APPENDIX L

Noise and Vibration Impacts Technical Report

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NOISE AND VIBRATION IMPACTS TECHNICAL REPORT

NORTH HAIWEE DAM NO. 2 PROJECT

Prepared for:

Los Angeles Department of Water & Power
Environmental Affairs
111 North Hope Street, Room 1050
Los Angeles, CA 90012-2694

Prepared by:

Terry A. Hayes Associates
8522 National Boulevard, Suite 102
Culver City, CA 90232
(310) 839-4200

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1 Introduction

The Noise and Vibration Impacts Technical Report (Noise and Vibration Study) was prepared by Terry A. Hayes Associates Inc. for the Los Angeles Department of Water and Power (LADWP) to assess potential impacts associated with the North Haiwee Dam No. 2 Project (Proposed Project). As the lead agency under the National Environmental Policy Act (NEPA), the Bureau of Land Management (BLM) is required to determine the potential for the Proposed Project to result in adverse effects and to implement avoidance measures or develop alternatives where potentially significant effects occur. As the lead agency under the California Environmental Quality Act (CEQA), LADWP is required to determine the potential for the Proposed Project to result in significant impacts, to implement mitigation measures where potentially significant impacts occur, and to develop alternatives to reduce significant impacts. The results of the Noise and Vibration Study, and environmental analysis as a whole, will be taken into consideration as part of the decision-making process whether to approve the Proposed Project. This Noise and Vibration Study focused on construction (e.g., equipment and trucks) activities.

2 Project Description

LADWP proposes to improve the seismic reliability of the North Haiwee Reservoir (NHR), which is located in the Owens Valley, California, approximately 150 miles north of Los Angeles. LADWP has prepared this draft joint Environmental Impact Report/Environmental Assessment (EIR/EA) in cooperation with the Bureau of Land Management (BLM). The purpose of the Proposed Project is to construct North Haiwee Dam No. 2 (NHD2 or new Dam) to the north of North Haiwee Dam (NHD or existing Dam), which impounds NHR. Seismic studies have found that NHD would have potential to fail during a Maximum Credible Earthquake event, the largest possible earthquake which could happen. NHD2 would serve to improve the seismic reliability of NHR in the event that the existing Dam is damaged or breached by an earthquake event, thereby ensuring public health and safety and securing the City's water source. The Proposed Project would provide sufficient seismic reliability for NHR, maintain the function of an essential water conveyance infrastructure component for the City of Los Angeles, and protect local populations from a hazardous flooding event. The Proposed Project would also create a basin between NHD2 and NHD, allowing LADWP to divert water from the Los Angeles Aqueduct (LAA), through the basin, and through a notch in NHD into NHR.

This technical report includes the evaluation of the No Project Alternative, as well as two Build Alternatives: the Cement Deep Soil Mixing (CDSM) Alternative and the Excavate and Recompact Alternative. The Proposed Project consists of the following components, which are common to both Build Alternatives:

- Construction of the NHD2 components: NHD2, the east and west berms, and grading of the basin area between NHD and NHD2;
- Realignment of Cactus Flats Road;
- Realignment of the LAA and construction of the diversion structure and temporary bridge;
- Construction of the diversion channel and NHD modifications;
- Excavation of materials from Borrow Site 10[1]; and
- Purchase and hauling of materials from Borrow Site 15.

[1] Borrow Site 10 refers to the LAA Excavation Area and Borrow Site 15 refers to the existing mine in Keeler in the Draft EIR/EA.

The differentiating component between the two Build Alternatives is the method of construction of the foundation of NHD2, which affects the timeline and construction efforts of the NHD2 components and use of Borrow Sites 10 and 15. Construction of the remaining Proposed Project components is the same between the two Build Alternatives, except for the timeline of the diversion channel and NHD modifications.

Refer to Chapter 1.0 Introduction and Chapter 2.0 Project Description and Alternatives of the Draft EIR/EA for the full description of the Proposed Project, including purpose and need, objectives, regulatory requirements, alternatives, construction, and operations. Borrow Site 10 refers to the LAA Excavation Area and Borrow Site 15 refers to the existing mine in Keeler in the Draft EIR/EA.

3 Methodology

3.1 Noise Characteristic and Effects

3.1.1 Characteristics of Sound

Sound is technically described in terms of the loudness (amplitude) and frequency (pitch). The standard unit of measurement for sound is the decibel (dB). The human ear is not equally sensitive to sound at all frequencies. The A-weighted dB scale, abbreviated dBA, reflects the normal hearing sensitivity range of the human ear. On this scale, the range of human hearing extends from approximately 3 to 140 dBA. Figure 3-1 provides examples of A-weighted noise levels from common sounds.

3.1.2 Noise Definitions

This noise analysis discusses average sound levels in terms of Equivalent Noise Level (L_{eq}) and Community Noise Equivalent Level (CNEL).

Equivalent Noise Level (L_{eq})

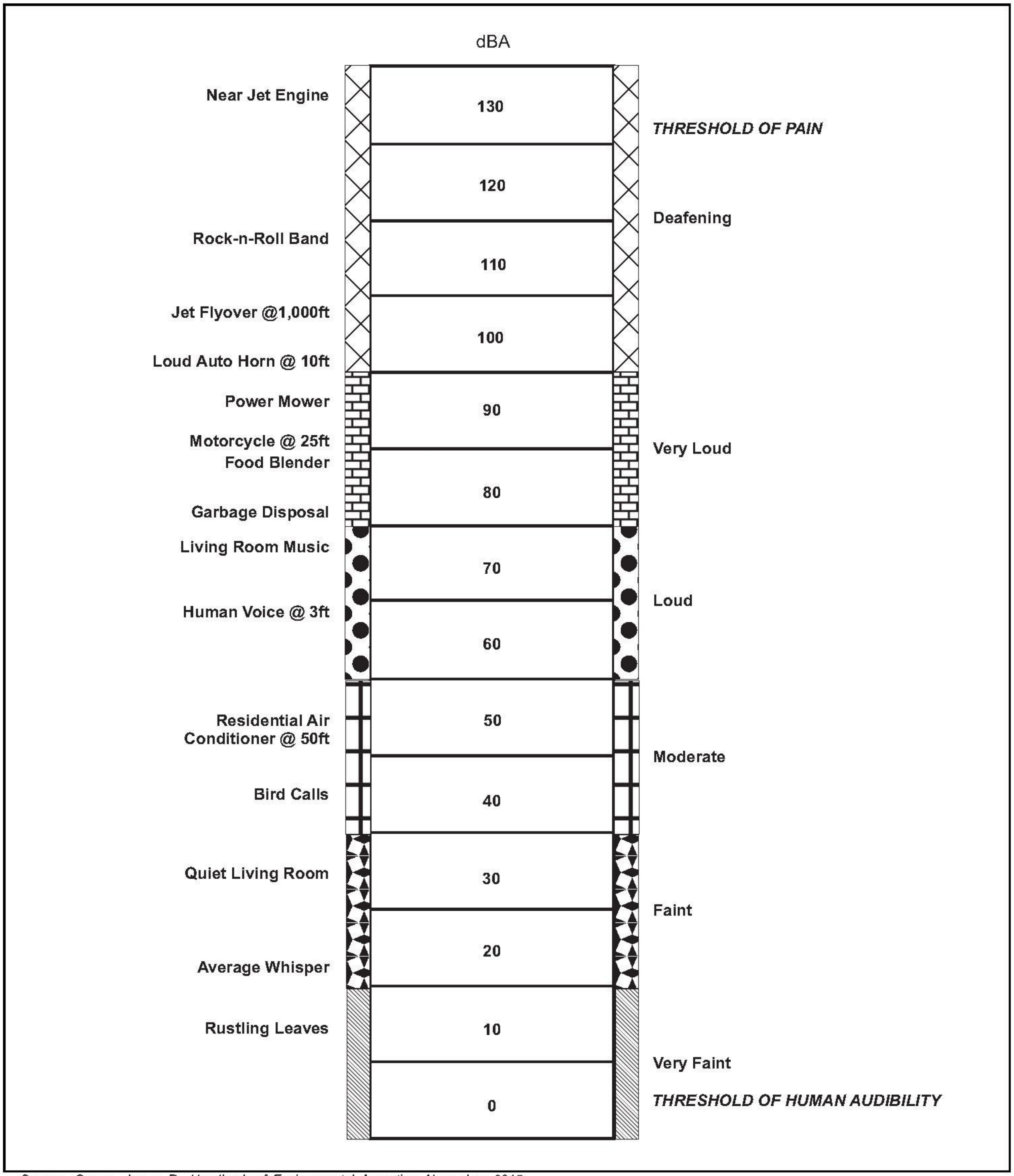
L_{eq} is the average sound level for any specific time period, on an energy basis. The L_{eq} for one hour is the energy average noise level during the hour. The average noise level is based on the energy content (acoustic energy) of the sound. L_{eq} can be thought of as the level of a continuous noise which has the same energy content as a fluctuating noise level. L_{eq} is expressed in units of dBA.

Community Noise Equivalent Level (CNEL)

The CNEL is an average sound level during a 24-hour period. The CNEL is a noise measurement scale, which accounts for noise source, distance, single-event duration, single-event occurrence, frequency, and time of day. Due to the lower background noise level, human reaction to sound between 7:00 p.m. and 10:00 p.m. is as if the sound were actually 5 dBA higher than if it occurred from 7:00 a.m. to 7:00 p.m. From 10:00 p.m. to 7:00 a.m., humans perceive sound as if it were 10 dBA higher. Hence, the CNEL is obtained by adding an additional 5 dBA to sound levels in the evening from 7:00 p.m. to 10:00 p.m. and 10 dBA to sound levels in the night from 10:00 p.m. to 7:00 a.m. Because the CNEL accounts for human sensitivity to sound, it is always a higher number than the actual 24-hour average sound level.

3.1.3 Effects of Noise

Noise is generally defined as unwanted sound. The degree to which noise can impact the human environment ranges from levels that interfere with speech and sleep (annoyance and nuisance) to levels that cause adverse health effects (hearing loss and psychological effects). Human response to noise is subjective and can vary greatly from person to person. Factors that influence individual response include the intensity, frequency, and pattern of noise; the amount of background noise present before the intruding noise; and the nature of work or human activity that is exposed to the noise source.



Source: Cowan, James P., *Handbook of Environmental Acoustics. November, 2015.*

NOT TO SCALE

Figure 3-1
A-Weighted Noise Levels

3.1.4 Audible Noise Changes

Studies have shown that the smallest perceptible change in sound level for a person with normal hearing sensitivity is approximately 3 dBA. A change of at least 5 dBA would be noticeable and may evoke community concern. A 10-dBA increase is subjectively heard as a doubling in loudness and would likely cause a community response.

Noise levels decrease as the distance from the noise source to the receiver increases. Noise levels generated by a stationary noise source, or "point source," will decrease by approximately 6 dBA over hard surfaces (e.g., pavement) and 7.5 dBA over soft surfaces (e.g., grass) for each doubling of distance. For example, if a noise source produces a noise level of 89 dBA at a reference distance of 50 feet, then the noise level would be 83 dBA at a distance of 100 feet over a hard surface from the noise source, 77 dBA at a distance of 200 feet, and so on. Noise levels generated by a mobile source will decrease by approximately 3 dBA over hard surfaces and 4.5 dBA over soft surfaces for each doubling of the distance.

Generally, noise is most audible when traveling by direct line-of-sight. In urban environments, barriers, such as walls, berms, or buildings, are often present, which break the line-of-sight between the source and the receiver, greatly reducing noise levels from the source since sound can only reach the receiver by bending over the top of the barrier (diffraction). However, if a barrier is not high or long enough to break the line-of-sight from the source to the receiver, its effectiveness is greatly reduced. In situations where the source or the receiver is located 3 meters (approximately 10 feet) above the ground, or whenever the line-of-sight averages more than 3 meters above the ground, sound levels would be reduced by approximately 3 dBA for each doubling of distance.

3.2 Vibration Characteristic and Effects

3.2.1 Characteristics of Vibration

Vibration is an oscillatory motion through a solid medium in which the motion's amplitude can be described in terms of displacement, velocity, or acceleration. Vibration can be a serious concern, causing buildings to shake and rumbling sounds to be heard. In contrast to noise, vibration is not a common environmental problem. It is unusual for vibration from sources, such as buses and trucks, to be perceptible, even in locations close to major roads. Some common sources of vibration are trains, buses on rough roads, and construction activities, such as rock blasting, pile driving, and heavy earth-moving equipment.

3.2.2 Vibration Definitions

There are several different methods that are used to quantify vibration. The peak particle velocity (PPV) is defined as the maximum instantaneous peak of the vibration signal. The PPV is most frequently used to describe vibration impacts to buildings and is usually measured in inches per second. The root mean square (RMS) amplitude is most frequently used to describe the effect of vibration on the human body. The RMS amplitude is defined as the average of the squared amplitude of the signal. The decibel notation (Vdb) is commonly used to measure RMS. The Vdb acts to compress the range of numbers required to describe vibration.

3.2.3 Effects of Vibration

High levels of vibration may cause physical personal injury or damage to buildings. However, vibration levels rarely affect human health. Instead, most people consider vibration to be an annoyance that may affect concentration or disturb sleep. In addition, high levels of vibration may damage fragile buildings or interfere with equipment that is highly sensitive to vibration (e.g., electron microscopes).

3.2.4 Perceptible Vibration Changes

In contrast to noise, vibration is not a phenomenon that most people experience every day. The background vibration velocity level in residential areas is usually 50 Vdb RMS or lower, well below the threshold of perception for humans which is around 65 Vdb RMS. Most perceptible indoor vibration is caused by sources within buildings, such as operation of mechanical equipment, movement of people, or slamming of doors. Typical outdoor sources of perceptible vibration are construction equipment, steel-wheeled trains, and traffic on rough roads. If the roadway is smooth, the vibration from traffic is rarely perceptible.

3.2.5 Methodology for Analysis

The noise and vibration analyses consider construction activities on the Project Site and related activity on the roadway network. On-site sources of noise and vibration include heavy-duty equipment and trucks. Reference noise levels were obtained from United States Environmental Protection Agency (USEPA) guidance related to phased equipment activities (USEPA, 1971). Although published in 1971, this source is the industry standard for obtaining phased construction noise levels. For example, this source is used in the City of Los Angeles Draft CEQA Thresholds Guide as guidance for assessing construction noise levels (City of Los Angeles, 2006). The estimate of construction noise at specific land uses was calculated by adjusting the reference noise levels based on noise attenuation from ground absorption. The Project Site was considered to be a soft site for ground absorption due to the undeveloped nature of the land. Using guidance published in the California Department of Transportation (Caltrans) Technical Noise Supplement, the following formula was used to estimate noise levels (Caltrans, 2009):

$$dBA_2 = dBA_1 + 10\log_{10}(D_1/D_2)^{2.5}$$

Where: dBA_1 = Reference Noise Level

dBA_2 = New Noise Level at Land Use

D_1 = Distance for the Reference Noise Level

D_2 = Distance to Land Use

Roadway noise was estimated using the Federal Highway Administration's (FHWA) Traffic Noise Model (TNM). TNM is the current Caltrans standard computer noise model for traffic noise analysis. The model allows for the input of roadway parameters, noise receivers, and sound barriers if applicable. Existing and Project-related traffic volumes were obtained from the project team. Refer to the Traffic Impacts Technical Report for truck volumes.

Vibration levels generated by construction equipment were estimated using example vibration levels and propagation formulas provided by Federal Transit Administration (FTA) (FTA, 2006). The analysis included damage and annoyance assessments. The potential for damage was assessed using the following formula:

$$PPV_{equip} = PPV_{ref} \text{ x } (25/D)^{1.5}$$

Where: PPV_{equip} = The vibration level adjusted for distance

PPV_{ref} = The reference vibration level at 25 feet

D = The distance from the equipment to the receiver

The potential for damage was assessed using the following formula:

$$\text{Vibration Level (D)} = \text{Reference Vibration Level (25 feet)} - 30\log(D/25)$$

Where: Vibration Level (D) = The vibration level adjusted for distance

Reference Vibration Level (25 feet) = The reference vibration level at 25 feet

D = The distance from the equipment to the receiver

3.3 Impact Criteria

3.3.1 CEQA Significance Criteria

In accordance with Appendix G of the State CEQA Guidelines, the Proposed Project would have a significant impact related to noise and vibration if it would:

- Create levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies, or result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the Proposed Project;
- Expose people to or generate excessive ground-borne vibration or ground-borne noise levels;
- Create a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the Proposed Project; and/or
- Create a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the Proposed Project.

Noise

Inyo County has not established quantitative significance thresholds to determine construction and operational noise impacts related to the Proposed Project. However, based on typical community response to increased noise levels and Caltrans guidance, the Proposed Project would have a significant impact related to noise if:

- Construction equipment activity results in a temporary noise level increase of 5 dBA L_{eq} or more at a noise-sensitive use;
- Construction-related roadway noise levels exceed 66 dBA L_{eq} at residences, schools, and parks, 72 dBA L_{eq} at motels, or result in any 12 dBA increase from existing conditions; and/or
- Operational activity results in a permanent noise level 5 dBA CNEL or more at a noise-sensitive use.

Vibration

There are no adopted State or local vibration standards. Based on federal guidelines, the Proposed Project would have a significant impact related to vibration if:

- Construction or operational activities would expose building to vibration levels that exceed 0.2 inches per second.

3.3.2 NEPA Requirements

The term “significantly” as used in NEPA requires considerations of both context and intensity (40 Code of Federal Regulations 1508.27). Therefore, thresholds serve as a benchmark for determining if a project action would result in a significant adverse environmental impact when evaluated against the baseline. The environmental effects analysis of the Proposed Project related to safety and security includes an assessment of the context and intensity of the impacts as defined in the NEPA implementing regulations, 40 Code of Federal Regulations 1508.27, and the BLM *NEPA Handbook H-1790-1* of 2008. The BLM *NEPA Handbook H-1790-1* requires that duration be considered and that both short- and long-term adverse and beneficial impacts be disclosed in the NEPA analysis. The effects analysis must demonstrate that BLM took a “hard look” at the impacts of the action. The level of detail must be sufficient to support reasoned conclusions by comparing the amount and the degree of change (impact) caused by the proposed action and alternatives (BLM *NEPA Handbook H-1790-1*, 2008, p. 55). Additionally, direct, indirect, and cumulative impacts for the Proposed Project must be considered. BLM, the federal lead agency, has not adopted noise impact criteria directly relevant to the Proposed Project.

4 Regulatory Framework

4.1 Federal

4.1.1 National Environmental Policy Act

NEPA was enacted "To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality" (USEPA, 1970).

4.1.2 Noise Control Act

The Federal Noise Control Act of 1972 established programs and guidelines to identify and address the effects of noise on public health, welfare, and the environment. In 1981, USEPA administrators determined that subjective issues such as noise would be better addressed at local levels of government, thereby allowing more individualized control for specific issues by designated federal, State, and local government agencies. Consequently, in 1982, responsibilities for regulating noise control policies were transferred to specific federal agencies and State and local governments. However, noise control guidelines and regulations contained in USEPA rulings in prior years remain in place. BLM has not established noise standards. No federal noise regulations are directly applicable to the Proposed Project.

4.1.3 Vibration

FTA has published guidance for assessing building damage impacts from vibration. Table 4-1 shows the FTA building damage criteria for vibration. It is assumed that the rural residential structures near construction activity are non-engineering timber and masonry buildings (Category III).

TABLE 4-1
CONSTRUCTION VIBRATION DAMAGE CRITERIA

Building Category	Peak Particle Velocity (inches per second)
I. Reinforced-concrete, steel or timber (no plaster)	0.5
II. Engineered concrete and masonry (no plaster)	0.3
III. Non-engineered timber and masonry buildings	0.2
IV. Buildings extremely susceptible to vibration damage	0.12

Source: FTA, *Transit Noise and Vibration Impact Assessment*, May 2006.

4.2 State

4.2.1 California Environmental Quality Act

CEQA was adopted in 1970 and incorporated in the Public Resources Code Sections 21000-21177. Its purposes are to: inform about the potential significant environmental effects of proposed activities; identify ways that environmental damage can be avoided or significantly reduced; require changes in projects through the use of alternatives or mitigation measures when feasible; and, publicly disclose the reasons why a project was approved if significant environmental effects are involved. CEQA Guidelines questions relevant to the noise and vibration analyses for the Proposed Project relate to short-term temporary and long-term permanent changes in noise levels.

Caltrans has published guidance for assessing roadway noise (Caltrans, 2011). The guidance includes Noise Abatement Criteria (NAC), which are used to identify potential impacts. The exterior NAC for land uses such as residences, schools, and parks is 67 dBA L_{eq}. The exterior NAC for motels and other commercial land uses is 72 dBA L_{eq}. In California, a noise level is considered to approach the NAC for a given activity category if it is within 1 dBA of the NAC. In addition, Caltrans guidance states that a substantial noise increase is considered to occur when project-related hourly noise levels exceed existing hourly noise levels by 12 dBA or more. The use of 12 dB was established in California many years ago and is based on the concept that a 10 dB increase generally is perceived as a doubling of loudness.

4.2.2 Noise

The State of California has adopted noise standards in areas of regulation not preempted by the federal government. State standards regulate noise levels of motor vehicles, sound transmission through buildings, occupational noise control, and noise insulation. State regulations governing noise levels generated by individual motor vehicles and occupational noise control are not applicable to planning efforts nor are these areas typically subject to CEQA analysis.

4.2.3 Vibration

There are no adopted State vibration standards.

4.3 Regional and Local

4.3.1 Inyo County

Inyo County is in the process of updating the General Plan. The May 2013 Draft Zoning Code and General Plan Update does not have a noise element. Instead, noise is referenced in the Public Safety Element and the goal is to maintain a rural atmosphere in the County by protecting local residents and visitors from exposure to excessive noise related to highways and roadways, large mining or industrial facilities, and airports. Goals and policies in the Draft Zoning Code and General Plan Update related to noise and vibration and applicable to the construction of NHD2 are identified in Table 4-2. Land use compatibility guidelines have not been summarized as these relate to permanent noise and the Proposed Project would not generate operational noise or vibration. Inyo County has not established vibration standards relevant to the Proposed Project.

TABLE 4-2
APPLICABLE GENERAL PLAN NOISE DESIGN ELEMENT GOALS AND POLICIES

Goal/Policy	Objective/Policy Description
Goal NOI-1	Prevent incompatible land uses, by reason of excessive noise levels, from occurring in the future. This includes protecting sensitive land uses from exposure to excessive noise and to protect the economic base of the County by preventing the encroachment of incompatible land uses within areas affected by existing or planned noise-producing uses.
Policy NOI-1.5	Require that proponents of new projects provide or fund the implementation of noise-reducing mitigation measures to reduce noise to required levels.
Policy NOI-1.7	Construction contractors shall be required to implement noise-reducing mitigation measures during construction when residential uses or other sensitive receptors are located within 500 feet.
Policy NOI-1.8	The County will encourage other government agencies to implement noise-reducing measures when impacts to receptors within the County’s jurisdiction occur.
Goal NOI-2	Preserve and maintain a quiet rural environmental character.

TABLE 4-2
APPLICABLE GENERAL PLAN NOISE DESIGN ELEMENT GOALS AND POLICIES

Goal/Policy	Objective/Policy Description
Policy NOI-2.2	Discourage the use of sound walls along roadway facilities. Non-structural mitigation is preferred, such as soft berms, provision of landscaping, buffer distances, and elevated or depressed roadways or structures.

Note: NOI = Noise
Source: Inyo County*, Draft Zoning Code and General Plan Update*, May 2013.

5 Existing Conditions

5.1 Sensitive Receptors

Noise- and vibration-sensitive land uses are locations where people reside or where the presence of unwanted sound could adversely affect the use of the land. Residences, schools, hospitals, guest lodging, libraries, and some passive recreation areas would each be considered noise- and vibration-sensitive and may warrant unique measures for protection from intruding noise. As discussed above, ranch houses are located west and north of the Project Site. In addition, residences and motels are located at various places along the U.S. Highway (US-) 395, State Route (SR-) 136, and SR-190.

5.2 Project Site

The Project Site is developed with few sources of noise. Noise generation is limited to occasional automobile trips on North Haiwee and Cactus Flats Roads, farm equipment associated with the ranch house and related agricultural activities, and common noise from the adjacent reservoir keeper's residence (e.g., barking dogs and household equipment). These noise sources are typical for agricultural and residential land uses. The Project Site is approximately 0.6 miles east of US-395, and highway noise is not audible at the Project Site. Sound measurements were taken using a SoundPro DL Sound Level Meter between 9:00 a.m. and 12:30 p.m. on July 29, 2015 to determine existing ambient daytime noise levels. Noise monitoring locations are shown in Figure 5-1. As shown in Table 5-1, existing noise levels at the Project Site ranged from 36.9 to 52.5 dBA L_{eq}. Field observations indicate that vibration is not typically perceptible at the Project Site from any sources, including traffic.

TABLE 5-1
EXISTING NOISE LEVELS

Key to Figure 5-1	General Location Relevant to Project Elements	Specific Location	Sound Level (dBA, L_{eq})
1	Borrow Site 15	Residence on SR-136	61.6
2	Haul Route	Ranch Motel on US-395	68.7
3	Project Site	Residence on Cactus Flats Road	52.5
4	Project Site	Reservoir Keeper’s Residence on North Haiwee Road	36.9

Notes: SR-136 = State Route 136; US-395 = U.S. Highway 395
Source: Terry A. Hayes Associates Inc., 2015.

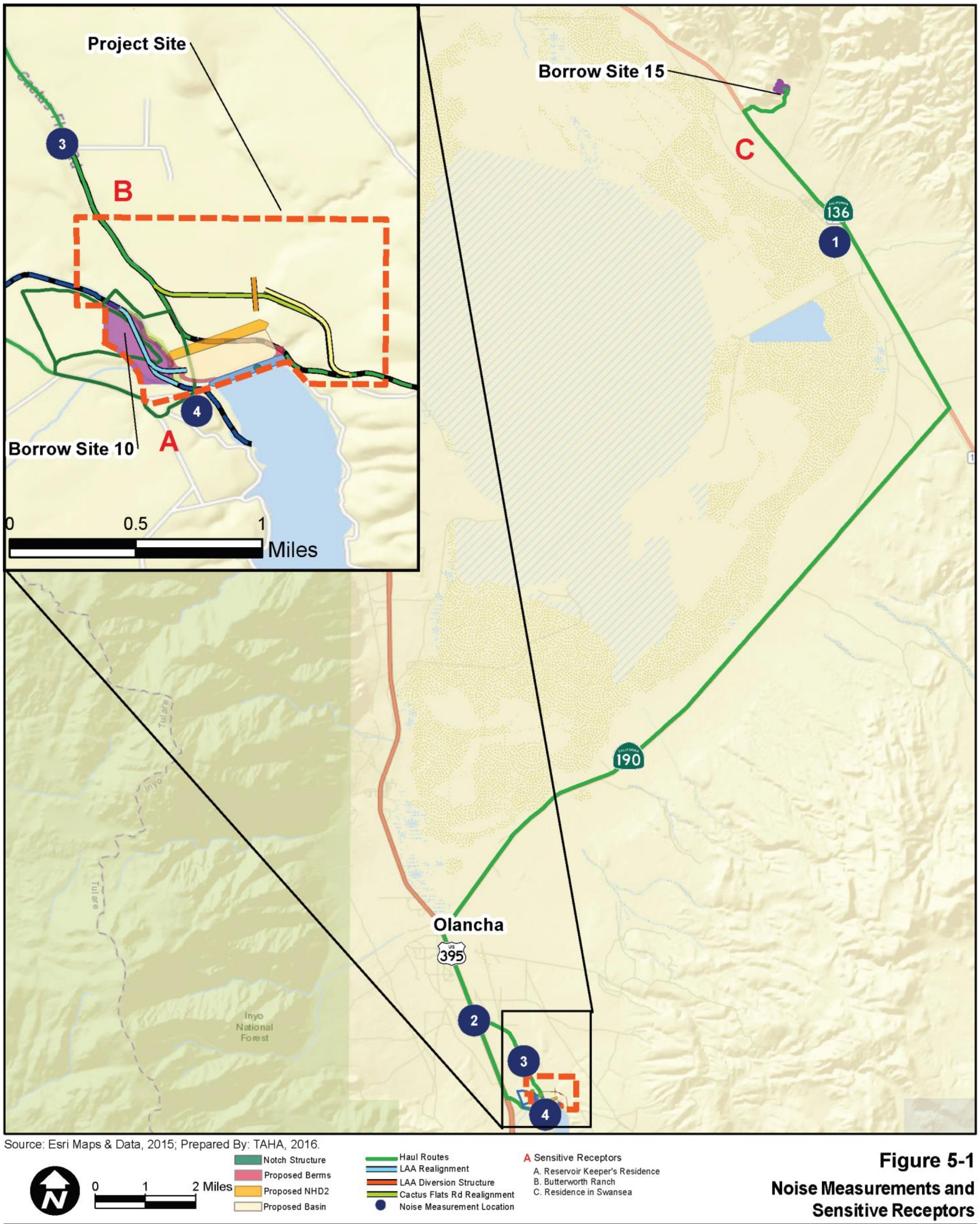


Figure 5-1
Noise Measurements and Sensitive Receptors

5.3 Borrow Sites

The discussion of the study area for the borrow sites will be defined by the name of the site. For example, Borrow Site 15 will be referred to as Borrow Site 15. Furthermore, the scope of Borrow Site 15 evaluated in the Noise and Vibrations Study is limited to the haul routes associated with this borrow site; Borrow Site 15 would remain the same as under existing conditions and materials would be purchased from the site. No new mining would occur.

5.3.1 Borrow Site 10

Borrow Site 10 is located on the west side of the LAA, adjacent to the site of the new Dam. A portion of Borrow Site 10 is within the footprint for the LAA Realignment. There are no noise sources near Borrow Site 10, and it is anticipated that the noise level would be similar to the 36.9 to 52.5 dBA L_{eq} range recorded at the Project Site. There are no existing sources of vibration at Borrow Site 10.

5.3.2 Borrow Site 15

Borrow Site 15 is located east of SR-136 in the foothills of the mountains forming the western boundary of Death Valley National Park. Borrow Site 15 is a functioning mine and there exists noise and vibration typical of mine operations that is generated by equipment and trucks. Noise levels associated with operation of the mine were monitored at a residence in Keeler. The monitored noise level was 61.6 dBA L_{eq}. Field observations indicated that vibration is not perceptible at land uses from activity at Borrow Site 15.

6 Impact Analysis

6.1 Construction Impacts

6.1.1 Equipment Noise

Construction noise at the Project Site and the borrow sites would be generated by heavy-duty equipment and trucks. Increased noise levels would be a function of location of the equipment, the timing and duration of the noise-generating construction activities, and the distance to noise-sensitive receptors. Typical noise levels from various types of equipment that may be used during construction are listed in Table 6-1. The noise levels are presented as if the equipment would operate under full power conditions. However, equipment used on construction sites often operate at less than full power. USEPA has identified a reference noise level for multiple pieces of equipment operating during different phases of construction. Based on the scheduled mix of equipment by construction phase, the structural construction phase of the Project elements is anticipated to have the highest number of equipment operating at the same time. The USEPA reference level for site preparation activity is 89 dBA L_{eq} at 50 feet. This reference noise level is an accurate representation of multiple pieces of equipment operating at the same time and, thus, also represents overlapping construction activities.

TABLE 6-1
CONSTRUCTION EQUIPMENT NOISE LEVEL RANGES

Construction Equipment	Noise Level at 50 feet (dBA, Leq)
Backhoe	84
Front Loader	80
Trucks	89
Generators	76
Scraper/Grader	87
Cranes	88
Concrete Mixers	82
Compressors	81
Auger Drilling	77

Notes: dBA = A-weighted dB scale; L_{eq} = Equivalent Noise Level
Source: USEPA. *Noise from Construction Equipment and Operations, Building Equipment and Home Appliances*, PB 206717, 1971.

CDSM Alternative

The CDSM Alternative would require portable batch plants, drill rigs with multi-axis augers, articulated end dump trucks, a track-mounted drill rig for coring, cement delivery trucks, track-mounted backhoes, and loaders. As discussed above, the USEPA reference level for site preparation activity is 89 dBA L_{eq} at 50 feet. This reference noise level is an accurate representation of multiple pieces of equipment operating at the same time and, thus, also represents overlapping construction activities.

Equipment noise levels were assessed at the Project Site for the CDSM Alternative.

North Haiwee Dam No. 2

NHD2-related construction equipment would be located within approximately 600 feet of the reservoir keeper's residence on North Haiwee Road and 2,700 feet of the Butterworth Ranch, as shown in Figure 5-1. As shown in Table 6-2, equipment-related noise levels during all construction activities would exceed existing noise levels by more than 5 dBA L_{eq} at both receptors during all construction activities. Therefore, without mitigation, NHD2 construction activity would result in a significant impact related to equipment noise.

TABLE 6-2
CDSM ALTERNATIVE - EQUIPMENT NOISE LEVELS - UNMITIGATED

Elements and Sensitive Receptors	Distance (Feet)	Estimated dBA, L_{eq}			
		Equipment Noise Level	Existing Noise Level	New Ambient Noise Level	Noise Increase[a]
NHD2					
Reservoir Keeper's Residence	600	62.0	36.9	62.0	**25.1**
Butterworth Ranch	2,700	45.7	36.9	46.2	**9.3**
LAA REALIGNMENT					
Reservoir Keeper's Residence	Adjacent	89.0	36.9	89.0	**52.1**
Butterworth Ranch	2,000	48.9	36.9	49.2	**12.3**
CACTUS FLATS ROAD REALIGNMENT					
Reservoir Keeper's Residence	1,800	50.1	36.9	50.3	**13.4**
Butterworth Ranch	1,800	50.1	36.9	50.3	**13.4**
BASIN AND BERMS					
Reservoir Keeper's Residence	200	73.9	36.9	73.9	**37.0**
Butterworth Ranch	2,930	44.8	36.9	45.5	**8.6**
NOTCH					
Reservoir Keeper's Residence	1,450	52.4	36.9	52.6	**15.7**
Butterworth Ranch	4,000	41.4	36.9	42.7	**5.8**
DIVERSION CHANNEL					
Reservoir Keeper's Residence	450	65.1	36.9	65.2	**28.3**
Butterworth Ranch	3,000	44.5	36.9	45.2	**8.3**
BORROW SITE 10					
Reservoir Keeper's Residence	50	89.0	36.9	89.0	**52.1**
Butterworth Ranch	1,700	50.7	36.9	50.9	**14.0**

Notes: dBA = A-weighted dB scale; L_{eq} = Equivalent Noise Level; NHD2 = North Haiwee Dam No. 2
[a] The threshold for noise increase is 5 dBA L_{eq}. Increases meeting or exceeding this threshold are shown in **bold** text.
Source: Terry A. Hayes Associates Inc., 2015.

LAA Realignment

The LAA Realignment construction equipment would be located adjacent to the reservoir keeper's residence on North Haiwee Road and within 2,000 feet of the Butterworth Ranch. As shown in Table 6-2, equipment-related noise levels would exceed existing noise levels by more than 5 dBA L_{eq} at both receptors during all construction activities. Therefore, without mitigation, LAA Realignment construction activity would result in a significant impact related to equipment noise.

Cactus Flats Road Realignment

The Cactus Flats Road Realignment construction equipment would be located within approximately 1,800 feet of the reservoir keeper's residence on North Haiwee Road and the Butterworth Ranch. As shown in Table 6-2, equipment-related noise levels would exceed existing noise levels by more than 5 dBA L_{eq} at both receptors during all construction activities. Therefore, without mitigation, Cactus Flats Road Realignment construction activity would result in a significant impact related to equipment noise.

Basin and Berms

The basin and berms construction equipment would be located within approximately 200 feet of the reservoir keeper's residence on North Haiwee Road and 2,930 feet of the Butterworth Ranch. As shown in Table 6-2, equipment-related noise levels would exceed existing noise levels by more than 5 dBA L_{eq} at both receptors during all construction activities. Therefore, without mitigation, basin and berms construction activity would result in a significant impact related to equipment noise.

Notch

The notch construction equipment would be located within approximately 1,450 feet of the reservoir keeper's residence on North Haiwee Road and 4,000 feet of the Butterworth Ranch. As shown in Table 6-2, equipment-related noise levels would exceed existing noise levels by more than 5 dBA L_{eq} at both receptors during all construction activities. Therefore, without mitigation, notch construction activity would result in a significant impact related to equipment noise.

Diversion Channel

The diversion channel construction equipment would be located within approximately 450 feet of the reservoir keeper's residence on North Haiwee Road and 3,000 feet of the Butterworth Ranch. As shown in Table 6-2, equipment-related noise levels would exceed existing noise levels by more than 5 dBA L_{eq} at both receptors during all construction activities. Therefore, without mitigation, diversion channel construction activity would result in a significant impact related to equipment noise.

Borrow Site 10

Borrow Site 10 construction equipment would be located adjacent to the reservoir keeper's residence on North Haiwee Road and 1,700 feet of the Butterworth Ranch. As shown in Table 6-2, equipment-related noise levels would exceed existing noise levels by more than 5 dBA L_{eq} at both receptors. Therefore, without mitigation, Borrow Site 10 construction activity would result in a significant impact related to equipment noise.

Excavate and Recompact Alternative

The Excavate and Recompact Alternative would require less equipment than the CDSM Alternative. As discussed above, the USEPA reference level for site preparation activity is 89 dBA L_{eq} at 50 feet. This reference noise level is an accurate representation of multiple pieces of equipment operating at the same time and, thus, also represents overlapping construction activities.

Similar to the CDSM Alternative, and as shown in Table 6-3, without mitigation, construction activity would result in significant impacts for all of the Proposed Project components. Therefore, without mitigation, the Excavate and Recompact Alternative would result in a significant impact related to equipment noise.

TABLE 6-3
EXCAVATE AND RECOMPACT ALTERNATIVE - EQUIPMENT NOISE LEVELS - UNMITIGATED

		Estimated dBA, L_{eq}			
Elements and Sensitive Receptors	**Distance (Feet)**	**Equipment Noise Level**	**Existing Noise Level**	**New Ambient Noise Level**	**Noise Increase[a]**
NHD2					
Reservoir Keeper's Residence	600	62.0	36.9	62.0	**25.1**
Butterworth Ranch	2,700	45.7	36.9	46.2	**9.3**
LAA REALIGNMENT					
Reservoir Keeper's Residence	Adjacent	89.0	36.9	89.0	**52.1**
Butterworth Ranch	2,000	48.9	36.9	49.2	**12.3**

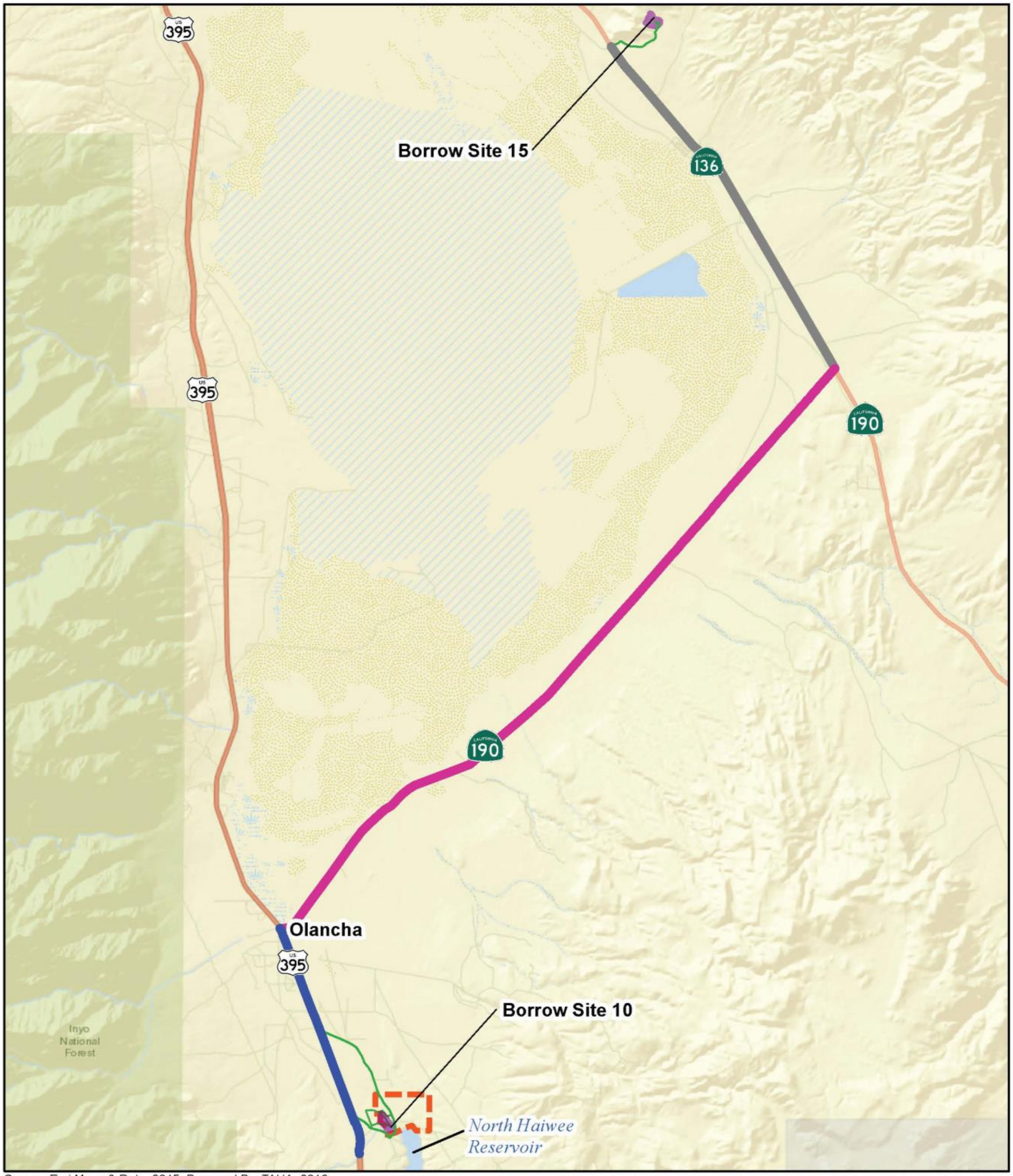
TABLE 6-3
EXCAVATE AND RECOMPACT ALTERNATIVE - EQUIPMENT NOISE LEVELS - UNMITIGATED

Elements and Sensitive Receptors	Distance (Feet)	Estimated dBA, L_{eq}			
		Equipment Noise Level	Existing Noise Level	New Ambient Noise Level	Noise Increase[a]
CACTUS FLATS ROAD REALIGNMENT					
Reservoir Keeper's Residence	1,800	50.1	36.9	50.3	**13.4**
Butterworth Ranch	1,800	50.1	36.9	50.3	**13.4**
BASIN AND BERMS					
Reservoir Keeper's Residence	200	73.9	36.9	73.9	**37.0**
Butterworth Ranch	2,930	44.8	36.9	45.5	**8.6**
NOTCH					
Reservoir Keeper's Residence	1,450	52.4	36.9	52.6	**15.7**
Butterworth Ranch	4,000	41.4	36.9	42.7	**5.8**
DIVERSION CHANNEL					
Reservoir Keeper's Residence	450	65.1	36.9	65.2	**28.3**
Butterworth Ranch	3,000	44.5	36.9	45.2	**8.3**
BORROW SITE 10					
Reservoir Keeper's Residence	50	89.0	36.9	89.0	**52.1**
Butterworth Ranch	1,700	50.7	36.9	50.9	**14.0**

Notes: dBA = A-weighted dB scale; L_{eq} = Equivalent Noise Level; NHD2 = North Haiwee Dam No. 2
[a] The threshold for noise increase is 5 dBA L_{eq}. Increases meeting or exceeding this threshold are shown in **bold** text.
Source: Terry A. Hayes Associates Inc., 2015.

6.1.2 Truck Noise on Haul Routes

The Proposed Project would generate truck and worker vehicle trips that would increase noise on the roadway network. Traffic volumes were assessed for each alternative and construction year on three road segments: SR-136 north of SR-190, SR-190 between US-395 and SR-136, and US-395 south of SR-190. The segments are shown in Figure 6-1. The mobile noise analysis for each alternative focused on the year with the highest truck volumes as an indicator of a potential impact. Mobile noise levels were assessed based on peak hour traffic as opposed to average daily traffic. Per industry standard, the peak hour was assumed to be 10 percent of average daily traffic. The number of haul trucks per hour was calculated by dividing total daily truck traffic by an 8-hour work day. Total daily haul truck trips for each segment and alternative are shown in Table 6-4. Roadway noise levels are shown in Table 6-5.



Source: Esri Maps & Data, 2015; Prepared By: TAHA, 2016.

0 1 2 Miles

Project Site
Borrow Sites
Haul Routes

Seg. 1- SR 136 north of SR-190
Seg.2- SR 190 between US-395 and SR-136
Seg.3- US-395 south of SR-190

Figure 6-1
Truck Noise Roadway Segments

TABLE 6-4
TOTAL DAILY HAUL TRUCK TRIPS

Alternative and Segment	2018	2019	2020	2021	2022	2023	2024
CDSM ALTERNATIVE							
Segment 1 - SR-136 north of SR-190	0	176	90	90	0	0	0
Segment 2 - SR-190 between US-395 zSR-136	0	176	90	90	0	0	0
Segment 3 - US-395 south of SR-190	2	58	350	90	0	0	0
EXCAVATE AND RECOMPACT ALTERNATIVE							
Segment 1 - SR-136 north of SR-190	0	114	90	90	0	0	0
Segment 2 - SR-190 between US-395 and SR-136	0	114	90	90	0	0	0
Segment 3 - US-395 south of SR-190	3	114	122	122	24	10	14

Source: Translutions Inc., *Transportation/Technical Report*, *North Haiwee Dam No.2 Project*, April 2017.

TABLE 6-5
ROADWAY NOISE

Alternative and Segment	Noise Levels (dBA, L_{eq})					
	Existing Condition	Future With Project	Change	Future No Project	Future With Project	Change
CDSM ALTERNATIVE						
Segment 1 - SR-136 north of SR-190	49	56	7	49	56	7
Segment 2 - SR-190 between US-395 and SR-136	41	48	7	41	48	7
Segment 3 - US-395 south of SR-190	63	65	2	64	65	1
EXCAVATE AND RECOMPACT ALTERNATIVE						
Segment 1 - SR-136 north of SR-190	49	55	6	49	55	6
Segment 2 - SR-190 between US-395 and SR-136	41	47	6	41	47	6
Segment 3 - US-395 south of SR-190	63	64	1	64	64	0

Notes: dBA = A-weighted dB scale; L_{eq} = Equivalent Noise Level; NHD2 = North Haiwee Dam No. 2
Source: FHWA, Traffic Noise Model.

CDSM Alternative

The CDSM Alternative would require truck trips from Borrow Sites 10 and 15. Truck trips associated with Borrow Site 10 would occur near the Project Site and would not utilize highways. Under the CDSM Alternative, the most truck traffic would be added to the roadway network in the year 2020. There would be approximately 22 haul trucks per hour on SR-136 and SR-190. Approximately 44 haul trucks per hour would traverse US-395. As shown in Table 6-5, roadway noise levels would not exceed the 67 or 72 dB NAC along any roadway segment, or increase noise levels by 12 dBA. Therefore, the CDSM Alternative would result in a less than significant impact related to truck noise.

Excavate and Recompact Alternative

Under the Excavate and Recompact Alternative, the most truck traffic would be added to the roadway network in the year 2019 for SR-136 and SR-190. US-395 would experience the most truck traffic in the years 2020 and 2021. There would be approximately 15 haul trucks per hour on SR-136 and SR-190. Approximately 16 haul trucks per hour would traverse US-395. As shown in Table 6-5, roadway noise levels would not exceed the 67 or 72 dB NAC along any roadway segment, or increase noise levels by 12 dBA. Therefore, the Excavate and Recompact Alternative would result in a less than significant impact related to truck noise.

6.1.3 Equipment Vibration

Construction activity can generate varying degrees of vibration, depending on the construction procedure and the construction equipment used. Operation of construction equipment generates vibrations that spread through the ground and diminish in amplitude with distance from the source. The effect on buildings located in the vicinity of a construction site often varies depending on soil type, ground strata, and construction characteristics of the receiver building(s). The results from vibration can range from no perceptible effects at the lowest vibration levels, to low rumbling sounds and perceptible vibration at moderate levels, and to slight damage at the highest levels.

In most cases, the primary concern regarding construction vibration relates to damage. Activities that can result in damage include demolition and drilling in close proximity to sensitive structures. Typical vibration levels associated with construction equipment are provided in Table 6-6. Heavy equipment (e.g., large bulldozer) generates vibration levels of 0.089 inches per second at a distance of 25 feet. This reference vibration level would be 0.19 inches per second at 15 feet, which would be below the 0.2 inches per second significance threshold. Vibration dissipates rapidly with distance (e.g., the vibration level at 15 feet is more than 1.5 times greater in comparison to vibration level at 20 feet).

TABLE 6-6
VIBRATION VELOCITIES FOR CONSTRUCTION EQUIPMENT

Equipment	Peak Particle Velocity at 25 feet (inches/second)	Peak Particle Velocity at 15 feet (inches/second)
Large Bulldozer	0.089	0.191
Caisson Drill	0.089	0.191
Loaded Truck	0.076	0.163
Jackhammer	0.035	0.075
Small Bulldozer	0.003	0.006

Source: FTA, *Transit Noise and Vibration Impact Assessment*, May 2006.

CDSM Alternative

Equipment noise levels were assessed at the Project Site and for Borrow Site 10.

North Haiwee Dam No. 2

During construction of NHD2, trucks would generally travel on unpaved roads or roadways that are not regularly maintained. As discussed above, trucks would generate a vibration level of less than the 0.2 inches-per-second significance threshold when located outside 15 feet of buildings. It is not anticipated that trucks would travel within 15 feet of the reservoir keeper’s residence on North Haiwee Road or Butterworth Ranch. Therefore, NHD2 construction activity would result in a less than significant impact related to equipment vibration.

LAA Realignment

During construction of the LAA Realignment, it is not anticipated that equipment would travel within 15 feet of the reservoir keeper’s residence on North Haiwee Road or Butterworth Ranch, which is where the only sensitive receptors to vibration are present. Therefore, LAA Realignment construction activity would result in a less than significant impact related to equipment vibration.

Cactus Flats Road Realignment

During construction of the Cactus Flats Road Realignment, it is not anticipated that equipment would travel within 15 feet of the reservoir keeper's residence on North Haiwee Road or Butterworth Ranch. Therefore, Cactus Flats Road Realignment construction activity would result in a less than significant impact related to equipment vibration.

Basin and Berms

During construction of the basin and berms, it is not anticipated that equipment would travel within 15 feet of the reservoir keeper's residence on North Haiwee Road or Butterworth Ranch. Therefore, basin and berms construction activity would result in a less than significant impact related to equipment vibration.

Notch

During construction of the notch, it is not anticipated that equipment would travel within 15 feet of the reservoir keeper's residence on North Haiwee Road or Butterworth Ranch. Therefore, notch construction activity would result in a less than significant impact related to equipment vibration.

Diversion Channel

During construction of the diversion channel, it is not anticipated that equipment would travel within 15 feet of the reservoir keeper's residence on North Haiwee Road or Butterworth Ranch. Therefore, diversion channel construction activity would result in a less than significant impact related to equipment vibration.

Borrow Site 10

Construction activities at Borrow Site 10 would not require equipment to travel within 15 feet of the reservoir keeper's residence on North Haiwee Road or Butterworth Ranch. Therefore, Borrow Site 10 construction activity would result in a less than significant impact related to equipment vibration.

Excavate and Recompact Alternative

Similar to the CDSM Alternative, construction activity would results in less than significant impacts for all of the Proposed Project components.

6.1.4 Truck Vibration on Haul Routes

Haul trucks would travel on paved and unpaved roads. Rubber-tired vehicles do not typically generate perceptible vibration on well-maintained, paved roads (FTA, 2006). Trucks traveling on unpaved roads would generate 0.076 inches per second of vibration at 25 feet. This reference vibration level would be 0.18 inches per second at 14 feet, which would be below the 0.2 inches per second significance threshold.

CDSM Alternative

Truck vibration levels were assessed at the Project Site and for each Borrow Site.

North Haiwee Dam No. 2

During construction of NHD2, trucks would generally travel on unpaved roads or roadways that are not regularly maintained. As discussed above, trucks would generate a vibration level less than the significance threshold of 0.2 inches per second when located further than 14 feet from buildings. It is not anticipated that trucks would travel within 14 feet of the reservoir keeper's residence at North Haiwee Road or Butterworth Ranch. Therefore, NHD2 construction activity would result in a less than significant impact related to truck vibration.

LAA Realignment

During construction of the LAA Realignment, it is not anticipated that trucks would travel within 14 feet of the reservoir keeper's residence on North Haiwee Road or Butterworth Ranch. Therefore, LAA Realignment construction activity would result in a less than significant impact related to truck vibration.

Cactus Flats Road Realignment

During construction of the Cactus Flats Road Realignment, it is not anticipated that trucks would travel within 14 feet of the reservoir keeper's residence on North Haiwee Road or Butterworth Ranch. Therefore, Cactus Flats Road Realignment construction activity would result in a less than significant impact related to truck vibration.

Basin and Berms

During construction of the basin and berms, it is not anticipated that trucks would travel within 14 feet of the reservoir keeper's residence on North Haiwee Road or Butterworth Ranch. Therefore, basin and berms construction activity would result in a less than significant impact related to truck vibration.

Notch

During construction of the notch, it is not anticipated that trucks would travel within 14 feet of the reservoir keeper's residence on North Haiwee Road or Butterworth Ranch. Therefore, notch construction activity would result in a less than significant impact related to truck vibration.

Diversion Channel

During construction of the diversion channel, it is not anticipated that trucks would travel within 14 feet of the reservoir keeper's residence on North Haiwee Road or Butterworth Ranch. Therefore, diversion channel construction activity would result in a less than significant impact related to truck vibration.

Borrow Sites

Borrow Site 10

For haul routes associated with Borrow Site 10, it is not anticipated that trucks would travel within 14 feet of the reservoir keeper's residence on North Haiwee Road or Butterworth Ranch. Therefore, Borrow Site 10 construction activity would result in a less than significant impact related to truck vibration.

Borrow Site 15

For haul routes associated with Borrow Site 15, it is not anticipated that trucks would travel within 14 feet of any residence. Trucks associated with Borrow Site 15 would also travel on US-395 and other well-maintained paved roads. FTA has determined that rubber-tired vehicles on well-maintained paved roads do not generate perceptible vibration. Consequently, trucks traveling on the paved roadway network would have no potential to damage buildings located along these paved roadways. Therefore, Borrow Site 15 construction activity would result in a less than significant impact related to truck vibration.

Excavate and Recompact Alternative

As discussed above, truck vibration would result in less than significant impacts for all of the Proposed Project components. Therefore, the Excavate and Recompact Alternative construction activity would result in a less than significant impact related to truck vibration.

6.2 Operational Impacts

6.2.1 Noise

CDSM Alternative

Operational noise levels were assessed at the Project Site.

North Haiwee Dam No. 2

The NHD2 does not include significant sources of operational noise. Maintenance activity would generally be limited to site visits from the reservoir-keeper employee, which would not include the operation of heavy equipment. There is no potential for a permanent increase in existing noise levels above the 5-dBA CNEL significance threshold. Therefore, NHD2 activity would result in a less than significant impact related to operational noise.

LAA Realignment

The LAA Realignment does not include significant sources of new operational noise, such as mechanical equipment. Running water would produce low levels of operational noise which would be similar to existing conditions. There is no potential for a permanent increase in existing noise levels above the 5-dBA CNEL significance threshold. Therefore, LAA Realignment activity would result in a less than significant impact related to operational noise.

Cactus Flats Road Realignment

The Cactus Flats Road Realignment does not include significant sources of operational noise. Traffic on Cactus Flats Road is infrequent and not a significant source of noise to the reservoir keeper's residence on North Haiwee Road or Butterworth Ranch. The Proposed Project would not generate new traffic on Cactus Flats Road, and future noise levels would be similar to existing noise levels. There is no potential for a permanent increase in existing noise levels above the 5-dBA CNEL significance threshold. Therefore, Cactus Flats Road Realignment activity would result in a less than significant impact related to operational noise.

Basin and Berms

The basin and berms do not include significant sources of operational noise. Maintenance activity would generally be limited to site visits from the reservoir keeper, and would not include the operation of heavy equipment. Running water would produce low levels of operational noise which would be similar to existing conditions. There is no potential for a permanent increase in existing noise levels above the 5-dBA CNEL significance threshold. Therefore, basin and berms activity would result in a less than significant impact related to operational noise.

Notch

The notch does not include significant sources of new operational noise, such as mechanical equipment. Running water would produce low levels of operational noise which would be similar to existing conditions. There is no potential for a permanent increase in existing noise levels above the 5-dBA CNEL significance threshold. Therefore, notch activity would result in a less than significant impact related to operational noise.

Diversion Channel

The diversion channel does not include significant sources of new operational noise, such as continuously operating mechanical equipment. Running water would produce low levels of operational noise which would be similar to existing conditions. There is no potential for a permanent increase in existing noise levels above the 5-dBA CNEL significance threshold. Therefore, diversion channel activity would result in a less than significant impact related to operational noise.

Borrow Site 10

No operational activity related to the Proposed Project would occur at Borrow Site 10, and noise levels would be similar to existing conditions. There is no potential for a permanent increase in existing noise levels above the 5-dBA CNEL significance threshold. Therefore, Borrow Site 10 would result in no impact related to operational noise.

Excavate and Recompact Alternative

As discussed above, operational noise would result in less than significant impacts for the all of the Proposed Project components. Therefore, the Excavate and Recompact Alternative would result in a less than significant impact related to operational noise.

6.2.2 Vibration

CDSM Alternative

Operational vibration levels were assessed at the Project Site.

North Haiwee Dam No. 2

The NHD2 does not include sources of operational vibration. Therefore, NHD2 would result in no impact related to operational vibration.

LAA Realignment, Basin, and Notch

The LAA Realignment, basin, and notch do not include significant sources of operational vibration. Water rushing through the LAA generates low levels of vibration. However, based on field visits, the vibration is not perceptible adjacent to the channel. The LAA Realignment, basin, and notch would not generate perceptible vibration at a new location beyond the existing vibration conditions. Therefore, the LAA Realignment would result in a less than significant impact related to operational vibration.

Cactus Flats Road Realignment

The Cactus Flats Road Realignment does not include significant sources of operational vibration. Traffic on Cactus Flats Road is infrequent and not a significant source of vibration to the reservoir keeper’s residence on North Haiwee Road or Butterworth Ranch. In addition, the location with the shortest distance between Cactus Flats Road and the residences would not change with the Proposed Project. There would be no change to traffic-related vibration levels at receptors as a result of the Cactus Flats Road Realignment. Therefore, Cactus Flats Road Realignment activity would result in a less than significant impact related to operational vibration.

Borrow Site 10

No operational activity related to the Proposed Project would occur at Borrow Site 10. Therefore, Borrow Site 10 would result in no impact related to operational vibration.

Excavate and Recompact Alternative

As discussed above for each location, operational vibration would result in no impacts for NHD2, LAA Realignment, the basin and berms, and other Proposed Project components, and Borrow Site 10, and a less than significant impact for the Cactus Flats Road Realignment. Therefore, the Excavate and Recompact Alternative would result in a less than significant impact related to operational vibration.

6.3 Cumulative Impacts

6.3.1 Noise

Cumulative noise and vibration have been assessed for construction and operational activities. Noise and vibration are localized impacts, typically limited to within a few hundred feet of the source. Construction activities at the Project Site are sufficiently isolated such that no related projects have the potential to generate noise or vibration that would coincide with Project-related noise and vibration. The truck analysis was based on the traffic study, which accounted for cumulative traffic in the future conditions. As no impact related to traffic levels or congestion was identified in the Project analysis, there is no potential for the Proposed Project to contribute to cumulative off-site noise or vibration impacts. Borrow Site 15 is an existing mine and the Proposed Project would not generate new noise or vibration at this site. Therefore, no significant cumulative construction noise or vibration impacts at the Project Site are anticipated as a result of the Proposed Project.

As discussed above, the Proposed Project would not result in significant new operational noise or vibration impacts. Operational noise and vibration levels associated NHD2, LAA Realignment, Cactus Flats Road Realignment, the basin and berms, and other Proposed Project components would be similar to existing conditions, and no Project-related operational activity would occur at Borrow Site 10. Therefore, no significant cumulative operational noise or vibration impacts are anticipated as a result of the Proposed Project.

7 Mitigation Measures

7.1 Mitigation Measures Related to Construction Impacts

The following mitigation measures apply to the CDSM and Excavate and Recompact Alternatives for construction equipment activities associated with the Proposed Project components.

NV-A Construction equipment shall be properly maintained and equipped with mufflers.

NV-B Rubber-tired equipment rather than tracked equipment shall be used when operating on flat terrain.

NV-C Equipment shall be turned off when not in use for an excess of five minutes, except for equipment that requires idling to maintain performance.

NV-D The construction contractor shall locate construction staging areas away from sensitive uses.

NV-E LADWP or their contractor shall designate a public liaison for construction of the Proposed Project construction. The public liaison will be responsible for addressing public concerns about construction activities, including excessive noise. As needed, the liaison shall determine the cause of the concern (e.g., starting too early, bad muffler) and implement measures to address the concern.

NV-F LADWP shall provide ear protection to sensitive receptors which would experience noise increases greater than 5 dBA after implementation of mitigation measures NV-A through NV-E.

7.2 Mitigation Measures Related to Operational Impacts

There are no significant impacts related to the operation of the Proposed Project and therefore, no mitigation measures are proposed.

7.3 Mitigation Measures Related to Cumulative Impacts

There are no significant impacts related to the cumulative effects of the Proposed Project and therefore, no mitigation measures are proposed.

8 CEQA Significance Conclusions

Consistent with Appendix G of the CEQA Guidelines, the Proposed Project would result in a significant impact to noise and vibration if it would:

- Create levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies, or result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project;
- Expose people to or generate excessive ground-borne vibration or ground-borne noise levels;
- Create a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project; and/or
- Create a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.

As described above, the Proposed Project would have significant impacts related to construction equipment noise. The Proposed Project would not result in significant impacts related to construction haul truck noise, construction vibration, operational noise, or operational vibration. However, unmitigated construction equipment noise associated with NHD2, west and east berms, basin grading, LAA Realignment, diversion structure and bridge, Cactus Flats Road Realignment, notch, diversion channel, and Borrow Site 10 would exceed the 5-dBA L_{eq} significance threshold. Mitigation Measures NV-A through NV-F in Section 7.1 are designed to reduce construction noise levels. The equipment mufflers associated with mitigation measure NV-A would reduce construction noise levels by approximately 3 dBA. Mitigation Measures NV-B through NV-F, although difficult to quantify, would also reduce and/or control construction noise levels. Other measures were considered, such as electric equipment. However, electric equipment would generate less noise than diesel equipment, but is not widely available, and the horsepower associated with electric equipment would not meet Proposed Project requirements. Mitigated noise levels are shown in Tables 8-1 and 8-2 for the CDSM and Excavate and Recompact Alternatives, respectively. Equipment noise levels would still exceed the 5-dBA L_{eq} significance threshold at sensitive receptors (reservoir keeper's residence and Butterworth Ranch) near the Project Site and Borrow Site 10. Therefore, construction equipment noise related to the NHD2, west and east Berms, basin grading, LAA Realignment, diversion structure and bridge, Cactus Flats Road Realignment, diversion channel, and Borrow Site 10 would result in significant and unavoidable impacts to the reservoir keeper's residence and Butterworth Ranch under the CDSM and Excavate and Recompact Alternatives. With implementation of mitigation measures, construction equipment noise related to the proposed Notch would result in less than significant impacts to Butterworth Ranch, but would result in significant and unavoidable impacts to the reservoir keeper's residence.

TABLE 8-1
CDSM ALTERNATIVE - EQUIPMENT NOISE LEVELS - MITIGATED

Elements and Sensitive Receptors	Distance (Feet)	Estimated dBA, L_{eq}			
		Equipment Noise Level	Existing Noise Level	New Ambient Noise Level	Noise Increase[a]
NHD2					
Reservoir Keeper's Residence	600	59.0	36.9	59.0	**22.1**
Butterworth Ranch	2,700	42.7	36.9	43.7	**6.8**
LAA REALIGNMENT					
Reservoir Keeper's Residence	Adjacent	86.0	36.9	86.0	**49.1**
Butterworth Ranch	2,000	45.9	36.9	46.5	**9.6**
CACTUS FLATS ROAD REALIGNMENT					
Reservoir Keeper's Residence	1,800	47.1	36.9	47.5	**10.6**
Butterworth Ranch	1,800	47.1	36.9	47.5	**10.6**
BASIN AND BERMS					
Reservoir Keeper's Residence	200	70.9	36.9	71.0	**34.1**
Butterworth Ranch	2,930	41.8	36.9	43.0	**6.1**
NOTCH					
Reservoir Keeper's Residence	1,450	49.4	36.9	49.7	**12.8**
Butterworth Ranch	4,000	38.4	36.9	40.7	3.8
DIVERSION CHANNEL AND STRUCTURES					
Reservoir Keeper's Residence	450	62.1	36.9	62.2	**25.3**
Butterworth Ranch	3,000	41.5	36.9	42.8	**5.9**
BORROW SITE 10					
Reservoir Keeper's Residence	50	86.0	36.9	86.0	**49.1**
Butterworth Ranch	1,700	47.7	36.9	48.1	**11.2**

Notes: dBA = A-weighted dB scale; L_{eq} = Equivalent Noise Level; NHD2 = North Haiwee Dam No. 2
[a] The threshold for noise increase is 5 dBA L_{eq}. Increases meeting or exceeding this threshold are shown in **bold** text.
Source: Terry A. Hayes Associates Inc., 2015.

TABLE 8-2
EXCAVATE AND RECOMPACT ALTERNATIVE - EQUIPMENT NOISE LEVELS - MITIGATED

Elements and Sensitive Receptors	Distance (Feet)	Estimated dBA, L_{eq}			
		Equipment Noise Level	Existing Noise Level	New Ambient Noise Level	Noise Increase[a]
NHD2					
Reservoir Keeper's Residence	600	59.0	36.9	59.0	**22.1**
Butterworth Ranch	2,700	42.7	36.9	43.7	**6.8**
LAA REALIGNMENT					
Reservoir Keeper's Residence	Adjacent	86.0	36.9	86.0	**49.1**
Butterworth Ranch	2,000	45.9	36.9	46.5	**9.6**
CACTUS FLATS ROAD REALIGNMENT					
Reservoir Keeper's Residence	1,800	47.1	36.9	47.5	**10.6**
Butterworth Ranch	1,800	47.1	36.9	47.5	**10.6**
BASIN AND BERMS					
Reservoir Keeper's Residence	200	70.9	36.9	71.0	**34.1**
Butterworth Ranch	2,930	41.8	36.9	43	**6.1**
NOTCH					
Reservoir Keeper's Residence	1,450	49.4	36.9	49.7	**12.8**
Butterworth Ranch	4,000	38.4	36.9	40.7	3.8
DIVERSION CHANNEL AND STRUCTURES					
Reservoir Keeper's Residence	450	62.1	36.9	62.2	**25.3**
Butterworth Ranch	3,000	41.5	36.9	42.8	**5.9**
BORROW SITE 10					
Reservoir Keeper's Residence	50	86.0	36.9	86.0	**49.1**
Butterworth Ranch	1,700	47.7	36.9	48.1	**11.2**

Notes: dBA = A-weighted dB scale; L_{eq} = Equivalent Noise Level; NHD2 = North Haiwee Dam No. 2
[a] The threshold for noise increase is 5 dBA L_{eq}. Increases meeting or exceeding this threshold are shown in **bold** text.
Source: Terry A. Hayes Associates Inc., 2015.

9 NEPA Impacts Summary

Construction noise would be audible at the nearby land uses, but would be intermittent and variable depending on the location and intensity of activity. Refer to the above analysis for the quantification of noise and vibration levels. Mitigation Measures NV-A through NV-F would be implemented to control temporary construction noise. The Proposed Project does not include significant sources of new operational noise.

10 References

City of Los Angeles, City of L.A. CEQA Thresholds Guide, 2006.

California Department of Transportation, Technical Noise Supplement, November 2009.

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11 List of Abbreviations and Acronyms

BLM	The Bureau of Land Management
Caltrans	California Department of Transportation
CDSM	Cement Deep Soil Mixing
CEQA	California Environmental Quality Act
CNEL	Community Noise Equivalent Level
dB	Decibels
dBA	A-weighted decibel(s)
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
LAA	Los Angeles Aqueduct
LADWP	Los Angeles Department of Water and Power
L_{eq}	Equivalent Noise Level
NAC	Noise Abatement Criteria
NEPA	National Environmental Policy Act
NHD	North Haiwee Dam or existing Dam
NHD2	North Haiwee Dam No. 2 or new Dam
NHR	North Haiwee Reservoir
PPV	Peak Particle Velocity
RMS	Root Mean Square
SR-	State Route
TNM	Traffic Noise Model
US-	U.S. Highway
USEPA	United States Environmental Protection Agency
Vdb	Vibration Decibels

12 Preparer Qualifications

12.1 Terry A. Hayes Associates Inc.

Sam Silverman, Noise Technical Lead

Seyedehsan Hosseini, PhD, Environmental Scientist

Rosa Soria, Graphic Artist

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Appendix

Construction Noise

EQUIPMENT NOISE - UNMITIGATED

Reference Noise Distance	**50**					
Reference Noise Level	**89**					
Sensitive Receptor	**Distance (feet)**	**Attenuation Factors**	**Maximum Construction Noise Level (dBA)**	**Existing Ambient (dBA, Leq)**	**New Ambient (dBA, Leq)**	**Increase**
NHD2						
Residence Adjacent to Dam	600	0	**62.0**	36.9	**62.0**	**25.1**
Butterworth Ranch	2,700	0	**45.7**	36.9	**46.2**	**9.3**
LAA Realignment						
Residence Adjacent to Dam	50	0	**89.0**	36.9	**89.0**	**52.1**
Butterworth Ranch	2,000	0	**48.9**	36.9	**49.2**	**12.3**
Cactus Flats Road Realignment						
Residence Adjacent to Dam	1,800	0	**50.1**	36.9	**50.3**	**13.4**
Butterworth Ranch	1,800	0	**50.1**	36.9	**50.3**	**13.4**
Basin and Berms						
Residence Adjacent to Dam	200	0	**73.9**	36.9	**73.9**	**37.0**
Butterworth Ranch	870	0	**58.0**	36.9	**58.0**	**21.1**
Notch						
Residence Adjacent to Dam	1,450	0	**52.4**	36.9	**52.6**	**15.7**
Butterworth Ranch	2,970	0	**44.7**	36.9	**45.3**	**8.4**
Diversion Channel and Structures						
Residence Adjacent to Dam	450	0	**65.1**	36.9	**65.2**	**28.3**
Butterworth Ranch	3,000	0	**44.5**	36.9	**45.2**	**8.3**
Borrow Site 9						
Residence on Sage Flats Road	1,300	0	**53.6**	60.0	**60.9**	**0.9**
Borrow Site 10						
Residence Adjacent to Dam	50	0	**89.0**	36.9	**89.0**	**52.1**
Butterworth Ranch	1,700	0	**50.7**	36.9	**50.9**	**14.0**
Borrow Site 15						
Residence in Swansea	5,000	10	**29.0**	61.6	**61.6**	**0.0**
Borrow Site 24						
Residence on Enchanted Lake Road	3,000	0	**44.5**	60.7	**60.8**	**0.1**

EQUIPMENT NOISE - MITIGATED

Reference Noise Distance	**50**					
Reference Noise Level	**89**					
Sensitive Receptor	**Distance (feet)**	**Attenuation Factors**	**Maximum Construction Noise Level (dBA)**	**Existing Ambient (dBA, Leq)**	**New Ambient (dBA, Leq)**	**Increase**
NHD2						
Residence Adjacent to Dam	600	3	**59.0**	36.9	**59.0**	**22.1**
Butterworth Ranch	2,700	3	**42.7**	36.9	**43.7**	**6.8**
LAA Realignment						
Residence Adjacent to Dam	50	3	**86.0**	36.9	**86.0**	**49.1**
Butterworth Ranch	2,000	3	**45.9**	36.9	**46.5**	**9.6**
Cactus Flats Road Realignment						
Residence Adjacent to Dam	1,800	3	**47.1**	36.9	**47.5**	**10.6**
Butterworth Ranch	1,800	3	**47.1**	36.9	**47.5**	**10.6**
Basin and Berms						
Residence Adjacent to Dam	200	3	**70.9**	36.9	**71.0**	**34.1**
Butterworth Ranch	870	3	**55.0**	36.9	**55.1**	**18.2**
Notch						
Residence Adjacent to Dam	1,450	3	**49.4**	36.9	**49.7**	**12.8**
Butterworth Ranch	2,970	3	**41.7**	36.9	**42.9**	**6.0**
Diversion Channel and Structures						
Residence Adjacent to Dam	450	3	**62.1**	36.9	**62.2**	**25.3**
Butterworth Ranch	3,000	3	**41.5**	36.9	**42.8**	**5.9**
Borrow Site 9						
Residence on Sage Flats Road	1,300	3	**50.6**	60.0	**60.5**	**0.5**
Borrow Site 10						
Residence Adjacent to Dam	50	3	**86.0**	36.9	**86.0**	**49.1**
Butterworth Ranch	1,700	3	**47.7**	36.9	**48.1**	**11.2**
Borrow Site 15						
Residence in Swansea	5,000	13	**26.0**	61.6	**61.6**	**0.0**
Borrow Site 24						
Residence on Enchanted Lake Road	3,000	3	**41.5**	60.7	**60.8**	**0.1**

TNM Model Runs

Abbreviations

- **CDSM:Cement and Deep Soil Mixing Alternative**
- **ERA: Excavate and Recompact Alternative (ERA)**
- **SEG1: Segment 1 – SR-136 north of SR-190**
- **SEG2: Segment 2 – SR-190 between US-395 and SR-136**
- **SEG3: Segment 3 –US-395 south of SR-190**

Existing Conditions

Terry A. Hayes Associates					**20 April 2017**							
Ehsan Hosseini, PhD/ Sam Silverman					**TNM 2.5**							
INPUT: ROADWAYS							**Average pavement type shall be used unless**					
PROJECT/CONTRACT:	**North Haiwee Dam No.2 Project**						**a State highway agency substantiates the use**					
RUN:	**Existing - SEG1**						**of a different type with the approval of FHWA**					
Roadway		**Points**										
Name	**Width**	**Name**	**No.**	**Coordinates (pavement)**			**Flow Control**			**Segment**		
				X	**Y**	**Z**	**Control Device**	**Speed Constraint**	**Percent Vehicles Affected**	**Pvmt Type**	**On Struct?**	
	m			m	m	m		km/h	%			
Freeway	7.3	point3	3	-500.0	0.0	0.00				Average		
		point4	4	1,500.0	0.0	0.00						

Terry A. Hayes Associates **20 April 2017**
Ehsan Hosseini, PhD/ Sam Silverman **TNM 2.5**

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: **North Haiwee Dam No.2 Project**
RUN: **Existing - SEG1**

Roadway	**Points**												
Name	**Name**	**No.**	**Segment**										
			Autos		**MTrucks**		**HTrucks**		**Buses**		**Motorcycles**		
			V	**S**	**V**	**S**	**V**	**S**	**V**	**S**	**V**	**S**	
			veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	
Freeway	point3	3	50	65	0	0	2	65	0	0	0	0	
	point4	4											

Terry A. Hayes Associates **20 April 2017**
Ehsan Hosseini, PhD/ Sam Silverman **TNM 2.5**

INPUT: RECEIVERS
PROJECT/CONTRACT: **North Haiwee Dam No.2 Project**
RUN: **Existing - SEG1**

Receiver											
Name	**No.**	**#DUs**	**Coordinates (ground)**			**Height**	**Input Sound Levels and Criteria**				**Active**
			X	**Y**	**Z**	**above**	**Existing**	**Impact Criteria**		**NR**	**in**
						Ground	**LAeq1h**	**LAeq1h**	**Sub'l**	**Goal**	**Calc.**
			m	m	m	m	dBA	dBA	dB	dB	
Receptor at 100 feet	1	1	500.0	34.1	0.00	1.50	0.00	66	10.0	8.0	Y

Terry A. Hayes Associates							**20 April 2017**					
Ehsan Hosseini, PhD/ Sam Silverman							**TNM 2.5**					
							Calculated with TNM 2.5					
RESULTS: SOUND LEVELS												
PROJECT/CONTRACT:		**North Haiwee Dam No.2 Project**										
RUN:		**Existing - SEG1**										
BARRIER DESIGN:		**INPUT HEIGHTS**						**Average pavement type shall be used unless**				
								a State highway agency substantiates the use				
ATMOSPHERICS:		**20 deg C, 50% RH**						**of a different type with approval of FHWA.**				
Receiver												
Name	**No.**	**#DUs**	**Existing**	**No Barrier**					**With Barrier**			
			LAeq1h	**LAeq1h**		**Increase over existing**		**Type**	**Calculated**	**Noise Reduction**		
				Calculated	**Crit'n**	**Calculated**	**Crit'n**	**Impact**	**LAeq1h**	**Calculated**	**Goal**	**Calculated**
							Sub'l Inc					**minus**
												Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receptor at 100 feet	1	1	0.0	49.2	66	49.2	10	----	49.2	0.0	8	-8.0

Dwelling Units	**# DUs**	**Noise Reduction**		
		Min	**Avg**	**Max**
		dB	**dB**	**dB**
All Selected	1	0.0	0.0	0.0
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

Terry A. Hayes Associates			**20 April 2017**	
Ehsan Hosseini, PhD/ Sam Silverman			**TNM 2.5**	
			Calculated with TNM 2.5	
RESULTS: SOUND-LEVEL DIAGNOSIS BY VEHICLE TYPE				
PROJECT/CONTRACT:	**North Haiwee Dam No.2 Project**			
RUN:	**Existing - SEG1**			
BARRIER DESIGN:	**INPUT HEIGHTS**			
ATMOSPHERICS:	**20 deg C, 50% RH**			
Receivers				
Name	**No.**	**Total**	**Vehicle Type**	
		LAeq1h	**Name**	**Partial**
				LAeq1h
		dBA		dBA
Receptor at 100 feet	1	49.2	Autos	47.3
			MTrucks	
			HTrucks	44.8
			Buses	
			Motorcycles	

Terry A. Hayes Associates 20 April 2017
Ehsan Hosseini, PhD/Sam Silverman TNM 2.5

INPUT: ROADWAYS

PROJECT/CONTRACT: North Haiwee Dam No.2 Project
RUN: Existing - SEG2

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with the approval of FHWA

Roadway Name	Width	Points Name	No.	Coordinates (pavement) X	Y	Z	Flow Control Control Device	Speed Constraint	Percent Vehicles Affected	Segment Pvmt Type	On Struct?
	m			m	m	m		km/h	%		
SR-190	7.3	point3	3	-500.0	0.0	0.00				Average	
		point4	4	1,500.0	0.0	0.00					

Terry A. Hayes Associates				**20 April 2017**									
Ehsan Hosseini, PhD/Sam Silverman				**TNM 2.5**									
INPUT: TRAFFIC FOR LAeq1h Volumes													
PROJECT/CONTRACT:	**North Haiwee Dam No.2 Project**												
RUN:	**Existing - SEG2**												
Roadway	**Points**												
Name	**Name**	**No.**	**Segment**										
			Autos		**MTrucks**		**HTrucks**		**Buses**		**Motorcycles**		
			V	**S**	**V**	**S**	**V**	**S**	**V**	**S**	**V**	**S**	
			veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	
SR-190	point3	3	25	65	0	0	5	65	0	0	0	0	
	point4	4											

Terry A. Hayes Associates **20 April 2017**
Ehsan Hosseini, PhD/Sam Silverman **TNM 2.5**

INPUT: RECEIVERS
PROJECT/CONTRACT: **North Haiwee Dam No.2 Project**
RUN: **Existing - SEG2**

Receiver											
Name	**No.**	**#DUs**	**Coordinates (ground)**			**Height**	**Input Sound Levels and Criteria**				**Active**
			X	**Y**	**Z**	**above**	**Existing**	**Impact Criteria**		**NR**	**in**
						Ground	**LAeq1h**	**LAeq1h**	**Sub'l**	**Goal**	**Calc.**
			m	m	m	m	dBA	dBA	dB	dB	
Receptor at 100 meters	1	1	500.0	100.2	0.00	1.50	0.00	66	10.0	8.0	Y

Terry A. Hayes Associates							**20 April 2017**					
Ehsan Hosseini, PhD/Sam Silverman							**TNM 2.5**					
							Calculated with TNM 2.5					
RESULTS: SOUND LEVELS												
PROJECT/CONTRACT:		**North Haiwee Dam No.2 Project**										
RUN:		**Existing - SEG2**										
BARRIER DESIGN:		**INPUT HEIGHTS**						**Average pavement type shall be used unless**				
								a State highway agency substantiates the use				
ATMOSPHERICS:		**20 deg C, 50% RH**						**of a different type with approval of FHWA.**				
Receiver												
Name	**No.**	**#DUs**	**Existing**	**No Barrier**					**With Barrier**			
			LAeq1h	**LAeq1h**		**Increase over existing**		**Type**	**Calculated**	**Noise Reduction**		
				Calculated	**Crit'n**	**Calculated**	**Crit'n**	**Impact**	**LAeq1h**	**Calculated**	**Goal**	**Calculated**
							Sub'l Inc					**minus**
												Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receptor at 100 meters	1	1	0.0	41.2	66	41.2	10	----	41.2	0.0	8	-8.0

Dwelling Units		**# DUs**	**Noise Reduction**		
			Min	**Avg**	**Max**
			dB	**dB**	**dB**
All Selected		1	0.0	0.0	0.0
All Impacted		0	0.0	0.0	0.0
All that meet NR Goal		0	0.0	0.0	0.0

Terry A. Hayes Associates			**20 April 2017**	
Ehsan Hosseini, PhD/Sam Silverman			**TNM 2.5**	
			Calculated with TNM 2.5	
RESULTS: SOUND-LEVEL DIAGNOSIS BY VEHICLE TYPE				
PROJECT/CONTRACT:	**North Haiwee Dam No.2 Project**			
RUN:	**Existing - SEG2**			
BARRIER DESIGN:	**INPUT HEIGHTS**			
ATMOSPHERICS:	**20 deg C, 50% RH**			
Receivers				
Name	**No.**	**Total**	**Vehicle Type**	
		LAeq1h	**Name**	**Partial**
				LAeq1h
		dBA		dBA
Receptor at 100 meters	1	41.2	Autos	32.9
			MTrucks	
			HTrucks	40.6
			Buses	
			Motorcycles	

Terry A. Hayes Associates					**20 April 2017**							
Ehsan Hosseini, PhD/Sam Silverman					**TNM 2.5**							
INPUT: ROADWAYS							**Average pavement type shall be used unless**					
PROJECT/CONTRACT:	**North Haiwee Dam No.2 Project**						**a State highway agency substantiates the use**					
RUN:	**Existing - SEG3**						**of a different type with the approval of FHWA**					
Roadway		**Points**										
Name	**Width**	**Name**	**No.**	**Coordinates (pavement)**			**Flow Control**			**Segment**		
				X	**Y**	**Z**	**Control Device**	**Speed Constraint**	**Percent Vehicles Affected**	**Pvmt Type**	**On Struct?**	
	m			m	m	m		km/h	%			
SR-190	7.3	point3	3	-500.0	0.0	0.00				Average		
		point4	4	1,500.0	0.0	0.00						

Terry A. Hayes Associates **20 April 2017**
Ehsan Hosseini, PhD/Sam Silverman **TNM 2.5**

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: **North Haiwee Dam No.2 Project**
RUN: **Existing - SEG3**

Roadway	Points												
Name	Name	No.	Segment										
			Autos		MTrucks		HTrucks		Buses		Motorcycles		
			V	S	V	S	V	S	V	S	V	S	
			veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	
SR-190	point3	3	458	65	0	0	114	65	0	0	0	0	
	point4	4											

Terry A. Hayes Associates **20 April 2017**
Ehsan Hosseini, PhD/Sam Silverman **TNM 2.5**

INPUT: RECEIVERS
PROJECT/CONTRACT: **North Haiwee Dam No.2 Project**
RUN: **Existing - SEG3**

Receiver

Name	No.	#DUs	Coordinates (ground)			Height	Input Sound Levels and Criteria				Active
			X	Y	Z	above	Existing	Impact Criteria		NR	in
						Ground	LAeq1h	LAeq1h	Sub'l	Goal	Calc.
			m	m	m	m	dBA	dBA	dB	dB	
Receptor at 100 feet	1	1	500.0	34.1	0.00	1.50	0.00	66	10.0	8.0	Y

Terry A. Hayes Associates
Ehsan Hosseini, PhD/Sam Silverman

20 April 2017
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS

PROJECT/CONTRACT: North Haiwee Dam No.2 Project
RUN: Existing - SEG3
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 20 deg C, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receptor at 100 feet	1	1	0.0	63.4	66	63.4	10	----	63.4	0.0	8	-8.0

Dwelling Units	# DUs	Noise Reduction Min	Avg	Max
		dB	dB	dB
All Selected	1	0.0	0.0	0.0
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

Terry A. Hayes Associates			**20 April 2017**	
Ehsan Hosseini, PhD/Sam Silverman			**TNM 2.5**	
			Calculated with TNM 2.5	
RESULTS: SOUND-LEVEL DIAGNOSIS BY VEHICLE TYPE				
PROJECT/CONTRACT:	**North Haiwee Dam No.2 Project**			
RUN:	**Existing - SEG3**			
BARRIER DESIGN:	**INPUT HEIGHTS**			
ATMOSPHERICS:	**20 deg C, 50% RH**			
Receivers				
Name	**No.**	**Total**	**Vehicle Type**	
		LAeq1h	**Name**	**Partial**
				LAeq1h
		dBA		dBA
Receptor at 100 feet	1	63.4	Autos	56.9
			MTrucks	
			HTrucks	62.3
			Buses	
			Motorcycles	

Future: No Build Alternative

Terry A. Hayes Associates **20 April 2017**
Ehsan Hosseini, PhD/ Sam Silverman **TNM 2.5**

INPUT: ROADWAYS
PROJECT/CONTRACT: **North Haiwee Dam No.2 Project**
RUN: **Future without Project - SEG1**

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with the approval of FHWA

Roadway Name	Width	Points Name	No.	Coordinates (pavement) X	Y	Z	Flow Control Control Device	Speed Constraint	Percent Vehicles Affected	Segment Pvmt Type	On Struct?
	m			m	m	m		km/h	%		
Freeway	7.3	point3	3	-500.0	0.0	0.00				Average	
		point4	4	1,500.0	0.0	0.00					

Terry A. Hayes Associates **20 April 2017**
Ehsan Hosseini, PhD/ Sam Silverman **TNM 2.5**

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: **North Haiwee Dam No.2 Project**
RUN: **Future without Project - SEG1**

Roadway	Points												
Name	**Name**	**No.**	**Segment**										
			Autos		**MTrucks**		**HTrucks**		**Buses**		**Motorcycles**		
			V	**S**	**V**	**S**	**V**	**S**	**V**	**S**	**V**	**S**	
			veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	
Freeway	point3	3	53	65	0	0	2	65	0	0	0	0	
	point4	4											

Terry A. Hayes Associates — **20 April 2017**
Ehsan Hosseini, PhD/ Sam Silverman — **TNM 2.5**

INPUT: RECEIVERS
PROJECT/CONTRACT: **North Haiwee Dam No.2 Project**
RUN: **Future without Project - SEG1**

Receiver											
Name	**No.**	**#DUs**	**Coordinates (ground)**			**Height**	**Input Sound Levels and Criteria**				**Active**
			X	**Y**	**Z**	**above**	**Existing**	**Impact Criteria**		**NR**	**in**
						Ground	**LAeq1h**	**LAeq1h**	**Sub'l**	**Goal**	**Calc.**
			m	m	m	m	dBA	dBA	dB	dB	
Receptor at 100 feet	1	1	500.0	34.1	0.00	1.50	0.00	66	10.0	8.0	Y

Terry A. Hayes Associates							**20 April 2017**					
Ehsan Hosseini, PhD/ Sam Silverman							**TNM 2.5**					
							Calculated with TNM 2.5					
RESULTS: SOUND LEVELS												
PROJECT/CONTRACT:		**North Haiwee Dam No.2 Project**										
RUN:		**Future without Project - SEG1**										
BARRIER DESIGN:		**INPUT HEIGHTS**						**Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.**				
ATMOSPHERICS:		**20 deg C, 50% RH**										

Receiver Name	**No.**	**#DUs**	**Existing LAeq1h**	**No Barrier LAeq1h Calculated**	**Crit'n**	**Increase over existing Calculated**	**Crit'n Sub'l Inc**	**Type Impact**	**With Barrier Calculated LAeq1h**	**Noise Reduction Calculated**	**Goal**	**Calculated minus Goal**
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receptor at 100 feet	1	1	0.0	49.4	66	49.4	10	----	49.4	0.0	8	-8.0

Dwelling Units	**# DUs**	**Noise Reduction Min**	**Avg**	**Max**
		dB	**dB**	**dB**
All Selected	1	0.0	0.0	0.0
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

Terry A. Hayes Associates			**20 April 2017**	
Ehsan Hosseini, PhD/ Sam Silverman			**TNM 2.5**	
			Calculated with TNM 2.5	
RESULTS: SOUND-LEVEL DIAGNOSIS BY VEHICLE TYPE				
PROJECT/CONTRACT:	**North Haiwee Dam No.2 Project**			
RUN:	**Future without Project - SEG1**			
BARRIER DESIGN:	**INPUT HEIGHTS**			
ATMOSPHERICS:	**20 deg C, 50% RH**			
Receivers				
Name	**No.**	**Total**	**Vehicle Type**	
		LAeq1h	**Name**	**Partial**
				LAeq1h
		dBA		dBA
Receptor at 100 feet	1	49.4	Autos	47.6
			MTrucks	
			HTrucks	44.8
			Buses	
			Motorcycles	

Terry A. Hayes Associates **20 April 2017**
Ehsan Hosseini, PhD/Sam Silverman **TNM 2.5**

INPUT: ROADWAYS
PROJECT/CONTRACT: **North Haiwee Dam No.2 Project**
RUN: **Future without Project - SEG2**

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with the approval of FHWA

Roadway Name	Width	Points Name	No.	Coordinates (pavement) X	Y	Z	Flow Control Control Device	Speed Constraint	Percent Vehicles Affected	Segment Pvmt Type	On Struct?
	m			m	m	m		km/h	%		
SR-190	7.3	point3	3	-500.0	0.0	0.00				Average	
		point4	4	1,500.0	0.0	0.00					

Terry A. Hayes Associates **20 April 2017**
Ehsan Hosseini, PhD/Sam Silverman **TNM 2.5**

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: **North Haiwee Dam No.2 Project**
RUN: **Future without Project - SEG2**

Roadway	**Points**												
Name	**Name**	**No.**	**Segment**										
			Autos		**MTrucks**		**HTrucks**		**Buses**		**Motorcycles**		
			V	**S**	**V**	**S**	**V**	**S**	**V**	**S**	**V**	**S**
			veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h
SR-190	point3	3	26	65	0	0	5	65	0	0	0	0
	point4	4										

Terry A. Hayes Associates **20 April 2017**
Ehsan Hosseini, PhD/Sam Silverman **TNM 2.5**

INPUT: RECEIVERS
PROJECT/CONTRACT: **North Haiwee Dam No.2 Project**
RUN: **Future without Project - SEG2**

Receiver Name	No.	#DUs	Coordinates (ground) X	Y	Z	Height above Ground	Input Sound Levels and Criteria Existing LAeq1h	Impact Criteria LAeq1h	Sub'l	NR Goal	Active in Calc.
			m	m	m	m	dBA	dBA	dB	dB	
Receptor at 100 meters	1	1	500.0	100.2	0.00	1.50	0.00	66	10.0	8.0	Y

Terry A. Hayes Associates **20 April 2017**
Ehsan Hosseini, PhD/Sam Silverman **TNM 2.5**
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: North Haiwee Dam No.2 Project
RUN: Future without Project - SEG2
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 20 deg C, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receptor at 100 meters	1	1	0.0	41.3	66	41.3	10	----	41.3	0.0	8	-8.0

Dwelling Units	# DUs	Noise Reduction Min	Avg	Max
		dB	dB	dB
All Selected	1	0.0	0.0	0.0
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

Terry A. Hayes Associates			**20 April 2017**	
Ehsan Hosseini, PhD/Sam Silverman			**TNM 2.5**	
			Calculated with TNM 2.5	
RESULTS: SOUND-LEVEL DIAGNOSIS BY VEHICLE TYPE				
PROJECT/CONTRACT:	**North Haiwee Dam No.2 Project**			
RUN:	**Future without Project - SEG2**			
BARRIER DESIGN:	**INPUT HEIGHTS**			
ATMOSPHERICS:	**20 deg C, 50% RH**			
Receivers				
Name	**No.**	**Total**	**Vehicle Type**	
		LAeq1h	**Name**	**Partial**
				LAeq1h
		dBA		dBA
Receptor at 100 meters	1	41.3	Autos	33.1
			MTrucks	
			HTrucks	40.6
			Buses	
			Motorcycles	

Terry A. Hayes Associates **20 April 2017**
Ehsan Hosseini, PhD/ Sam Silverman **TNM 2.5**

INPUT: ROADWAYS
PROJECT/CONTRACT: **North Haiwee Dam No.2 Project**
RUN: **Future without Project - SEG3**

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with the approval of FHWA

Roadway Name	Width	Points Name	No.	Coordinates (pavement) X	Y	Z	Flow Control Control Device	Speed Constraint	Percent Vehicles Affected	Segment Pvmt Type	On Struct?
	m			m	m	m		km/h	%		
Freeway	7.3	point3	3	-500.0	0.0	0.00				Average	
		point4	4	1,500.0	0.0	0.00					

Terry A. Hayes Associates				**20 April 2017**									
Ehsan Hosseini, PhD/ Sam Silverman				**TNM 2.5**									
INPUT: TRAFFIC FOR LAeq1h Volumes													
PROJECT/CONTRACT:	**North Haiwee Dam No.2 Project**												
RUN:	**Future without Project - SEG3**												
Roadway	**Points**												
Name	**Name**	**No.**	**Segment**										
			Autos		**MTrucks**		**HTrucks**		**Buses**		**Motorcycles**		
			V	**S**	**V**	**S**	**V**	**S**	**V**	**S**	**V**	**S**	
			veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	
Freeway	point3	3	481	65	0	0	120	65	0	0	0	0	
	point4	4											

Terry A. Hayes Associates 20 April 2017
Ehsan Hosseini, PhD/ Sam Silverman TNM 2.5

INPUT: RECEIVERS
PROJECT/CONTRACT: North Haiwee Dam No.2 Project
RUN: Future without Project - SEG3

Receiver Name	No.	#DUs	Coordinates (ground) X	Y	Z	Height above Ground	Input Sound Levels and Criteria Existing LAeq1h	Impact Criteria LAeq1h	Sub'l	NR Goal	Active in Calc.
			m	m	m	m	dBA	dBA	dB	dB	
Receptor at 100 feet	1	1	500.0	34.1	0.00	1.50	0.00	66	10.0	8.0	Y

Terry A. Hayes Associates — 20 April 2017
Ehsan Hosseini, PhD/ Sam Silverman — TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS

PROJECT/CONTRACT: North Haiwee Dam No.2 Project
RUN: Future without Project - SEG3
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 20 deg C, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	No Barrier LAeq1h Crit'n	Increase over existing Calculated	Increase over existing Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Noise Reduction Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receptor at 100 feet	1	1	0.0	63.7	66	63.7	10	----	63.7	0.0	8	-8.0

Dwelling Units	# DUs	Noise Reduction Min	Avg	Max
		dB	dB	dB
All Selected	1	0.0	0.0	0.0
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

Terry A. Hayes Associates			**20 April 2017**	
Ehsan Hosseini, PhD/ Sam Silverman			**TNM 2.5**	
			Calculated with TNM 2.5	
RESULTS: SOUND-LEVEL DIAGNOSIS BY VEHICLE TYPE				
PROJECT/CONTRACT:	**North Haiwee Dam No.2 Project**			
RUN:	**Future without Project - SEG3**			
BARRIER DESIGN:	**INPUT HEIGHTS**			
ATMOSPHERICS:	**20 deg C, 50% RH**			
Receivers				
Name	**No.**	**Total**	**Vehicle Type**	
		LAeq1h	**Name**	**Partial**
				LAeq1h
		dBA		dBA
Receptor at 100 feet	1	63.7	Autos	57.2
			MTrucks	
			HTrucks	62.6
			Buses	
			Motorcycles	

Future: Cement Deep Soil Mixing Alternative (CDSM)

Terry A. Hayes Associates					**20 April 2017**						
Ehsan Hosseini, PhD/Sam Silverman					**TNM 2.5**						
INPUT: ROADWAYS							**Average pavement type shall be used unless**				
PROJECT/CONTRACT:	**North Haiwee Dam No.2 Project**						**a State highway agency substantiates the use**				
RUN:	**Future with Project CDSM-SEG1**						**of a different type with the approval of FHWA**				
Roadway		**Points**									
Name	**Width**	**Name**	**No.**	**Coordinates (pavement)**			**Flow Control**			**Segment**	
				X	**Y**	**Z**	**Control Device**	**Speed Constraint**	**Percent Vehicles Affected**	**Pvmt Type**	**On Struct?**
	m			m	m	m		km/h	%		
Freeway	7.3	point3	3	-500.0	0.0	0.00				Average	
		point4	4	1,500.0	0.0	0.00					

Terry A. Hayes Associates **20 April 2017**
Ehsan Hosseini, PhD/Sam Silverman **TNM 2.5**

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: **North Haiwee Dam No.2 Project**
RUN: **Future with Project CDSM-SEG1**

Roadway	Points												
Name	Name	No.	Segment										
			Autos		MTrucks		HTrucks		Buses		Motorcycles		
			V	S	V	S	V	S	V	S	V	S	
			veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	
Freeway	point3	3	53	65	0	0	24	65	0	0	0	0	
	point4	4											

Terry A. Hayes Associates						**20 April 2017**					
Ehsan Hosseini, PhD/Sam Silverman						**TNM 2.5**					
INPUT: RECEIVERS											
PROJECT/CONTRACT:	**North Haiwee Dam No.2 Project**										
RUN:	**Future with Project CDSM-SEG1**										
Receiver											
Name	**No.**	**#DUs**	**Coordinates (ground)**			**Height**	**Input Sound Levels and Criteria**				**Active**
			X	**Y**	**Z**	**above**	**Existing**	**Impact Criteria**		**NR**	**in**
						Ground	**LAeq1h**	**LAeq1h**	**Sub'l**	**Goal**	**Calc.**
			m	m	m	m	dBA	dBA	dB	dB	
Receptor at 100 feet	1	1	500.0	34.1	0.00	1.50	0.00	66	10.0	8.0	Y

Terry A. Hayes Associates — **20 April 2017**
Ehsan Hosseini, PhD/Sam Silverman — **TNM 2.5**
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: North Haiwee Dam No.2 Project
RUN: Future with Project CDSM-SEG1
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 20 deg C, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receptor at 100 feet	1	1	0.0	56.2	66	56.2	10	----	56.2	0.0	8	-8.0

Dwelling Units	# DUs	Noise Reduction Min	Avg	Max
		dB	dB	dB
All Selected	1	0.0	0.0	0.0
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

Terry A. Hayes Associates			**20 April 2017**	
Ehsan Hosseini, PhD/Sam Silverman			**TNM 2.5**	
			Calculated with TNM 2.5	
RESULTS: SOUND-LEVEL DIAGNOSIS BY VEHICLE TYPE				
PROJECT/CONTRACT:	**North Haiwee Dam No.2 Project**			
RUN:	**Future with Project CDSM-SEG1**			
BARRIER DESIGN:	**INPUT HEIGHTS**			
ATMOSPHERICS:	**20 deg C, 50% RH**			
Receivers				
Name	**No.**	**Total**	**Vehicle Type**	
		LAeq1h	**Name**	**Partial**
				LAeq1h
		dBA		dBA
Receptor at 100 feet	1	56.2	Autos	47.6
			MTrucks	
			HTrucks	55.6
			Buses	
			Motorcycles	

Terry A. Hayes Associates					**20 April 2017**							
Ehsan Hosseini, PhD/Sam Silverman					**TNM 2.5**							
INPUT: ROADWAYS							**Average pavement type shall be used unless**					
PROJECT/CONTRACT:	**North Haiwee Dam No.2 Project**						**a State highway agency substantiates the use**					
RUN:	**Future with Project CDSM-SEG2**						**of a different type with the approval of FHWA**					
Roadway		**Points**										
Name	**Width**	**Name**	**No.**	**Coordinates (pavement)**			**Flow Control**			**Segment**		
				X	**Y**	**Z**	**Control Device**	**Speed Constraint**	**Percent Vehicles Affected**	**Pvmt Type**	**On Struct?**	
	m			m	m	m		km/h	%			
SR-190	7.3	point3	3	-500.0	0.0	0.00				Average		
		point4	4	1,500.0	0.0	0.00						

Terry A. Hayes Associates **20 April 2017**
Ehsan Hosseini, PhD/Sam Silverman **TNM 2.5**

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: **North Haiwee Dam No.2 Project**
RUN: **Future with Project CDSM-SEG2**

Roadway	**Points**											
Name	**Name**	**No.**	**Segment**									
			User 1		**User 2**		**User 3**		**User 4**		**<unknown>**	
			V	**S**	**V**	**S**	**V**	**S**	**V**	**S**	**V**	**S**
			veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h
SR-190	point3	3										
	point4	4										

Terry A. Hayes Associates 20 April 2017
Ehsan Hosseini, PhD/Sam Silverman TNM 2.5

INPUT: RECEIVERS
PROJECT/CONTRACT: North Haiwee Dam No.2 Project
RUN: Future with Project CDSM-SEG2

Receiver Name	No.	#DUs	Coordinates (ground) X	Y	Z	Height above Ground	Input Sound Levels and Criteria Existing LAeq1h	Impact Criteria LAeq1h	Sub'l	NR Goal	Active in Calc.
			m	m	m	m	dBA	dBA	dB	dB	
Receptor at 100 meters	1	1	500.0	100.2	0.00	1.50	0.00	66	10.0	8.0	Y

Terry A. Hayes Associates | 20 April 2017
Ehsan Hosseini, PhD/Sam Silverman | TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: North Haiwee Dam No.2 Project
RUN: Future with Project CDSM-SEG2
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 20 deg C, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receptor at 100 meters	1	1	0.0	48.0	66	48.0	10	----	48.0	0.0	8	-8.0

Dwelling Units	# DUs	Noise Reduction Min	Avg	Max
		dB	dB	dB
All Selected	1	0.0	0.0	0.0
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

Terry A. Hayes Associates			**20 April 2017**	
Ehsan Hosseini, PhD/Sam Silverman			**TNM 2.5**	
			Calculated with TNM 2.5	
RESULTS: SOUND-LEVEL DIAGNOSIS BY VEHICLE TYPE				
PROJECT/CONTRACT:	**North Haiwee Dam No.2 Project**			
RUN:	**Future with Project CDSM-SEG2**			
BARRIER DESIGN:	**INPUT HEIGHTS**			
ATMOSPHERICS:	**20 deg C, 50% RH**			
Receivers				
Name	**No.**	**Total**	**Vehicle Type**	
		LAeq1h	**Name**	**Partial**
				LAeq1h
		dBA		dBA
Receptor at 100 meters	1	48.0	Autos	33.1
			MTrucks	
			HTrucks	47.9
			Buses	
			Motorcycles	

Terry A. Hayes Associates 20 April 2017
Ehsan Hosseini, PhD/Sam Silverman TNM 2.5

INPUT: ROADWAYS

PROJECT/CONTRACT: North Haiwee Dam No.2 Project
RUN: Future with Project - CDSM - SEG3

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with the approval of FHWA

Roadway Name	Width	Points Name	No.	Coordinates (pavement) X	Y	Z	Flow Control Control Device	Speed Constraint	Percent Vehicles Affected	Segment Pvmt Type	On Struct?
	m			m	m	m		km/h	%		
Freeway	7.3	point3	3	-500.0	0.0	0.00				Average	
		point4	4	1,500.0	0.0	0.00					

Terry A. Hayes Associates **20 April 2017**
Ehsan Hosseini, PhD/Sam Silverman **TNM 2.5**

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: **North Haiwee Dam No.2 Project**
RUN: **Future with Project - CDSM - SEG3**

Roadway	Points												
Name	Name	No.	Segment										
			Autos		MTrucks		HTrucks		Buses		Motorcycles	
			V	S	V	S	V	S	V	S	V	S
			veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h
Freeway	point3	3	490	65	0	0	164	65	0	0	0	0
	point4	4										

Terry A. Hayes Associates						**20 April 2017**					
Ehsan Hosseini, PhD/Sam Silverman						**TNM 2.5**					
INPUT: RECEIVERS											
PROJECT/CONTRACT:	**North Haiwee Dam No.2 Project**										
RUN:	**Future with Project - CDSM - SEG3**										
Receiver											
Name	**No.**	**#DUs**	**Coordinates (ground)**			**Height**	**Input Sound Levels and Criteria**				**Active**
			X	**Y**	**Z**	**above**	**Existing**	**Impact Criteria**		**NR**	**in**
						Ground	**LAeq1h**	**LAeq1h**	**Sub'l**	**Goal**	**Calc.**
			m	m	m	m	dBA	dBA	dB	dB	
Receptor at 100 feet	1	1	500.0	34.1	0.00	1.50	0.00	66	10.0	8.0	Y

Terry A. Hayes Associates
Ehsan Hosseini, PhD/Sam Silverman

20 April 2017
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS

PROJECT/CONTRACT: North Haiwee Dam No.2 Project
RUN: Future with Project - CDSM - SEG3
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 20 deg C, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver												
Name	No.	#DUs	Existing	No Barrier					With Barrier			
			LAeq1h	LAeq1h		Increase over existing		Type	Calculated	Noise Reduction		
				Calculated	Crit'n	Calculated	Crit'n	Impact	LAeq1h	Calculated	Goal	Calculated
							Sub'l Inc					minus
												Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receptor at 100 feet	1	1	0.0	64.8	66	64.8	10	----	64.8	0.0	8	-8.0

Dwelling Units	# DUs	Noise Reduction		
		Min	Avg	Max
		dB	dB	dB
All Selected	1	0.0	0.0	0.0
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

Terry A. Hayes Associates			**20 April 2017**	
Ehsan Hosseini, PhD/Sam Silverman			**TNM 2.5**	
			Calculated with TNM 2.5	
RESULTS: SOUND-LEVEL DIAGNOSIS BY VEHICLE TYPE				
PROJECT/CONTRACT:	**North Haiwee Dam No.2 Project**			
RUN:	**Future with Project - CDSM - SEG3**			
BARRIER DESIGN:	**INPUT HEIGHTS**			
ATMOSPHERICS:	**20 deg C, 50% RH**			
Receivers				
Name	**No.**	**Total**	**Vehicle Type**	
		LAeq1h	**Name**	**Partial**
				LAeq1h
		dBA		dBA
Receptor at 100 feet	1	64.8	Autos	57.2
			MTrucks	
			HTrucks	63.9
			Buses	
			Motorcycles	

Future: Excavate and Recompact Alternative (ERA)

Terry A. Hayes Associates					**20 April 2017**						
Ehsan Hosseini, PhD/Sam Silverman					**TNM 2.5**						
INPUT: ROADWAYS							**Average pavement type shall be used unless**				
PROJECT/CONTRACT:	**North Haiwee Dam No.2 Project**						**a State highway agency substantiates the use**				
RUN:	**Future with Project ERA-SEG1**						**of a different type with the approval of FHWA**				
Roadway		**Points**									
Name	**Width**	**Name**	**No.**	**Coordinates (pavement)**			**Flow Control**			**Segment**	
				X	**Y**	**Z**	**Control Device**	**Speed Constraint**	**Percent Vehicles Affected**	**Pvmt Type**	**On Struct?**
	m			m	m	m		km/h	%		
Freeway	7.3	point3	3	-500.0	0.0	0.00				Average	
		point4	4	1,500.0	0.0	0.00					

Terry A. Hayes Associates **20 April 2017**
Ehsan Hosseini, PhD/Sam Silverman **TNM 2.5**

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: **North Haiwee Dam No.2 Project**
RUN: **Future with Project ERA-SEG1**

Roadway	Points												
Name	Name	No.	Segment										
			Autos		MTrucks		HTrucks		Buses		Motorcycles		
			V	S	V	S	V	S	V	S	V	S	
			veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	
Freeway	point3	3	52	65	0	0	17	65	0	0	0	0	
	point4	4											

Terry A. Hayes Associates						**20 April 2017**					
Ehsan Hosseini, PhD/Sam Silverman						**TNM 2.5**					
INPUT: RECEIVERS											
PROJECT/CONTRACT:	**North Haiwee Dam No.2 Project**										
RUN:	**Future with Project ERA-SEG1**										
Receiver											
Name	**No.**	**#DUs**	**Coordinates (ground)**			**Height**	**Input Sound Levels and Criteria**				**Active**
			X	**Y**	**Z**	**above**	**Existing**	**Impact Criteria**		**NR**	**in**
						Ground	**LAeq1h**	**LAeq1h**	**Sub'l**	**Goal**	**Calc.**
			m	m	m	m	dBA	dBA	dB	dB	
Receptor at 100 feet	1	1	500.0	34.1	0.00	1.50	0.00	66	10.0	8.0	Y

Terry A. Hayes Associates		20 April 2017
Ehsan Hosseini, PhD/Sam Silverman		TNM 2.5
		Calculated with TNM 2.5
RESULTS: SOUND LEVELS		
PROJECT/CONTRACT:	North Haiwee Dam No.2 Project	
RUN:	Future with Project ERA-SEG1	
BARRIER DESIGN:	INPUT HEIGHTS	Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.
ATMOSPHERICS:	20 deg C, 50% RH	

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receptor at 100 feet	1	1	0.0	54.9	66	54.9	10	----	54.9	0.0	8	-8.0

Dwelling Units	# DUs	Noise Reduction Min	Avg	Max
		dB	dB	dB
All Selected	1	0.0	0.0	0.0
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

Terry A. Hayes Associates			**20 April 2017**	
Ehsan Hosseini, PhD/Sam Silverman			**TNM 2.5**	
			Calculated with TNM 2.5	
RESULTS: SOUND-LEVEL DIAGNOSIS BY VEHICLE TYPE				
PROJECT/CONTRACT:	**North Haiwee Dam No.2 Project**			
RUN:	**Future with Project ERA-SEG1**			
BARRIER DESIGN:	**INPUT HEIGHTS**			
ATMOSPHERICS:	**20 deg C, 50% RH**			
Receivers				
Name	**No.**	**Total**	**Vehicle Type**	
		LAeq1h	**Name**	**Partial**
				LAeq1h
		dBA		dBA
Receptor at 100 feet	1	54.9	Autos	47.5
			MTrucks	
			HTrucks	54.1
			Buses	
			Motorcycles	

Terry A. Hayes Associates					**20 April 2017**							
Ehsan Hosseini, PhD/Sam Silverman					**TNM 2.5**							
INPUT: ROADWAYS							**Average pavement type shall be used unless**					
PROJECT/CONTRACT:	**North Haiwee Dam No.2 Project**						**a State highway agency substantiates the use**					
RUN:	**Future with Project - ERA - SEG2**						**of a different type with the approval of FHWA**					
Roadway		**Points**										
Name	**Width**	**Name**	**No.**	**Coordinates (pavement)**			**Flow Control**			**Segment**		
				X	**Y**	**Z**	**Control Device**	**Speed Constraint**	**Percent Vehicles Affected**	**Pvmt Type**	**On Struct?**	
	m			m	m	m		km/h	%			
SR-190	7.3	point3	3	-500.0	0.0	0.00				Average		
		point4	4	1,500.0	0.0	0.00						

Terry A. Hayes Associates 20 April 2017
Ehsan Hosseini, PhD/Sam Silverman TNM 2.5

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: North Haiwee Dam No.2 Project
RUN: Future with Project - ERA - SEG2

Roadway	Points													
Name	Name	No.	Segment											
			Autos		MTrucks		HTrucks		Buses		Motorcycles			
			V	S	V	S	V	S	V	S	V	S		
			veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h		
SR-190	point3	3	26	65	0	0	20	65	0	0	0	0		
	point4	4												

Terry A. Hayes Associates | **20 April 2017**
Ehsan Hosseini, PhD/Sam Silverman | **TNM 2.5**

INPUT: RECEIVERS
PROJECT/CONTRACT: North Haiwee Dam No.2 Project
RUN: Future with Project - ERA - SEG2

Receiver Name	No.	#DUs	Coordinates (ground) X	Y	Z	Height above Ground	Input Sound Levels and Criteria Existing LAeq1h	Impact Criteria LAeq1h	Sub'l	NR Goal	Active in Calc.
			m	m	m	m	dBA	dBA	dB	dB	
Receptor at 100 meters	1	1	500.0	100.2	0.00	1.50	0.00	66	10.0	8.0	Y

Terry A. Hayes Associates							**20 April 2017**					
Ehsan Hosseini, PhD/Sam Silverman							**TNM 2.5**					
							Calculated with TNM 2.5					
RESULTS: SOUND LEVELS												
PROJECT/CONTRACT:		**North Haiwee Dam No.2 Project**										
RUN:		**Future with Project - ERA - SEG2**										
BARRIER DESIGN:		**INPUT HEIGHTS**						**Average pavement type shall be used unless**				
								a State highway agency substantiates the use				
ATMOSPHERICS:		**20 deg C, 50% RH**						**of a different type with approval of FHWA.**				
Receiver												
Name	**No.**	**#DUs**	**Existing**	**No Barrier**					**With Barrier**			
			LAeq1h	**LAeq1h**		**Increase over existing**		**Type**	**Calculated**	**Noise Reduction**		
				Calculated	**Crit'n**	**Calculated**	**Crit'n**	**Impact**	**LAeq1h**	**Calculated**	**Goal**	**Calculated**
							Sub'l Inc					**minus**
												Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receptor at 100 meters	1	1	0.0	46.8	66	46.8	10	----	46.8	0.0	8	-8.0

Dwelling Units	**# DUs**	**Noise Reduction**		
		Min	**Avg**	**Max**
		dB	**dB**	**dB**
All Selected	1	0.0	0.0	0.0
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

Terry A. Hayes Associates			20 April 2017	
Ehsan Hosseini, PhD/Sam Silverman			TNM 2.5	
			Calculated with TNM 2.5	
RESULTS: SOUND-LEVEL DIAGNOSIS BY VEHICLE TYPE				
PROJECT/CONTRACT:	North Haiwee Dam No.2 Project			
RUN:	Future with Project - ERA - SEG2			
BARRIER DESIGN:	INPUT HEIGHTS			
ATMOSPHERICS:	20 deg C, 50% RH			
Receivers				
Name	No.	Total	Vehicle Type	
		LAeq1h	Name	Partial
				LAeq1h
		dBA		dBA
Receptor at 100 meters	1	46.8	Autos	33.1
			MTrucks	
			HTrucks	46.6
			Buses	
			Motorcycles	

Terry A. Hayes Associates					**20 April 2017**						
Ehsan Hosseini, PhD/Sam Silverman					**TNM 2.5**						
INPUT: ROADWAYS							**Average pavement type shall be used unless**				
PROJECT/CONTRACT:	**North Haiwee Dam No.2 Project**						**a State highway agency substantiates the use**				
RUN:	**Future with Project - ERA - SEG3**						**of a different type with the approval of FHWA**				
Roadway		**Points**									
Name	**Width**	**Name**	**No.**	**Coordinates (pavement)**			**Flow Control**			**Segment**	
				X	**Y**	**Z**	**Control Device**	**Speed Constraint**	**Percent Vehicles Affected**	**Pvmt Type**	**On Struct?**
	m			m	m	m		km/h	%		
Freeway	7.3	point3	3	-500.0	0.0	0.00				Average	
		point4	4	1,500.0	0.0	0.00					

Terry A. Hayes Associates **20 April 2017**
Ehsan Hosseini, PhD/Sam Silverman **TNM 2.5**

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: **North Haiwee Dam No.2 Project**
RUN: **Future with Project - ERA - SEG3**

Roadway	Points												
Name	Name	No.	Segment										
			Autos		MTrucks		HTrucks		Buses		Motorcycles		
			V	S	V	S	V	S	V	S	V	S
			veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h	veh/hr	km/h
Freeway	point3	3	494	65	0	0	137	65	0	0	0	0
	point4	4										

Terry A. Hayes Associates 20 April 2017
Ehsan Hosseini, PhD/Sam Silverman TNM 2.5

INPUT: RECEIVERS
PROJECT/CONTRACT: North Haiwee Dam No.2 Project
RUN: Future with Project - ERA - SEG3

Receiver Name	No.	#DUs	Coordinates (ground) X	Y	Z	Height above Ground	Input Sound Levels and Criteria: Existing LAeq1h	Impact Criteria LAeq1h	Impact Criteria Sub'l	NR Goal	Active in Calc.
			m	m	m	m	dBA	dBA	dB	dB	
Receptor at 100 feet	1	1	500.0	34.1	0.00	1.50	0.00	66	10.0	8.0	Y

Terry A. Hayes Associates							**20 April 2017**					
Ehsan Hosseini, PhD/Sam Silverman							**TNM 2.5**					
							Calculated with TNM 2.5					
RESULTS: SOUND LEVELS												
PROJECT/CONTRACT:		**North Haiwee Dam No.2 Project**										
RUN:		**Future with Project - ERA - SEG3**										
BARRIER DESIGN:		**INPUT HEIGHTS**						**Average pavement type shall be used unless**				
								a State highway agency substantiates the use				
ATMOSPHERICS:		**20 deg C, 50% RH**						**of a different type with approval of FHWA.**				
Receiver												
Name	**No.**	**#DUs**	**Existing**	**No Barrier**					**With Barrier**			
			LAeq1h	**LAeq1h**		**Increase over existing**		**Type**	**Calculated**	**Noise Reduction**		
				Calculated	**Crit'n**	**Calculated**	**Crit'n**	**Impact**	**LAeq1h**	**Calculated**	**Goal**	**Calculated**
							Sub'l Inc					**minus**
												Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receptor at 100 feet	1	1	0.0	64.1	66	64.1	10	----	64.1	0.0	8	-8.0

Dwelling Units	**# DUs**	**Noise Reduction**		
		Min	**Avg**	**Max**
		dB	**dB**	**dB**
All Selected	1	0.0	0.0	0.0
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

Terry A. Hayes Associates			**20 April 2017**	
Ehsan Hosseini, PhD/Sam Silverman			**TNM 2.5**	
			Calculated with TNM 2.5	
RESULTS: SOUND-LEVEL DIAGNOSIS BY VEHICLE TYPE				
PROJECT/CONTRACT:	**North Haiwee Dam No.2 Project**			
RUN:	**Future with Project - ERA - SEG3**			
BARRIER DESIGN:	**INPUT HEIGHTS**			
ATMOSPHERICS:	**20 deg C, 50% RH**			
Receivers				
Name	**No.**	**Total**	**Vehicle Type**	
		LAeq1h	**Name**	**Partial**
				LAeq1h
		dBA		dBA
Receptor at 100 feet	1	64.1	Autos	57.3
			MTrucks	
			HTrucks	63.1
			Buses	
			Motorcycles	