

Guide to Modeling and Voting Methodologies for Trails

(Version 3/14/2017)

Introduction:

This guidance document was created in response to a recurring theme observed across the Federal-aid program of Type I projects. The purpose of this document is to address the proper approach to noise modeling, receptor placement, cost threshold calculation, and voting in Type I projects with a trail component.

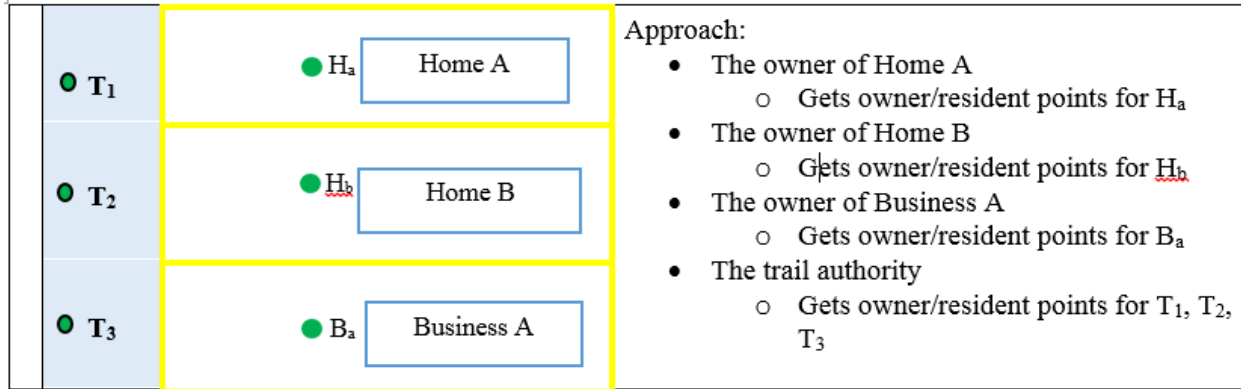
There are eleven primary assumptions across the six examples:

1. There is only one owner. The owner is the person or entity that has fee title ownership to a parcel or the land a portion of trail sits upon. For example, a trail authority with a form of easement or permit across a parcel does not constitute an 'owner' for purposes of a noise analysis process.
2. There are some situations where an owner does not get to vote.
3. The analyst shall include additional modeling point if there is not a trail modeling point anywhere on the property for the 250' interval for trails. The added modeling point shall denote with the subscribe "A" as shown on the example.
4. The creation of any additional trail receptors (inside the normal 250' trail receptor placement) neither restarts the 250-linear-foot placement and spacing of trail receptors nor increases the overall cost effectiveness threshold for a given barrier. (i.e., the calculation of the cost effectiveness threshold for a given barrier does not include trail receptors added inside the 250' internal per the current noise requirements.)
5. When a trail authority gets to vote, it is *only* for trail receptors placed at the 250' interval that meet the requirements of a benefited receptor.
6. Don't get caught up in the likelihood of the trail geometrics. This is a convenient example to illustrate a point.
7. All points associated with a given vote must all be yes, no, or no response.
8. [Solicitation results for submittal to FHWA](#) must include receptor addresses.
9. The homes and businesses are illustrative. They could be schools, churches, and such as well with the same end result.
10. The home owners live in the homes; no renters.
11. The business is owned and operated by the same entity; no renter.

Legend

	Trail (trail authority has fee title land ownership)
	Trail (trail authority does not have fee title land ownership)
	Parcel boundary line for home or business
●	Benefited receptor
●	Not benefited receptor
●	Benefited receptor has fee title ownership to the land a portion of trail sits upon
●	Not benefited receptor has fee title ownership to the land a portion of trail sits upon
T ₁ , H _a , B _a	Unique receptor IDs (trails, homes, businesses)

Example I: Trail Authority Has Fee Title to the Entire Trail



Assumptions for Example I:

- All receptors are benefited receptors; T₁, T₂, and T₃ are benefited receptors placed at 250' intervals per the current Minnesota Noise Requirements. Therefore, each of the parcels is at least 250' wide as well.
- The trail authority *has* fee title to the land the trail sits upon. So, the trail owner and operator are the same entity.

Noise Analysis Approach

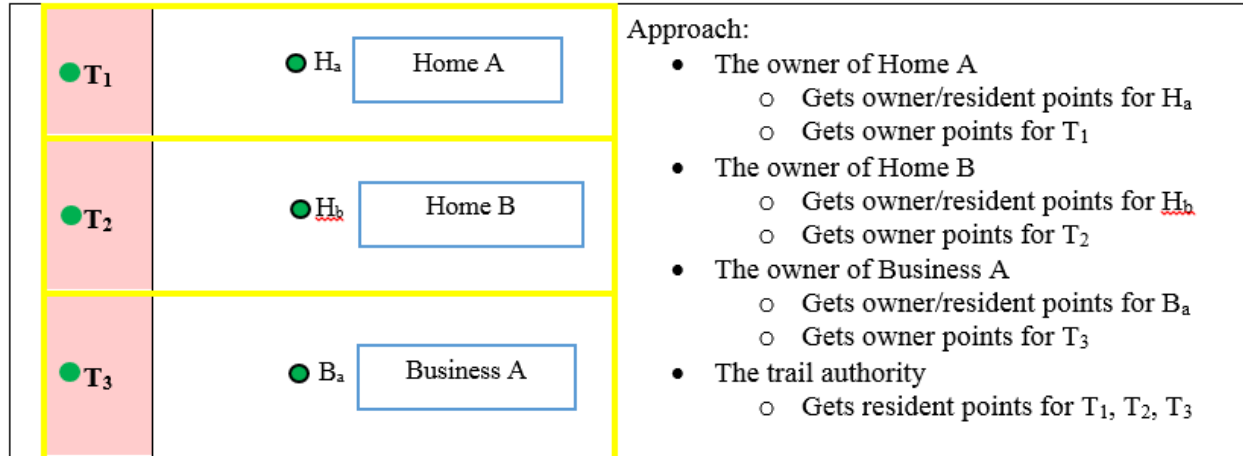
- Cost effectiveness threshold calculation example

Receptors	Benefited Receptor?	Cost/benefited receptor	Cost effectiveness threshold
T ₁	Yes	\$78,500	\$471,000
T ₂	Yes	\$78,500	
T ₃	Yes	\$78,500	
H _a	Yes	\$78,500	
H _b	Yes	\$78,500	
B _a	Yes	\$78,500	

- Voting example for submittals to FHWA

Receptors	Benefited Receptor?	Location		Voting Points		
		Abutting	Non-abutting	Owner/Resident	Owner	Resident
T ₁	Yes	X		6	-	-
T ₂	Yes	X		6	-	-
T ₃	Yes	X		6	-	-
H _a	Yes		X	3	-	-
H _b	Yes		X	3	-	-
B _a	Yes		X	3	-	-

Example II: Trail Authority Does Not Have Fee Title to Any Portion of the Trail



Assumptions for Example II:

- All receptors are benefited receptors. T₁, T₂, and T₃ are receptors placed at 250’ intervals per the current Minnesota Noise Requirements. Therefore each of the lots is at least 250’ wide as well.
- The trail authority does *not* have fee title to the land the trail sits upon.

Noise Analysis Approach

- Cost effectiveness threshold calculation example

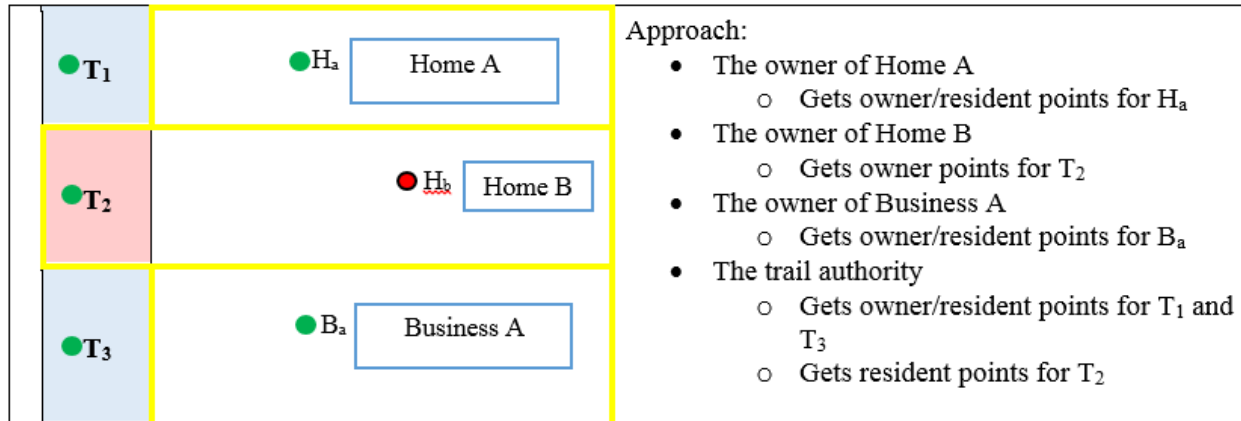
Receptors	Benefited Receptor?	Cost/benefited receptor	Cost effectiveness threshold
T ₁	Yes	\$78,500	\$471,000
T ₂	Yes	\$78,500	
T ₃	Yes	\$78,500	
H _a	Yes	\$78,500	
H _b	Yes	\$78,500	
B _a	Yes	\$78,500	

- Voting point example for submittals to FHWA

Receptors	Benefited Receptor?	Location		Voting Points		
		Abutting	Non-abutting	Owner/Resident	Owner ⁽¹⁾	Resident
T ₁	Yes	X		-	4	2
T ₂	Yes	X		-	4	2
T ₃	Yes	X		-	4	2
H _a	Yes	X		6	-	-
H _b	Yes	X		6	-	-
B _a	Yes	X		6	-	-

Note: (1) The owner points for T₁, T₂, and T₃ follow votes for H_a, H_b, and B_a respectively.

Example III: The Trail Authority Has Fee Title Ownership to Select Portions of the Trail



Assumptions for Example III:

- Home B is **NOT** a benefited receptor but H_a and B_a are benefited receptors.
- T₁, T₂, and T₃ are receptors placed at 250' intervals per the current Minnesota Noise Requirements. Therefore each of the parcels is at least 250' wide as well. T₁, T₂, and T₃ are benefited receptors.
- The trail authority has a mix of fee title and non-fee title land the trail sits upon.

Noise Analysis Approach

- Cost effectiveness threshold calculation example

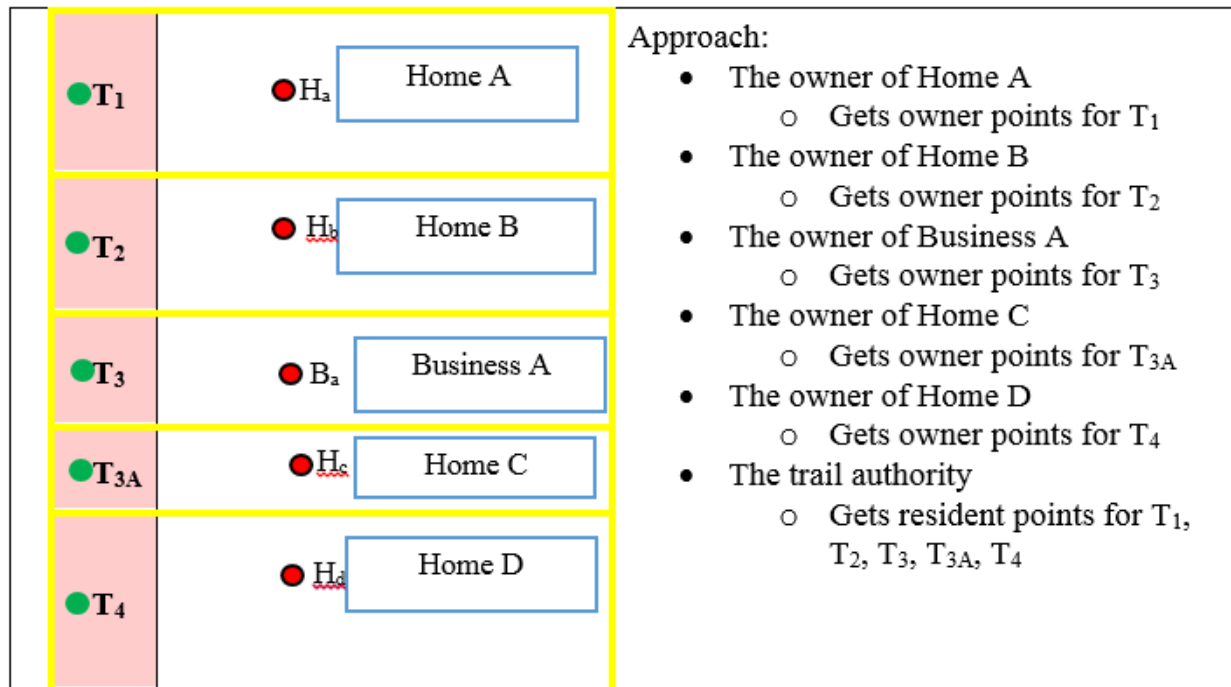
Receptors	Benefited Receptor?	Cost/benefited receptor	Cost effectiveness threshold
T ₁	Yes	\$78,500	\$392,500
T ₂	Yes	\$78,500	
T ₃	Yes	\$78,500	
H _a	Yes	\$78,500	
H _b	No	\$0	
B _a	Yes	\$78,500	

- Voting point example for submittals to FHWA

Receptors	Benefited Receptor?	Location		Voting Points		
		Abutting	Non-abutting	Owner/Resident	Owner ⁽¹⁾	Resident
T ₁	Yes	X		6	-	-
T ₂	Yes	X		-	4	2
T ₃	Yes	X		6	-	-
H _a	Yes		X	3	-	-
H _b	No	X		-	-	-
B _a	Yes		X	3	-	-

Note: (1) The owner points for T₂ follow votes for H_b.

Example IV: Insertion of Additional Trail Modeling Point to Check Acoustical Threshold



Assumptions for Example IV:

- T₁, T₂, T₃, and T₄ are receptors placed at 250' intervals per the current Minnesota Noise Requirements. T₁, T₂, T₃, and T₄ are benefited receptors.
- None of the homes or businesses are impacted receptors. Therefore the only reason to analysis noise abatement measures are due to impacted receptors on the trail.
- T_{3A} is an additional receptor point created because the 250' interval for trail receptors does not provide a receptor point for that portion of the trail on the parcel of Home C. Modeling indicates that T_{3A} meets the acoustical requirements normally associated with a benefitted receptor (i.e. both of: crossing thresholds of applicable NAC [or ≥5dBA increase] plus noise mitigation measure provides ≥5dBA reduction)

Noise Analysis Approach

- Cost effectiveness threshold calculation
 - \$78,500x4(4 for the trail + 0 for the homes and businesses)=\$314,000 for the entire barrier. The '4' is for receptors T₁, T₂, T₃, and T₄. T_{3A} is *not* included in the cost effectiveness threshold calculations. This is because the MN Noise Requirements stipulates that there is one receptor per 250' of trail. The additional receptor, T_{3A}, is being added to the modeling to (1) verify if it meets the acoustical thresholds normally associated with a benefitted receptor, and (2) provides equity to the parcel owner in the voting process where practicable.
- Summary
 - The points associated with T_{3A} become part of the voting points tally but the cost effectiveness threshold for the overall barrier does not include any allowance for T_{3A}. Cost effectiveness threshold calculation example

Receptors	Benefited Receptor?	Cost/benefited receptor	Cost effectiveness threshold
T ₁	Yes	\$78,500	\$314,000
T ₂	Yes	\$78,500	
T ₃	Yes	\$78,500	
T _{3A}	Yes	\$0	
T ₄	Yes	\$78,500	
H _a	No	\$0	
H _b	No	\$0	
B _a	No	\$0	
H _c	No	\$0	
H _d	No	\$0	

- Voting point example for submittals to FHWA

Receptors	Benefited Receptor?	Location		Voting Points		
		Abutting	Non-abutting	Owner/Resident	Owner ⁽¹⁾	Resident
T ₁	Yes	X		-	4	2
T ₂	Yes	X		-	4	2
T ₃	Yes	X		-	4	2
T _{3A}	Yes	X		-	4	2
T ₄	Yes	X		-	4	2
H _a	No	X		-	-	-
H _b	No	X		-	-	-
B _a	No	X		-	-	-
H _c	No	X		-	-	-
H _d	No	X		-	-	-

Note: (1) The owner points for T₁, T₂, T₃, T_{3A}, and T₄ follow votes for H_a, H_b, B_a, H_c and H_d respectively.

Example V: Insertion of Additional Trail Modeling Point Demonstrated Not to Meet Acoustical Threshold Requirements

● T ₁	● H _a	Home A
● T ₂	● H _b	Home B
● T ₃	● B _a	Business A
● T _{3A}	● H _c	Home C
● T ₄	● H _d	Home D

Approach:

- The owner of Home A
 - Gets owner points for T₁
- The owner of Home B
 - Gets owner points for T₂
- The owner of Business A
 - Gets owner points for T₃
- The owner of Home C
 - Gets no vote or points whatsoever
- The owner of Home D
 - Gets owner points for T₄
- The trail authority
 - Gets resident points for T₁, T₂, T₃, T₄
 - Does not get any points for T_{3A}

Assumptions for the above Example V:

- T₁, T₂, T₃, and T₄ are receptors placed at 250' intervals per the current Minnesota Noise Requirements.
- T_{3A} is a receptor point created because the 250' interval for trail receptors does not provide a receptor point for that portion of the trail on the parcel of Home C. Modeling (not assumption) indicates that T_{3A} *does not meet* the acoustical requirements associated with a benefitted receptor (i.e. both of: crossing thresholds of applicable NAC [or ≥5dBA increase] plus noise mitigation measure provides ≥5dBA reduction)
- None of the homes or businesses are impacted receptors. Therefore the only reason to analysis noise abatement measures are due to impacted receptors on the trail.

Noise Analysis Approach

- Cost effectiveness threshold calculation
 - \$78,500x4(4 for the trail + 0 for the homes and businesses)=\$314,000 for the entire barrier. The '4' is for receptors T₁, T₂, T₃, and T₄. T_{3A} is *not* included in the cost effectiveness threshold calculations. This is because the MN Noise Requirements stipulates that there is one receptor per 250' of trail. The additional receptor, T_{3A}, is being added to the modeling to (1) verify if it meets the acoustical thresholds normally associated with a benefitted receptor, and (2) provides equity to the parcel owner in the voting process where practicable.
- Voting points
 - The points associated with T_{3A} *do not* get counted as part of the overall voting point tally for the noise barrier. 23 CFR 772.13 only provides for 'Consideration

of the viewpoints of the property owner and residents of benefited receptors.’ T_{3A} does not meet the acoustical requirements of a benefited receptor. Therefore, the owner of Home C does not get a vote in the process.

- Summary
 - The potential points associated with T_{3A} neither become part of the voting points tally nor the cost effectiveness threshold for the overall barrier.
- Cost effectiveness threshold calculation example

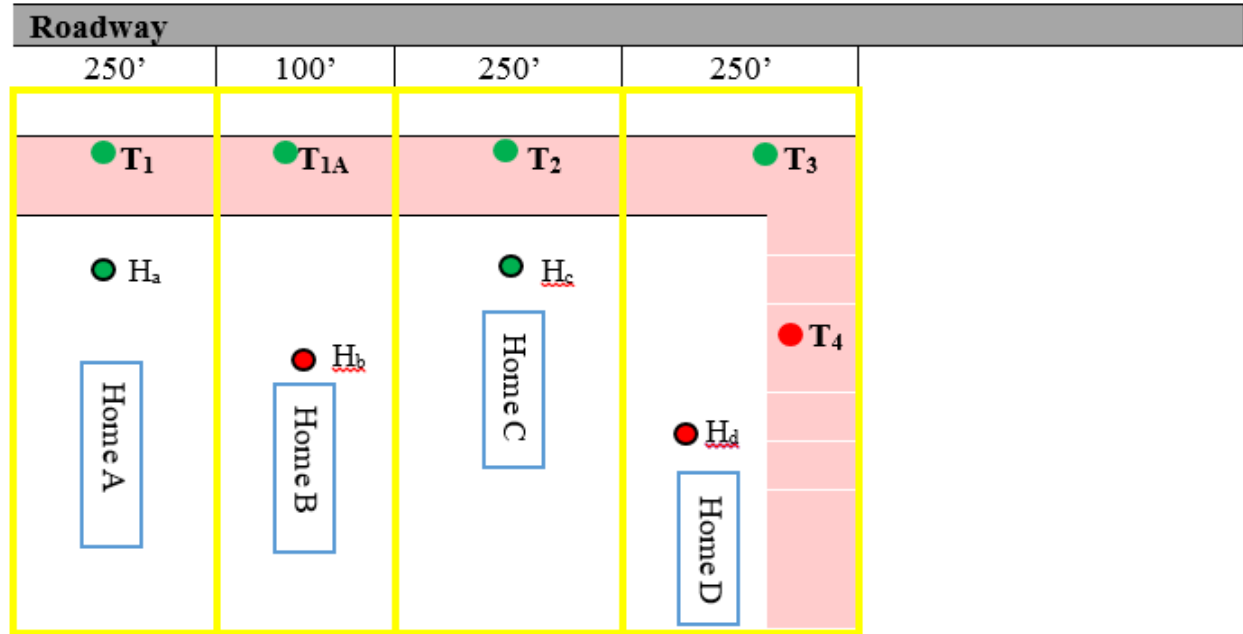
Receptors	Benefited Receptor?	Cost/benefited receptor	Cost effectiveness threshold
T ₁	Yes	\$78,500	\$314,000
T ₂	Yes	\$78,500	
T ₃	Yes	\$78,500	
T _{3A}	No	\$0	
T ₄	Yes	\$78,500	
H _a	No	\$0	
H _b	No	\$0	
B _a	No	\$0	
H _c	No	\$0	
H _d	No	\$0	

- Voting point example for submittals to FHWA

Receptors	Benefited Receptor?	Location		Voting Points		
		Abutting	Non-abutting	Owner/Resident	Owner ⁽¹⁾	Resident
T ₁	Yes	X		-	4	2
T ₂	Yes	X		-	4	2
T ₃	Yes	X		-	4	2
T _{3A}	No	X		-	-	-
T ₄	Yes	X		-	4	2
H _a	No	X		-	-	-
H _b	No	X		-	-	-
B _a	No	X		-	-	-
H _c	No	X		-	-	-
H _d	No	X		-	-	-

Note: (1) The owner points for T₁, T₂, T₃, and T₄ follow votes for H_a, H_b, B_a, and H_d respectively.

Example VI: Comprehensive Example



Assumptions for Example VI:

Receptor	Description:	Benefited Receptor?	Included in Cost Effectiveness Calculation?	Does homeowner get to vote for this receptor on their property?
T ₁	Trail modeling point for 250' per noise requirements	Yes	Yes	Yes
T _{1A}	Additional modeling point inserted because there is not a modeling point anywhere on the property for the 250' interval for trails as outlined in the noise requirements.	It meets the acoustical effectiveness requirements associated with a benefited receptor per noise requirements.	No	Yes
T ₂	Trail modeling point for 250' per noise requirements	Yes	Yes	Yes
T ₃	Trail modeling point for 250' per noise requirements	Yes	Yes	Yes
T ₄	Trail modeling point for 250' per noise requirements	No	No	No
H _a	The center of human activity (modeling point) for home A	Yes	Yes	Yes

Receptor	Description:	Benefited Receptor?	Included in Cost Effectiveness Calculation?	Does homeowner get to vote for this receptor on their property?
H _b	The center of human activity (modeling point) for home B	No	No	No
H _c	The center of human activity (modeling point) for home C	Yes	Yes	Yes
H _d	The center of human activity (modeling point) for home D	No	No	No

Noise Analysis Approach

- Cost effectiveness threshold calculation
 - $\$78,500 \times 5(3 \text{ for the trail} + 2 \text{ for the homes}) = \$392,500$ for the entire barrier because the MN Noise Requirements stipulates that there is one receptor per 250' of trail. T_{1A} does not get counted toward the cost effectiveness calculation because it is inside the 250' interval per the noise requirements.
 - The additional receptor, T_{1A}, is being added to the modeling to (1) verify if it meets the acoustical thresholds normally associated with a benefited receptor, and (2) provides equity to the parcel owner in the voting process where practicable.
- Voting points
 - The points associated with T_{1A} do get counted toward the overall points for/against a given barrier.
 - The owner of home H_d does get owner points for receptor T₃.
 - Note: The additional modeling point T_{1A} is created only for a trail situation. We do not do this for homes because a home will or will not have an external center of human activity.
- Summary
 - The maximum cost of the noise barrier is based upon the total of benefited receptors (which are homes) plus the total of benefited receptors for the trail that were placed at 250' intervals per the noise requirements.
 - The noise modeler is expected to experiment with the 250' interval for trail receptor placement with the goal of eliminating the need for additional modeling receptors like T_{1A}.
- Variations
 - If the noise modeling results demonstrate that neither H_b nor T_{1A} met the acoustical thresholds required of a benefited receptor, then the owner of H_b would not get to vote whatsoever. While it is unlikely the geospatial site conditions and physics of the situation would cause us to encounter the scenario of T_{1A} not meeting the acoustical requirements of a benefited receptor when T₁, T₂ and T₃ do meet the acoustical requirements of a benefited receptor, the variation is

covered in this guidance to demonstrate the threshold when a parcel owner can no longer vote.

- Cost effectiveness threshold calculation example

Receptors	Benefited Receptor?	Cost/benefited receptor	Cost effectiveness threshold
T ₁	Yes	\$78,500	\$392,500
T _{1A}	Yes	\$0	
T ₂	Yes	\$78,500	
T ₃	Yes	\$78,500	
T ₄	No	\$0	
H _a	Yes	\$78,500	
H _b	No	\$0	
H _c	Yes	\$78,500	
H _d	No	\$0	

- Voting point example for submittals to FHWA

Receptors	Benefited Receptor?	Location		Voting Points		
		Abutting	Non-abutting	Owner/Resident	Owner ⁽¹⁾	Resident
T ₁	Yes	X		-	4	2
T _{1A}	Yes	X		-	4	2
T ₂	Yes	X		-	4	2
T ₃	Yes	X		-	4	2
T ₄	No	X		-	-	-
H _a	Yes	X		6	-	-
H _b	No	X		-	-	-
H _c	Yes	X		6	-	-
H _d	No	X		-	-	-

Note: The owner points for T₁, T_{1A}, T₂, and T₃ follow votes for H_a, H_b, H_c and H_d.