120 must be assessed in detail. In addition to evaluation of potential safety impacts at the SR 120/Sawmill Mountain Road intersection (where construction vehicles will enter and exit the Project site), consideration must also be given to the adverse operational effects of construction-related trucks and other vehicles along SR 120, with particular attention paid to segments of SR 120 that are especially curvy or are relatively steep, such as at Priest Grade, for example. **ORG11-23 cont.**

CONCLUSION

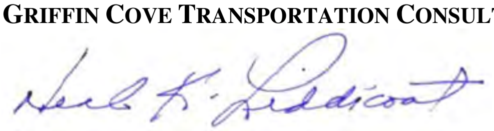
Our review of the Draft Environmental Impact Report completed in connection with the proposed Terra Vi Lodge Yosemite project in Tuolumne County, California revealed several issues regarding the adequacy of the transportation analysis. The deficiencies we have identified raise significant questions as to the validity of the conclusions presented in the DEIR with respect to Project-related impacts.

Of particular concern is the failure of the environmental analysis to include any analysis of the feasibility of safely evacuating the Project in the event of a wildland fire. It remains unknown whether the Project's sole evacuation route, State Route 120, would have sufficient capacity to provide a safe means of escape from an approaching wildfire. Moreover, the DEIR fails to disclose that the Project would increase hazards due to sight distance constraints and roadway design deficiencies. Further, the DEIR's estimate of the volume of Project-related traffic has substantial flaws that must be addressed. Similarly, the analysis of vehicle-miles-traveled, which provided the basis for determination of the Project's transportation impacts, is also highly flawed. **ORG11-24**

These issues must be addressed prior to approval of the proposed project and its environmental documentation by Tuolumne County. We hope this information is useful. If you have questions concerning any of the items presented here or would like to discuss them further, please feel free to contact me at (906) 847-8276.

Sincerely,

GRIFFIN COVE TRANSPORTATION CONSULTING, PLLC



Neal K. Liddicoat, P.E.
Principal

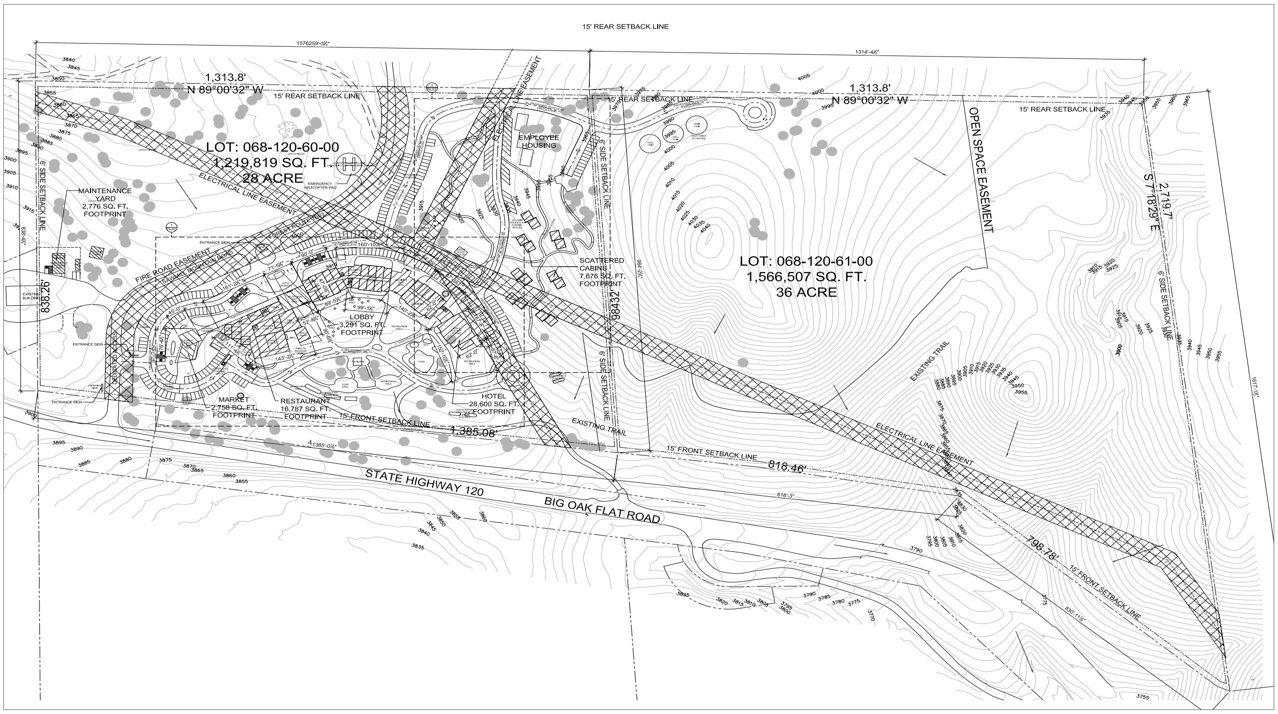
Attachments

ATTACHMENT A

Project Site Plan

(Source: Placeworks, *Terra Vi Lodge Project Draft Environmental Impact Report*, June 2020, Figure 3-4, p. 3-9.)

ORG11-025

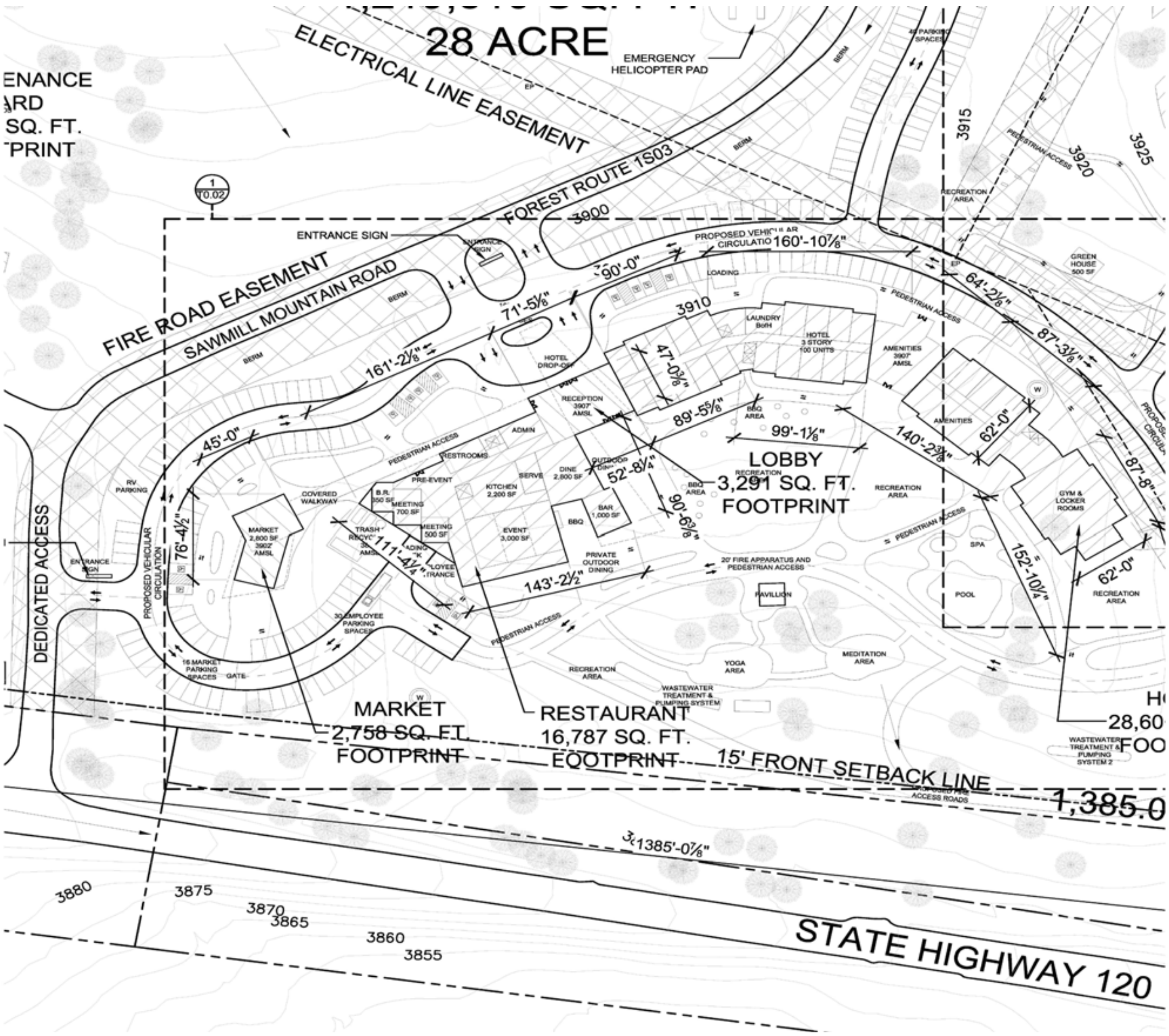


Source: AVRP Skyport, 2019.

0 2400
Scale (Feet)

Figure 3-4
Project Site Plan

ORG11-25
cont.



ORG11-25 cont.

ATTACHMENT B

Yosemite National Park Traffic Counts
Big Oak Flat
January 1985 – February 2020

(Source: National Park Service Website)

ORG11-26

Park Yosemite NP Add Color Ramp None View Report

1 of 1 Find | Next

TRAFFIC COUNT AT BIG OAK FLAT												
2020	12,319	17,772	0									
2019	9,604	6,592	18,003	39,035	48,886	70,783	81,448	77,356	63,972	52,413	25,992	14,211
2018	11,885	14,072	17,529	33,226	56,146	65,880	64,943	36,164	54,523	31,000	25,384	16,657
2017	9,623	8,838	3,807	9,043	50,361	70,602	62,000	72,143	55,575	44,396	17,040	9,312
2016	11,484	16,737	21,092	33,858	55,779	69,033	86,083	75,156	63,958	76,670	22,421	14,533
2015	6,975	8,400	16,275	27,305	48,629	56,726	68,724	64,515	48,137	38,434	13,500	11,323
2014	8,920	8,400	16,275	25,500	32,550	46,500	62,000	58,900	31,500	31,000	13,500	9,300
2013	6,975	8,400	16,275	23,471	43,298	50,773	59,164	22,800	31,500	31,000	15,167	9,265
2012	8,451	6,931	7,123	22,910	41,702	54,525	65,081	60,352	40,605	26,312	11,154	9,300
2011	7,782	6,946	7,548	24,025	40,870	60,856	75,667	66,429	50,263	33,233	11,207	10,352
2010	6,975	8,400	16,275	25,500	43,752	46,500	64,618	61,153	47,364	31,000	12,674	7,423
2009	7,678	5,426	11,778	23,912	43,186	48,083	56,955	59,502	35,866	32,813	13,500	9,300
2008	6,039	7,245	15,383	19,791	38,536	46,912	53,092	52,521	38,474	27,808	13,953	7,423
2007	7,312	7,226	11,941	21,634	37,259	43,790	50,333	50,203	38,729	26,336	16,205	8,066
2006	6,553	8,045	16,275	15,694	45,223	52,712	59,906	54,962	38,763	28,753	14,443	7,777
2005	5,996	6,925	11,462	17,585	35,632	50,572	54,638	49,840	36,672	27,459	13,877	6,846
2004	6,824	6,956	12,699	21,797	36,937	40,182	47,099	46,747	35,145	22,990	9,296	6,948
2003	8,023	8,064	12,167	15,321	30,723	42,769	47,147	48,141	35,066	27,442	10,448	6,437
2002	7,564	8,108	11,398	18,728	34,311	40,941	46,970	47,328	36,776	26,236	12,552	6,957
2001	7,127	6,694	13,176	20,777	37,868	41,311	48,650	46,897	36,768	26,536	13,630	7,120
2000	8,469	8,935	14,493	27,514	37,295	40,613	51,472	48,541	42,093	26,582	12,840	10,063
1999	3,722	4,214	10,126	13,847	36,287	36,585	98,308	47,841	41,672	33,347	16,536	12,435
1998	6,091	8,095	14,197	22,242	27,568	34,736	54,803	57,191	40,420	33,645	11,803	7,874
1997	0	7,286	14,316	20,406	34,609	41,386	53,475	60,629	43,291	30,008	13,101	7,378
1996	5,790	8,034	13,849	22,482	34,090	34,090	54,534	55,291	42,030	29,421	13,079	7,836
1995	7,022	9,867	13,611	22,276	15,250	45,673	59,671	58,753	49,140	33,684	16,597	4,703
1994	8,183	6,955	16,703	23,088	38,161	45,821	56,148	56,835	44,502	28,039	9,175	7,566
1993	3,709	4,458	13,762	23,914	38,046	37,098	50,687	53,449	42,434	30,702	16,255	9,065
1992	9,260	8,917	13,841	29,082	43,715	45,724	49,420	50,593	41,695	34,557	16,239	7,689
1991	9,012	11,267	10,392	20,181	41,394	38,002	49,888	57,949	43,008	30,849	17,128	9,744
1990	9,201	6,951	14,459	28,109	41,987	42,833	47,908	35,414	37,072	26,733	17,255	9,153
1989	7,561	6,749	13,497	23,198	40,537	37,659	46,270	48,740	39,003	25,408	14,974	10,518
1988	5,841	9,935	17,418	23,045	36,881	38,089	41,963	49,253	38,260	28,189	13,602	7,056
1987	8,452	6,995	11,167	22,491	39,491	38,864	45,153	48,601	17,491	27,709	13,549	7,628
1986	7,971	5,919	10,360	19,219	33,727	35,675	41,344	48,812	33,093	25,937	17,024	8,443
1985	6,923	6,827	9,503	17,914	32,229	35,221	38,700	46,315	32,864	23,780	9,653	6,713
TRAFFIC COUNT AT BIG TREE												
2020	0	0	0									
2019	0	0	0	9,450	21,700	35,344	29,450	30,225	24,750	19,375	7,500	0
2018	0	0	0	0	0	26,250	23,750	16,575	24,750	19,375	0	32,066

ORG11-26 cont.

ATTACHMENT C

Table 201.1
Sight Distance Standards

(Source: Caltrans, *Highway Design Manual,* 7th Edition, July 1, 2020.)

ORG11-27

Table 201.1

Sight Distance Standards

Design Speed[1] (mph)	Stopping[2] (ft)	Passing (ft)
10	50	---
15	100	---
20	125	800
25	150	950
30	200	1,100
35	250	1,300
40	300	1,500
45	360	1,650
50	430	1,800
55	500	1,950
60	580	2,100
65	660	2,300
70	750	2,500
75	840	2,600
80	930	2,700

Notes:

(1)See Topic 101 for selection of design speed.

(2)For sustained downgrades, refer to underlined standard in Index 201.3

The sight distance available for passing at any place is the longest distance at which a driver whose eyes are 3 ½ feet above the pavement surface can see the top of an object 4 ¼ feet high on the road. See Table 201.1 for the calculated values that are associated with various design speeds.

In general, 2-lane highways should be designed to provide for passing where possible, especially those routes with high volumes of trucks or recreational vehicles. Passing should be done on tangent horizontal alignments with constant grades or a slight sag vertical curve. Not only are drivers reluctant to pass on a long crest vertical curve, but it is impracticable to design crest vertical curves to provide for passing sight distance because of high cost where crest cuts are involved. Passing sight distance for crest vertical curves is 7 to 17 times longer than the stopping sight distance.

Ordinarily, passing sight distance is provided at locations where combinations of alignment and profile do not require the use of crest vertical curves.

ORG11-27 cont.

ATTACHMENT D

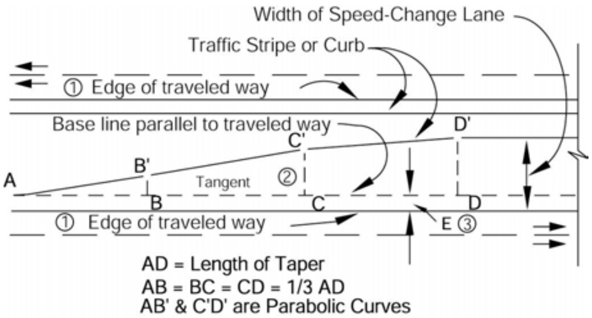
Table 405.2B
Deceleration Lane Length

(Source: Caltrans, *Highway Design Manual,* 7th Edition, July 1, 2020.)

ORG11-28

Table 405.2A

Bay Taper for Median Speed-change Lanes



	LENGTH OF TAPER - feet			OFFSET DISTANCE			
	60	90	120	DD' = 10'	DD' = 11'	DD' = 12'	
	Distance From Point "A"						
	-	-	-	0.00	0.00	0.00	
	5	7.5	10.0	0.16	0.17	0.19	
	10	15.0	20.0	0.62	0.69	0.75	
	15	22.5	30.0	1.41	1.55	1.69	
B'	20	30.0	40.0	2.50	2.75	3.00	B'
	30	45.0	60.0	5.00	5.50	6.00	
C'	40	60.0	80.0	7.50	8.25	9.00	C'
	45	67.5	90.0	8.59	9.45	10.31	
	50	75.0	100.0	9.38	10.31	11.25	
	55	82.5	110.0	9.84	10.83	11.81	
	60	90.0	120.0	10.00	11.00	12.00	

NOTES:

(1) The table gives offsets from a base line parallel to the edge of traveled way at intervals measured from point "A". Add "E" for measurements from edge of traveled way.

(2) Where edge of traveled way is a curve, neither base line nor taper between B & C will be a tangent. Use proportional offsets from B to C.

(3) The offset "E" is usually 2 ft along edge of traveled way for curbed medians; Use "E" = 0 ft. for striped medians.

ORG11-28 cont.

Table 405.2B

Deceleration Lane Length

Design Speed (mph)	Length to Stop (ft)
30	235
40	315
50	435
60	530

ATTACHMENT E

Table F.14
Pass-By and Non-Pass-By Trips Weekday, PM Peak Period
Land Use Code 851 – Convenience Market (Open 24 Hours)

(Source: Institute of Transportation Engineers, *Trip Generation Handbook*, 3rd Edition, August 2014)

ORG11-29

TRIP GENERATION HANDBOOK

3rd Edition • An ITE Proposed Recommended Practice

ORG11-29 cont.

ite

August 2014
Institute of Transportation Engineers

Table F.14 Pass-By and Non-Pass-By Trips Weekday, PM Peak Period Land Use Code 851—Convenience Market (Open 24 Hours)

SIZE (1,000 SQ. FT. GFA)	LOCATION	WEEKDAY SURVEY DATE	NO. OF INTERVIEWS	TIME PERIOD	PASS-BY TRIP (%)	NON-PASS-BY TRIPS (%)			ADJ. STREET PEAK HOUR VOLUME	SOURCE
						PRIMARY	DIVERTED	TOTAL		
3	Overland Park, KS	Aug. 1987	68	4:30–5:30 p.m.	34	53	13	66	—	—
3	Overland Park, KS	July 1987	68	4:30–5:30 p.m.	28	50	22	72	—	—
~1.9	Billings, MT	1987	461	4:00–6:00 p.m.	62	13	25	38	—	ITE Montana Section Tech Comm
<50.0	Chicago suburbs, IL	1987	72	3:00–6:00 p.m.	28	—	—	72	—	Kenig, O'Hara, Humes, Flock
<50.0	Chicago suburbs, IL	1987	54	3:00–6:00 p.m.	78	—	—	22	—	Kenig, O'Hara, Humes, Flock
<50.0	Chicago suburbs, IL	1987	34	3:00–6:00 p.m.	69	—	—	31	—	Kenig, O'Hara, Humes, Flock
<50.0	Chicago suburbs, IL	1987	100	3:00–6:00 p.m.	63	—	—	37	—	Kenig, O'Hara, Humes, Flock
<50.0	Chicago suburbs, IL	1987	43	3:00–6:00 p.m.	43	—	—	57	—	Kenig, O'Hara, Humes, Flock
<50.0	Chicago suburbs, IL	1987	135	3:00–6:00 p.m.	39	—	—	61	—	Kenig, O'Hara, Humes, Flock
<50.0	Chicago suburbs, IL	1987	74	3:00–6:00 p.m.	53	—	—	47	—	Kenig, O'Hara, Humes, Flock
<50.0	Chicago suburbs, IL	1987	80	3:00–6:00 p.m.	64	—	—	36	—	Kenig, O'Hara, Humes, Flock

Average Pass-By Trip Percentage: 51
"—" means no data were provided

ORG11-29 cont.

Table F.15 Pass-By and Non-Pass-By Trips Weekday, AM Peak Period Land Use Code 853—Convenience Market with Gasoline Pumps

SIZE (1,000 SQ. FT. GFA)	LOCATION	WEEKDAY SURVEY DATE	NO. OF INTERVIEWS	TIME PERIOD	PASS-BY TRIP (%)	NON-PASS-BY TRIPS (%)			ADJ. STREET PEAK HOUR VOLUME	SOURCE
						PRIMARY	DIVERTED	TOTAL		
2.8	Louisville area, KY	1993	—	7:00–9:00 a.m.	54	11	35	46	1,240	Barton-Aschman Assoc.
2.4	Louisville area, KY	1993	—	7:00–9:00 a.m.	48	17	35	52	1,210	Barton-Aschman Assoc.
4.2	Louisville area, KY	1993	47	7:00–9:00 a.m.	62	19	19	38	1,705	Barton-Aschman Assoc.
2.6	Crestwood, KY	1993	—	7:00–9:00 a.m.	72	15	13	28	940	Barton-Aschman Assoc.
3.7	Louisville area, KY	1993	49	7:00–9:00 a.m.	66	16	18	34	990	Barton-Aschman Assoc.
3.0	New Albany, IN	1993	62	7:00–9:00 a.m.	74	10	16	26	790	Barton-Aschman Assoc.
2.3	Louisville, KY	1993	58	7:00–9:00 a.m.	64	5	31	36	1,255	Barton-Aschman Assoc.
2.2	New Albany, IN	1993	79	7:00–9:00 a.m.	56	6	38	44	635	Barton-Aschman Assoc.
3.6	Louisville area, KY	1993	49	7:00–9:00 a.m.	67	4	29	33	1,985	Barton-Aschman Assoc.

Average Pass-By Trip Percentage: 63
"—" means no data were provided

ATTACHMENT F

Table 5.11
Pass-By Trips and Diverted Linked Trips
Weekday, p.m. Peak Period
Land Use 851 – Convenience Market (Open 24 Hours)

(Source: Institute of Transportation Engineers, *Trip Generation Handbook*, Second Edition, June 2004)

ORG11-30

1277735.1

Trip Generation Handbook

Second Edition

An ITE Recommended Practice

ORG11-30 cont.

June 2004
Institute of Transportation Engineers

Table 5.11
Pass-By Trips and Diverted Linked Trips
Weekday, p.m. Peak Period

Land Use 851—Convenience Market (Open 24 Hours)

SIZE (1,000 SQ. FT. GFA)	LOCATION	WEEKDAY SURVEY DATE	NO. OF INTERVIEWS	TIME PERIOD	PRIMARY TRIP (%)	NON-PASS-BY TRIP (%)	DIVERTED LINKED TRIP (%)	PASS-BY TRIP (%)	ADJ. STREET PEAK HOUR VOLUME	SOURCE
3	Overland Park, KS	Aug. 1987	68	4:30–5:30 p.m.	53	—	13	34	n/a	n/a
3	Overland Park, KS	Jul. 1987	68	4:30–5:30 p.m.	50	—	22	28	n/a	n/a
~1.9	Billings, MT	1987	461	4:00–6:00 p.m.	13	—	25	62	n/a	ITE Montana Section Tech Comm
<50.0	Chicago suburbs, IL	1987	72	3:00–6:00 p.m.	—	72	—	28	n/a	Kenig, O'Hara, Humes, Flock
<50.0	Chicago suburbs, IL	1987	54	3:00–6:00 p.m.	—	22	—	78	n/a	Kenig, O'Hara, Humes, Flock
<50.0	Chicago suburbs, IL	1987	34	3:00–6:00 p.m.	—	31	—	69	n/a	Kenig, O'Hara, Humes, Flock
<50.0	Chicago suburbs, IL	1987	100	3:00–6:00 p.m.	—	37	—	63	n/a	Kenig, O'Hara, Humes, Flock
<50.0	Chicago suburbs, IL	1987	43	3:00–6:00 p.m.	—	57	—	43	n/a	Kenig, O'Hara, Humes, Flock
<50.0	Chicago suburbs, IL	1987	135	3:00–6:00 p.m.	—	61	—	39	n/a	Kenig, O'Hara, Humes, Flock
<50.0	Chicago suburbs, IL	1987	74	3:00–6:00 p.m.	—	47	—	53	n/a	Kenig, O'Hara, Humes, Flock
<50.0	Chicago suburbs, IL	1987	80	3:00–6:00 p.m.	—	36	—	64	n/a	Kenig, O'Hara, Humes, Flock
2.6	Seminole Co., FL	July 1989	82	4:00–6:00 p.m.	20	—	7	73	n/a	Tipton Associates Inc.
2.6	Seminole Co., FL	July 1989	98	4:00–6:00 p.m.	15	—	4	81	n/a	Tipton Associates Inc.
2.6	Seminole Co., FL	July 1989	115	4:00–6:00 p.m.	16	—	15	69	n/a	Tipton Associates Inc.
2.6	Volusia Co., FL	July 1989	98	4:00–6:00 p.m.	15	—	11	74	n/a	Tipton Associates Inc.
2.4	Volusia Co., FL	July 1989	38	4:00–6:00 p.m.	24	—	2	74	n/a	Tipton Associates Inc.
2.6	Volusia Co., FL	July 1989	82	4:00–6:00 p.m.	8	—	5	87	n/a	Tipton Associates Inc.
2.6	Seminole Co., FL	July 1989	98	2:00–4:00 p.m.	28	—	8	64	n/a	Tipton Associates Inc.
2.4	Volusia Co., FL	July 1989	38	2:00–4:00 p.m.	21	—	11	68	n/a	Tipton Associates Inc.

Average Pass-By Trip Percentage: 61

ORG11-30 cont.

NEAL K. LIDDICOAT, P.E.
PRINCIPAL

Education

BSCE / Michigan State University, 1977

Graduate Studies, University of Tennessee, 1977 – 1980

Professional Affiliations

Institute of Transportation Engineers – Fellow

American Society of Civil Engineers – Member

Registrations

California – Civil Engineer C35005

Michigan – Professional Engineer 6201037605

Mr. Liddicoat has 42 years of experience in the analysis of a broad range of traffic engineering, parking, and transportation planning issues, for both public and private sector clients. He has conducted traffic and parking analyses for a wide variety of development proposals, including office buildings, retail/commercial centers, multiplex cinemas, and residential projects. He has a particular expertise in the analysis of unique development proposals, including stadiums, arenas, convention centers, theme parks, and other facilities where large numbers of vehicles and pedestrians converge in a short period of time.

Mr. Liddicoat has developed and presented seminars on technical procedures and quality control in the conduct of traffic impact analyses, both in-house and as a co-instructor for the UCLA Extension Public Policy Program. For several years, he served as instructor for the traffic engineering portion of the Civil Engineering licensing exam review course conducted by the Sacramento chapter of the American Society of Civil Engineers. Significant traffic impact analysis experience includes the following selected projects:

- ***Folsom, CA – Over 50 traffic analyses, including:***
  - ***Folsom Heights Mixed-Use***
  - ***Broadstone Estates***
  - ***Bidwell Pointe Residential***
  - ***Serenade Senior Housing***
  - ***Commons at Prairie City***
  - ***Country House Memory Care***
  - ***Prospect Ridge Residential***
- ***STAPLES Center Traffic Impact Analysis, Los Angeles, CA***
- ***Sacramento City College Transportation Master Plan Analysis, Sacramento, CA***
- ***Raley Field Traffic and Parking Analysis, West Sacramento, CA***
- ***Convention Center Traffic & Parking Studies, Sacramento, Los Angeles, and Anaheim, CA***
- ***Disney's "California Adventure" Preliminary Traffic Analysis, Anaheim, CA***
- ***Warner Bros. Studios Master Plan, Burbank, CA***
- ***Elk Grove Boulevard Master Plan, Elk Grove, CA***
- ***CSUS Bicycle/Pedestrian Study, Sacramento, CA***
- ***SR 99/Twin Cities Road Traffic Operations, Galt, CA***
- ***Thunder Valley Casino, Placer County, CA***

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Mr. Liddicoat is frequently called upon to serve as an expert "peer reviewer" for traffic impact analyses prepared by others. In that role, he has commented on the technical adequacy of traffic studies for a variety of projects, including retail centers, office complexes, and mixed-use master plans. His recent experience as a peer reviewer includes the following selected projects:

- ***Village at Squaw Valley, Placer County, CA***
- ***LAX Landside Access Modernization, Los Angeles, CA***
- ***Granite Bay Circulation Study, Placer County, CA***
- ***Oil Exploration Zoning Ordinance, Kern County, CA***
- ***State Route 85 Express Lanes, Santa Clara Co., CA***
- ***Vacaville General Plan, Vacaville, CA***
- ***Martis Valley West Specific Plan, Placer County, CA***
- ***LAX Terminals 2/3 Modernization, Los Angeles, CA***
- ***Town & Country Hotel/Convention Ctr, San Diego, CA***
- ***University Community Plan, San Diego, CA***
- ***Canyon Springs Residential, Truckee, CA***
- ***Fresno General Plan, Fresno, CA***
- ***Saddle Crest Homes, Orange County, CA***
- ***Brentwood Manor Hotel, Los Angeles, CA***
- ***Highway 43/198 Retail Center, Hanford, CA***
- ***Materials Recovery Facility, Irwindale, CA***
- ***Bridgepointe Master Plan Amendment, San Mateo, CA***
- ***Frog's Leap Winery, Napa County, CA***