Kentucky Transportation Cabinet

Department of Highways

Division of Environmental Analysis

NOISE ANALYSIS AND ABATEMENT POLICY

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INTRODUCTION

During the rapid expansion of the Interstate Highway System and other roadways in the 20th century, communities began to recognize that highway traffic noise and construction noise had become important environmental impacts. Traffic noise sources include tire pavement noise, engine noise, and exhaust noise. Construction noise is associated with the construction phase of the project and can include trucks, excavators, pile driving and other equipment noise. Construction noise is temporary in nature, lasting only as long as the project construction. In the 1972 Federal-aid Highway Act, the United States Congress required *the Federal Highway Administration (FHWA)* to develop a noise standard for new Federal-aid highway projects. These standards are contained in *23 Code of Federal Regulations (CFR) Part 772*, titled *Procedures for Abatement of Highway Traffic Noise and Construction Noise* (FHWA Noise Standard).

The FHWA Noise Standard defines what is considered traffic noise impacts and requires that noise abatement measures be considered when such impacts are identified for Type I Federal projects. Noise abatement measures that are found to be feasible and reasonable must be constructed for such projects. Feasible and reasonable noise abatement measures are eligible for Federal-aid participation at the same ratio or percentage as other eligible project costs. While providing national criteria and requirements for all highway agencies, this standard also gives state highway agencies flexibility that reflects state-specific methods and objectives in approaching the problem of highway traffic and construction noise.

The *Kentucky Transportation Cabinet (KYTC)* recognizes the potential for adverse effects that traffic noise may have on the citizens of the Commonwealth and will consider and evaluate reasonable measures to minimize these effects. Noise considerations are a part of the planning, design, and construction of a highway project. The identification of noise sensitive sites or areas shall be done early in the planning phase of the project. During project development, detailed analyses will be undertaken to assess specific traffic noise impacts and abatement measures at locations that may experience increased traffic noise levels as a result of the project. Concern for noise impacts continues into the construction phase with emphasis on minimizing disruption from construction noise.

In instances where changes in the traffic volume or composition of the vehicle mix may adversely increase traffic noise levels in areas where abatement measures were initially not warranted, additional analysis and possible abatement measures may be considered on a case-by-case basis for inclusion in KYTC's latest *Enacted Highway Plan* (see *Traffic Noise Abatement Considerations for State-Funded Retrofit Projects* in this policy).

PURPOSE

This *Noise Analysis and Abatement Policy* (*Noise Policy*) describes KYTC's implementation of the requirements of the FHWA Noise Standard. Where FHWA has given the state highway agencies flexibility in implementing the standard, this policy describes KYTC's approach to implementation. The policy addresses traffic noise prediction requirements, noise analyses, Noise Abatement Criteria (NAC), and requirements for informing local officials. It was developed by KYTC, with review and concurrence by FHWA, *and is effective July 1, 2020*, superseding all previous KYTC policies/guidance on the assessment of traffic noise impacts and abatement measures to be considered for highway projects in Kentucky.

APPLICABILITY

This policy applies to all Type I Federal or Federal-aid Highway Projects authorized under Title 23, United States Code. Therefore, this policy applies to any highway project or multimodal project, including those administered by Local Public Agencies (LPA), that:

1) Requires FHWA approval, regardless of funding sources, or
2) is funded with Federal-aid highway funds.

The requirements of this policy apply uniformly and consistently to all Type I federal projects throughout the Commonwealth. If there are any questions about whether a project is subject to this policy or the FHWA Noise Standard, contact the KYTC Division of Environmental Analysis (DEA) in the Frankfort Central Office at (502) 564-7250. Due to the long lead time required to complete a traffic noise study, questions regarding the applicability of this policy should be addressed as early in project scoping as practicable.

For ongoing federally funded projects, authorized prior to the effective date of this policy, noise analysis and abatement decisions may be advanced in accordance with the policy in effect at the time of the project authorization. The Project Team, at its discretion, may opt to apply this policy to ongoing projects, however, if applied, the project shall adhere to all aspects of the policy. All projects authorized after July 1, 2020, shall comply with this policy.

This policy is not applicable to federal projects defined as either Type II or Type III. KYTC does not consider use of federal funding for abatement of these project types.

DEFINITIONS

The following definitions apply to the terms used in this *Noise Policy* in consideration of noise impacts and abatement measures:

1) **BENEFITED RECEPTOR**. KYTC defines a benefited receptor as the recipient of an abatement measure that receives a noise reduction at or above the minimum threshold of 5 dB(A).
2) **COMMON NOISE ENVIRONMENT**. A group of receptors within the same Activity Category in Table 1 that are exposed to similar noise sources and levels; traffic volumes, traffic mix, and speed; and topographic features. Generally, common noise environments occur between two secondary noise sources, such as interchanges, intersections, or cross-roads.
3) **CONSTRUCTION NOISE**. Noise associated with the construction phase of the project and can include trucks, excavators, pile driving and other equipment noise.
4) **DATE OF PUBLIC KNOWLEDGE**. The date of approval of the Categorical Exclusion (CE), the Finding of No Significant Impact (FONSI), or the Record of Decision (ROD), as defined in 23 CFR 771.
5) **DEA**. Kentucky Transportation Cabinet's Division of Environmental Analysis.
6) **DECIBEL (dB)**. A logarithmic unit that expresses the ratio of the sound pressure level being measured to a standard reference level.
7) **DECIBEL A-WEIGHTED (dB(A))**. Frequencies to which the human ear does not respond are filtered out when measuring and predicting highway noise levels resulting in the A-weighted scale.
8) **DESIGN YEAR.** The future year used to estimate the probable traffic volume for which a highway is designed, typically a minimum of twenty (20) years into the future at the time of project initiation.
9) **EXISTING NOISE LEVELS.** The worst noise hour resulting from the combination of natural and mechanical sources and human activity usually present in a particular area.
10) **FEASIBILITY.** The combination of acoustical and engineering factors considered in the evaluation of a noise abatement measure.
11) **FHWA.** Federal Highway Administration.
12) **FRONT-ROW.** A descriptor that applies to receptors and property owners whose associated property borders the right of way for the proposed project.
13) **IMPACTED RECEPTOR.** A receptor that has a traffic noise impact.
14) **KYTC.** Kentucky Transportation Cabinet.
15) **L_{eq}.** The equivalent steady-state sound level which in a stated period of time contains the same acoustic energy as the time-varying sound level during the same time period, with $L_{eq}(h)$ being the hourly value of L_{eq}.
16) **MULTIFAMILY DWELLING.** A residential structure containing more than one residence. Each residence in a multifamily dwelling shall be counted as one receptor when determining impacted and benefited receptors.
17) **NEPA.** National Environmental Policy Act.

18) **NOISE ABATEMENT CRITERIA (NAC).** Sound pressure levels established by the FHWA that act as a standard for noise abatement measures giving consideration to specific land uses (refer to Table 1).
19) **NOISE BARRIER.** A physical obstruction that is constructed between the highway noise source and the noise sensitive receptor(s) that lowers the noise level, including standalone noise walls, noise berms (earth or other material), and combination berm/wall systems.
20) **NOISE REDUCTION DESIGN GOAL.** The optimum desired dB(A) noise reduction determined from calculating the difference between future build noise levels with abatement, to future build noise levels without abatement. For KYTC projects, the noise reduction design goal shall be 7 dB(A) for a minimum of 50% of front-row benefited receptors.
21) **NOISE.** Unwanted or unpleasant sound in the audible range.
22) **PERMITTED.** A definite commitment to develop land with an approved specific design of land use activities as evidenced by the issuance of a building permit.
23) **PLANNED DEVELOPMENT.** A land use, such as a residence, school, or church/place of worship, that is potentially noise sensitive and has received a building permit from the local agency with permitting authority but has not been constructed at the time of noise analysis.
24) **PROPERTY OWNER.** An individual or group of individuals that holds a title, deed, or other legal documentation of ownership of a property or a residence.
25) **REASONABLENESS.** The combination of social, economic, and environmental factors considered in the evaluation of a noise abatement measure.
26) **RECEIVER**. A point in the TNM model that representative one or more receptor(s).
27) **RECEPTOR**. A discrete or representative location of a noise sensitive area(s), for any of the land uses (Activity Categories) listed in Table 1.
28) **RESIDENCE**. A dwelling unit. Either a single-family residence or each dwelling unit in a multifamily dwelling.
29) **SOUND ATTENUATION.** The interruption and resulting reduction in sound energy or intensity.
30) **STATEMENT OF LIKELIHOOD**. A statement provided in the environmental clearance document based on the feasibility and reasonableness analysis completed at the time the environmental document is being approved.
31) **SUBSTANTIAL CONSTRUCTION**. The granting of a building permit, prior to right-of-way acquisition or construction approval for the highway.
32) **SUBSTANTIAL NOISE INCREASE**. KYTC defines a substantial noise increase as a 10 dB(A) or greater increase in noise levels in the design year compared to the existing noise level.

33) **TNM**. Traffic Noise Model, a software program developed by FHWA to predict traffic noise levels.
34) **TRAFFIC NOISE**. Noise associated with traffic, such as engine noise, exhaust, and tire contact with the pavement.
35) **TRAFFIC NOISE IMPACTS**. Impacts which occur when the predicted traffic noise levels approach or exceed the Noise Abatement Criteria (NAC) listed in Table 1 for the future build condition, or when the predicted traffic noise levels demonstrate a substantial noise increase over existing noise levels.
36) **TYPE I PROJECT**.
    a. The construction of a highway on new location; or,
    b. The physical alteration of an existing highway where there is either:
    i. *Substantial Horizontal Alteration*. A project that halves the distance between the traffic noise source and the closest receptor between the existing condition to the future build condition; or,
    ii. *Substantial Vertical Alteration*. A project that removes shielding, therefore, exposing the line-of- sight between the receptor and the traffic noise source. This is done by either altering the vertical alignment of the highway or by altering the topography between the highway traffic noise source and the receptor; or, the addition of a through-traffic lane(s). This includes the addition of a through-traffic lane that functions as a HOV lane, High-Occupancy Toll (HOT) lane, bus lane, or truck climbing lane; or,
    c. The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane; or,
    d. The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange; or,
    e. Restriping existing pavement for the purpose of adding a through-traffic lane or an auxiliary lane; or,
    f. The addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot, or toll plaza.
    g. If a project is determined to be a Type I project under this definition, then the entire project area as defined in the environmental document is a Type I project.
37) **TYPE II PROJECT**. A proposed Federal or Federal-aid highway project for noise abatement on an existing highway. Kentucky does not have a program for use of federal funds for noise abatement along existing highways where no other federal improvements are being proposed.
38) **TYPE III PROJECT**. A Federal or Federal-aid highway project that does not meet the classifications of a Type I or Type II project.

TRAFFIC NOISE PREDICTION

Pursuant to *23 CFR 772.9*, any traffic noise analysis required for a project must use the FHWA *Traffic Noise Model (TNM) software* which is described in *"FHWA Traffic Noise Model" Report No. FHWA-PD-96-010*, including Revision No. 1, dated April 14, 2004, or any other model determined by the FHWA to be consistent with the methodology of the FHWA TNM.

When developing the environmental document to satisfy the requirements of the *National Environmental Policy Act* (NEPA), future noise levels for all reasonable build alternatives must be predicted. This does not include those alternatives determined to be unreasonable that are rejected prior to detailed analysis. If any segment or component of an alternative meets the definition of a Type I project, then the entire alternative is considered to be Type I and is subject to the noise analysis requirements. However, no analysis is required for Type I projects where no noise sensitive receptors are identified within the study area.

For Type I projects with noise receptors within the project study area, KYTC will follow the methodology discussed in the following sections and outlined in a flowchart located in Appendix A.

For projects that are identified as a Type I project and with noise receptors within 500 feet of the proposed edge of pavement, KYTC will first utilize the *Traffic Noise Impact Screening Tool* (see Appendix B). This tool provides a two-step screening process to determine the level of analysis required. The first step determines if the project has the potential for traffic noise impacts and the second step determines if a noise abatement measure could satisfy KYTC's feasibility criteria. When the screening tool identifies no impacted receptor OR if there are impacted receptors identified but they are determined to be isolated impacts, then a *Traffic Noise Impact Analysis* report is not required and the NEPA requirements for a noise study are fulfilled. In addition, standard template language will be provided for use in the final NEPA document. When the screening tool identifies a cluster of three or more impacted receptors, a full analysis shall be performed as outlined in the following chapters and documented in a *Traffic Noise Impact Analysis* report. This screening tool may not be used projects on new alignment or Interstate projects. In addition, the tool can only be used for projects with Activity Category B or C receptors (see below for description of Activity Categories). This screening tool is intended for KYTC use only and should not be used for noise analysis by consultants.

In instances where the source of the traffic noise is a multilane facility, the model shall be developed to consider each lane individually and compile the data collectively for all the lanes. Average pavement type must be used for prediction of future noise levels. If any other

pavement type is being considered for a project, that pavement type may not be used in the TNM model without approval from the FHWA.

Noise contour lines may be used for project alternative screening and land use planning purposes to comply with *23 CRF 772.17* but are not to be used to determine traffic noise impacts. Additional questions on TNM should be directed to the KYTC Noise Specialist in DEA for clarification.

Traffic noise predictions for a project are to be based on projected traffic volumes for the design year (usually 20 years from the date of completion) and worst noise hour. Worst noise hour may not occur during AM and PM rush hour. Special attention should be paid to situations where congestion during rush hour impedes traffic flow and thus does not represent worst case noise conditions. Monitoring during peak hour traffic would not, in this case, allow for an accurate assessment of the traffic noise impact. For roadways where the peak hour traffic results in a Level of Service of "D" or worse, consult with the KYTC Noise Specialist for assistance in designing the evaluation of traffic volumes and modeling. In some areas, seasonal or weekend traffic may be heavier, depending on attractions in the area. These cases should be discussed with the KYTC Noise Specialist on a case-by-case basis to determine the appropriate scheduling of noise monitoring and traffic counts.

Typically, KYTC allows grouping of receptors by determining a single receptor to be representative of a small group. For projects with a large number of residences or calculated residential equivalents (as outlined in the *Reasonableness* section) it is not necessary to have traffic sound level predictions at every residence or residential equivalent to identify project impacts. Sufficient modeled receivers shall be included to accurately represent the predicted sound levels for every noise sensitive receptor in the project area and documented in the noise report. If impacts are identified, it may be necessary to include additional receivers in the noise model to evaluate barrier feasibility and reasonableness. Any other questions or unusual circumstances that may affect data collection or input parameters should similarly be discussed with the KYTC Noise Specialist.

DETERMINATION OF SOUND LEVELS

IDENTIFYING RECEPTORS

All outdoor areas of frequent human use, including those in areas zoned for commercial use, will be included in the traffic noise analysis. In areas without frequent outdoor human use, noise levels shall be determined at representative locations for land use planning purposes.

Receptor site locations shall be identified that are representative of the *Activity Category (AC)* of the area (common noise environment) as described below. Receptors shall be selected that are located within 500 feet of the proposed edge of pavement. For project alternatives where modeled impacts are demonstrated at 500 feet, the study area shall be expanded to 800 feet from the proposed edge of pavement. Site locations shall also be considered for any planned development in the vicinity of the project. Any questions regarding receptor locations must be resolved with the KYTC Noise Specialist.

ACTIVITY CATEGORY A includes lands on which serenity and quiet are of extraordinary significance and serves an important public need. The designation of an Activity Category A may occur on a site basis rather than the whole property. Examples of lands that have been analyzed as Activity Category A include the Tomb of the Unknown Soldier, a monastery, outdoor prayer areas and amphitheaters. KYTC will consider Category A sites on a case-by-case basis, as these land uses are not typically encountered. Documentation of the land use shall be submitted to the KYTC Noise Specialist, who will contact the FHWA Division Office and, if necessary, FHWA Headquarters to seek concurrence with the Category A designation.

ACTIVITY CATEGORY B includes exterior areas of single or multifamily homes and mobile home parks. Noise measurements are taken in exterior areas of frequent human use where traffic noise would interfere with normal conversation such as on balconies, patios or in the backyard of the residence. In multifamily units, balconies that have potential outdoor use and common areas, such as patios, club houses or pools are used.

ACTIVITY CATEGORY C includes exterior areas of non-residential lands as listed in Table 1 under Activity Category C such as Section 4(f) properties, schools, parks, cemeteries, etc. These land uses are analyzed for traffic noise impacts by taking exterior readings in areas of frequent human use such as in school playgrounds, sports fields, and similar areas.

ACTIVITY CATEGORY D includes certain land use facilities listed in Activity Category C that may have interior uses. These land uses shall be analyzed for traffic noise impacts per procedures found in FHWA's *Measurement of Highway Related Noise*.

ACTIVITY CATEGORY E includes exteriors of developed lands that are less sensitive to highway noise. These land uses are analyzed for traffic noise impacts by taking exterior readings in areas of frequent human use, such as a pool area, or courtyard in accordance with FHWA's *Measurement of Highway Related Noise*.

ACTIVITY CATEGORY F includes land uses that are not sensitive to highway traffic noise and do not require noise analysis per 23 CFR 772.

ACTIVITY CATEGORY G includes undeveloped land. If the land was permitted for building development prior to the date of public knowledge (the publication of the CE, FONSI or ROD), the area shall be analyzed for traffic noise impacts by collecting sound measurements and conducting modeling, as described in the previous section, using the activity category that best describes the proposed future land use, and treated as if developed. In cases where the land is not permitted prior to the date of public knowledge, noise abatement is not required nor is abatement eligible for federal aid at a future date. In areas regulated by local comprehensive planning and zoning requirements, future noise impacts are to be modeled and the information conveyed to local officials and included in the project environmental documentation. The modeling shall identify the distance from the edge of travelled way to the NAC for all exterior land use categories.

DATA COLLECTION

All data collection and analysis shall be consistent with FHWA guidance on the use of Traffic Noise Model 2.5, or most current FHWA-accepted version, including technical manuals, user guides and validation information. The methods shall also comply with *Measurement of Highway Related Noise*[1], as well as other applicable FHWA guidance. FHWA has developed best practice guidance for data collection contained in the *Noise Measurement Field Guide (FHWA-HEP-18-066)*.

SOUND LEVEL METER REQUIREMENTS

All noise readings must be taken with a Type 1 or Type 2 sound level meter approved by the USA American National Standards Institute (ANSI) that has been factory calibrated in accordance with the manufacturer's recommendations. Calibration requirements shall also apply to all equipment and accessories related to the meter, including the microphone, and calibrator. Documentation of the factory calibration shall be submitted as an appendix in the *Traffic Noise Impact Analysis* document.

[1] Cynthia S.Y. Lee, Gregg G. Fleming, Measurement of Highway Related Noise (U.S. Department of Transportation Research and Special Programs Administration, FHWA-PD-96-046 DOT-VNTSC-FHWA-96-5, May 1996)

TYPES OF NOISE MEASUREMENTS

For projects on new alignments, the determination of traffic noise impacts is conducted utilizing a comparison to sound levels obtained through field measurements of noise sensitive receptors of sufficient numbers to represent all the common noise environments with the project area. For projects on new alignment, the numbers and locations of ambient noise readings should be coordinated with the KYTC Noise Specialist.

For projects on existing alignments, the determination of traffic noise impacts is conducted utilizing a comparison of modeled existing sound levels to predicted future sound levels. The modeled existing sound levels are validated with validation readings in the project area that represent the common noise environments.

AMBIENT NOISE LEVELS

Existing ambient noise levels shall be monitored during peak traffic hours or worst noise hour and under meteorologically acceptable conditions at appropriate receptors (see the *Conducting Noise Level Measurements* section below). Noise level monitoring will be conducted at each receptor or representative site(s) for a period of at least fifteen (15) minutes during the AM and/or PM peak traffic condition (or worst noise hour as previously described) with and under meteorologically acceptable conditions (wind speed less than 12 miles per hour and dry pavement).

VALIDATION NOISE LEVELS

Validation noise readings should be taken in accordance with methods discussed in the *Conducting Noise Level Measurements* section below, with simultaneous traffic counts obtained. These measurements of the roadway noise source are utilized to validate the existing model constructed in TNM for the generation of existing sound levels. Using traffic counts and site-specific monitoring data, existing noise levels are to be calculated using the most current edition of the FHWA TNM. The model is considered validated if noise levels calculated by the model are within ±3 dB(A) of actual monitored levels at each site. If the difference is greater than ±3 dB(A), additional field data is to be collected to validate the model or, if there is an explanation for the discrepancy, a detailed discussion shall be provided in the *Traffic Noise Impact Analysis* document.

NOISE READINGS FOR AREAS OF PLANNED DEVELOPMENT

Measurements shall also be taken in areas of planned and permitted developments. For situations where no structures are identified on available plans, the KYTC Noise Specialist shall be consulted to discuss the location for noise monitoring. Noise abatement considerations will not be given to areas where there are no existing receivers or planned development.

Development which occurs adjacent to a proposed highway project after the date of public knowledge but prior to project construction shall not be eligible for mitigation.

CONDUCTING NOISE LEVEL MEASUREMENTS

The noise level measurements shall be performed according to the following guidelines.

SITE CONDITIONS AND SETUP

Measurements should be conducted:

- under meteorologically acceptable conditions, including wind speed less than 12 miles per hour (mph) and with dry pavement conditions,
- with a microphone height set at five (5) feet above the ground, and
- for a period of no less than fifteen (15) minutes.

LOCATION OF NOISE LEVEL MEASUREMENTS

Decibel (dB(A)) measurements will be taken at representative receptor site locations such as residential neighborhoods, commercial and industrial areas, parks, churches, schools, hospitals, libraries and other potentially noise sensitive locations to adequately characterize the project area. Measurements are to be taken in exterior areas of frequent human use, usually at an area between the right-of-way line and the building. Measurements for ambient receptors will be recorded during the AM and/or PM peak traffic condition or worst noise hour. Measurements for validation receivers do not have to be taken during AM or PM peak hours but should be indicative of typical traffic volumes for the facility if taken outside of these time periods.

Generally it is not feasible and/or reasonable to build a noise barrier tall enough to mitigate noise for floors above the ground level and therefore ground floor outdoor use areas are the primary consideration, however in multi-family dwellings where balconies are the only potential area of frequent outdoor use, these locations shall be considered for impacts. Proposed monitoring locations and modeling methods for multifamily dwellings with more than two levels shall be approved by the KYTC Noise Specialist prior to the measurements being taken, as there may be site specific conditions, such as terrain and roadway elevations, that warrant additional considerations. These residential units may be better represented by common outdoor use areas should they exist. A manual traffic count of vehicles, by type, shall be taken simultaneously with the noise level monitoring in order to obtain data to validate the noise prediction model. Vehicle types shall be classified as car/light truck, medium truck, heavy truck, bus, or motorcycle.

Consideration of interior noise impacts is appropriate at properties such as churches, hospitals, libraries, and similar institutions. Interior readings are not required unless predicted exterior

noise levels exceed the interior NAC by more than 10 dB(A) (see Table 1 for associated dB(A) levels). For buildings with windows that are fixed closed, interior noise readings are not required unless the predicted exterior noise levels exceed the interior NAC by more than 20 dB(A). Interior readings are also not required if exterior readings approach or exceed the NAC and thus abatement measures are already under consideration. When a more detailed evaluation of interior noise from exterior noise sources is required, proposed monitoring locations and modeling methods shall be consistent with FHWA's *Measurement of Highway Related Noise* and the best practice guidance contained in the *Noise Measurement Field Guide (FHWA-HEP-18-066)* and approved by the KYTC Noise Specialist prior to the measurements being taken. The KYTC Noise Specialist shall coordinate the location and methods for conducting interior noise readings and the traffic count.

IDENTIFYING TRAFFIC NOISE IMPACTS

The noise impacts of the proposed project are to be assessed based on the design year noise levels predicted by the model and guidance related to land uses (activity categories). A traffic noise impact is considered to occur when either of the following conditions is predicted:

1) **EXCEEDING NOISE ABATEMENT CRITERIA (NAC)**: The noise level predicted for the design year approaches (i.e. within 1 dB(A)) or exceeds the NAC for the land use category of the receptor (see Table 1);
2) **SUBSTANTIAL INCREASE:** A substantial increase over existing noise level (≥ 10 dB(A)) is predicted for the design year. This criterion is independent of the NAC and may result in a defined noise impact even though the NAC may not be approached or exceeded.

NOISE ABATEMENT CRITERIA (NAC)

Table 1 defines and describes various Activity Categories and their respective Noise Abatement Criteria (NAC). In areas where a combination of activity categories is present, the analysis shall consider the appropriate NAC for any activity category represented. The traffic noise analysis shall include an evaluation of noise impacts for all land use categories that are present within the project area.

TABLE 1: ACTIVITY CATEGORIES AND NOISE ABATEMENT CRITERIA (NAC)

Activity Category	Description of Activity Category (land use)	Activity Criteria $L_{EQ}(H)$ *	Evaluation Location
A	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue its intended purpose.	57	Exterior
B**	Residential.	67	Exterior
C**	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.	67	Exterior

D	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.	52	Interior
E**	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F.	72	Exterior
F	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.	----------	----------
G	Undeveloped lands that are not permitted.	----------	----------

* The L_{eq}(h) Activity Criteria values are for impact determination only and are not design standards for noise abatement measures.

**Includes undeveloped lands permitted for this activity category.

TRAFFIC NOISE ABATEMENT CONSIDERATIONS FOR TYPE I PROJECTS

If projected noise levels approach (within one dB(A)) or exceed the NAC levels listed in Table 1, or a substantial noise increase of 10 dB(A) or greater is predicted, additional modeling shall be performed to analyze the effectiveness of noise abatement measures. The *Feasibility* and *Reasonableness* of a proposed noise abatement measure, as described in subsequent sections of this policy, shall be considered for any abatement measure. In addition, a walkthrough of this analysis is provided for example scenarios in Appendix C.

Federal funds may be used for noise abatement measures when:

1) Traffic noise impacts have been identified; and
2) Abatement measures have been determined to be feasible and reasonable pursuant to 23 CFR 772.13(d) and this *Noise Policy*.

The following noise abatement measures may be considered for incorporation into a Type I project to reduce traffic noise impacts.

1) Construction of noise barriers, including acquisition of property rights, either within or outside the highway right-of-way. Landscaping is not a viable noise abatement measure.
2) Traffic management measures including, but not limited to, traffic control devices and signing for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, modified speed limits, and exclusive lane designations.
3) Alteration of horizontal and vertical alignments.
4) Acquisition of real property or interests therein (predominantly unimproved property) to serve as a buffer zone to preempt development which would be adversely impacted by traffic noise.
5) Noise insulation of Activity Category D land use facilities listed in Table 1. Post-installation maintenance and operational costs for noise insulation are not eligible for Federal-aid funding.

For the analysis of noise barriers, it may be necessary to model multiple locations, including along the right-of-way, outside of the clear zone for the roadway proposed (refer to AASHTO's Green Book and KYTC Design Guide Manual) and along the shoulder to fully assess the potential for barrier abatement. A barrier that breaks the line of site between the receptor and roadway will achieve a 5 dB(A) reduction in sound levels. Site conditions may make the placement of a barrier at one or more of these locations not feasible (e.g. elevations of the roadway in relation to the receptors or the reduced effective height of the barrier based on the bottom elevation in relation to the roadway). A barrier along the right-of-way or outside of the clear zone is

preferable to one along the shoulder. A considered approach to barrier placement and length/height optimization should be conducted for each location where barriers are evaluated for the abatement of receptor impacts.

KYTC is not part of an FHWA approved quiet pavement pilot program; therefore, the use of quiet pavement is not an acceptable option to provide noise abatement for a project.

FEASIBILITY

There are two measures required for a proposed noise abatement to be considered feasible:

1) *Acoustic Feasibility* – A substantial noise reduction (≥ 5 dB(A)) for three (3) or more impacted receptors.

2) *Engineering Feasibility* – The barrier does not pose overriding safety (visibility issues) or maintenance (drainage and right of way access) problems.

ACOUSTIC FEASIBILITY

When determining the acoustic feasibility of a proposed abatement measure, KYTC shall consider whether the measure provides a substantial noise reduction (≥ 5 dB(A)) for a reasonable number of impacted receptors to warrant consideration. If a proposed barrier will not provide a minimum 5 dB(A) reduction for, at minimum, three (3) impacted receptors, it will not be considered acoustically feasible.

Based on this feasibility criterion, the assessment of a barrier is not necessary for individual locations where there are not at least three impacted receptors. The noise practitioner should evaluate all receptors within a 115-foot radius from the impacted isolated receptor. If there are not two additional impacted receptors within this distance, a barrier analysis is not required and a statement of likelihood in the NEPA document should identify that noise abatement at that location is not feasible. If there are two additional impacted receptors within the 115-foot distance, then a barrier analysis should be performed, and the results included in the NEPA document.

ENGINEERING FEASIBILITY

Engineering or constructability issues may render an abatement measure infeasible. In determining if site characteristics are suitable for barrier construction, KYTC shall consider numerous factors including safety, maintenance, drainage, and access. Engineering judgment may dictate that a barrier is not feasible if the barrier would pose overriding safety or maintenance problems as dictated by the current versions of KYTC's *Highway Design Guidance Manual*, the American Association of State Highway Transportation Officials' (AASHTO) *A Policy*

on Geometric Design of Highways and Streets (the Green Book), AASHTO's *Roadside Design Guide* or FHWA's *Manual of Uniform Traffic Control Devices* (MUTCD).

REASONABLENESS

The determination of reasonableness of a proposed abatement measure shall be based upon three primary factors: 1) cost effectiveness, 2) the noise reduction design goal, 3) and the desires of the benefited receptors.

COST EFFECTIVENESS

1) To ensure a degree of reasonableness in assessing the mitigation at a location, the *Cost Per Benefited Receptor (CBR)* shall be calculated. Examples of this calculation are provided in the *KYTC Traffic Noise Abatement Calculation Guide* provided as *Appendix C.* The equation for calculating this value is:

EQUATION 1: COST PER BENEFITED RECEPTOR (CBR)

$$Cost\ per\ Benefited\ Receptor\ (CBR) = \frac{Cost\ of\ the\ Noise\ Barrier(\$)}{Number\ of\ Benefited\ Receptors}$$

Where:

- *Cost of the Noise Barrier ($)* = average unit cost criterion used in the TNM model.
- *Number of Benefited Receptors* = the total number of receptors receiving a noise reduction of at least 5 dB(A).

The *Cost of the Noise Barrier* shall be based upon the engineer's best estimate of total barrier costs. KYTC assumes an average cost of $32 per square foot of barrier wall. In preparation of the Engineer's Estimate for the noise wall, the Project Manager shall only adjust this average to account for site specific factors, such as extraordinary drainage issues, extraordinarily high right of way expenses, major utility relocation expenses, etc., that clearly will result in higher than average costs.

KYTC shall review the average cost of barrier construction at least every five (5) years to assure use of reasonable costs in this analysis. Reevaluation may occur more frequently if considered appropriate by KYTC and FHWA. Any adjustments to the average unit cost will be published by a memo on the KYTC DEA website or through an update to this *Noise Policy*. The latest average unit cost value should be used for any new projects initiated after the publication date of the memo or the effective date of this *Noise Policy*.

In cases where a berm is being considered for noise abatement, the *Cost of the Noise Barrier* shall be determined by an engineer on the project team. The *Cost of the Noise Barrier* in the

case of berms should be the best possible estimate of cost, considering site/project specific factors such as the amount of necessary earthwork, availability of material, and right of way considerations.

The *Number of Benefited Receptors* shall be a total count of all benefited receptors including those in single and multifamily residences, as well as an accounting for special uses identified as Activity Category C, D or E, including parks, schools, churches, day care facilities, etc. When a multifamily dwelling has a common exterior area of frequent human use, the equivalent receptor number should be included in the calculations. The equivalent receptor count for common use areas should account for capacity limitations for those uses. Apartment buildings or multifamily dwelling units with no frequent human exterior use will not require any type of noise analysis.

For Activity Category C, D or E uses, the property shall be considered by calculating an Equivalent Residences (ER) for input into the CBR formula using one of the following equations:

EQUATION 2: EQUIVALENT RECEPTORS

$$ER = \left(\frac{\#\ Persons}{2.5\ Persons\ per\ Average\ Household}\right) \times \left(\frac{Average\ Daily\ Hours\ Use}{24\ Hours\ per\ Day}\right)$$

~ OR ~

$$ER = \left(\frac{\#\ Persons}{2.5\ Persons\ per\ Average\ Household}\right) \times \left(\frac{Average\ Weekly\ Hours\ Use}{168\ Hours\ per\ Week}\right)$$

Where:

- *# Persons* are those people who use the facility within the study limit boundaries (500 feet or 800 feet as determined by the impact analysis). Where the facility is a building, such as a church, school or daycare, persons using the structure shall be included if any portion of the structure lies within the study limits. Structures lying totally beyond the study limits shall not be counted as benefited receptors. The number of persons shall be established through consultation with the school, church, day care, etc. and shall be based upon the greater of either the number enrolled or capacity of the facility. Where use involves a park, trail, or other exterior activity, the facility official shall be consulted to determine the use that occurs within the study limits and the extent of that use.
- *Average Daily Hours of Use* or *Average Weekly Hours of Use* is the average number of hours during which the "# Persons" use the facility. The average should account for all time that the facility is not in use such as nights and weekends.

KYTC has established a $40,000 CBR as a reasonable maximum threshold for this value. KYTC shall review the CBR at least every five (5) years to assure use of reasonable costs in this analysis. Reevaluation may occur more frequently if considered appropriate by KYTC and FHWA. Any adjustments to the CBR will be published by a memo on the KYTC DEA website or by an update to this *Noise Policy*. The latest CBR value should be used for any new projects initiated after the publication date of the memo or the effective date of the *Noise Policy*.

Locations with a CBR of $40,000 or less will be considered cost effective candidates for noise barrier construction. Locations where the CBR exceeds $40,000 will not be considered cost effective and abatement measures shall not be incorporated into the project unless it meets *Other Reasonableness Considerations* (see below) and associated CBR adjustments. Third party funding *CANNOT* be used to make up the difference in cost between the reasonable cost allowance and the actual cost. Third party funding can only be used to pay for additional features such as landscaping, aesthetic treatments, etc. for noise barriers that meet cost-effectiveness criteria.

Barriers are to be evaluated independently for feasibility and reasonableness. If a structural noise barrier contributes to the noise attenuation for receptors that have their noise impacts mitigated by another structural noise barrier, then these groups of barriers may be identified as barrier systems and may be evaluated as a group for feasibility and reasonableness. This would also apply in cases where two barriers are feasible together, but not independently.

NOISE REDUCTION DESIGN GOAL

KYTC' s noise reduction design goal is 7 dB(A) for a minimum of 50% of front row benefited receptors. For determining cost effectiveness of a proposed abatement measure, benefited receptors are considered those that will receive a minimum 5 dB(A) noise reduction. Noise reduction estimates shall be solely based upon the results of the TNM. Receptors receiving less than a 5 dB(A) reduction in noise from a proposed abatement measure shall not be considered as a benefited receptor for the purpose of calculating cost effectiveness.

DESIRES OF BENEFITED RECEPTORS

The views of the benefited receptors and property owners will be considered in determining the reasonableness of noise barriers. Input from the benefited receptors and property owners shall be gathered as outlined in this section. When the majority of benefited receptors and property owners, engaged through the public involvement process, are opposed to construction of a noise barrier, KYTC will give great deference to these opinions in making a final determination regarding the reasonableness of the measure regardless of whether the proposal satisfies all other criteria for consideration. Similarly, where the majority of the

benefited receptors and property owners involved in the public involvement process are in support of noise barrier construction, and the proposal satisfies all other criteria for consideration outlined in this *Noise Policy*, KYTC shall incorporate the abatement measures into the project. It should be noted that if the benefited receptors reject a noise barrier and then later change their opinion, the project would be considered a Type II project by FHWA. Since KYTC does not have a Type II program, noise abatement would only be considered as described in the *Traffic Noise Abatement Considerations for State-Funded Retrofit Projects* section of this *Noise Policy*.

The public and local officials will be advised through the NEPA public involvement process if traffic noise impacts are expected to occur. A *Noise Abatement Public Meeting* will be held with benefited receptors at each location where noise barriers were identified in the final environmental document as feasible, cost effective, and "likely to be constructed." Benefited receptors shall be identified and notified of the meeting and their opportunity for input into the determination for inclusion of noise mitigation measures into the project. This public meeting will include:

1) A brief presentation or printed materials on highway traffic noise to explain and demonstrate the characteristics of highway noise, the effects of noise barriers in attenuating noise, and the types of structural noise barriers being considered.
2) Specific details of the barrier proposed for each affected area including location, design, height, and length.
3) Discussion of alternatives to barrier construction.
4) Responses to questions and suggestions from the property owners.
5) Solicitation of the owners' and residents' preference of noise abatement measures by ballot (see *KYTC Noise Abatement Calculation Guide*). One owner ballot and one resident ballot shall be solicited for each benefited receptor. Ballots shall be weighted in accordance with the following:

    3 POINTS/BALLOT FOR BENEFITED FRONT-ROW PROPERTY OWNERS

    1 POINT/BALLOT FOR ALL OTHER BENEFITED PROPERTY OWNERS

    1 POINT/BALLOT FOR ALL BENEFITED RESIDENTS

Ballots shall be made available at the public meeting for completion by benefited owners and/or benefited residents who may attend. Benefited receptors who do not provide ballot input at the meeting shall be surveyed to determine their preference. Properties with special use such as churches, schools, playgrounds etc. shall be weighted in a manner similar to that described under the *Cost Effectiveness* section of this *Noise Policy*. The voting member shall be identified as the leader or head of the organization such as the school superintendent, park superintendent, etc. For each such property, both a resident and owner ballot shall be solicited,

weighted to account for equivalent residences and, if appropriate, further weighted in accordance with the respect to paragraph 5 of this section.

All benefited residents and property owners shall have a period of thirty (30) days following the *Noise Abatement Public Meeting* to cast their votes. Barrier walls shall include access doors and/or provisions for fire hydrant hookups spaced as specified after meeting with local fire officials to discuss site specific needs. Barrier walls will only be constructed when a simple majority of affirmative ballots, after appropriate weighting, indicate a preference for the abatement.

OTHER REASONABLENESS CONSIDERATIONS

KYTC shall provide additional consideration to circumstances where the predicted noise levels are considered extraordinary and/or where residential structures were in place prior to the development of the roadway or prior to the last capacity project on the adjacent roadway. Additional consideration shall be afforded by allowing a higher than average cost for each benefited receptor meeting the defined criteria. This shall be accomplished by reducing the total cost of the barrier by the total value of all adjustments as calculated in accordance with this section. The equation for adjusting the CBR calculation shall be:

EQUATION 3: ADJUSTMENT TO THE CBR

$$CBR_{adj} = \frac{\left(Cost\ of\ the\ Noise\ Barrier\ (\$)\right) - (Total\ Value\ of\ Adjustments)}{Number\ of\ Benefited\ Receptors}$$

The *Total Value of Adjustment* is the sum of the two potential adjustments described below.

ADJUSTMENT #1 – ABSOLUTE NOISE LEVEL

Absolute noise levels shall be considered extraordinary if they are greater than or equal to 76 dB(A). Each benefited receptor predicted to experience noise levels greater than or equal to 76 dB(A) shall be afforded an additional $2,500. The *Value of Adjustment* for absolute noise level shall be calculated based upon the number of benefited receptors where predicted noise levels are excessive. The calculation shall be as follows:

EQUATION 4: ADJUSTMENT FOR ABSOLUTE NOISE LEVELS

$$Value\ of\ Adjustment\ (\$) = [\sum \#\ of\ Receptors \geq 76\ dB(A)] \times \$2{,}500$$

ADJUSTMENT #2 – RESIDENTIAL

For NAC types A through C, additional consideration will be given to receivers that were in place prior to the construction of the roadway facility, or prior to the last project that added capacity to the roadway facility. This additional consideration only applies to roadways with both high volumes and travel speeds. For analyses where greater than or equal to 50% of the first row impacted receivers have predicted sound levels greater than or equal to 76 dB(A) Leq, then the modeler shall determine if the receptors were in place prior to the facilities construction or prior to the latest project increasing capacity within 1,200 feet. If the receptors were in place prior to the implementation of the roadway or its improvements, then each benefited receptor that meets the criteria will be afforded an additional $2,500. These criteria shall be evaluated for each NSA for the project whenever structural noise barriers are evaluated. The *Value of Adjustment* shall be as follows.

EQUATION 5: RESIDENTIAL ADJUSTMENT

$$Value\ of\ Adjustment\ (\$) = [\sum \#\ of\ Receptors] \times \$2{,}500$$

DOCUMENTATION AND REPORTING

The results of traffic noise analysis shall be documented in the *Traffic Noise Impact Analysis* document. The report shall address the content as prescribed by the *Noise Analysis and Abatement Guidance and Accountability Form (GAF)* (KYTC Form 58-42) and shall be formatted as detailed in the most current edition of the *KYTC Environmental Analysis Guidance Manual*. The report shall identify all areas where noise abatement measures are considered feasible and reasonable in accordance with this *Noise Policy*. The report shall also identify areas where a traffic noise impact is identified to potentially exist, but noise abatement measures are not considered feasible or reasonable. The findings of the *Traffic Noise Impact Analysis* document shall be summarized and incorporated into the NEPA documentation developed for the project. For areas where abatement measures have been determined to be feasible and reasonable, KYTC shall fully discuss these conclusions in the NEPA document. The document must include a statement of likelihood such as "For the proposed project, structural noise barriers are warranted for further consideration at [insert location description(s)] for alternative(s) [insert alternative designation(s) or description(s)]." The final decision regarding abatement measures will be made during detailed design considering information gathered during the public involvement process.

For projects where noise barriers are found to feasible and meet the reasonableness cost-effectiveness and design goal criterion, the report should include exhibit(s) to show the barrier location(s) and length(s) in relation to the proposed facility and the receptors. A barrier descriptions table, including coordinates of the wall segments, bottom elevations and top elevations should be also provided be provided for these proposed barrier walls.

KYTC shall maintain an inventory of all constructed noise abatement measures. The inventory shall build upon the existing database and include parameters such as abatement type, cost, average height, length, year of construction and all other parameters as required by 23 CFR 772.13(f). The inventory, in spreadsheet format, shall be maintained by the KYTC Noise Specialist in the DEA.

COORDINATION WITH LOCAL OFFICIALS

Coordination with and providing information to local officials is critical to a developing a comprehensive approach to creating livable communities adjacent to highways. Impacts of highway traffic noise can be reduced through a program of shared responsibility. Requests to approve land use changes adjacent to the highways should consider the current and predicted traffic noise. Approval of land uses adjacent to a highway that are particularly noise sensitive should be an informed decision and should only occur after careful consideration. Thus, where local government exercises control over land development through planning and zoning ordinances, KYTC shall share predicted noise levels along highway corridors and techniques that can be used to minimize highway noise related impacts to adjacent properties. KYTC shall provide this information to local officials for all Type I projects developed within these local jurisdictions.

Documentation of early coordination efforts shall be presented within the project's final environmental document. Approval of the environmental document is considered the date of public knowledge. KYTC IS NOT RESPONSIBLE FOR PROVIDING NOISE ABATEMENT FOR DEVELOPMENT THAT OCCURS ADJACENT TO THE PROPOSED HIGHWAY PROJECT THAT WAS NOT PERMITTED AS OF THE DATE OF PUBLIC KNOWLEDGE. Noise abatement measures for properties developed after the date of public knowledge should be considered by the local government or developer as permits and approvals for these land use changes are considered. Noise abatement measures would be considered for these developments in the future should another Type I project be proposed.

Information developed through the KYTC environmental process will be made available to appropriate local officials by KYTC's Chief District Engineer for use in evaluating proposed land use changes. The KYTC will provide the best estimates of future highway traffic noise levels for both developed and undeveloped lands in the immediate vicinity of the project. For undeveloped properties, KYTC shall provide minimum buffer distances to structures that should be maintained in order to prevent the occurrence of traffic noise impacts. This can be accomplished by developing noise contours or providing other data to adequately convey the information. This shall be incorporated within the final environmental document for the project, which shall be provided to the local officials.

CONSTRUCTION NOISE

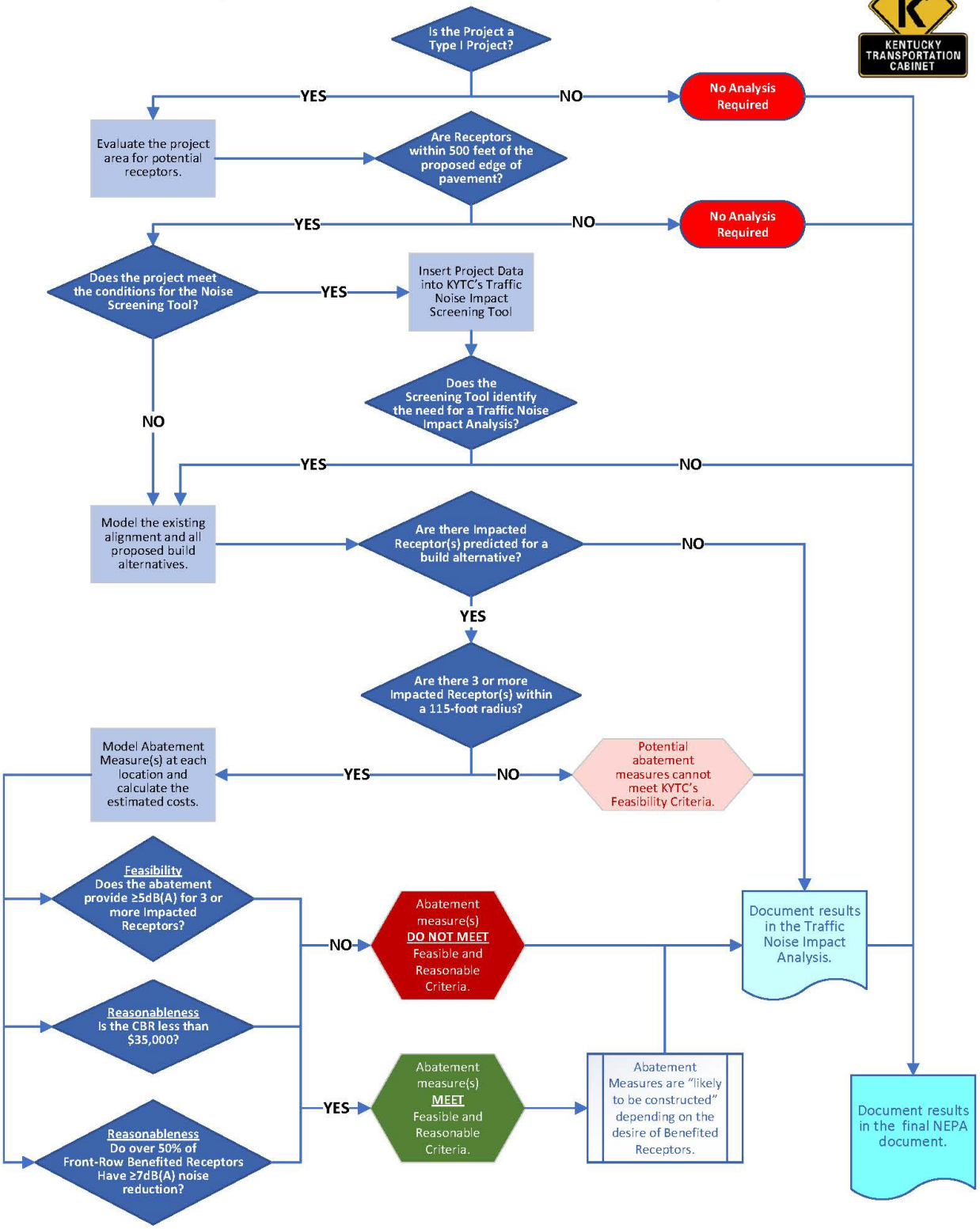
Construction noise is unavoidable but temporary in nature and reasonable efforts will be made to reduce impacts to receptors to the extent practicable. For the majority of projects, construction will not persist in a given area for a long period of time. In the unusual instance where construction will persist for a period longer than two (2) years and where impacts to nearby receptors are determined to be likely, the project team shall have the flexibility to incorporate construction noise abatement measures into the project. This may involve shielding of equipment with acoustic barriers, restricting certain types of work to specific hours of the day, requiring source control on equipment (mufflers) or other measures to reduce noise impacts.

TRAFFIC NOISE ABATEMENT CONSIDERATIONS FOR STATE-FUNDED RETROFIT PROJECTS

Noise abatement projects that will be advanced using state funds shall be programmed through KYTC's latest *Enacted Highway Plan*. Potential projects may be identified by citizens, local governments, legislative officials, or others. KYTC shall consider such requests when developing a recommendation for highway projects to be included in the *Enacted Highway Plan*. Similarly, requests for consideration of these projects may also be voiced to legislative officials. Final approval of the *Enacted Highway Plan* rests with the Kentucky General Assembly which may, at its discretion, include such projects in the *Enacted Highway Plan*. State funded noise abatement projects that are legislatively approved by inclusion in the approved *Enacted Highway Plan* shall be developed in accordance with the directives of the legislature.

APPENDIX A – TYPICAL NOISE ANALYSIS FLOWCHART

TYPICAL NOISE ANALYSIS FLOWCHART



APPENDIX B – TRAFFIC NOISE IMPACT SCREENING TOOL

The *Traffic Noise Impact Screening Tool* has been developed to provide KYTC DEA with a two-step screening process to determine the level of analysis required for a proposed Type I project in accordance with 23 CFR 772. The tool also provides a basis of analysis of potential alternative impacts due to highway noise to satisfy the NEPA process. This tool is intended for KYTC's internal use only and is not to be used by consultants. This screening tool may not be used projects on new alignment or Interstate projects. In addition, the tool can only be used for projects with Activity Category B or C receptors. For projects that do not meet these criteria, a full *Traffic Noise Impact Analysis* shall be performed. The two-strep screening include:

STEP 1 – PREDICTED NOISE LEVEL SCREENING

The goal of this screening is to determine if the project has the potential for traffic noise impacts due to noise levels that approach or exceed the Noise Abatement Criteria (NAC) for Activity Categories B and C. The user is required to enter project-specific data, including roadway characteristics and traffic. Once this data is entered, the predicted noise level for the given receptor distance(s) will automatically be calculated. This screening tool then identifies predicted noise levels of 65dB(A) or greater as an impact. This provides a 1 dB(A) buffer to the 66dB(A) that is typically considered an impact by KYTC for these Activity Categories.

STEP 2 – BARRIER FEASIBILITY SCREENING

For potential impacted receptors identified in *Step 1*, this screening will determine if a noise abatement measure could satisfy KYTC's feasibility. The user shall evaluate impacted receptors identified in Step 1 and determine if there are additional impacted receptors within a 115-foot radius of it. Locations where there are two or more impacted receptors within 115 feet of an impacted receptor are considered a cluster and noise abatement measure is capable of meeting KYTC's feasibility criteria. Locations without two other impacted receptors within a 115-foot radius of an impacted receptor are considered isolated and a noise abatement measure would be unable to meet the feasibility criteria.

CONCLUSION STATEMENTS

This section gives the final determination of the two-step screening process. No user input is required. When Step 1 shows potentially impacted receptors and Step 2 indicates there is a cluster of impacted receptors, then a full *Traffic Noise Impact Analysis* is required. If Step 1 shows no receptor impacts OR if there are impacted receptors identified but they are determined in Step 2 to be isolated, then a full *Traffic Noise Impact Analysis* is not required and the NEPA requirements for a noise study are fulfilled. For these situations, standard template language is provided for use in the final NEPA document.

KENTUCKY TRANSPORTATION CABINET
Department of Highways
DIVISON OF ENVIRONMENTAL ANALYSIS

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TRAFFIC NOISE IMPACT SCREENING TOOL

PROJECT INFORMATION

Item #: _____ County: _____ Route: _____ Alternative: _____

STEP 1 - PREDICTED NOISE LEVEL SCREENING

1. Determine the number of road segments with varying lane widths, design speed, traffic volumes, or vehicle type.

2. Input the roadway and traffic characteristics for each segment identified.

Roadway Characteristics	
Roadway Lanes:	
Each Lane Width:	
or Total Lane Width:	
Shoulder Width (Each):	

Traffic Charactistics	Segment 1	Segment 2	Segment 3	Segment 4
Design Speed:				
DHV:				
or ADT:				
% Trucks:				

3. Insert the distance (linear feet) from the proposed edge of pavement to the nearest receptors for each roadway segment to determine predicted noise levels (dB(A)). A mininum of 30 feet is required for each distance.

Segment 1		
	Distance (ft)	Noise Level dB(A)
Receptor 1:		
Receptor 2:		
Receptor 3:		
Receptor 4:		
Receptor 5:		

Segment 2		
	Distance (ft)	Noise Level dB(A)
Receptor 1:		
Receptor 2:		
Receptor 3:		
Receptor 4:		
Receptor 5:		

Segment 3		
	Distance (ft)	Noise Level dB(A)
Receptor 1:		
Receptor 2:		
Receptor 3:		
Receptor 4:		
Receptor 5:		

Segment 4		
	Distance (ft)	Noise Level dB(A)
Receptor 1:		
Receptor 2:		
Receptor 3:		
Receptor 4:		
Receptor 5:		

STEP 2 - BARRIER FEASIBILITY SCREENING

1. For any impacted receptor identified above, are there also two or more impacted receptors within a 115 feet radius of it? (answer Yes or No). If not, document these results by printing a map of the impacted receptor(s) and include with this screening tool.

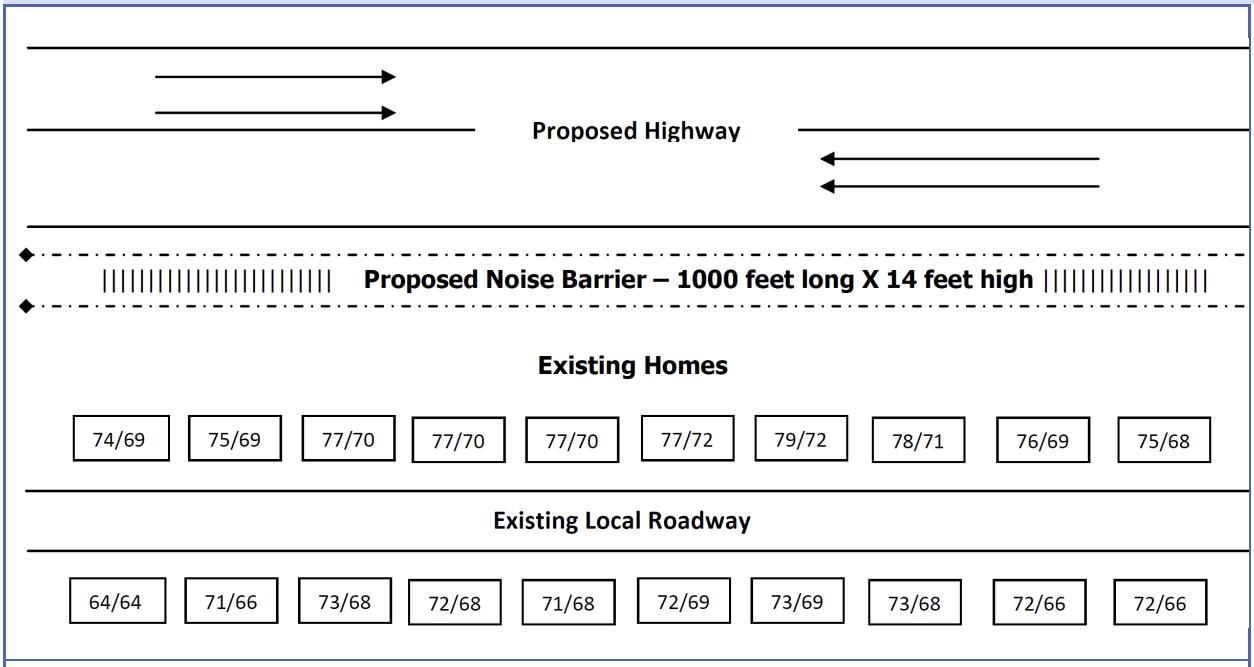
CONCLUSION

4. If Step 2 is RED, a full *Traffic Noise Impact Analysis* is required. Otherwise, insert the following language into the NEPA document to finalize the screening process and fulfill the NEPA requirements of a noise analysis.

APPENDIX C – TRAFFIC NOISE ABATEMENT CALCULATION GUIDE

This guide is provided to give examples of how the acoustical feasibility and noise reduction design goal calculations are to be used. For illustration purposes, the following scenarios will used to take into consideration various activity categories as found in Table 1. Each scenario will use a 4-lane roadway project (2 lanes in each direction) that will bring the alignment closer to the existing properties, has predicted noise levels that approach or exceed the NAC, and therefore must consider mitigation.

SCENARIO 1: ACTIVITY CATEGORY B – RESIDENTIAL: SINGLE-FAMILY RESIDENCES



Note: (xx/xx) = Predicted noise levels (dB(A)) without / with mitigation.

SCENARIO FEATURES. All single-family residences represent 1 receptor, so there are twenty (20) receptors in this scenario. Ten (10) of the receptors are considered front-row receptors. Nineteen (19) of the twenty (20) receptors in this scenario approach or exceed the NAC for Activity Category B. There are fifteen (15) receptors that achieve a minimum of 5 dB(A) reduction and therefore are considered benefited.

FEASIBILITY CRITERIA. A minimum of three (3) of the impacted receptors must achieve a minimum of 5 dB(A) reduction. Since fifteen (15) of the nineteen (19) impacted receptors achieve the necessary reduction, the wall is acoustically feasible.

REASONABLENESS CRITERIA: DESIGN GOAL. A minimum of 50% of the front-row benefited receptors must realize a minimum 7 dB(A) reduction. Seven (7) of the ten (10) front-row receptors reach 7 dB(A) reduction. The Design Goal is met.

REASONABLENESS CRITERIA: COST EFFECTIVENESS. The Cost per Benefited Receptor (CBR) shall be calculated to determine if the construction of a barrier for mitigation is reasonable (meets costs considerations). The barrier dimensions are 1,000 feet in length and 14 feet in height. The barrier cost shall use KYTC's current cost per square foot, which is currently set at $32 (as of July 1, 2022).

Using *Equation 1* of the *Cost Effectiveness* section in this *Noise Policy*, the CBR for this situation equals $29,867 (see calculations below). Therefore, the barrier is determined to be cost effective.

$$CBR = \frac{Cost\ of\ the\ Noise\ Barrier(\$)}{Number\ of\ Benefited\ Receptors}$$

$$CBR = \frac{\left(Length\ \times Height\ \times KYTC\ Cost\ per\ Square\ Foot(\$)\right)}{Number\ of\ Benefited\ Receptors}$$

$$CBR = \frac{(1{,}000\ \times 14\ \times \$32)}{15} = \frac{\$448{,}000}{15} = \$29{,}867$$

REASONABLENESS CRITERIA: DESIRE OF THE BENEFITED RECEPTORS. Ballots shall be made available at the public meeting for completion by benefited owners and/or benefited residents who may attend. Benefited receptors that do not provide ballot input at the meeting shall be surveyed to determine their preference. For each such property, both a resident and owner ballot shall be solicited. One owner ballot and one resident ballot shall be solicited for each benefited receptor. As outlined in the *Desires of Benefited Receptors* section in this *Noise Policy*, points per ballot shall be distributed in the following weighted manner.

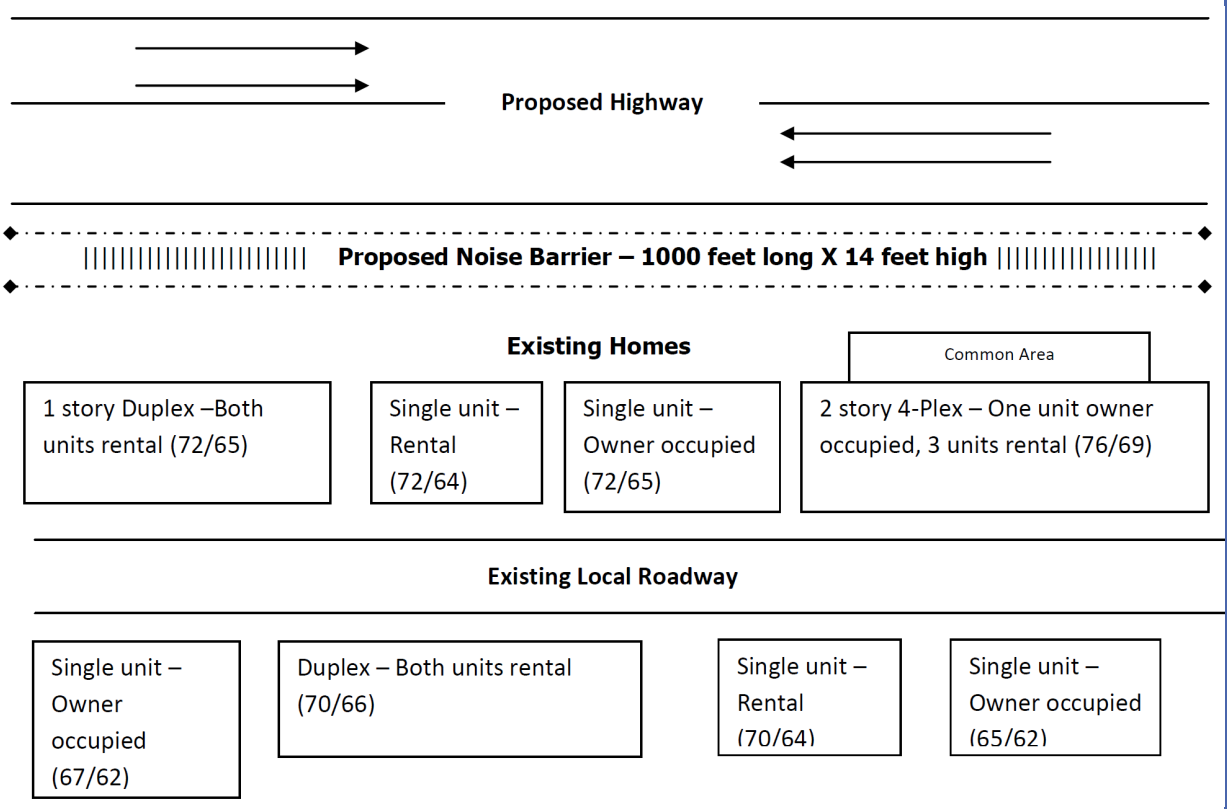
3 POINTS/BALLOT FOR BENEFITED FRONT-ROW PROPERTY OWNERS

1 POINT/BALLOT FOR ALL OTHER BENEFITED PROPERTY OWNERS

1 POINT/BALLOT FOR ALL BENEFITED RESIDENTS

Each benefited receptor on the front row would 4 total points and the second row benefited receptors would have 2 total points. In the event that some of the properties are rentals, the vote would split according to the breakdown above. The barrier would be constructed if the total points in favor of construction exceed those opposed.

SCENARIO 2: ACTIVITY CATEGORY B – RESIDENTIAL: MULTIFAMILY RESIDENCES



Note: (xx/xx) = Predicted noise levels (dB(A)) without / with mitigation.

SCENARIO FEATURES. The single-unit residences represent one (1) receptor, the duplexes represent two (2) receptors, and the four-plex represents four (4) receptors for a total of thirteen (13) receptors in this scenario. Eight (8) of the receptors are considered front-row receptors. Twelve (12) of the thirteen (13) receptors in this scenario approach or exceed the NAC for Activity Category B.

A reduction of at least 5 dB(A) must be realized for a receptor to be considered benefited. Per the *Noise Policy's* methods for calculating Equivalent Receptors (Equation 2) for multifamily dwellings, there are ten receptors that meet this criterion. Because the noise levels in the common use area (typically an outdoor area available for use by all occupants i.e. picnic table, playground, etc.) of the two-story 4-plex achieves more than a 5 dB(A) reduction, all units are considered benefited.

FEASIBILITY CRITERIA. A minimum of three (3) of the impacted receptors must achieve a minimum of 5 dB(A) reduction. Twelve (12) of the thirteen (13) receptors are considered

impacted per the definition of impacted receptor in the *Noise Policy*. Ten (10) of the twelve (12) impacted receptors achieve the necessary reduction. The wall is acoustically feasible.

REASONABLENESS CRITERIA: DESIGN GOAL. A minimum of 50% of the front-row benefited receptors must realize a minimum 7 dB(A) reduction. In this scenario, all eight (8) front-row benefited receptors achieve the necessary reduction. The Design Goal is met.

REASONABLENESS CRITERIA: COST EFFECTIVENESS. The barrier dimensions are 1,000 feet in length and 14 feet in height. Using KYTC's current cost per square foot of $32 (as of July 1, 2022), the CBR for this situation equals $44,800 (see calculations below). This CBR is greater than the current $40,000 maximum threshold, therefore, the barrier is not determined to be cost effective and reasonable.

$$CBR = \frac{(1{,}000 \times 14 \times \$32)}{10} = \frac{\$448{,}000}{10} = \$44{,}800$$

If the CBR had been less than $40,000, input from the affected residents would have been solicited through the ballot process. Details how the ballots would be compiled for the various structures is outlined below.

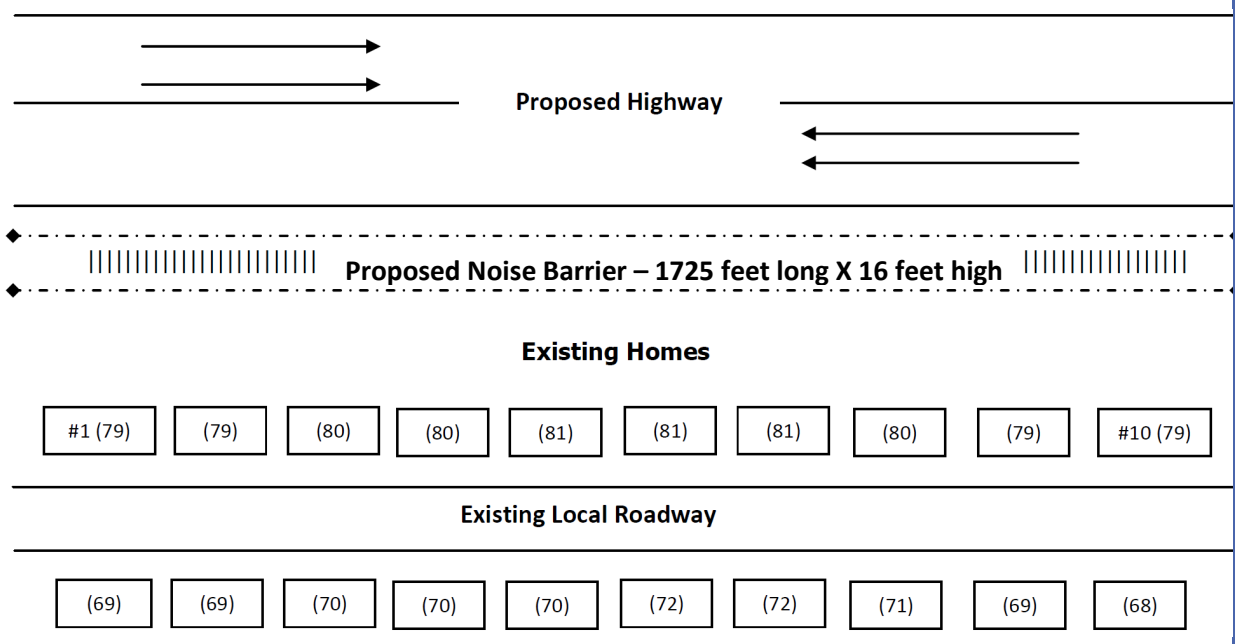
SCENARIO 2 – BALLOT DISTRIBUTION

Receptors	Owner – 3 points/ballot for Benefited Front-row Receptor	Owner – 1 point/ballot for Benefited Front-Row Receptor	Occupant – 1 point/ballot for all Benefited Residents	Total
Front-row Receptors				
1-Story Duplex Rental	6	--	2	8
Single Unit Rental	3	--	1	4
Single Unit Owner-occupied	3	--	1	4
2-story 4-plex	12	--	4	16
Second-row Receptors				
Single Unit Owner-occupied	--	1	1	2
Duplex Rental*	--	0	0	0
Single Unit Rental	--	1	1	2

Single Unit Owner-Occupied	--	1	1	2

* Does not achieve the required 5 dB(A) reduction to be considered a benefited receptor.

SCENARIO 3: ACTIVITY CATEGORY B – RESIDENTIAL: SINGLE-FAMILY RESIDENCES WITH EXTRAORDINARY PREDICTED NOISE LEVELS



Note: (xx/xx) = Predicted noise levels (dB(A)) without / with mitigation.

SCENARIO FEATURES. All single-family residences represent one receptor, so there are twenty (20) receptors in this scenario. All twenty (20) receptors were built prior to proposed highway. Ten (10) of the receptors are considered front-row receptors. All twenty (20) receptors in this scenario exceed the NAC for Activity Category B.

REASONABLENESS CRITERIA: COST EFFECTIVENESS. The Cost per Benefited Receptor (CBR) shall be calculated to determine if the construction of a barrier for mitigation is reasonable (meets costs considerations). All residences in this example are impacted at 68 to 81 dB(A). The barrier dimensions are 1,725 feet in length and 16 feet in height. The barrier cost shall use KYTC's current cost per square foot, which is currently set at $32 (as of July 1, 2022).

In this scenario, it is considered that each of the twenty (20) residences receive at least 5 dB(A) noise reduction as a result of the proposed barrier and that eight (8) of the ten (10) receptors in

the front-row receive a noise reduction of 7 dB(A). The CBR for this situation equals $44,160 (see calculations below). Therefore, the barrier is not determined to be cost effective and reasonable. However, since predicted noise levels greater than or equal to 76 dB(A), they are considered extraordinary, so an adjustment is calculated.

$$CBR = \frac{Cost\ of\ the\ Noise\ Barrier(\$)}{Number\ of\ Benefited\ Receptors}$$

$$CBR = \frac{\left(Length\ \times Height\ \times KYTC\ Cost\ per\ Square\ Foot(\$)\right)}{Number\ of\ Benefited\ Receptors}$$

$$CBR = \frac{(1{,}725\ \times 16\ \times \$32)}{20} = \frac{\$883{,}200}{20} = \$44{,}160$$

CBR ADJUSTMENT. As described in the *Other Reasonableness Considerations* section of the *Noise Policy*, there are two adjustments methods for adjusting the CBR calculation. The first method states that each benefited receptor predicted to experience noise levels greater than or equal to 76 dB(A) shall be afforded an additional $2,500 per dB(A) over this limit. The calculation, as provided in *Equation 4* of the *Other Reasonableness Considerations* section, shall be as follows:

$$Value\ of\ Adjustment\ (\$) = [\sum \#\ of\ Receptors \geq 76\ dB(A)]\ \times\ \$2{,}500$$
$$Value\ of\ Adjustment\ (\$) = [20]\ \times\ \$2{,}500 = \$50{,}000$$

The second adjustment method allows for additional consideration for NAC type A through C receptors that were in place prior to the construction of the roadway facility, or prior to the last project that added capacity to the roadway facility. All twenty houses in this scenario meet this condition, and therefore each benefited receptor are afforded an additional $2,500. The calculation, as provided in *Equation 5* of the *Other Reasonableness Considerations* section, shall be as follows:

$$Value\ of\ Adjustment\ (\$) = [\sum \#\ of\ Receptors]\ \times\ \$2{,}500$$
$$Value\ of\ Adjustment\ (\$) = [20]\ \times\ \$2{,}500 = \$50{,}000$$

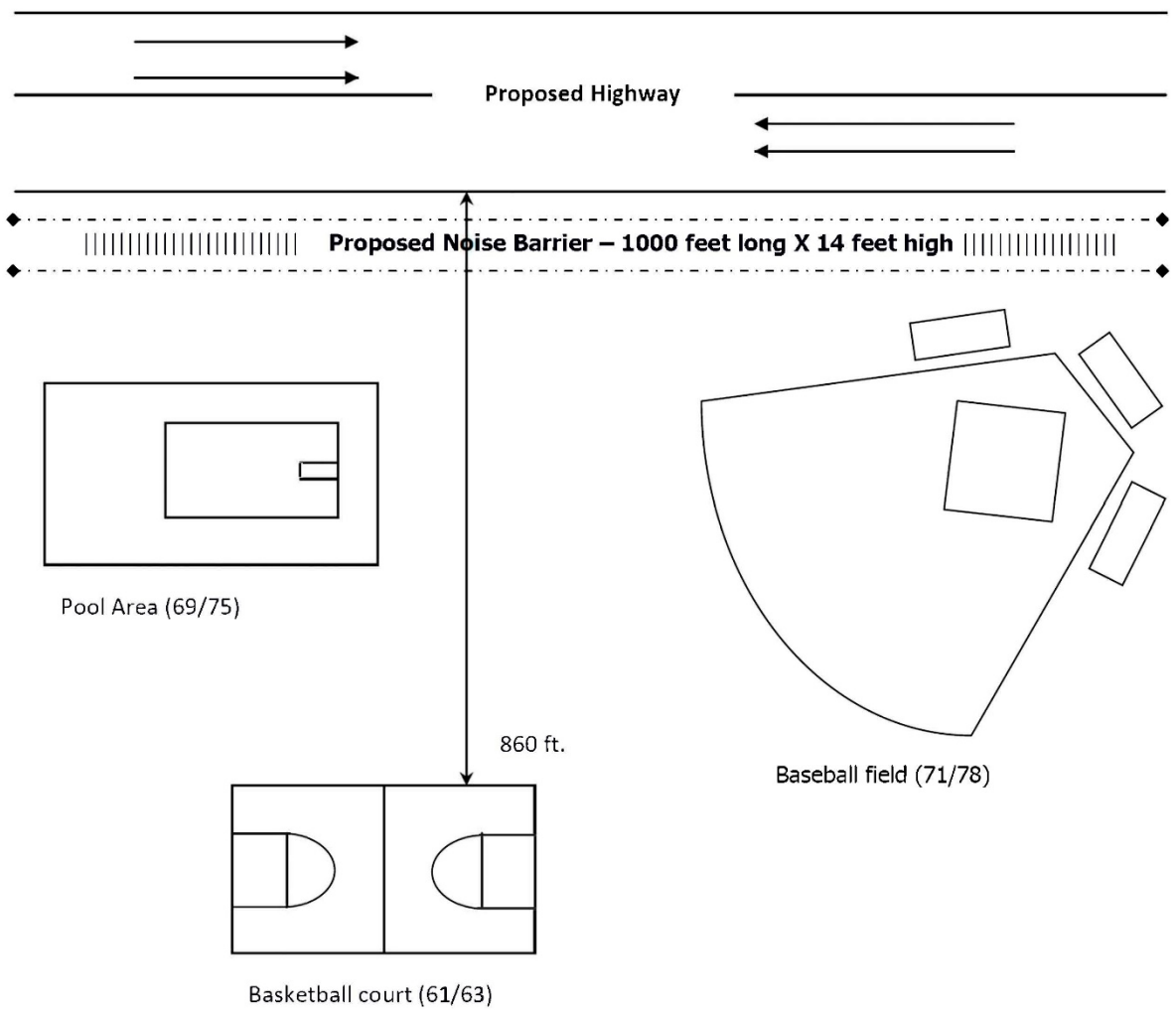
The *Total Value of Adjustment* for CBR calculation is the sum of the two adjustment methods. For Scenario 3, the adjustment is calculated as follows:

$$CBR_{adj} = \frac{\big(Cost\ of\ the\ Noise\ Barrier(\$)\big) - (Total\ Value\ of\ Adjustments)}{Number\ of\ Benefited\ Receptors}$$

$$CBR_{adj} = \frac{(\$883{,}200) - (\$50{,}000 + \$50{,}000)}{20} = \frac{\$783{,}200}{20} = \$39{,}160$$

The adjustment to the CBR for predicted noise levels brings the CBR below $40,000 which warrants the barrier for further consideration through the public involvement balloting process previously described.

SCENARIO 4: ACTIVITY CATEGORY C – PARK



Note: (xx/xx) = Predicted noise levels (dB(A)) without / with mitigation.

SCENARIO FEATURES. Because this scenario assumes impacts were predicted within 500-foot, the study area was extended to 800 feet. The park's pool and baseball field are the only noise receptors within this scenario's study area, so noise levels were predicted at each of these locations. The basketball court is beyond the 800-foot study area. To complete the analysis for this scenario, the Equivalent Residences (ER) must be calculated. For Activity Category C, D, or E uses, the property shall be considered by calculating the Equivalent Residences (ER) for input into the CBR formula (Equation 1).

EQUIVALENT RESIDENCES. The ER is calculated by using Equation 2 as shown below.

$$ER = \left(\frac{\#\ Persons}{2.5\ Persons\ per\ Average\ Household}\right) \times \left(\frac{Average\ Daily\ Hours\ Use}{24\ Hours\ per\ Day}\right)$$

~ OR ~

$$ER = \left(\frac{\#\ Persons}{2.5\ Persons\ per\ Average\ Household}\right) \times \left(\frac{Average\ Weekly\ Hours\ Use}{168\ Hours\ per\ Week}\right)$$

The pool area ER could be calculated using the *Average Daily Hours Use* equation. Through consultation with the park officials, it is determined that approximately 500 people on a daily average use the pool during the 3 months of operation for 10 hours per day. For this scenario, a factor of 0.25 is used to reflect three months of use throughout the year. The ER calculation for the pool area of the park would be:

$$ER = \left(\frac{500\ \times 0.25}{2.5}\right) \times \left(\frac{10}{24}\right) = 20$$

The baseball area ER could be calculated using the *Average Weekly Hours Use* equation. During the week, the ball field is used for 6 hours a day and it is used for 15 hours per day on the weekend. Through consultation with the park officials, it is determined that the ball field is used 5 months per year by 30 players (15 players per team), with two parents and one sibling in attendance per player, an eight coaches and umpires per game. This results in approximately 83 persons. There are two games played per day during the week and seven games played per day on the weekend. The total number of people using the facility would be 830 during the weekdays (83 persons x 2 games per day x 5 days) and 1,162 persons on the weekends (83 persons x 7 games per day x 2 days) for an average weekly total of 1,992 persons. For this

scenario, a factor of 0.41 is used to reflect the five months of use throughout the year. The ER calculation for the pool area of the park would be:

$$ER = \left(\frac{1{,}992 \times 0.41}{2.5}\right) \times \left(\frac{60}{168}\right) = 116$$

The total ER for the park would be 20 + 116 = 136.

FEASIBILITY CRITERIA. A minimum of three (3) impacted receptors must achieve a minimum of 5 dB(A) reduction. All the impacted receptors (136 Equivalent Residences) achieve the necessary reduction. The wall is acoustically feasible.

DESIGN GOAL. A minimum of 50% of the front-row benefited receptors must realize a minimum of 7 dB(A) reduction. Both the baseball field and the pool area would be considered front row. The baseball field receives at least a 7 dB(A) reduction and the pool does not, so 116 of 135 equivalent residences meet the threshold (85%). The Design Goal is met.

REASONABLENESS CRITERIA: COST EFFECTIVENESS. The Cost per Benefited Receptor (CBR) shall be calculated to determine if the construction of a barrier for mitigation is reasonable (meets costs considerations). The park in this example is impacted at 75 to 78 dB(A). The barrier dimensions are 2,000 feet in length and 14 feet in height. The barrier cost shall use KYTC's current cost per square foot, which is currently set at $32 (as of July 1, 2022).

Using *Equation 1* of the *Cost Effectiveness* section in this *Noise Policy*, the CBR for this situation equals $6,176 (see calculations below). Therefore, the barrier is determined to be cost effective and reasonable.

$$CBR = \frac{Cost\ of\ the\ Noise\ Barrier(\$)}{Number\ of\ Benefited\ Receptors}$$

$$CBR = \frac{\left(Length \times Height \times KYTC\ Cost\ per\ Square\ Foot(\$)\right)}{Number\ of\ Benefited\ Receptors}$$

$$CBR = \frac{(2{,}000 \times 14 \times \$32)}{136} = \frac{\$840{,}000}{136} = \$6{,}176$$

REASONABLENESS CRITERIA: DESIRE OF THE BENEFITED RECEPTORS. Basically, the jurisdictional authority of the park would have control over all the votes, unless they solicited the opinion of the general public who use the park. In the event that public opinion is sought on the proposed construction of the noise barrier, ballots would be made available at the public

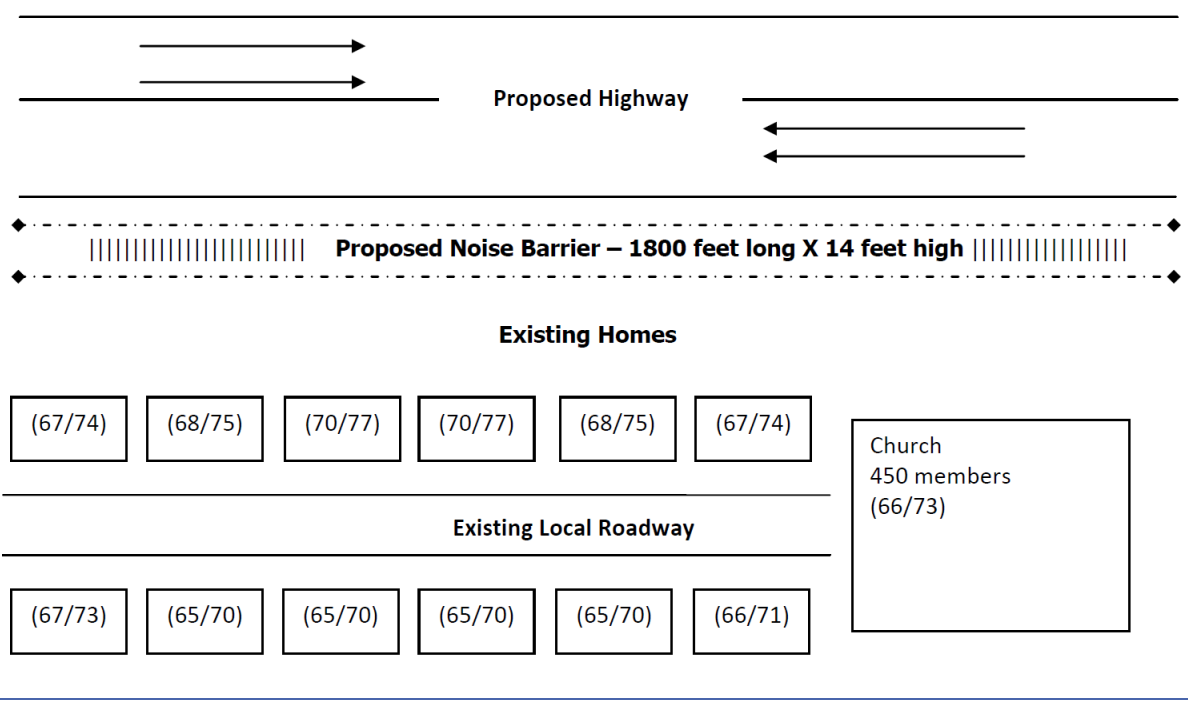
meeting for completion by all users who may attend. In this scenario, the park authority would receive all front-row benefited receptor votes as owner plus one point per benefited receptor as occupant and the park users in attendance would receive one point per ballot as occupant The barrier would be constructed as long as the total points in favor of construction exceed those opposed.

3 POINTS/BALLOT FOR BENEFITED FRONT-ROW PROPERTY OWNERS (PARK AUTHORITY)

1 POINT/BALLOT FOR ALL OTHER BENEFITED PROPERTY OWNERS (NONE)

1 POINT/BALLOT FOR ALL BENEFITED RESIDENTS (PARK AUTHORITY AND USERS)

SCENARIO 5: ACTIVITY CATEGORY C: CHURCH IN A RESIDENTIAL AREA



Note: (xx/xx) = Predicted noise levels (dB(A)) without / with mitigation.

SCENARIO FEATURES. The twelve (12) single-family homes each represent 1 receptor. The twelve (12) single-family homes were not built prior to the roadway. To complete the analysis for this scenario, however the ER must be calculated for the church.

EQUIVALENT RESIDENCES. The ER for the church is calculated by using Equation 2 as shown below.

$$ER = \left(\frac{\#\ Persons}{2.5\ Persons\ per\ Average\ Household}\right) \times \left(\frac{Average\ Daily\ Hours\ Use}{24\ Hours\ per\ Day}\right)$$

~ OR ~

$$ER = \left(\frac{\#\ Persons}{2.5\ Persons\ per\ Average\ Household}\right) \times \left(\frac{Average\ Weekly\ Hours\ Use}{168\ Hours\ per\ Week}\right)$$

When evaluating the church, ER would be calculated using the *Average Weekly Hours Use* equation. Through consultation with the church leader, it is determined that an average of 400 people use the church for an average of 10 hours per week. Therefore, the approximate number of people using the church is:

$$ER = \left(\frac{450}{2.5}\right) \times \left(\frac{10}{168}\right) = 10.62 \approx 10$$

This is added to the twelve (12) single-family residences that each represent one receptor, for a total of 22 receptors. For clarity, if the church offered a wide variety of services on various nights of the week, as well as multiple services on weekends to accommodate large congregations, you may consider a use analysis similar to that of the park in Scenario #5.

FEASIBILITY CRITERIA. A minimum of three (3) impacted receptors must achieve a minimum of 5 dB(A) reduction. All twenty-two (22) receptors are impacted and all twenty-two (22) receive a 5 dB(A) reduction. The wall is acoustically feasible.

DESIGN GOAL. A minimum of 50% of the front-row benefited receptors must realize a minimum of 7 dB(A) reduction. Including the ten (10) at the church, there are sixteen (16) front-row benefited receptors. All of them (100%) receive a 7 dB(A) reduction so the Design Goal is met.

REASONABLENESS CRITERIA: COST EFFECTIVENESS. The Cost per Benefited Receptor (CBR) shall be calculated to determine if the construction of a barrier for mitigation is reasonable (meets costs considerations). The barrier dimensions are 1,800 feet in length and 14 feet in height. The barrier cost shall use KYTC's current cost per square foot, which is currently set at $32 (as of July 1, 2022). Two of the homes have predicted noise levels greater than or equal to 76 dB(A), so there is a *Total Value of Adjustment* of $5,000 applied.

Using *Equation 3* of the *Cost Effectiveness* section in this *Noise Policy*, the CBR for this situation equals $36,428 (see calculations below). Therefore, the barrier is determined to be cost effective and reasonable.

$$CBR_{adj} = \frac{\big(Cost\ of\ the\ Noise\ Barrier(\$)\big) - (Total\ Value\ of\ Adjustments)}{Number\ of\ Benefited\ Receptors}$$

$$CBR_{adj} = \frac{(1{,}800\ x\ 14\ x\ \$32) - (\$5{,}000)}{22} = \frac{\$801{,}400}{22} = \$36{,}428$$

REASONABLENESS CRITERIA: DESIRE OF THE BENEFITED RECEPTORS. Ballots shall be made available at the public meeting for completion by benefited owners and/or benefited residents who may attend. Benefited receptors that do not provide ballot input at the meeting shall be surveyed to determine their preference. For each such property, both a resident and owner ballot shall be solicited. One owner ballot and one resident ballot shall be solicited for each benefited receptor. As outlined in the *Desires of Benefited Receptors* section in this *Noise Policy*, points per ballot shall be distributed in the following weighted manner.

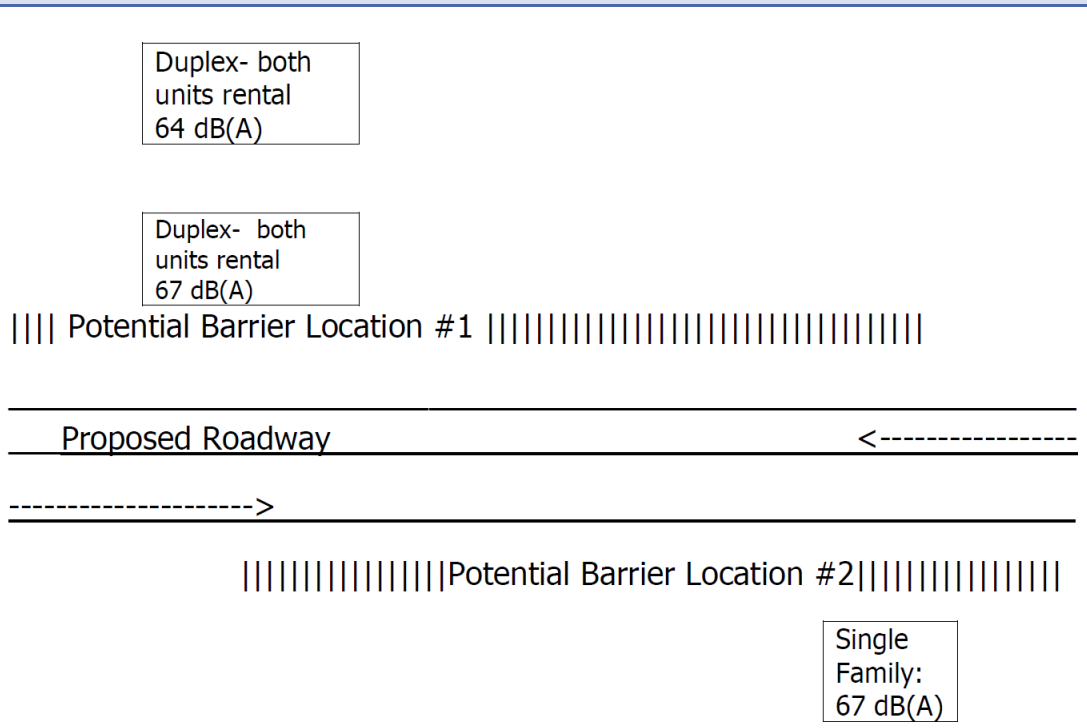
3 POINTS/BALLOT FOR BENEFITED FRONT-ROW PROPERTY OWNERS

1 POINT/BALLOT FOR ALL OTHER BENEFITED PROPERTY OWNERS

1 POINT/BALLOT FOR ALL BENEFITED RESIDENTS

Each benefited receptor on the front row would count for 4 total points and the second row benefited receptors would count for 2 points. The church ballots would count for 4 points times the number of ER (10) for a total of 40 points. The barrier would be constructed as long as the total points in favor of construction exceed those opposed.

SCENARIO 6: ACTIVITY CATEGORY B – RESIDENTIAL: ISOLATED IMPACTED RECEPTORS



Note: (xx/xx) = Predicted noise levels (dB(A)) without / with mitigation.

SCENARIO FEATURES. The single-unit resident on the south side of the roadway represents one (1) receptor, is a front-row receptor, and is an impacted receptor. On the north side of the roadway, both duplexes represent two (2) receptors for a total of four (4) receptors. One duplex is considered a front-row receptor. Only one of the duplexes approaches or exceeds the NAC for Activity Category B, so there are two (2) impacted receptors north of the proposed roadway.

FEASIBILITY CRITERIA. For any given proposed abatement measure, a minimum of three (3) impacted receptors much achieve a minimum of 5 dB(A) reduction. Abatement must be considered when impacts are present, but in this case, there are very few impacted receptors grouped together for a barrier to benefit. Potential Barrier Location #1 only has two (2) impacted receptors (the front-row duplex). Even before modeling to find out if the impacted duplex could receive a 5 dB(A) reduction from the barrier, it is clear that a barrier is not acoustically feasible since there is no way that it could provide the reduction to three (3) impacted receptors. The same is true for the home on the south side of the roadway, therefore Potential Barrier Location #2 could never benefit three (3) or more impacted residences because there is only one impacted receptor.

To determine if an impacted receptor meets this definition for feasibility criteria, all impacted receptors within a 115-foot radius should be considered.

Without any modeling of abatement, it is already clear that acoustical feasibility cannot be met for either potential barrier. No further consideration of a barrier is necessary for the impacted receptors at those locations.