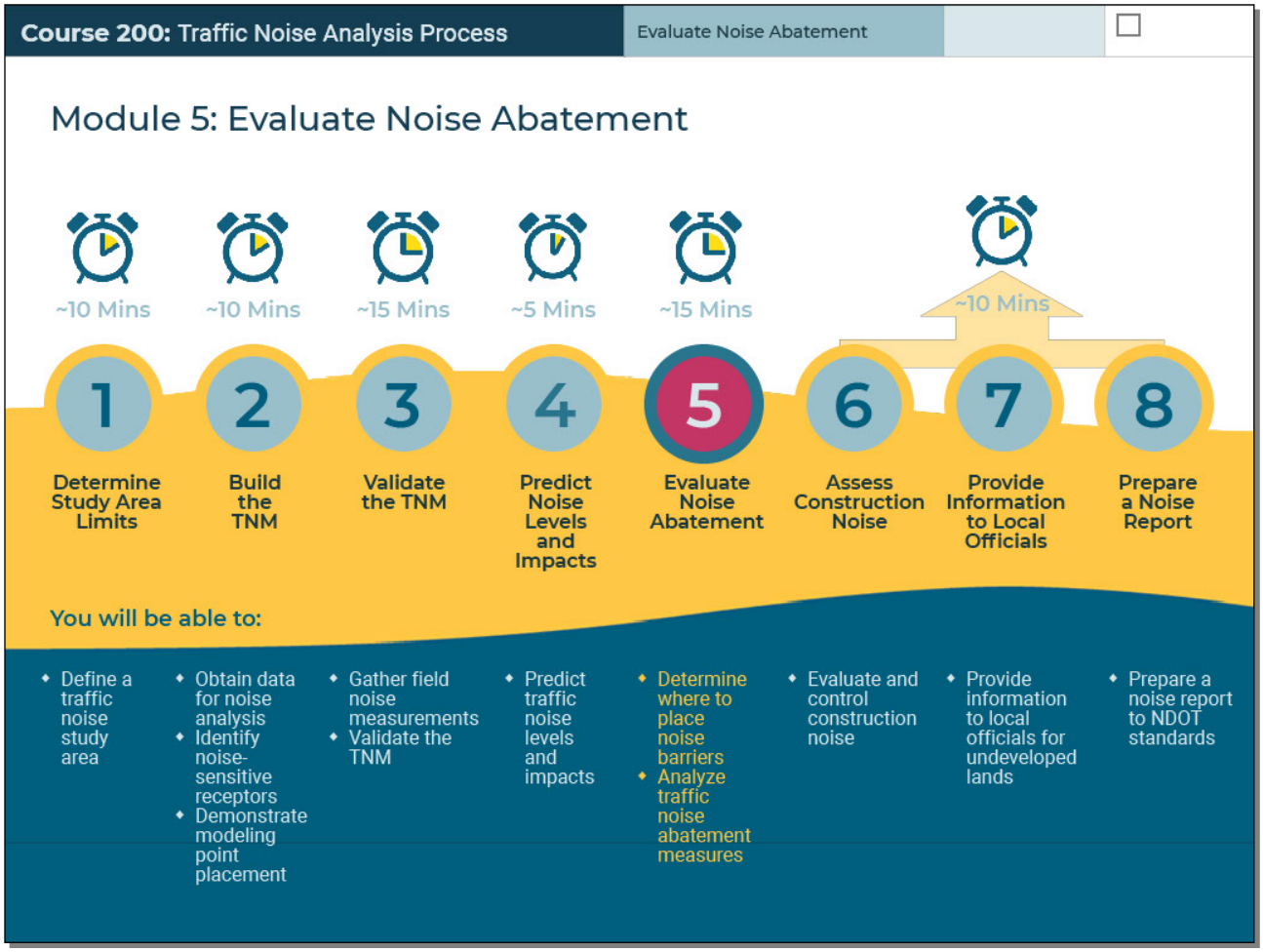
Slide 1 - Slide 1



Audio Script and Notes to Reviewers

Welcome to Module Five. In this module, you will learn how to determine where to place noise barriers and analyze noise abatement measures.

Text Captions

Module 5: Evaluate Noise Abatement

You will be able to:

Evaluate Noise Abatement

- Determine where to place noise barriers
- Analyze traffic noise abatement measures

Determine Study Area Limits

- Define a traffic noise study area

Build the TNM

- Obtain data for noise analysis
- Identify noise- sensitive receptors
- Demonstrate modeling point placement

Validate the TNM

- Gather field noise measurements

- Validate the TNM

Predict Noise Levels and Impacts

- Predict traffic noise levels and impacts

Assess Construction Noise

- Evaluate and control construction noise

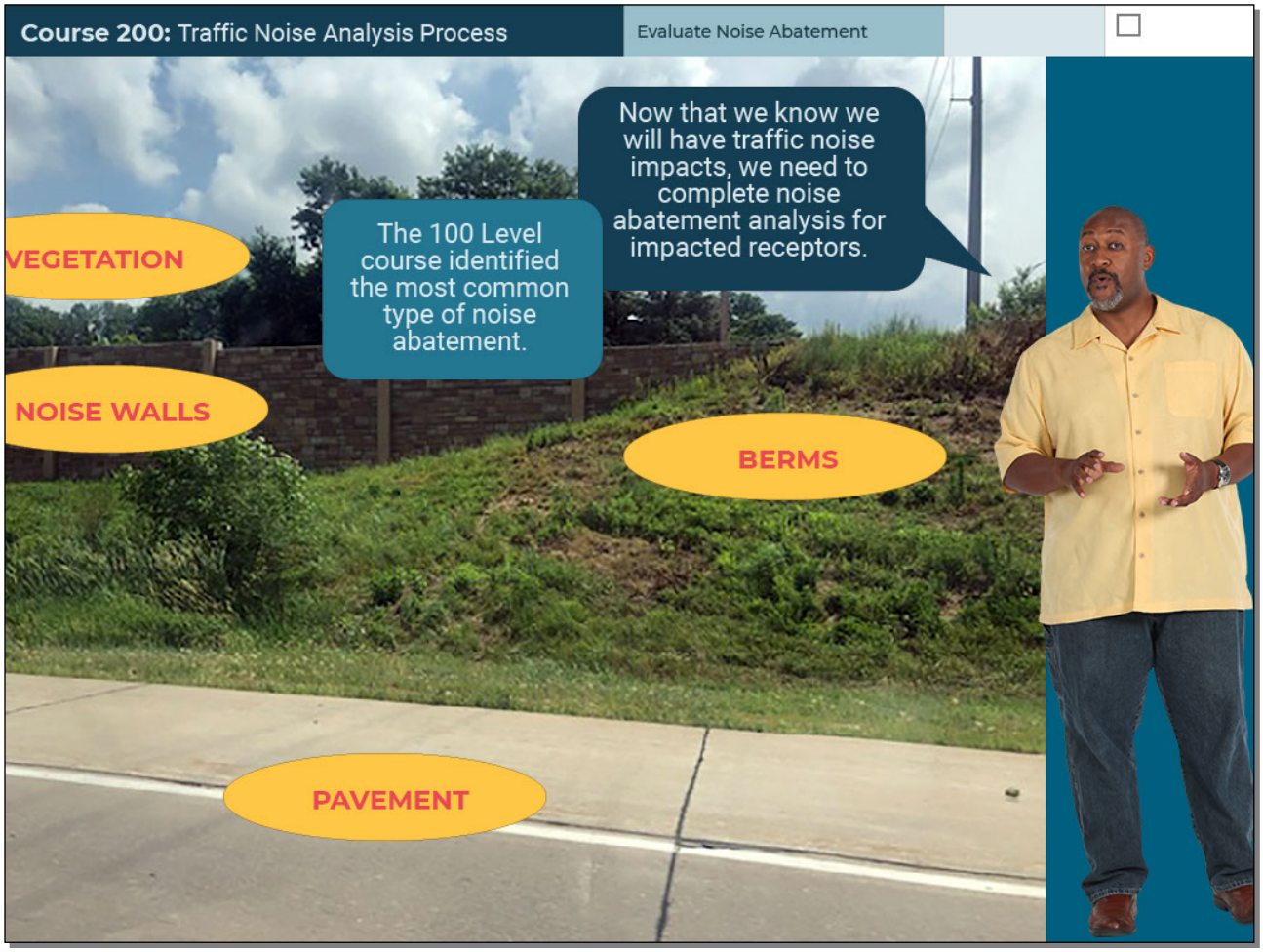
Provide Information to Local Officials

- Provide information to local officials for undeveloped lands

Prepare a Noise Report

- Prepare a noise report to NDOT standards

Slide 2 - Slide 2



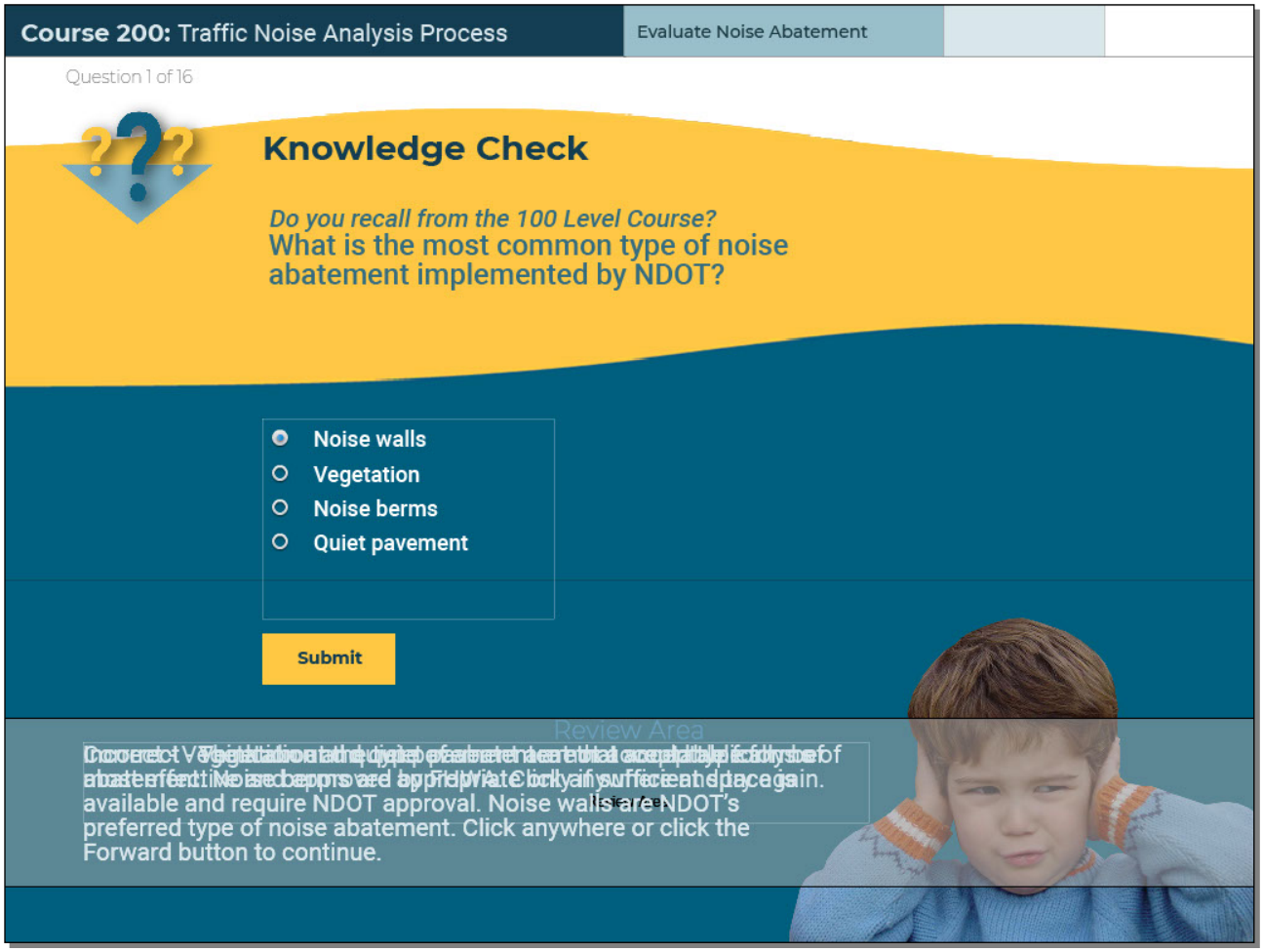
Audio Script and Notes to Reviewers

Now that we know we will have traffic noise impacts, we need to complete noise abatement analysis for impacted receptors. The One-Hundred Level course identified the most common type of noise abatement.

Text Captions

Now that we know we will have traffic noise impacts, we need to complete noise abatement analysis for impacted receptors.
The 100 Level course identified the most common type of noise abatement.
VEGETATION
NOISE WALLS
BERMS
PAVEMENT

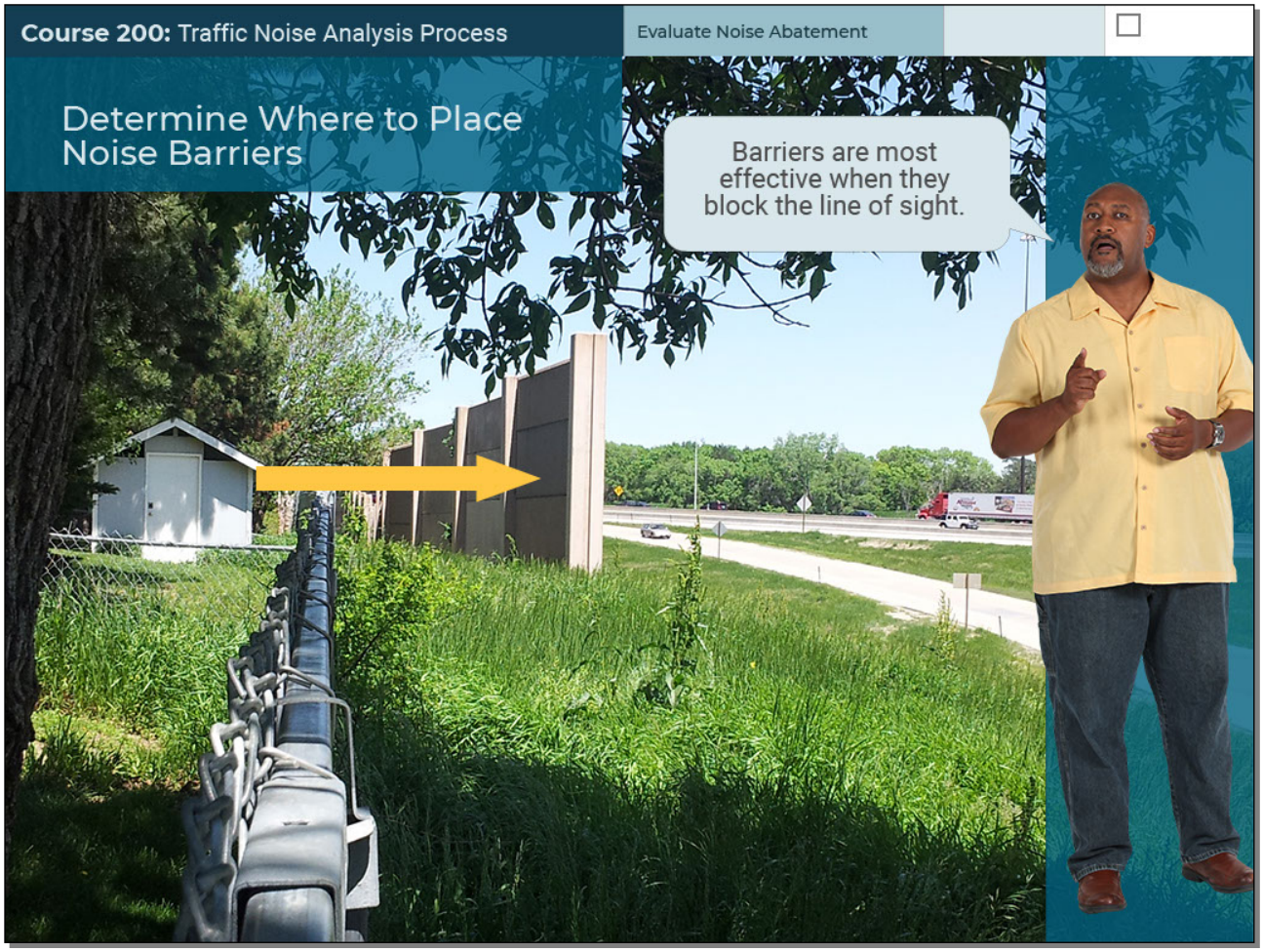
Slide 3 - Slide 3



Audio Script and Notes to Reviewers
What is the most common type of noise abatement implemented by N-dot?
NOTE: We don't have an objective/master test question for this. Should we? If not, delete.

Text Captions
Knowledge Check
Do you recall from the 100 Level Course?
What is the most common type of noise abatement implemented by NDOT?
Correct feedback: Correct - Vegetation and quiet pavement are not acceptable forms of abatement. Noise berms are appropriate only if sufficient space is available and require NDOT approval. Noise walls are NDOT's preferred type of noise abatement. Click anywhere or click the Forward button to continue.
1st incorrect feedback: Incorrect - Think about the type of abatement that would typically be most effective and approved by FHWA. Click anywhere and try again.
2nd incorrect feedback: Incorrect - Vegetation and quiet pavement are not acceptable forms of abatement. Noise berms are appropriate only if sufficient space is available and require NDOT approval. Noise walls are NDOT's preferred type of noise abatement. Click anywhere or click the Forward button to continue.

Slide 4 - Slide 4



Audio Script and Notes to Reviewers
Barriers are most effective when they block the line of sight.

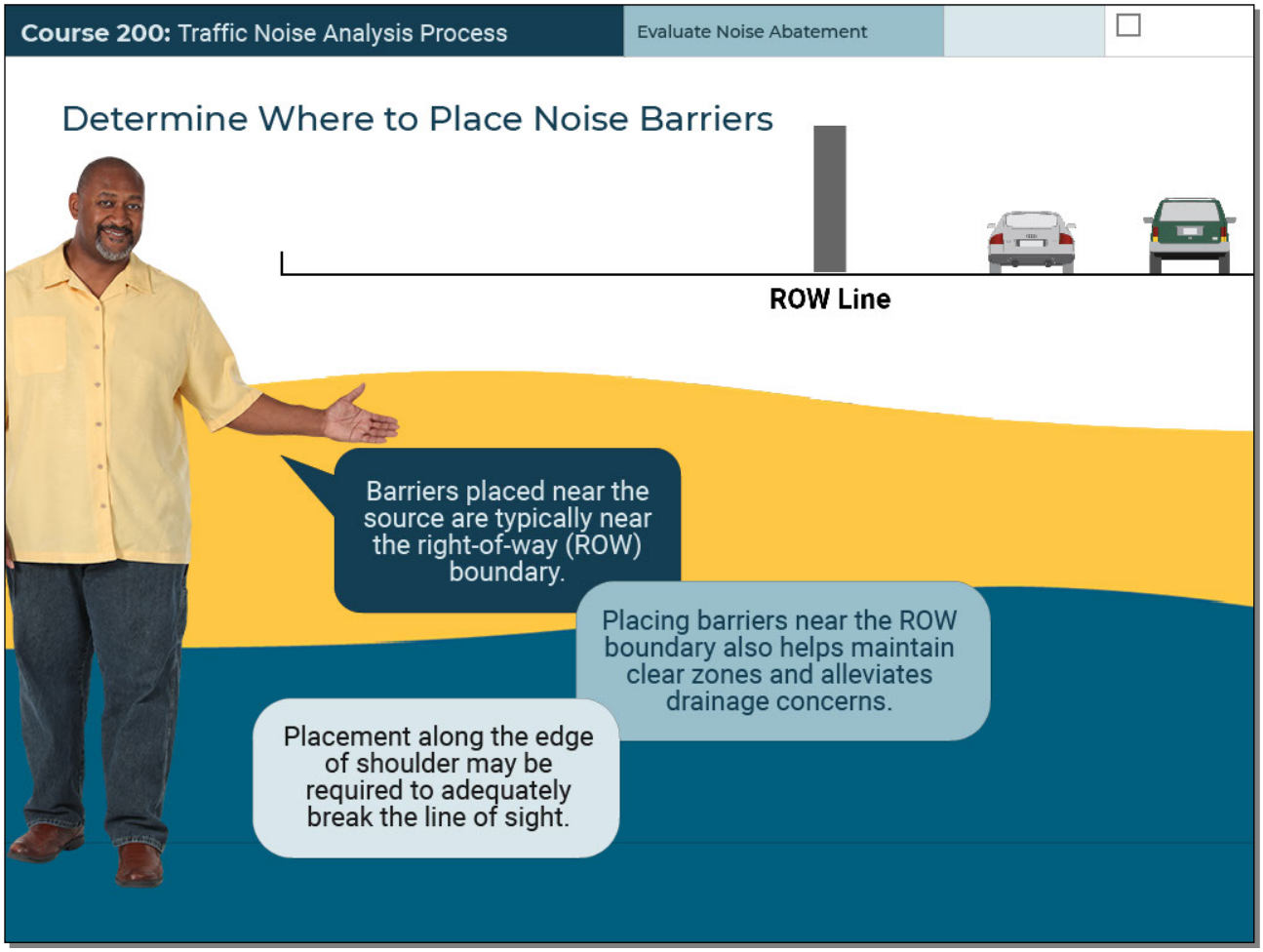
Text Captions
Determine Where to Place Noise Barriers
Barriers are most effective when they block the line of sight.

Slide 5 - Slide 5

Audio Script and Notes to Reviewers
Place barriers in close proximity to the noise source or the receptor.

Determine Where to Place Noise Barriers
Place barriers in close proximity to the noise source or the receptor.
CLOSE TO NOISE SOURCE
CLOSE TO RECEPTOR

Slide 6 - Slide 6



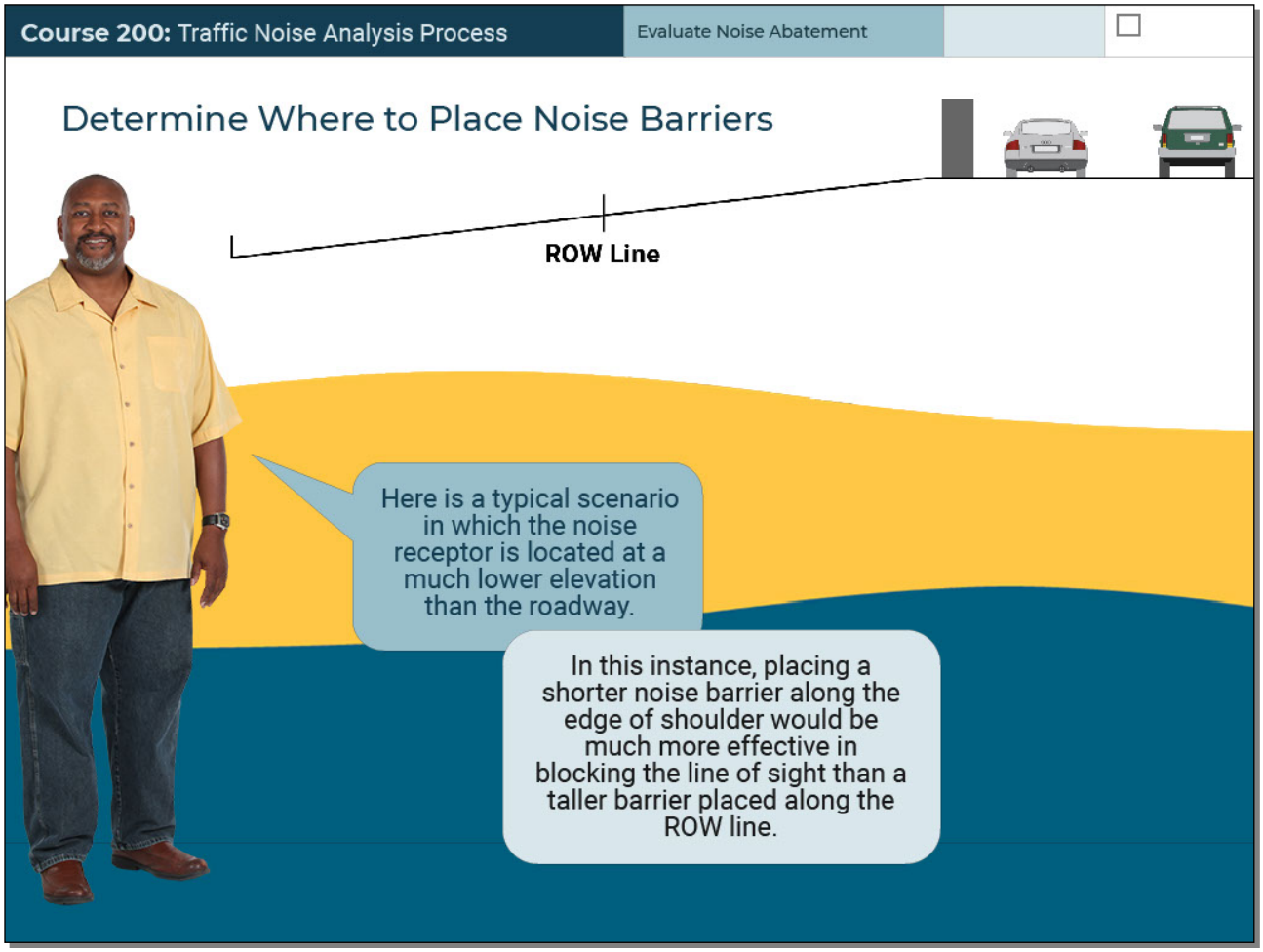
Audio Script and Notes to Reviewers

Barriers placed near the source -- meaning, the roadway -- are typically near the right-of-way boundary. Placing barriers near the right-of-way boundary also helps maintain clear zones and alleviates drainage concerns. However, in some instances, placement along the edge of shoulder may be required to adequately break the line of sight.

Text Captions

Determine Where to Place Noise Barriers
Barriers placed near the source are typically near the right-of-way (ROW) boundary.
Placing barriers near the ROW boundary also helps maintain clear zones and alleviates drainage concerns.
Placement along the edge of shoulder may be required to adequately break the line of sight.

Slide 7 - Slide 7



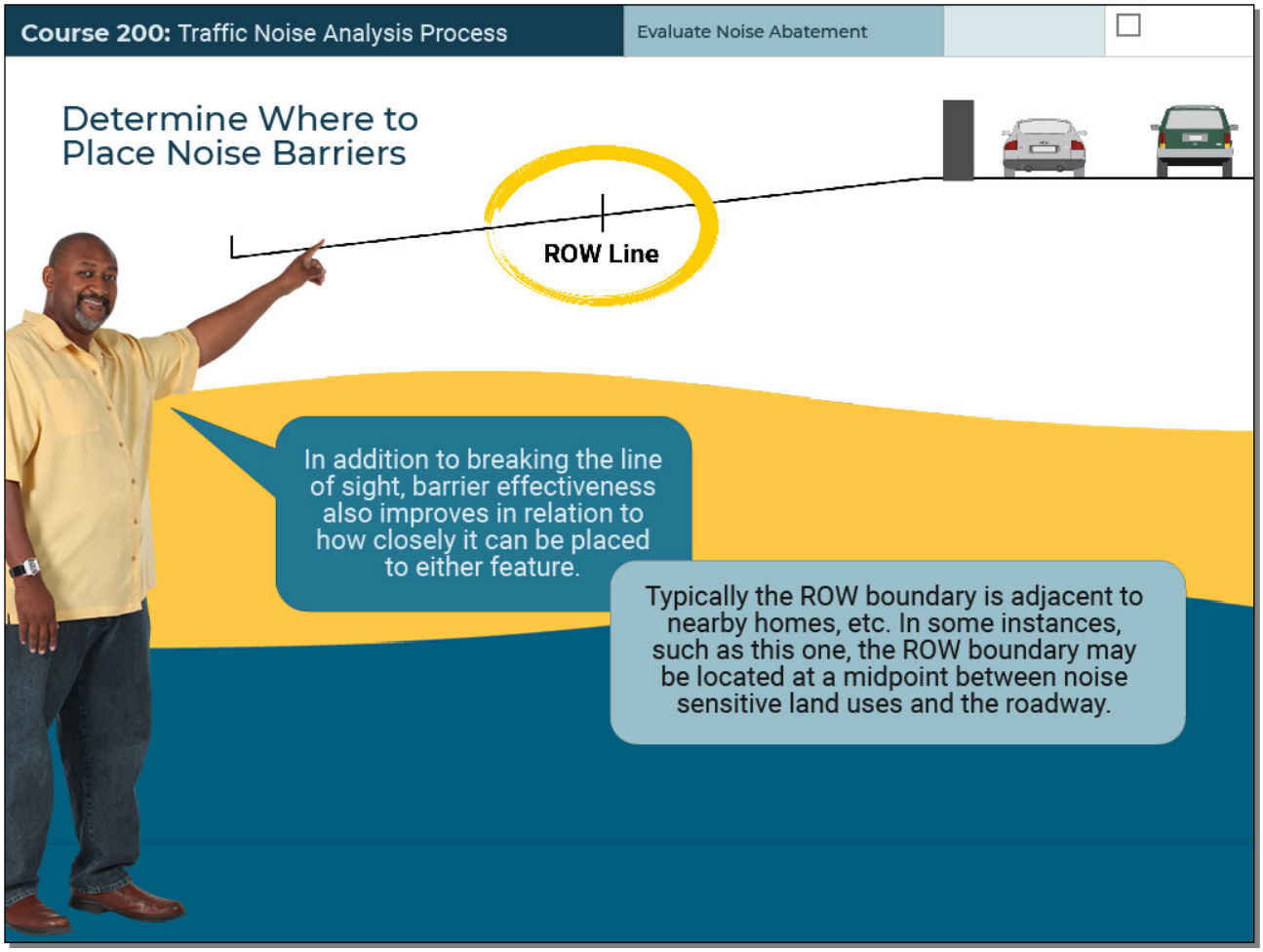
Audio Script and Notes to Reviewers

Here is a typical scenario in which the noise receptor is located at a much lower elevation than the roadway. In this instance, placing a shorter noise barrier along the edge of the shoulder would be much more effective in blocking the line of sight than a taller barrier placed along the right-of-way line.

Text Captions

Determine Where to Place Noise Barriers
Here is a typical scenario in which the noise receptor is located at a much lower elevation than the roadway.
In this instance, placing a shorter noise barrier along the edge of shoulder would be much more effective in blocking the line of sight than a taller barrier placed along the ROW line.

Slide 8 - Slide 8



Audio Script and Notes to Reviewers

In addition to breaking the line of sight, barrier effectiveness also improves in relation to how closely it can be placed to either feature. Typically the right-of-way boundary is adjacent to nearby homes, etcetera. In some instances, such as this one, the right-of-way boundary may be located at a midpoint between noise sensitive land uses and the roadway.

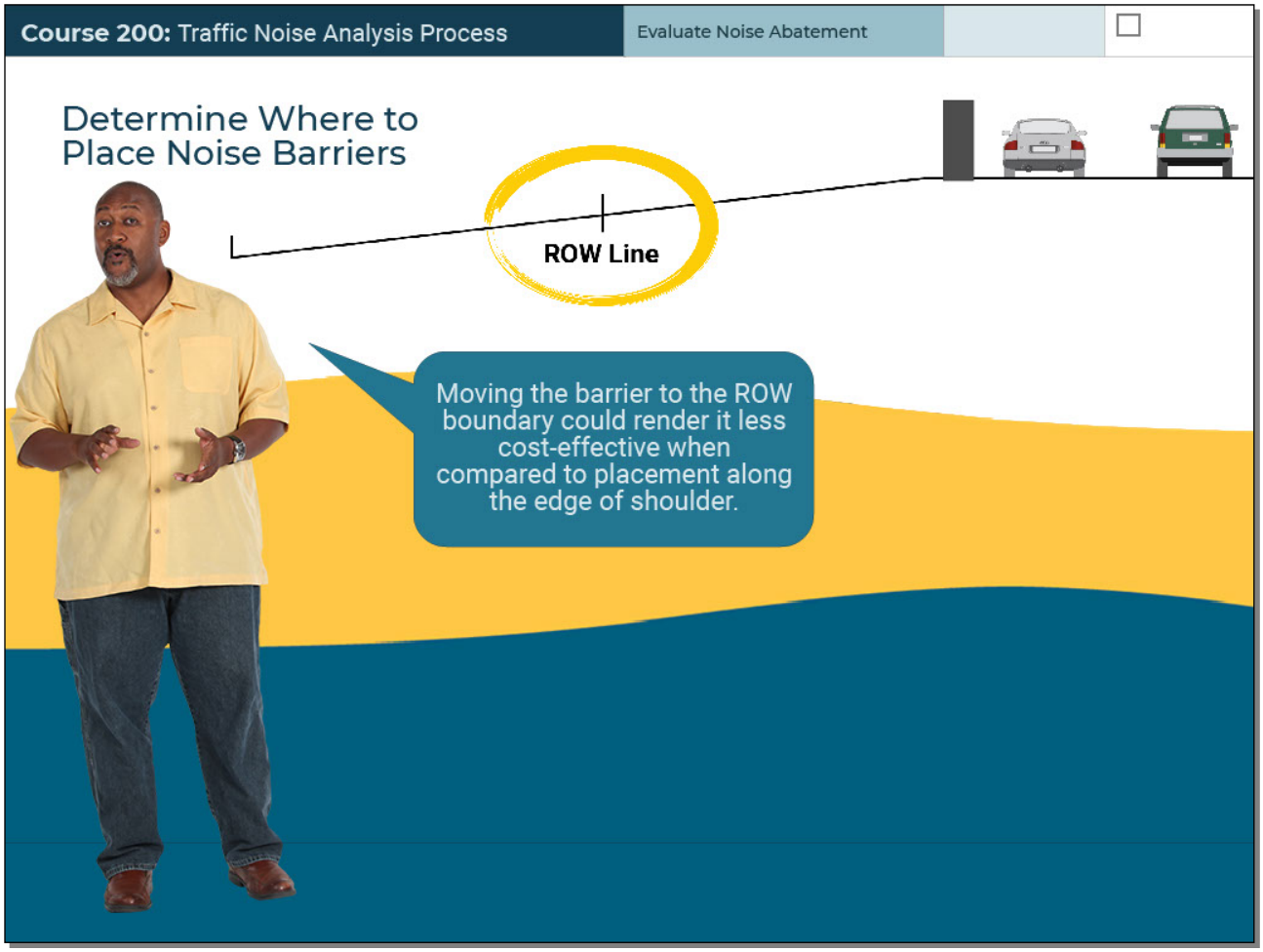
Text Captions

Determine Where to Place Noise Barriers

In addition to breaking the line of sight, barrier effectiveness also improves in relation to how closely it can be placed to either feature.

Typically the ROW boundary is adjacent to nearby homes, etc. In some instances, such as this one, the ROW boundary may be located at a midpoint between noise sensitive land uses and the roadway.

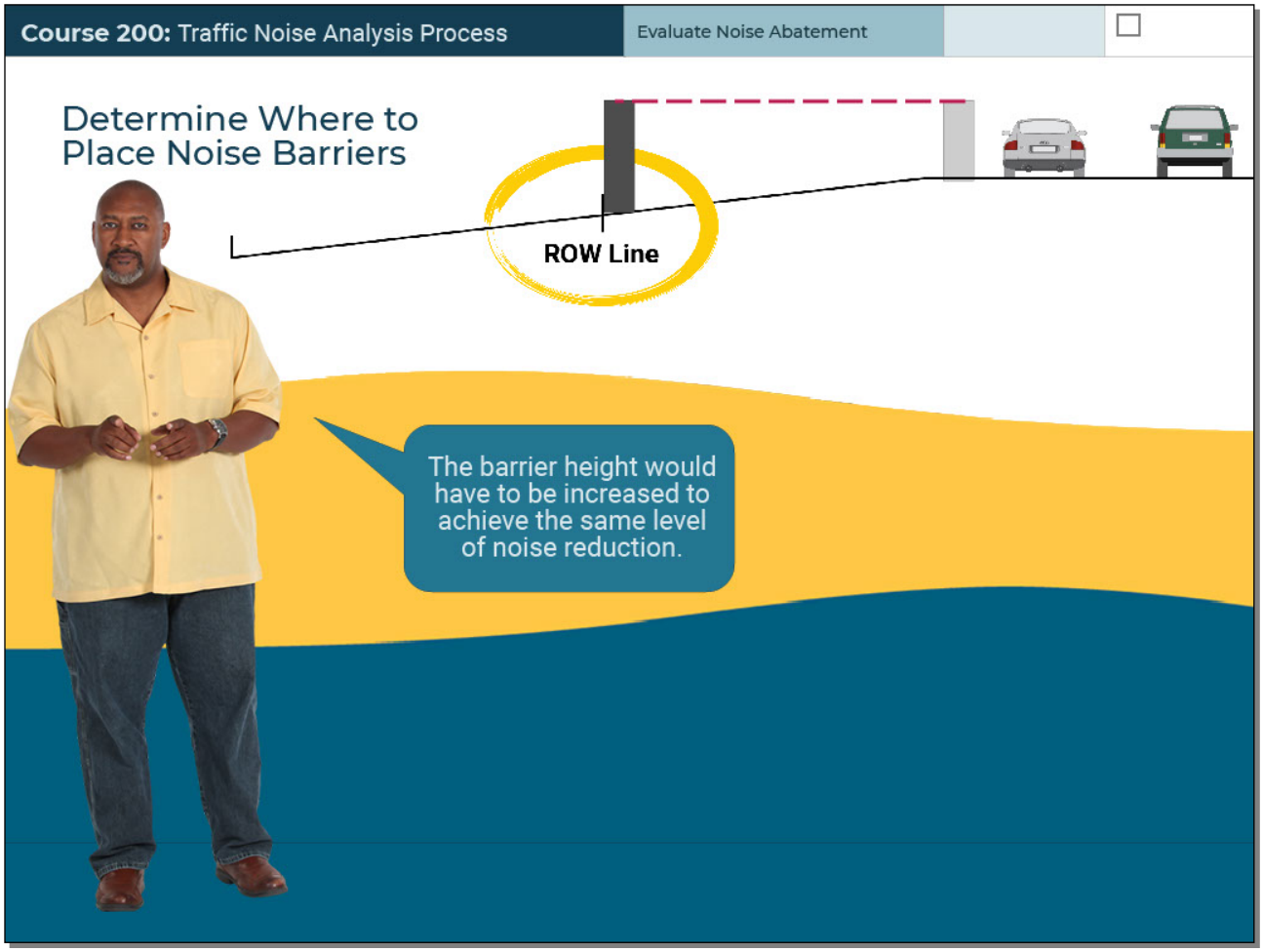
Slide 9 - Slide 9



Audio Script and Notes to Reviewers
Moving the barrier to the right-of-way boundary could render it less cost-effective when compared to placement along the edge of shoulder.

Text Captions
Determine Where to Place Noise Barriers
Moving the barrier to the ROW boundary could render it less cost-effective when compared to placement along the edge of shoulder.

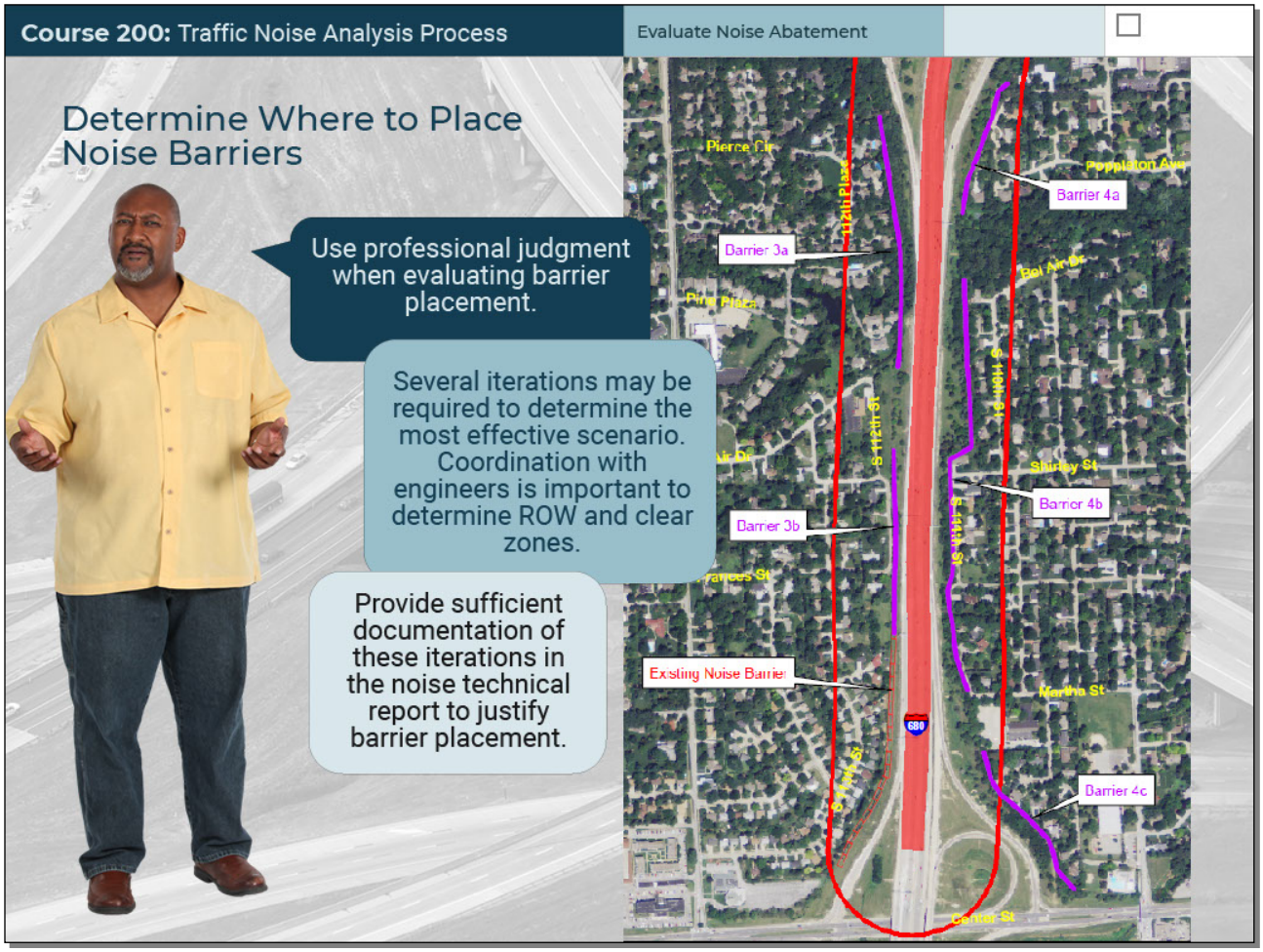
Slide 10 - Slide 10



Audio Script and Notes to Reviewers
That's because the barrier height would have to be increased to achieve the same level of noise reduction.

Text Captions
Determine Where to Place Noise Barriers
The barrier height would have to be increased to achieve the same level of noise reduction.

Slide 11 - Slide 11



Audio Script and Notes to Reviewers

Use professional judgment when evaluating barrier placement. Several iterations may be required to determine the most effective scenario. Coordination with engineers is important to determine right-of-way and clear zones. Provide sufficient documentation of these iterations in the noise technical report to justify barrier placement.

Text Captions

Determine Where to Place Noise Barriers
Use professional judgment when evaluating barrier placement.
Several iterations may be required to determine the most effective scenario. Coordination with engineers is important to determine ROW and clear zones.
Provide sufficient documentation of these iterations in the noise technical report to justify barrier placement.

Slide 12 - Slide 12

Audio Script and Notes to Reviewers
How do we make sure we benefit all impacted receptors?
Benefiting every impacted noise sensitive receptor is not always possible. Therefore, strive to determine the most cost-effective scenario that satisfies the feasibility and reasonableness criteria while protecting as many receptors as possible.

Text Captions
Determine Where to Place Noise Barriers
How do we make sure we benefit all impacted receptors?
Benefiting every impacted noise sensitive receptor is not always possible.
Strive to determine the most cost-effective scenario that satisfies the feasibility and reasonableness criteria while protecting as many receptors as possible.

Slide 13 - Slide 13

Audio Script and Notes to Reviewers
Noise reductions typically increase with increased barrier height and/or length. However, at some point, further increases in barrier height and-or length result in smaller and smaller increases in reductions until you reach a point of diminishing returns.

Text Captions
Determine Where to Place Noise Barriers
Noise reductions typically increase with increased barrier height and/or length.
At some point, further increases in barrier height and/or length result in smaller and smaller increases in reductions until you reach a point of diminishing returns.

Slide 14 - Slide 14

Audio Script and Notes to Reviewers
Strive to find the best balance between cost and benefit.

Text Captions
Determine Where to Place Noise Barriers
Strive to find the best balance between cost and benefit.

Slide 15 - Slide 15

Audio Script and Notes to Reviewers

To achieve the most cost-effective results, a barrier with varying heights is often required as opposed to a continuous height. For example, due to topography or changes in distances to receptors, you may need a fifteen-foot high barrier along one segment, but only a twelve-foot barrier along another. This helps to reduce cost while providing benefits to most receptors.

Text Captions

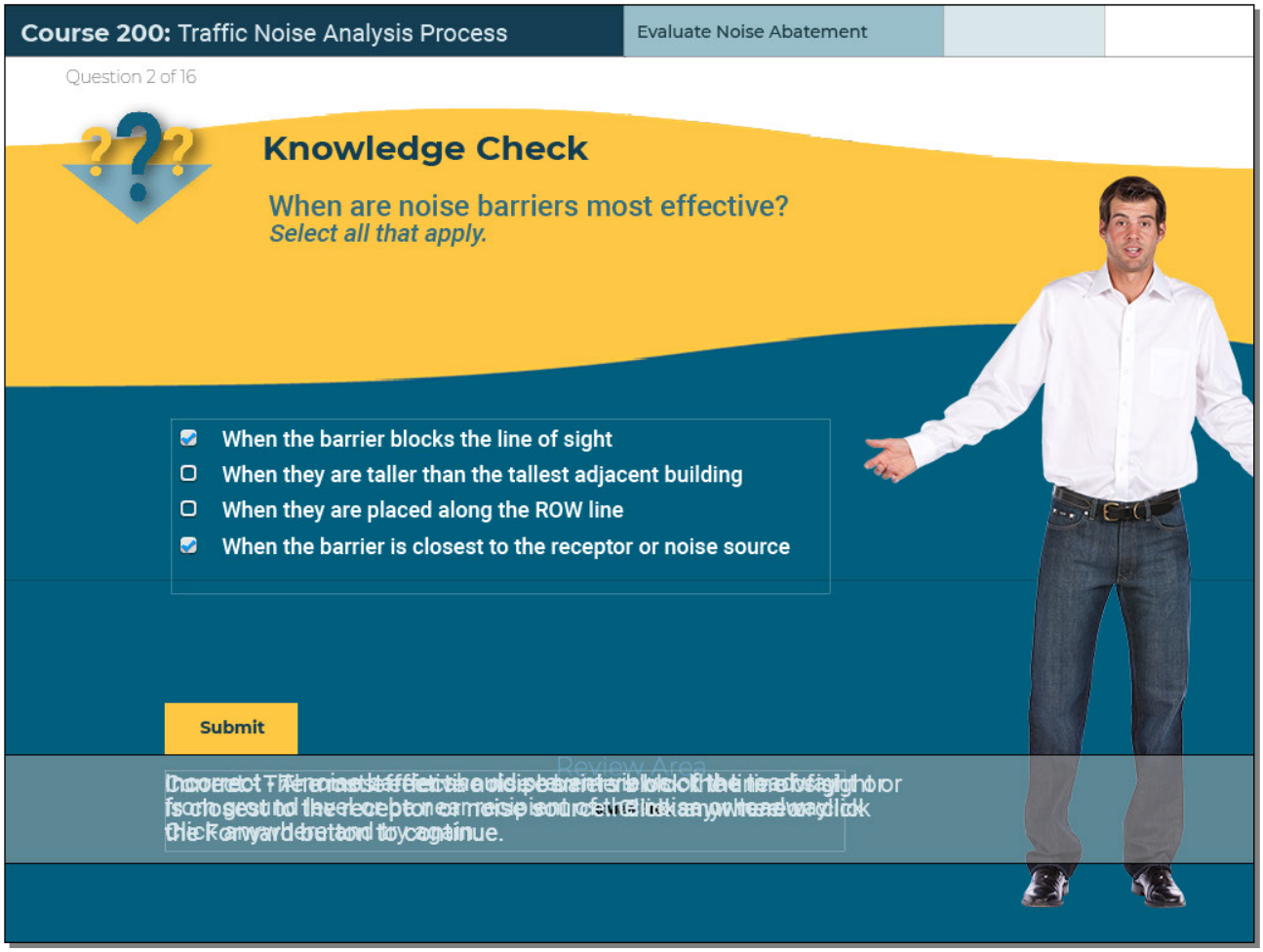
Determine Where to Place Noise Barriers
A barrier with varying heights is often required as opposed to a continuous height.
For example, due to topography or changes in distances to receptors, you may need a 15-foot high barrier along one segment, but only a 12-foot barrier along another. This helps to reduce cost while providing benefits to most receptors.

Slide 16 - Slide 16

Audio Script and Notes to Reviewers
Balance transitions in height along the length of the barrier to improve constructability. Limit transitions between different barrier segments to two- to four-foot transitions, if possible.

Text Captions
Determine Where to Place Noise Barriers
Balance transitions in height along the length of the barrier to improve constructability.
Limit transitions between different barrier segments to 2- to 4-foot transitions, if possible.

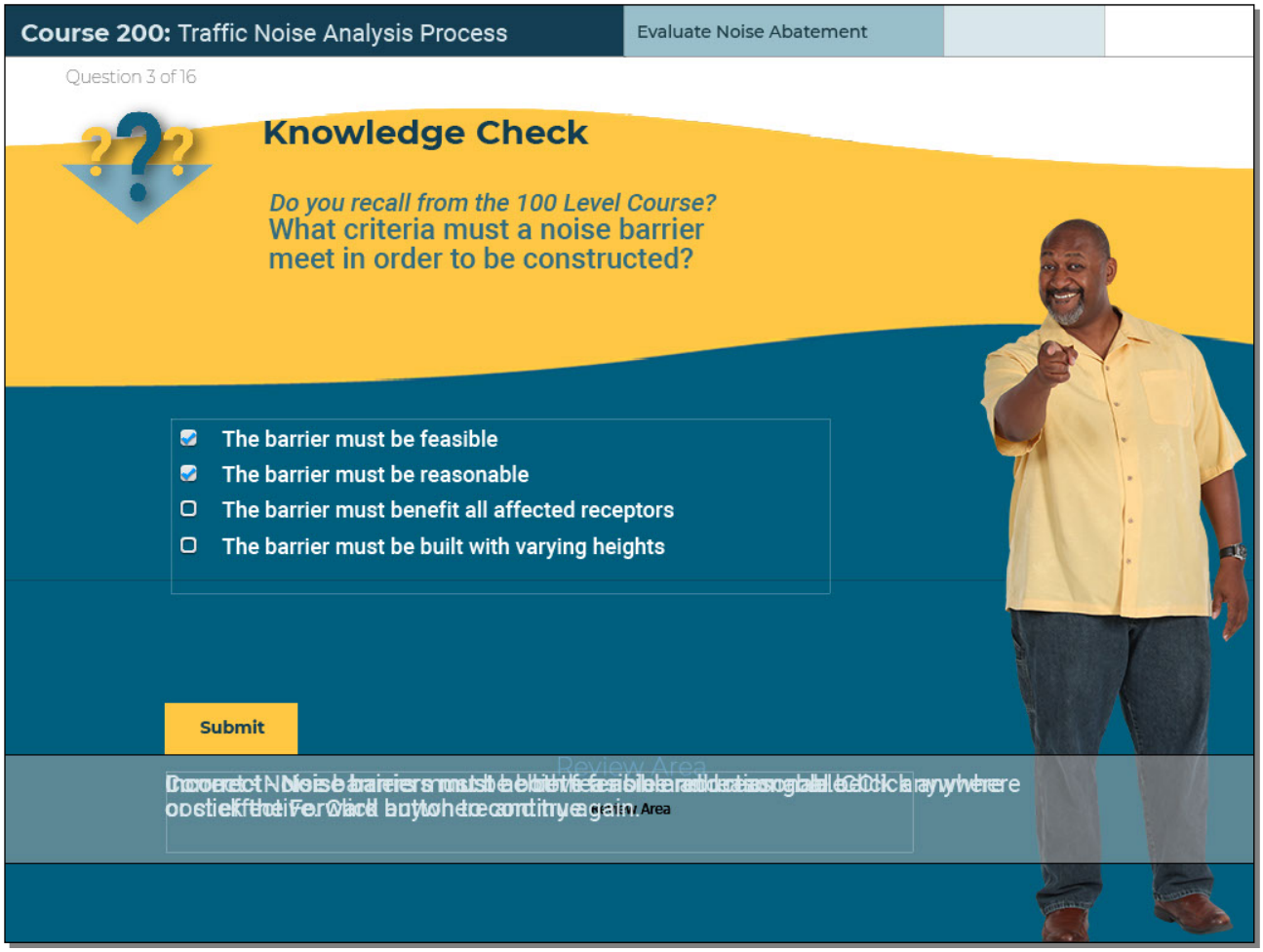
Slide 17 - Slide 17



Audio Script and Notes to Reviewers
When are noise barriers most effective?
NOTE: We don't have an objective/master test question for this. Should we? If not, delete.

Text Captions
Knowledge Check
When are noise barriers most effective?
Select all that apply.
Correct feedback: Correct - The most effective noise barriers block the line of sight or is closest to the receptor or noise source. Click anywhere or click the Forward button to continue.
1st incorrect feedback: Incorrect - A noise barrier should prevent views of the roadway from ground level or be near recipient of the noise or roadway. Click anywhere and try again.
2nd incorrect feedback: Incorrect - The most effective noise barriers block the line of sight or is closest to the receptor or noise source. Click anywhere or click the Forward button to continue.

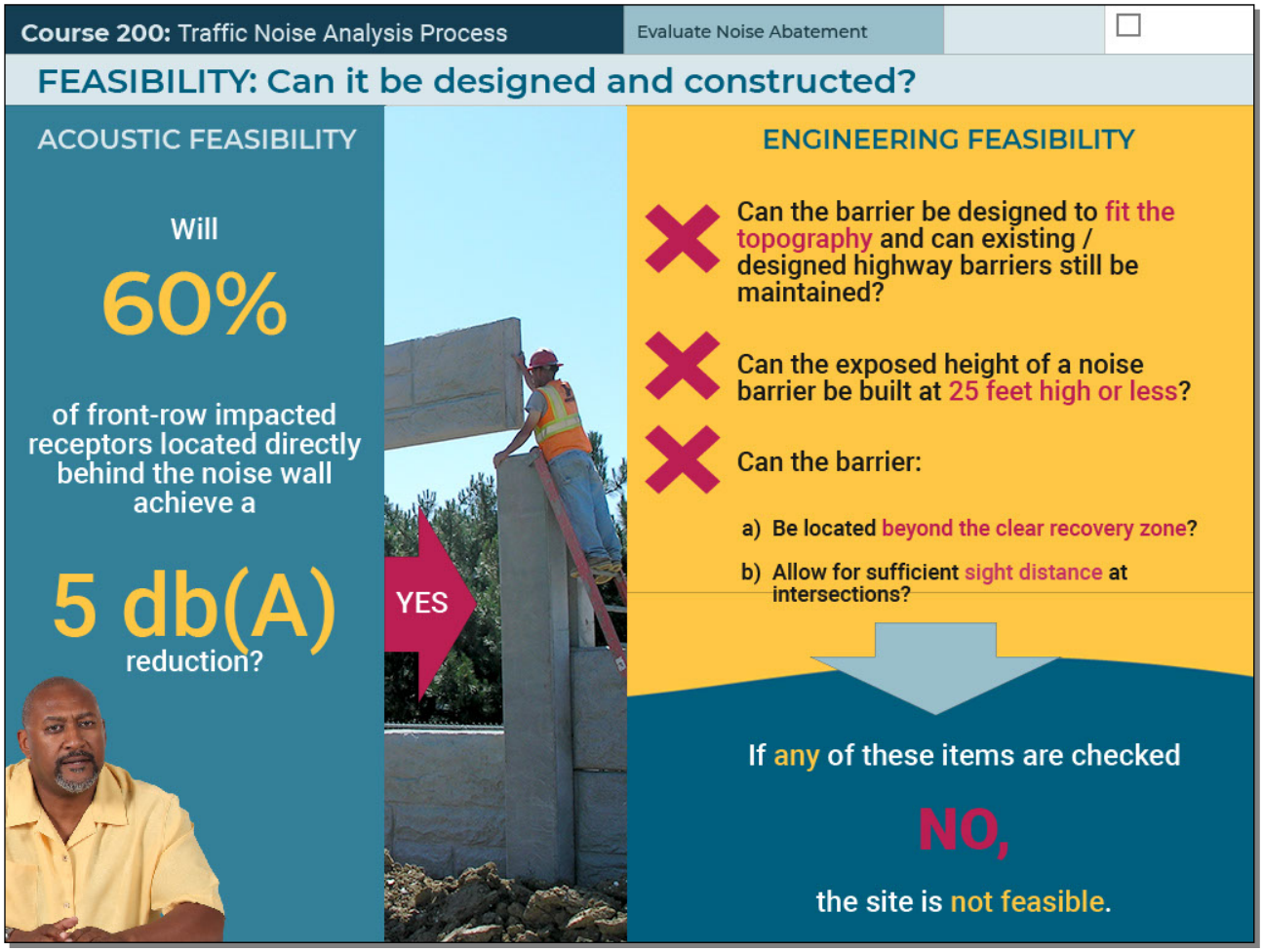
Slide 18 - Slide 18



Audio Script and Notes to Reviewers
What criteria must a noise barrier meet in order to be constructed?

Text Captions
Knowledge Check
Do you recall from the 100 Level Course?
What criteria must a noise barrier meet in order to be constructed?
Correct feedback: Correct - Noise barriers must be both feasible and reasonable. Click anywhere or click the Forward button to continue.
1st Incorrect feedback: Incorrect - Noise barriers must achieve a noise reduction goal be cost effective. Click anywhere and try again.
2nd incorrect feedback: Incorrect - Noise barriers must be both feasible and reasonable. Click anywhere or click the Forward button to continue.

Slide 19 - Slide 19



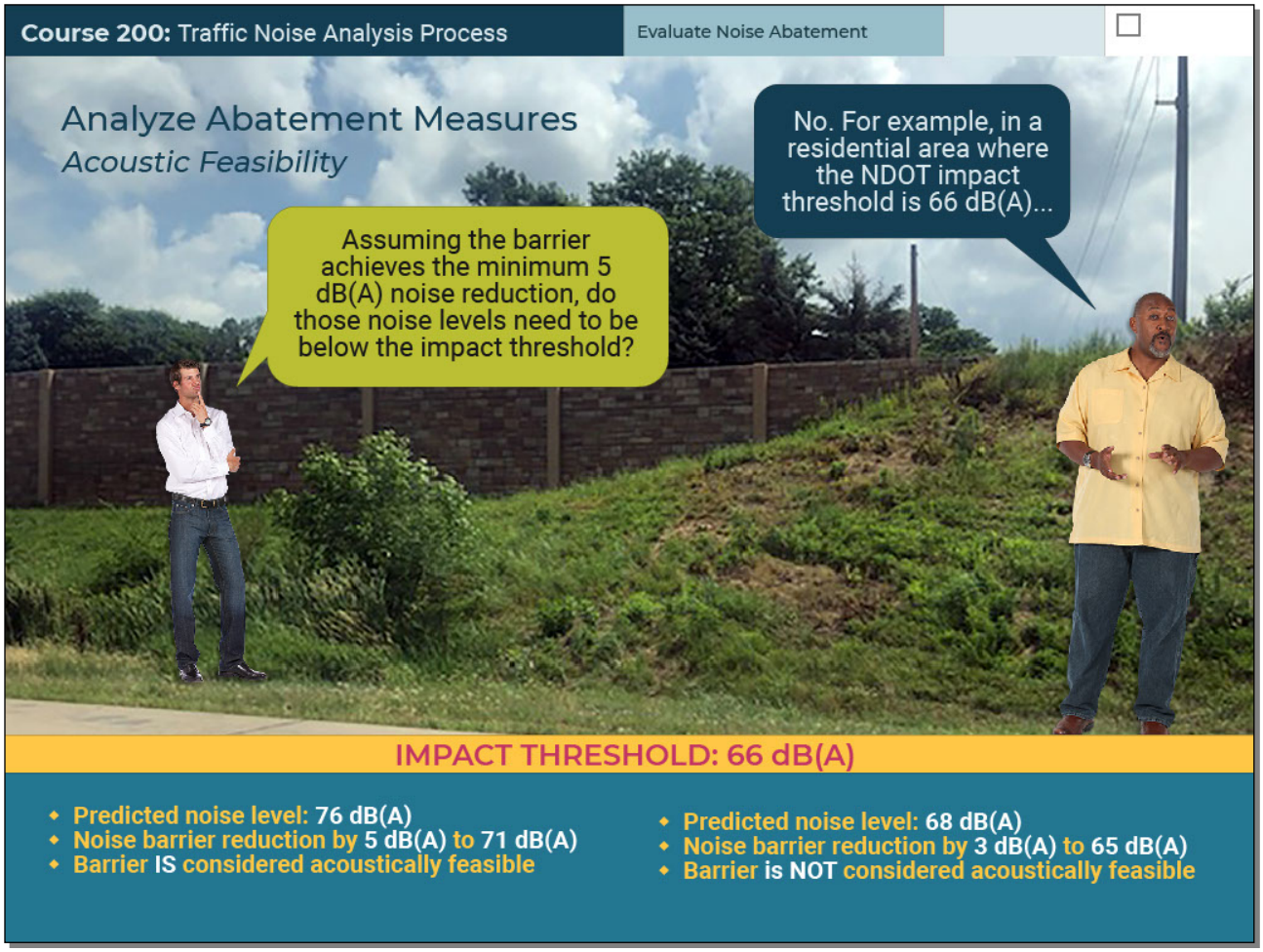
Audio Script and Notes to Reviewers

There are two components to feasibility: Acoustic and Engineering. When considering acoustic feasibility, ask if sixty percent of front-row impacted receptors located directly behind the noise wall will achieve a five D-B-A reduction. If the answer is yes, then consider engineering feasibility. Can the barrier be designed to fit the topography, and can any existing highway barriers still be maintained? Can the exposed height of a noise barrier be built at twenty-five feet high or less? If not, noise barriers beyond this height are typically not cost-effective and present structural and aesthetic considerations. Can the barrier address safety concerns? Can it be located beyond the clear recovery zone? And can it allow for sufficient sight distance at intersections? If any of these items are checked no, the site is not feasible.

Text Captions

FEASIBILITY: Can it be designed and constructed?
ACOUSTIC FEASIBILITY
Will 60% of front-row impacted receptors located directly behind the noise wall achieve a 5 db(A) reduction?
YES
ENGINEERING FEASIBILITY
Can the barrier be designed to fit the topography and can existing / designed highway barriers still be maintained?
Can the exposed height of a noise barrier be built at 25 feet high or less?
Can the barrier:
a) Be located beyond the clear recovery zone?
b) Allow for sufficient sight distance at intersections?
If any of these items are checked No, the site is not feasible.

Slide 20 - Slide 20



Audio Script and Notes to Reviewers

Assuming the barrier achieves the minimum five D-B-A noise reduction, do those noise levels need to be below the impact threshold?

No. For example, assume we are working in a residential area where the N-dot impact threshold is sixty-six D-B-A and the predicted noise level is seventy-six D-B-A. The noise barrier is expected to result in a five D-B-A reduction to seventy-one D-B-A, which is above the sixty-six D-B-A specified as the N-dot impact threshold. However, the barrier in this example is considered acoustically feasible even though it does not reach the impact threshold. Conversely, assume the predicted noise level is sixty-eight D-B-A. The noise barrier is expected to result in a three D-B-A reduction to sixty-five D-B-A. Even though the resulting noise level would be below the N-dot impact threshold, the barrier does not meet the five D-B-A reduction required for noise barriers to be considered feasible.

Text Captions

Analyze Abatement Measures

Acoustic Feasibility

Assuming the barrier achieves the minimum 5 dB(A) noise reduction, do those noise levels need to be below the impact threshold?

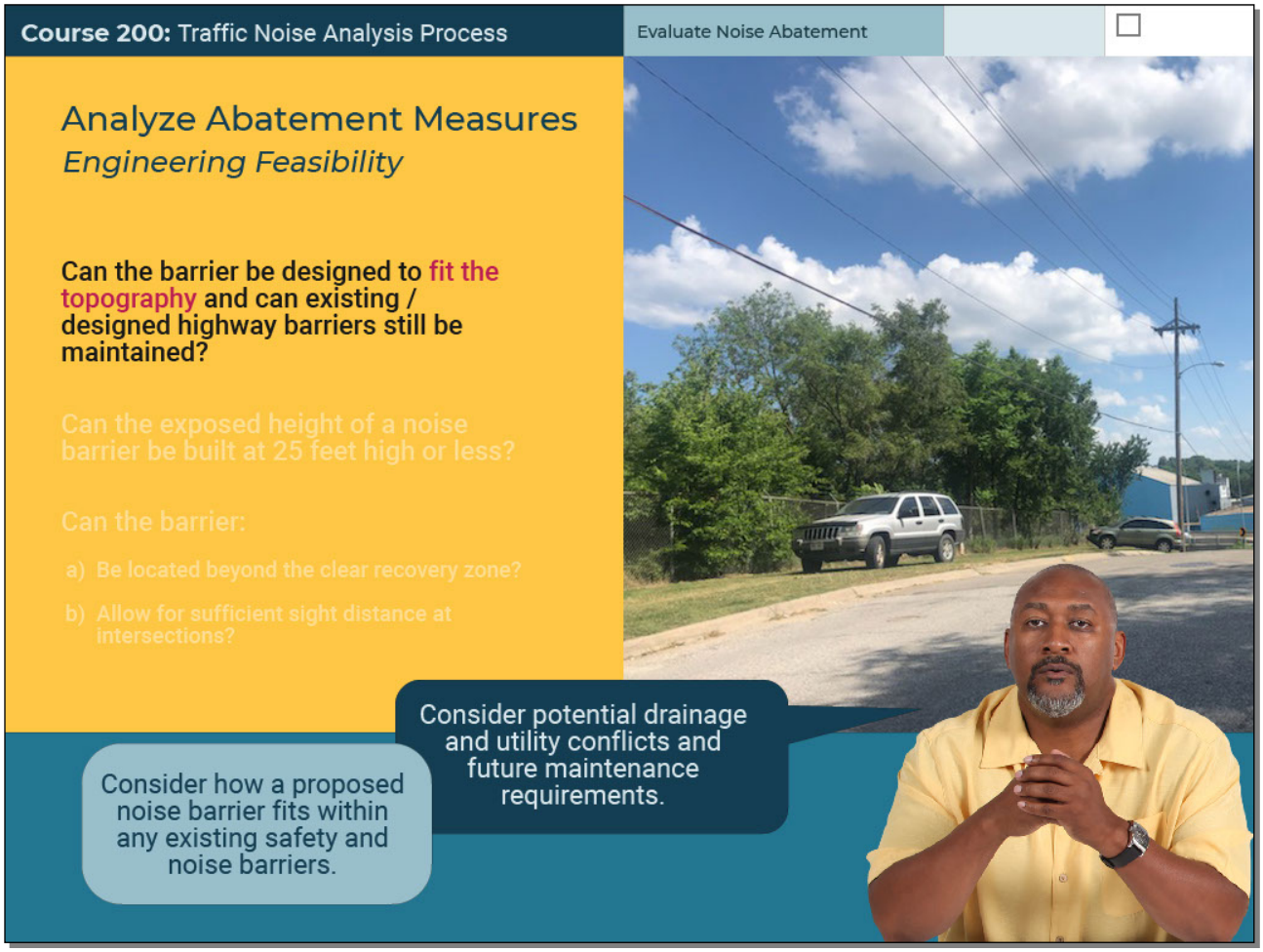
No. For example, in a residential area where the NDOT impact threshold is 66 dB(A)...

IMPACT THRESHOLD: 66 dB(A)

- Predicted noise level: 76 dB(A)
- Noise barrier reduction by 5 dB(A) to 71 dB(A)

- Barrier IS considered acoustically feasible
- Predicted noise level: 68 dB(A)
- Noise barrier reduction by 3 dB(A) to 65 dB(A)
- Barrier is NOT considered acoustically feasible

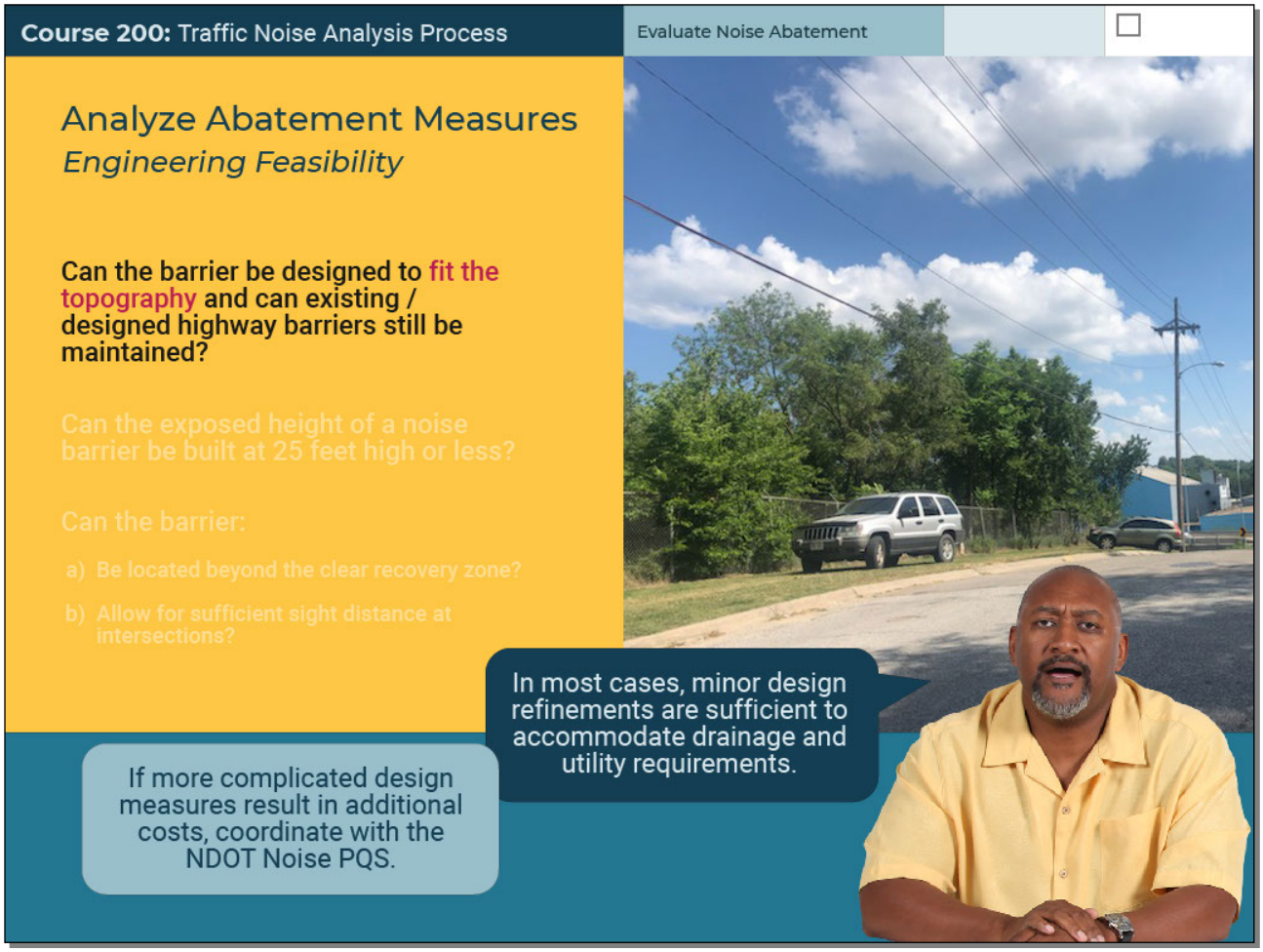
Slide 21 - Slide 21



Audio Script and Notes to Reviewers
When thinking about engineering feasibility and topography, consider potential drainage and utility conflicts and future maintenance requirements. Also consider how a proposed noise barrier fits within any existing safety and noise barriers.

Text Captions
Analyze Abatement Measures
Engineering Feasibility
Can the barrier be designed to fit the topography and can existing / designed highway barriers still be maintained?
Consider potential drainage and utility conflicts and future maintenance requirements.
Consider how a proposed noise barrier fits within any existing safety and noise barriers.

Slide 22 - Slide 22



Audio Script and Notes to Reviewers

In most cases, minor design refinements are sufficient to accommodate drainage and utility requirements. However, if more complicated design measures result in additional costs, such as construction or right-of-way costs, coordinate with the N-dot Noise P-Q-S.

Text Captions

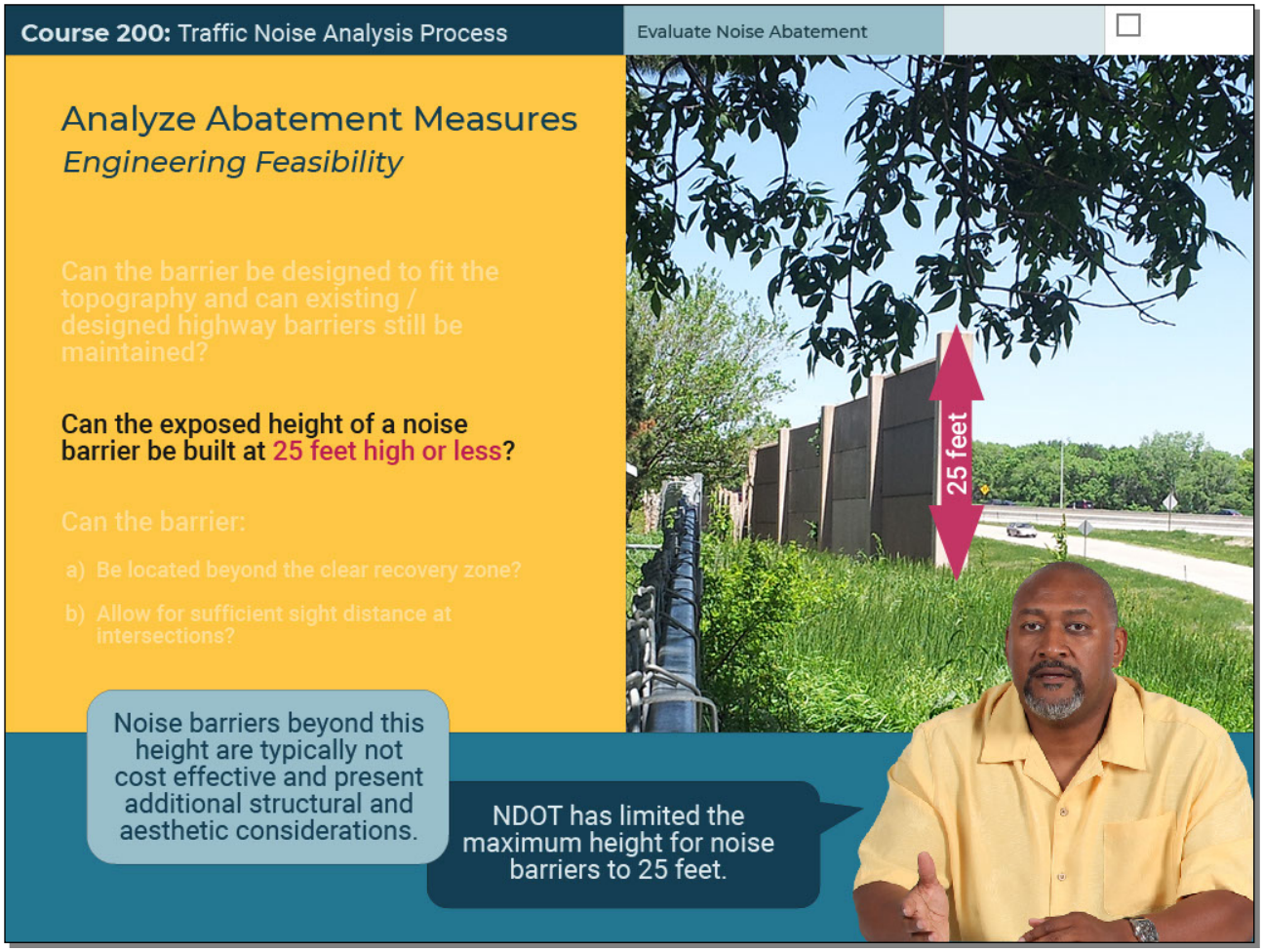
Analyze Abatement Measures
Engineering Feasibility
Can the barrier be designed to fit the topography and can existing / designed highway barriers still be maintained?
In most cases, minor design refinements are sufficient to accommodate drainage and utility requirements.
If more complicated design measures result in additional costs, coordinate with the NDOT Noise PQS.

Slide 23 - Slide 23

Audio Script and Notes to Reviewers
Use a setback distance of ten feet from both the roadway edge of shoulder, as well as the right-of-way line, if space allows. This allows for barrier repair and maintenance, such as mowing. However, if sufficient space isn't available, a minimum five-foot permanent easement is required.

Text Captions
Analyze Abatement Measures
Engineering Feasibility
Can the barrier be designed to fit the topography and can existing / designed highway barriers still be maintained?
Use a setback of 10 feet from the roadway edge of shoulder and the ROW line.
If sufficient space isn't available, a minimum 5-foot permanent easement is required.

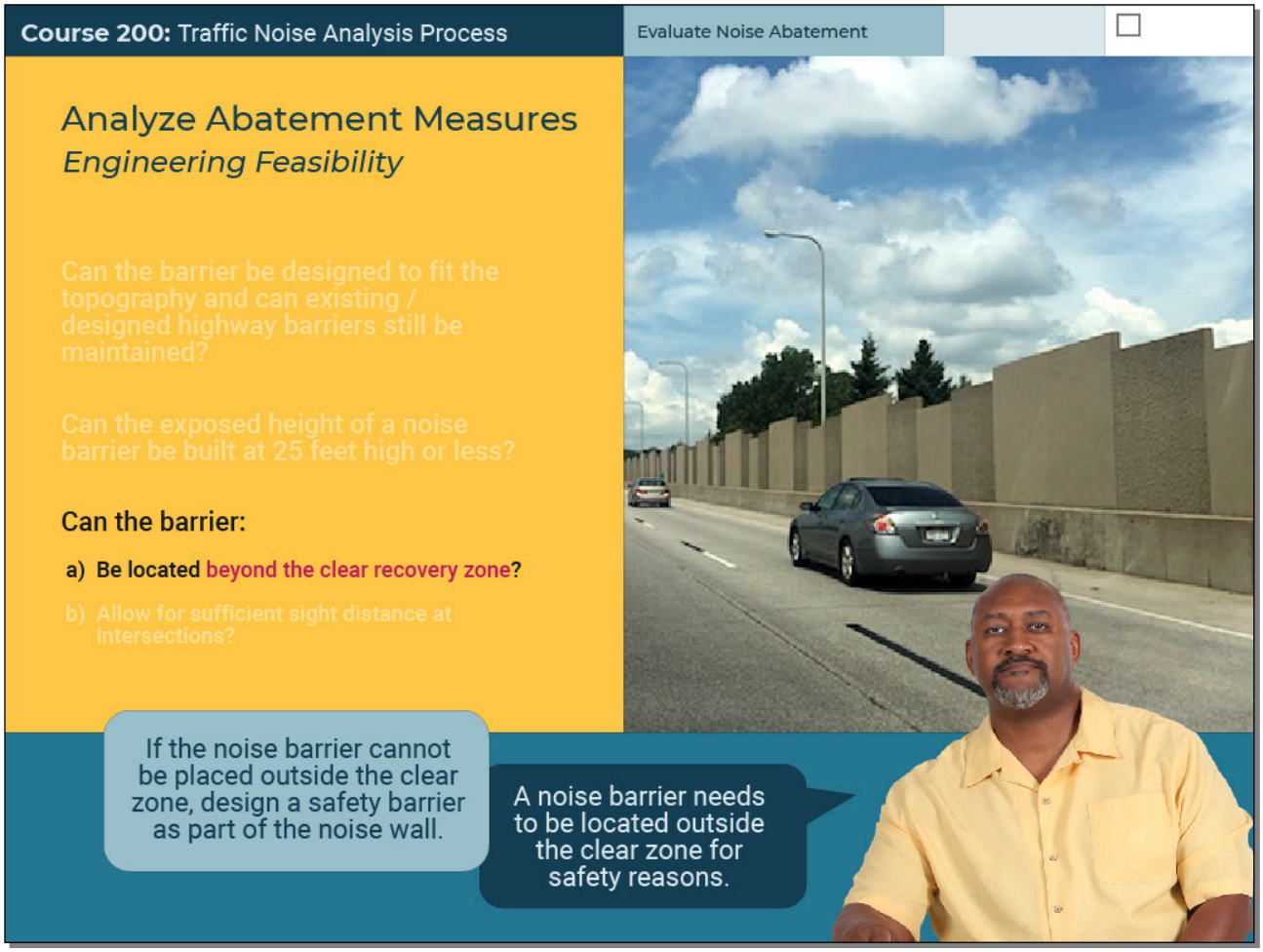
Slide 24 - Slide 24



Audio Script and Notes to Reviewers
Regarding height, N-dot has limited the maximum height for noise barriers to twenty-five feet. Noise barriers beyond this height are typically not cost effective and present additional structural and aesthetic considerations.

Text Captions
Analyze Abatement Measures
Engineering Feasibility
Can the exposed height of a noise barrier be built at 25 feet high or less?
NDOT has limited the maximum height for noise barriers to 25 feet.
Noise barriers beyond this height are typically not cost effective and present additional structural and aesthetic considerations.
25 feet

Slide 25 - Slide 25



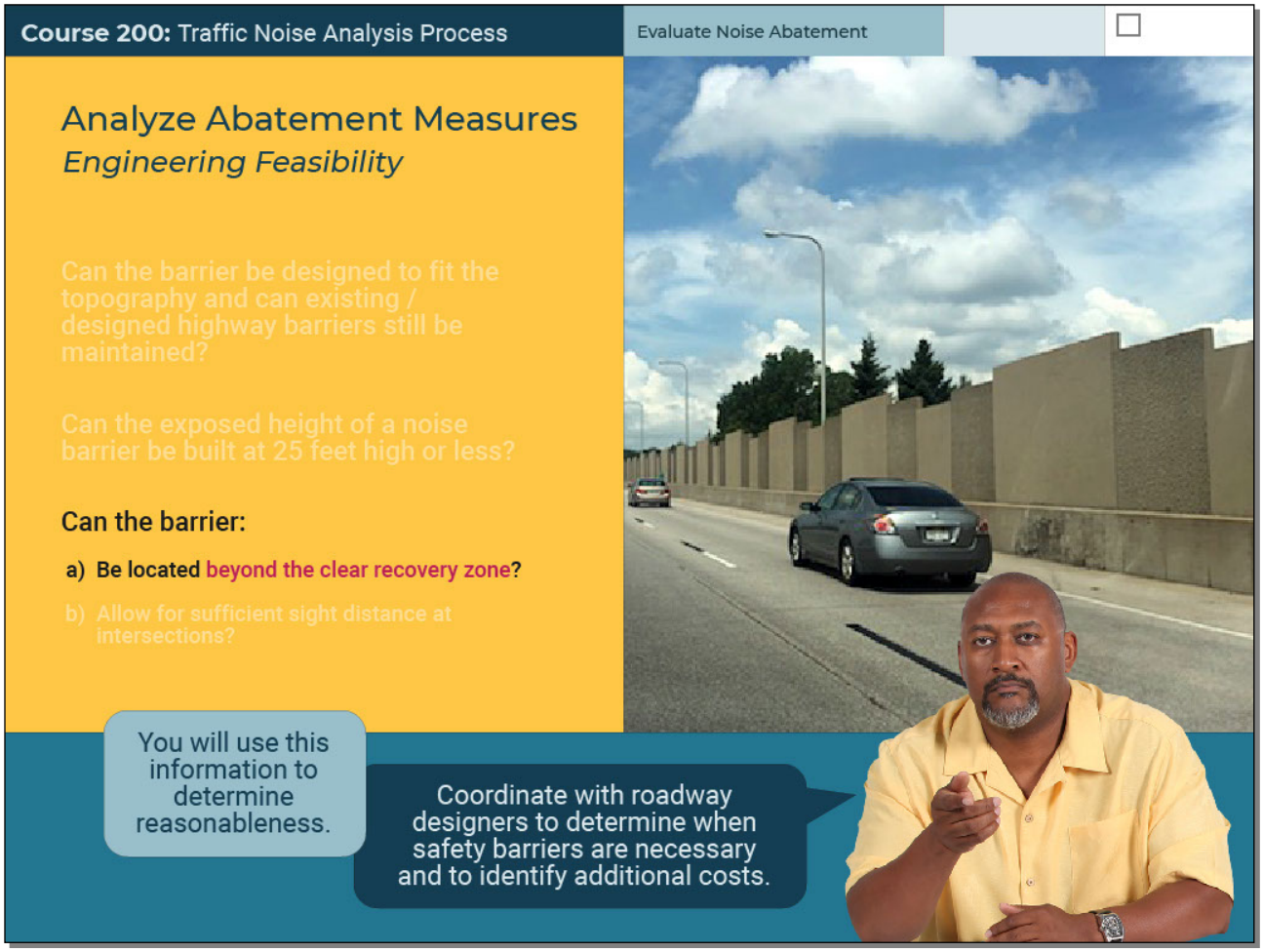
Audio Script and Notes to Reviewers

A noise barrier needs to be located outside the clear zone so that errant vehicles have sufficient opportunity to recover. This reduces the potential for collision with the noise wall. However, sometimes a noise barrier cannot be placed outside the clear zone because of site constraints, for instance along the edge of shoulder. In such cases, you must design a safety barrier, such as a guardrail or Jersey barrier, as part of the noise wall.

Text Captions

Analyze Abatement Measures
Engineering Feasibility
Can the barrier:
a) Be located beyond the clear recovery zone?☐
A noise barrier needs to be located outside the clear zone for safety reasons.
If the noise barrier cannot be placed outside the clear zone, design a safety barrier as part of the noise wall.

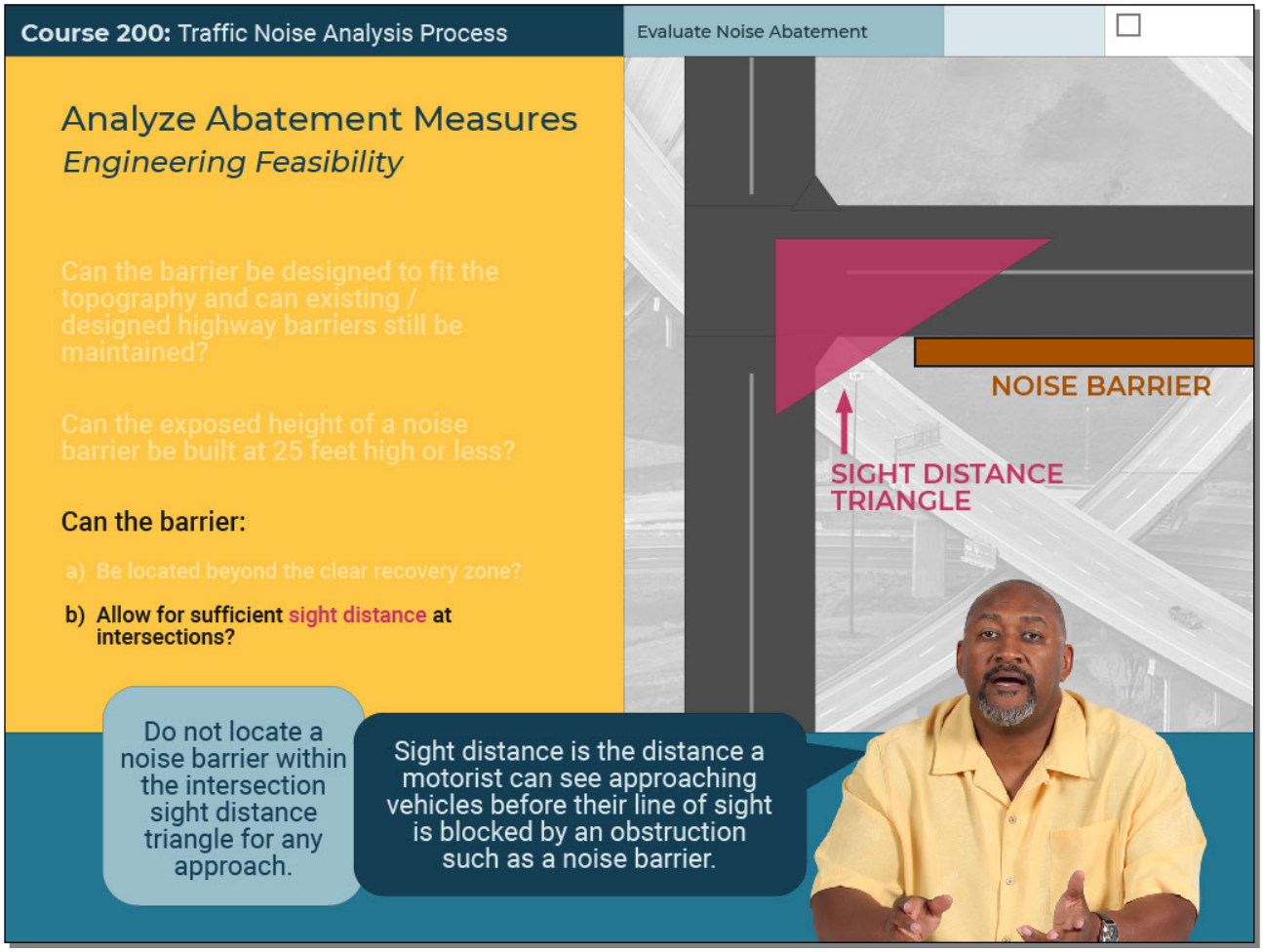
Slide 26 - Slide 26



Audio Script and Notes to Reviewers
Coordinate with roadway designers to determine when safety barriers are necessary. Also work with them to identify additional costs that should be included in the total cost of the noise barrier. You will use this information to determine reasonableness of the barrier, if necessary.

Text Captions
Analyze Abatement Measures
Engineering Feasibility
Can the barrier:
a) Be located beyond the clear recovery zone?☐
Coordinate with roadway designers to determine when safety barriers are necessary and to identify additional costs.
You will use this information to determine reasonableness.

Slide 27 - Slide 27



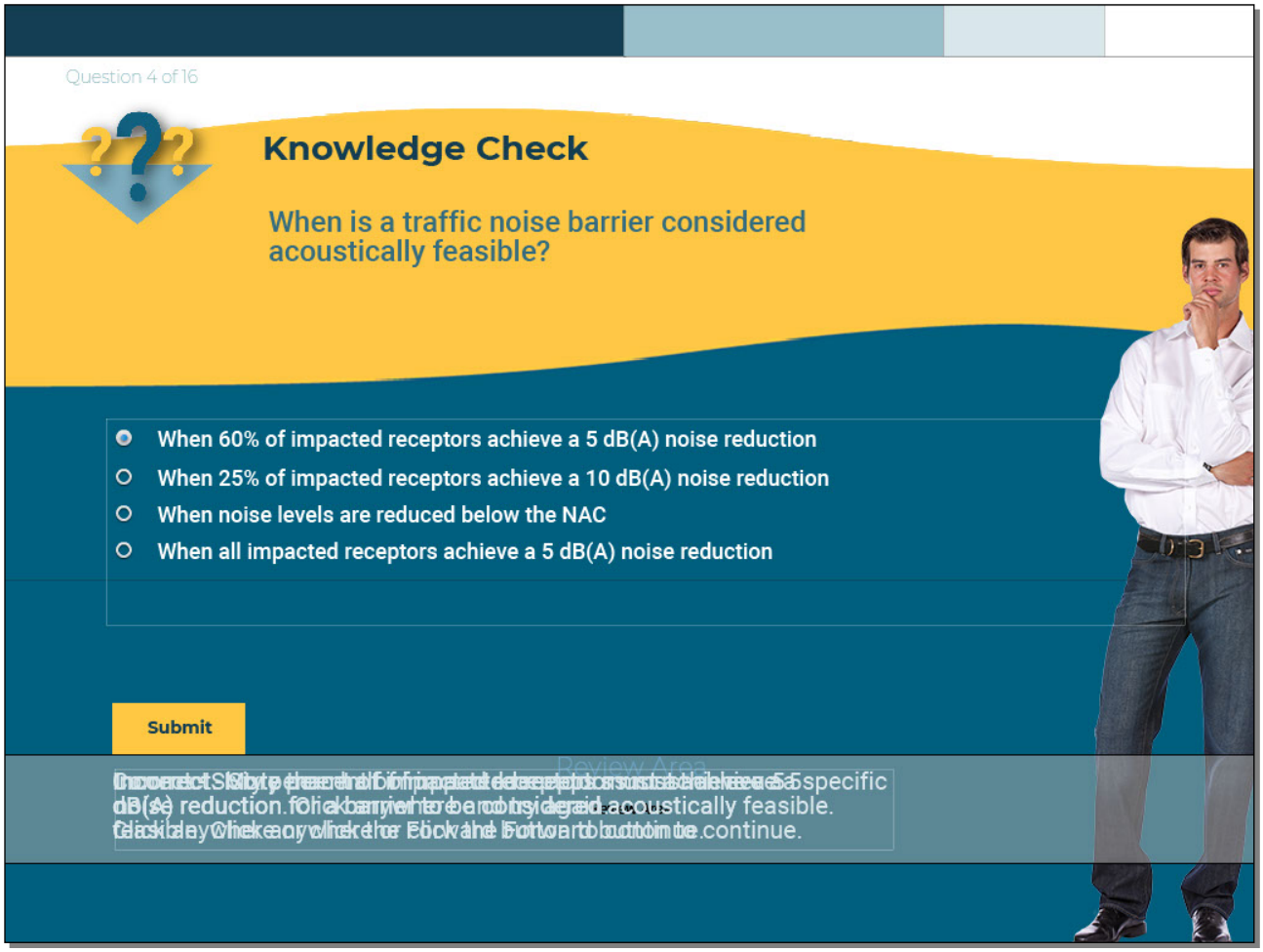
Audio Script and Notes to Reviewers

Sight distance specific to intersections is typically the distance a motorist can see approaching vehicles before their line of sight is blocked by an obstruction, such as a noise barrier. Poor sight distance can increase the potential for crashes at intersections because motorists are unable to see and react to approaching vehicles. Therefore, do not locate a noise barrier within the intersection sight distance triangle for any approach. Coordinate with the roadway design team to determine if the proposed barrier maintains sufficient sight distance at intersections.

Text Captions

Analyze Abatement Measures
Engineering Feasibility
Can the barrier:
b) Allow for sufficient sight distance at intersections?
Can the exposed height of a noise barrier be built at 25 feet high or less?
SIGHT DISTANCE TRIANGLE
NOISE BARRIER
Sight distance is the distance a motorist can see approaching vehicles before their line of sight is blocked by an obstruction such as a noise barrier. Do not locate a noise barrier within the intersection sight distance triangle for any approach.

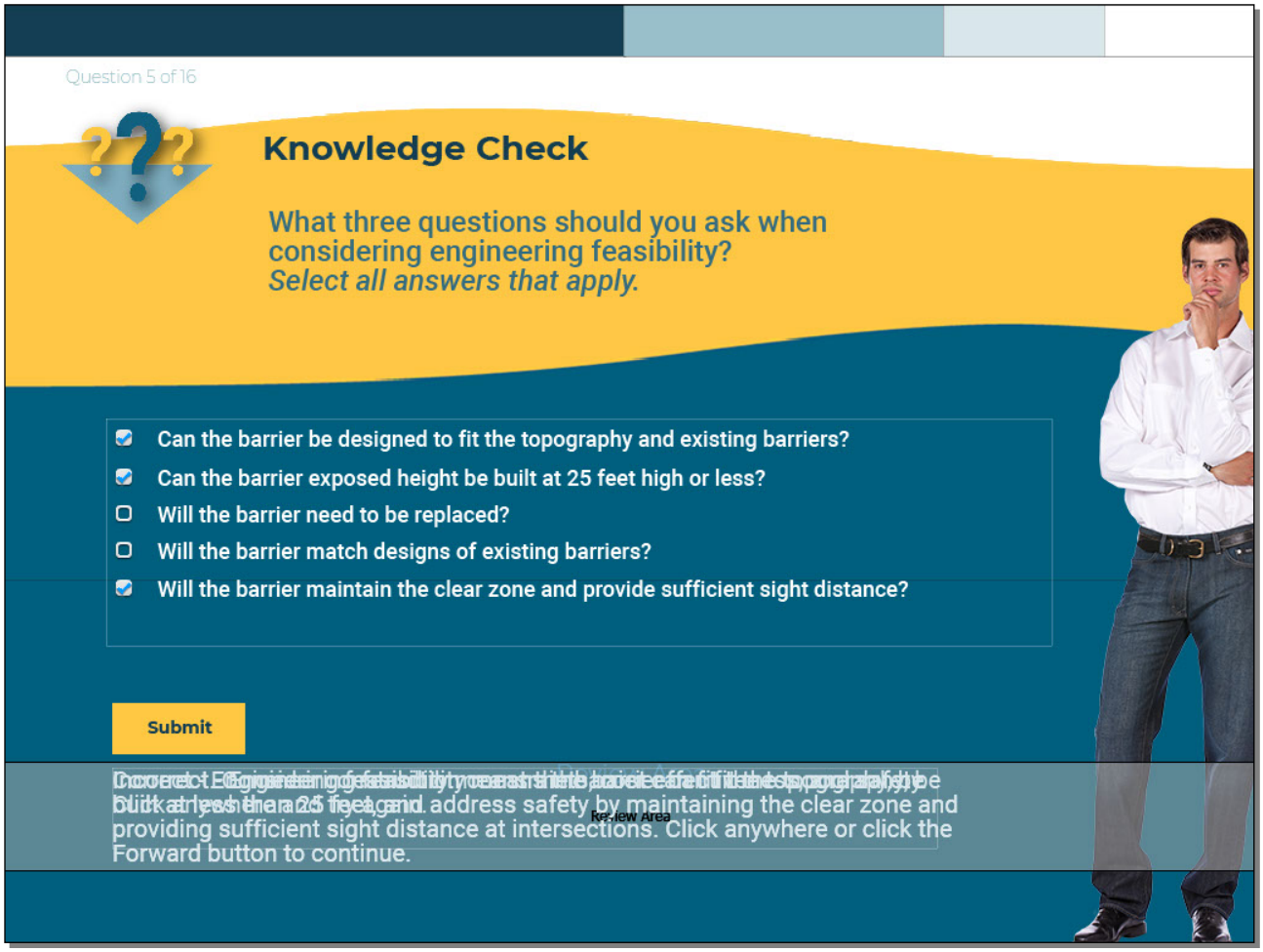
Slide 28 - Slide 28



Audio Script and Notes to Reviewers
When is a traffic noise barrier considered acoustically feasible?

Text Captions
Knowledge Check
When is a traffic noise barrier considered acoustically feasible?
Correct feedback: Correct - Sixty percent of impacted receptors must achieve a 5 dB(A) reduction for a barrier to be considered acoustically feasible. Click anywhere or click the Forward button to continue.
1st incorrect feedback: Incorrect. More than half of impacted receptors must achieve a specific noise reduction. Click anywhere and try again.
2nd incorrect feedback: Incorrect - Sixty percent of impacted receptors must achieve a 5 dB(A) reduction for a barrier to be considered acoustically feasible. Click anywhere or click the Forward button to continue.

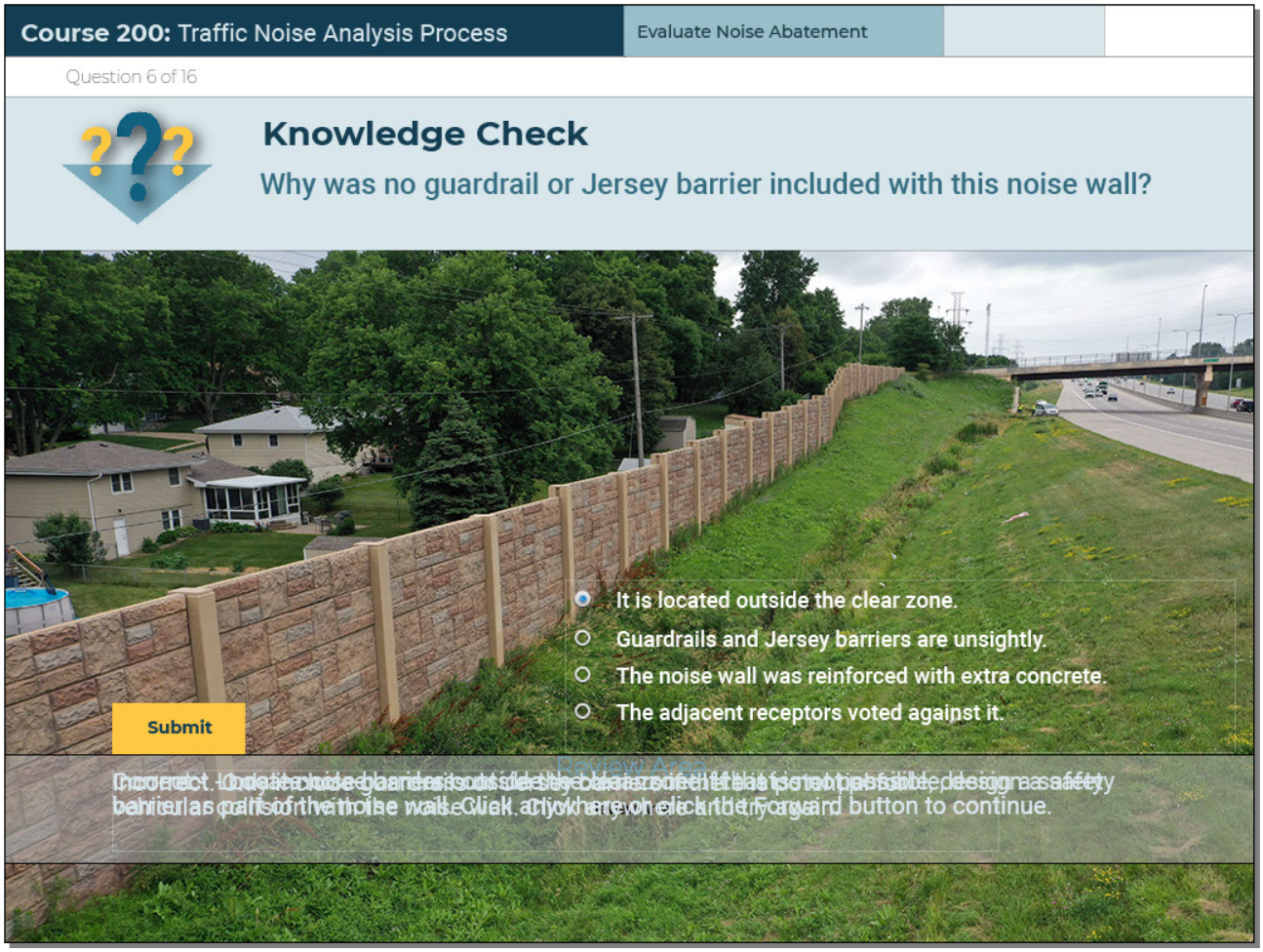
Slide 29 - Slide 29



Audio Script and Notes to Reviewers
What three questions should you ask when considering reasonableness?

Text Captions
Knowledge Check
What three questions should you ask when considering engineering feasibility?
Select all answers that apply.
Correct feedback: Correct - Engineering feasibility means the barrier can fit the topography, be built at less than 25 feet, and address safety by maintaining the clear zone and providing sufficient sight distance at intersections. Click anywhere or click the Forward button to continue.
1st incorrect feedback: Incorrect. Consider construction constraints, cost-effectiveness, and safety. Click anywhere and try again.
2nd incorrect feedback: Incorrect - Engineering feasibility means the barrier can fit the topography, be built at less than 25 feet, and address safety by maintaining the clear zone and providing sufficient sight distance at intersections. Click anywhere or click the Forward button to continue.

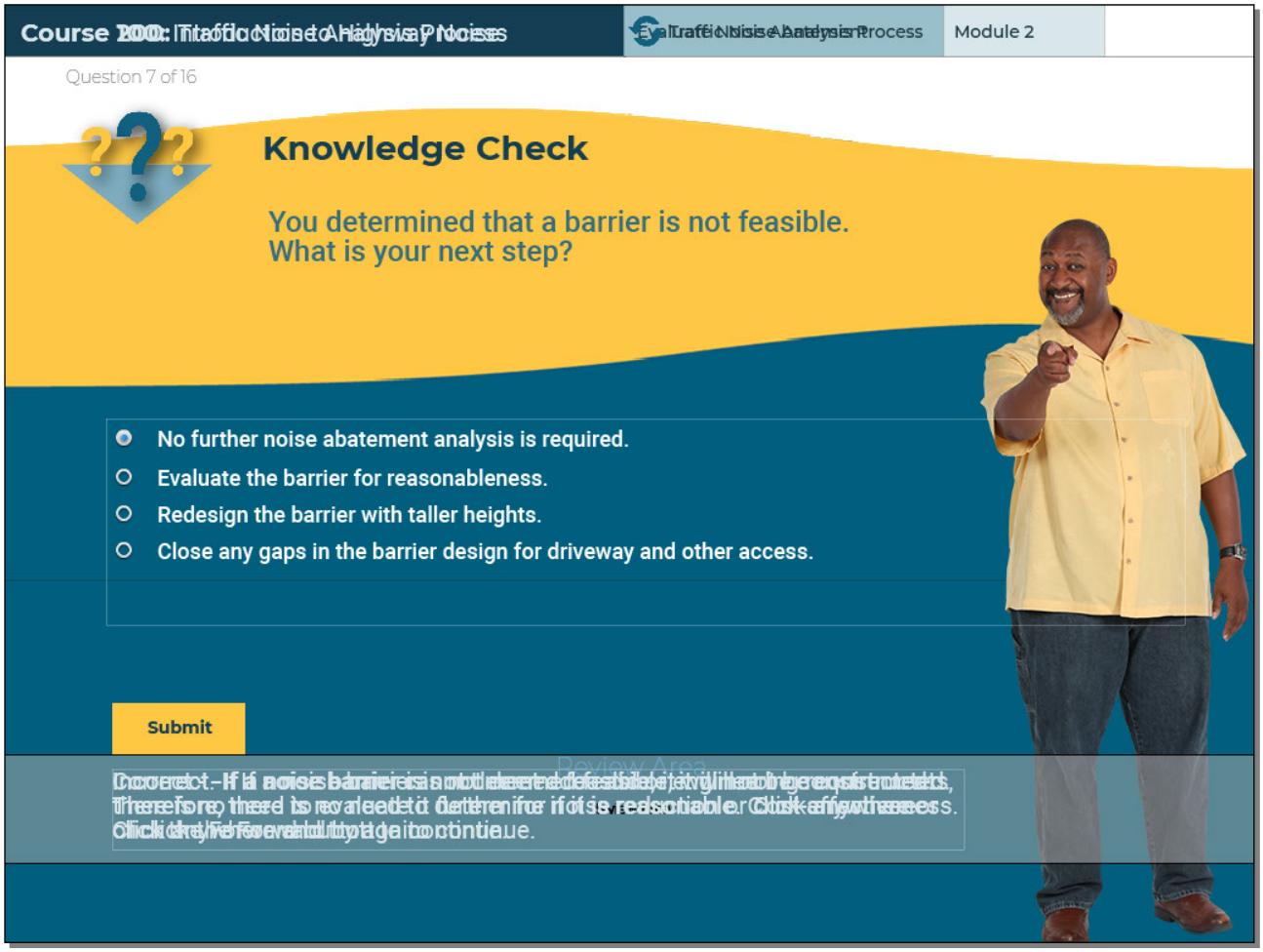
Slide 30 - Slide 30



Audio Script and Notes to Reviewers
Why was no guardrail or Jersey barrier included with this noise wall?

Text Captions
Knowledge Check
Why was no guardrail or Jersey barrier included with this noise wall?
Correct feedback: Correct - Locate noise barriers outside the clear zone. If that is not possible, design a safety barrier as part of the noise wall. Click anywhere or click the Forward button to continue.
1st incorrect feedback: Incorrect. Only include guardrails or Jersey barriers if there is potential for vehicular collision with the noise wall. Click anywhere and try again.
2nd incorrect feedback: Incorrect - Locate noise barriers outside the clear zone. If that is not possible, design a safety barrier as part of the noise wall. Click anywhere or click the Forward button to continue.

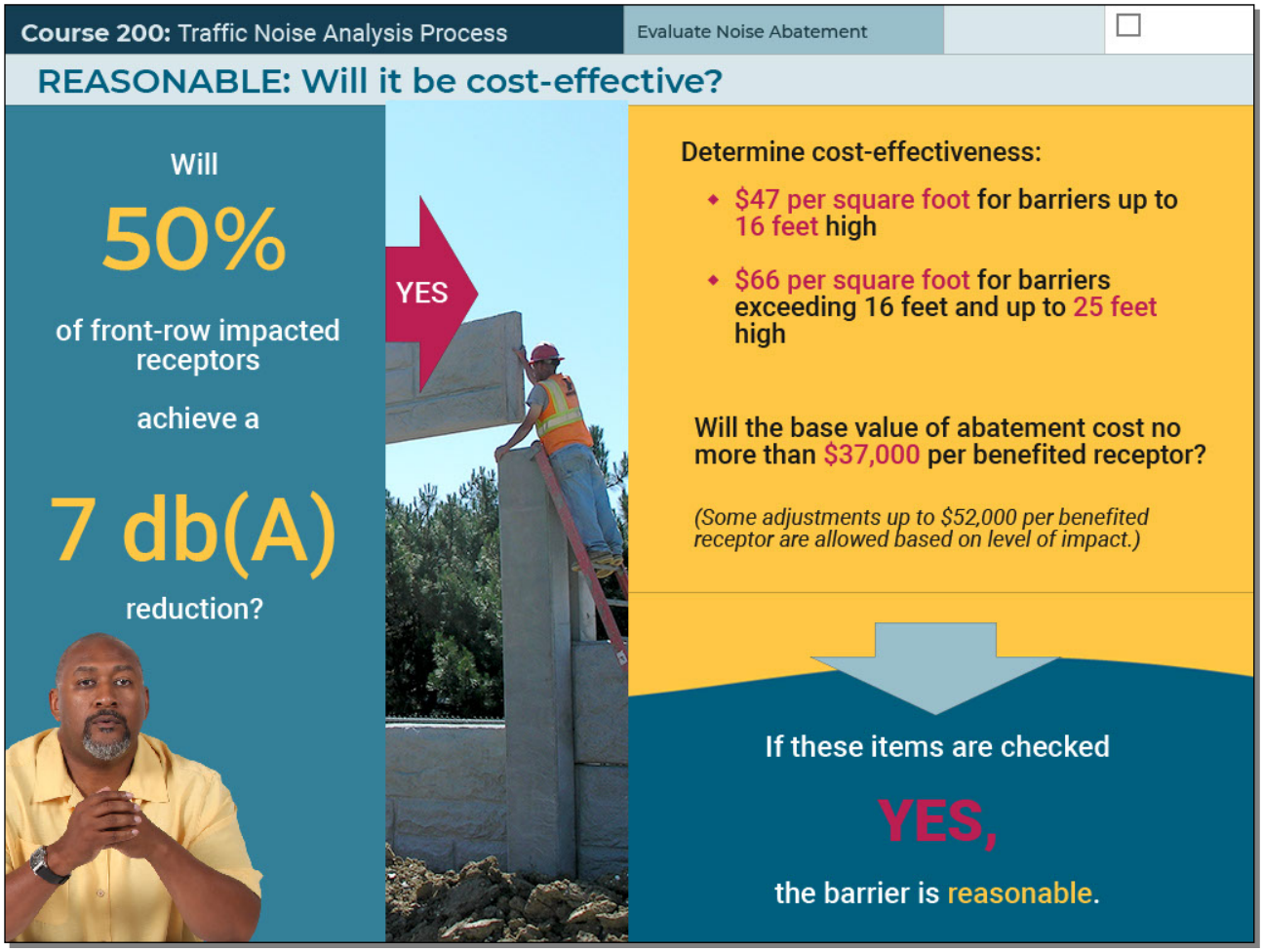
Slide 31 - Slide 31



Audio Script and Notes to Reviewers
You determined that a barrier is not feasible. What is your next step?

Text Captions
Knowledge Check
You determined that a barrier is not feasible. What is your next step?
Correct feedback: Correct - If a noise barrier is not deemed feasible, it will not be constructed. Therefore, there is no need to determine if it is reasonable. Click anywhere or click the Forward button to continue.
1st incorrect feedback: Incorrect. If a noise barrier cannot meet acoustic or engineering requirements, there is no need to evaluate it further for noise reduction or cost-effectiveness. Click anywhere and try again.
2nd incorrect feedback: Incorrect - If a noise barrier is not deemed feasible, it will not be constructed. Therefore, there is no need to determine if it is reasonable. Click anywhere or click the Forward button to continue.

Slide 32 - Slide 32



Audio Script and Notes to Reviewers

If the site is feasible, then consider if it is reasonable. That is, can the barrier meet the noise reduction design goal at a reasonable cost? When considering reasonableness, ask if fifty percent of front-row impacted receptors will achieve a seven D-B-A reduction. If yes, determine if the barrier will be cost-effective. A reasonably-priced barrier is calculated using a unit cost of forty-seven dollars per square foot for barriers up to sixteen feet high. For barriers between seventeen and twenty-five feet high, a reasonably-priced barrier is calculated at sixty-six dollars per square foot. The base value of the abatement must cost no more than thirty-seven thousand dollars per benefited receptor. However, some adjustments up to fifty-two thousand dollars per benefited receptor are allowed based on level of impact. If all of these criteria are met, the barrier is considered reasonable.

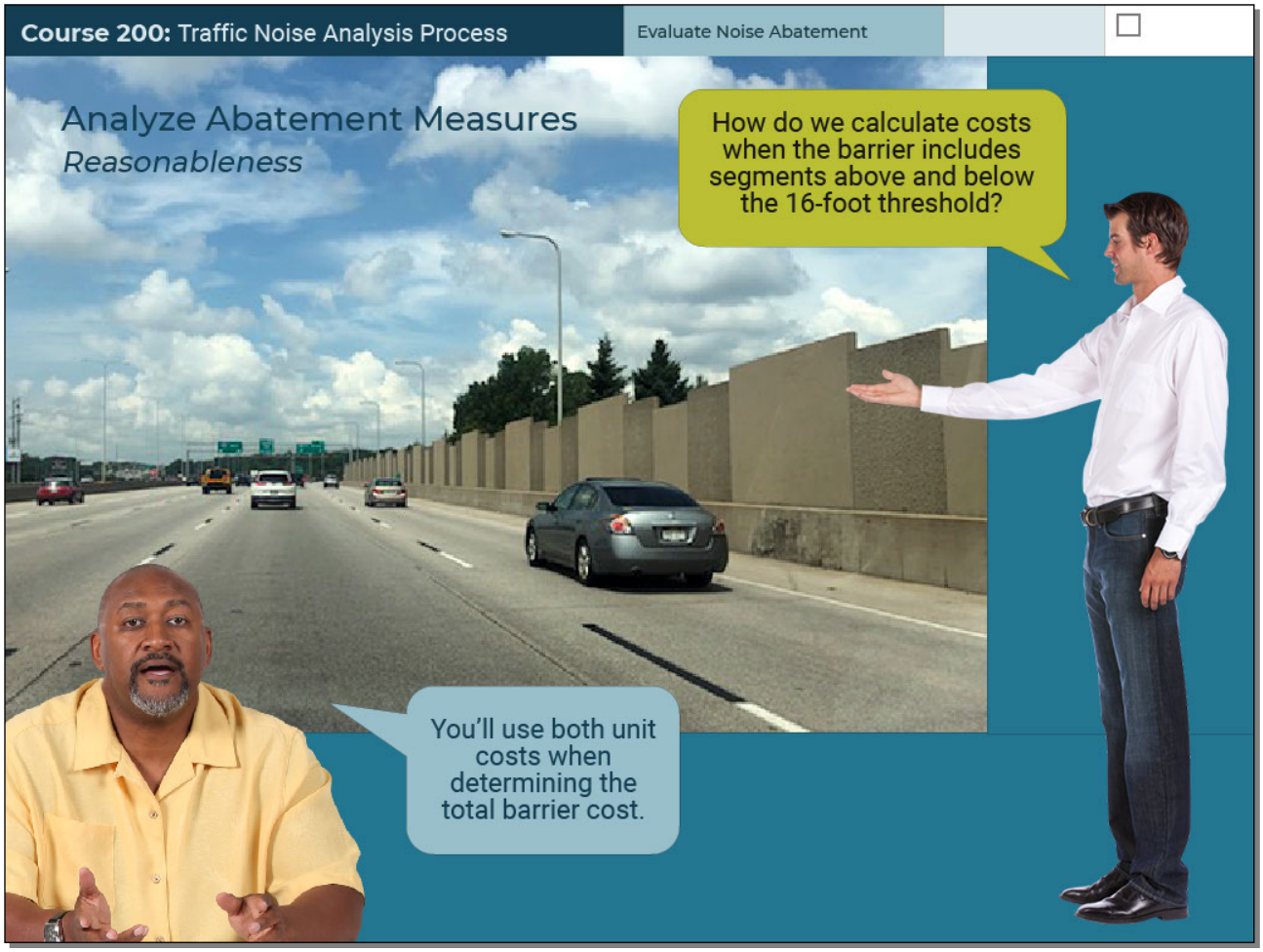
Text Captions

REASONABLE: Will it be cost-effective?
Will 50% of front-row impacted receptors achieve a 7 db(A) reduction?
YES
Determine cost-effectiveness:

- $47 per square foot for barriers up to 16 feet high
- $66 per square foot for barriers exceeding 16 feet and up to 25 feet high

Will the base value of abatement cost no more than $37,000 per benefited receptor?
(Some adjustments up to $52,000 per benefited receptor are allowed based on level of impact.)
If these items are checked YES, the barrier is reasonable.

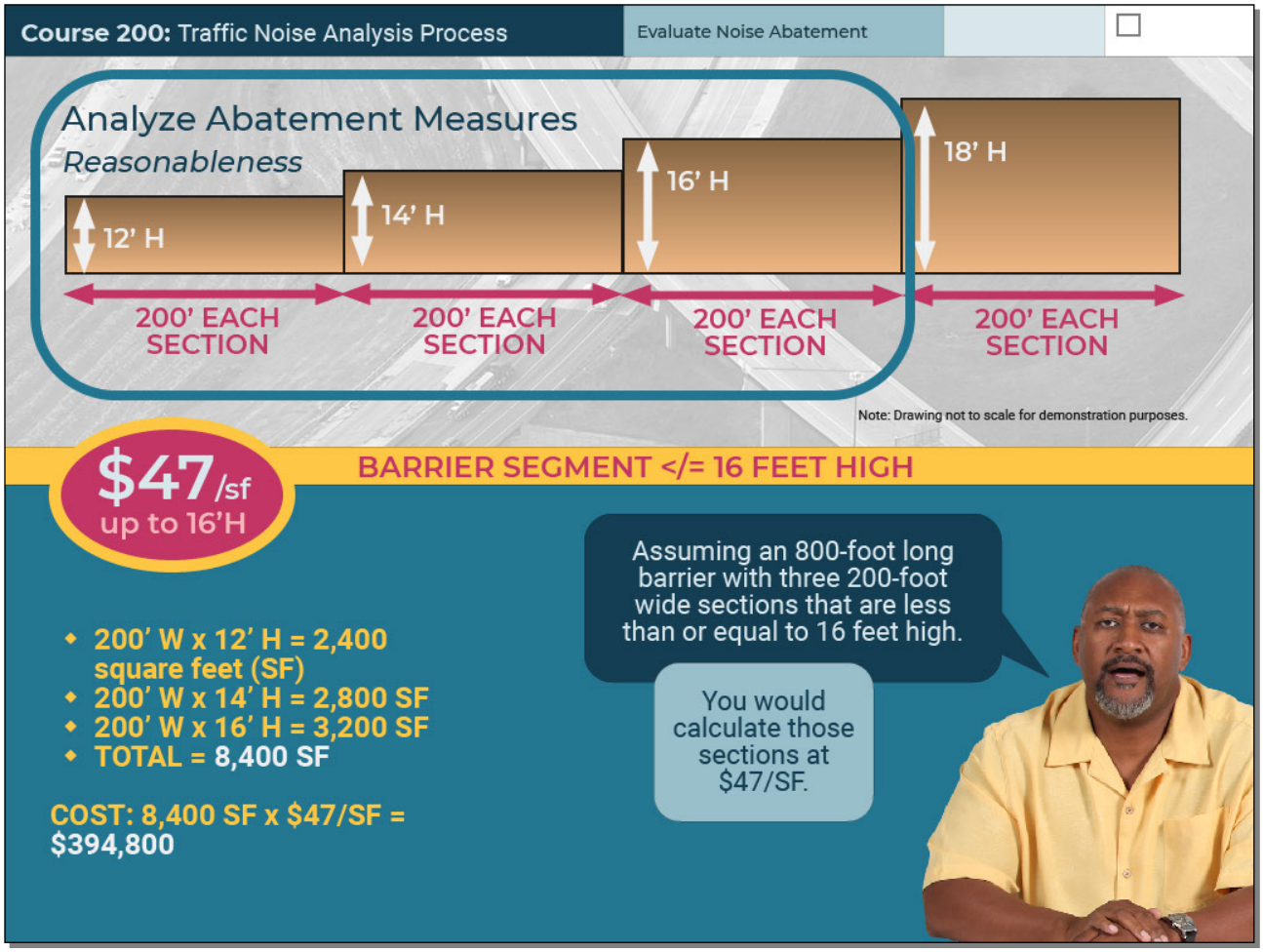
Slide 33 - Slide 33



Audio Script and Notes to Reviewers
How do we calculate costs when the barrier includes segments both above and below the sixteen-foot threshold?
You'll use both unit costs when determining the total barrier cost.

Text Captions
Analyze Abatement Measures
Reasonableness
How do we calculate costs when the barrier includes segments above and below the 16-foot threshold?
You'll use both unit costs when determining the total barrier cost.

Slide 34 - Slide 34



Audio Script and Notes to Reviewers

For example, assuming you have an eight-hundred-foot long barrier with three two-hundred-foot wide sections that are less than or equal to sixteen feet high. You would calculate those sections at forty-seven dollars per square foot.

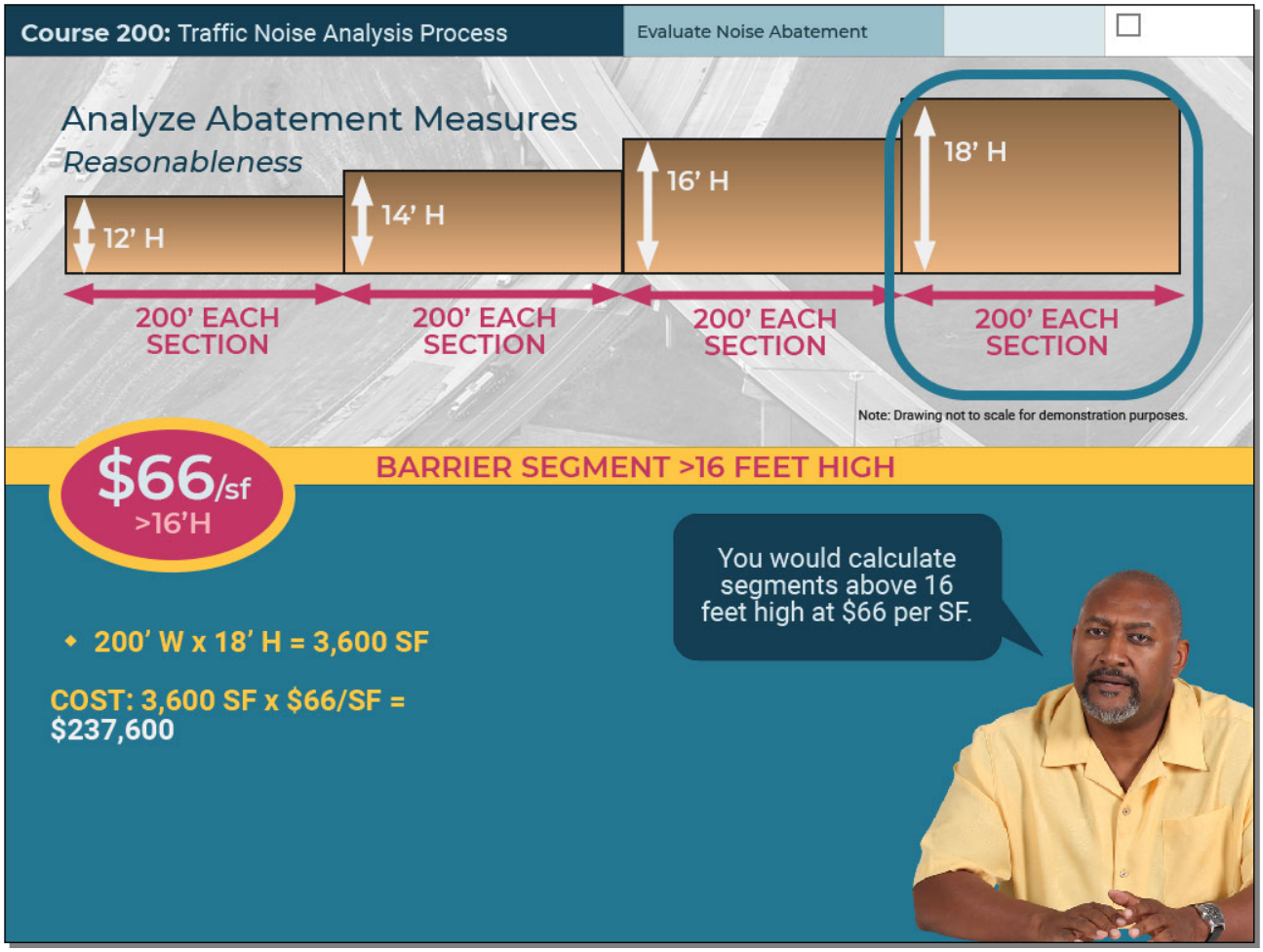
Text Captions

Note: Drawing not to scale for demonstration purposes.
Analyze Abatement Measures
Reasonableness
$47/sf up to 16'H
BARRIER SEGMENT </= 16 FEET HIGH

- 200' W x 12' H = 2,400 square feet (SF)
- 200' W x 14' H = 2,800 SF
- 200' W x 16' H = 3,200 SF
- TOTAL = 8,400 SF

COST: 8,400 SF x $47/SF = $394,800
Assuming an 800-foot long barrier with three 200-foot wide sections that are less than or equal to 16 feet high.
You would calculate those sections at $47/SF.

Slide 35 - Slide 35

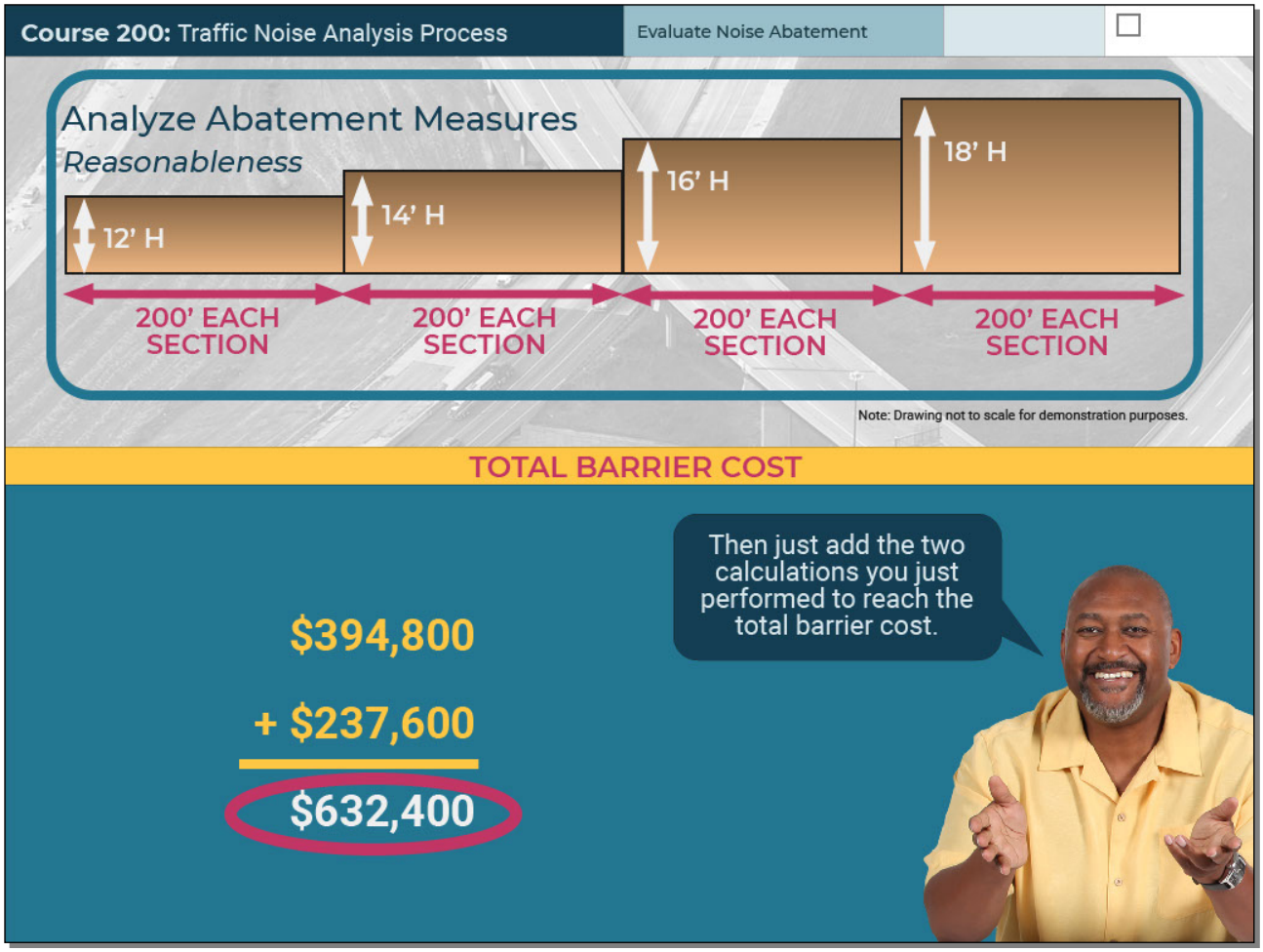


Audio Script and Notes to Reviewers
You would then calculate segments above sixteen feet high at sixty-six dollars per SF.

Text Captions
Note: Drawing not to scale for demonstration purposes.
Analyze Abatement Measures
Reasonableness
$66/sf >16'H
BARRIER SEGMENT >16 FEET HIGH
- 200' W x 18' H = 3,600 SF

COST: 3,600 SF x $66/SF = $237,600
You would calculate segments above 16 feet high at $66 per SF.

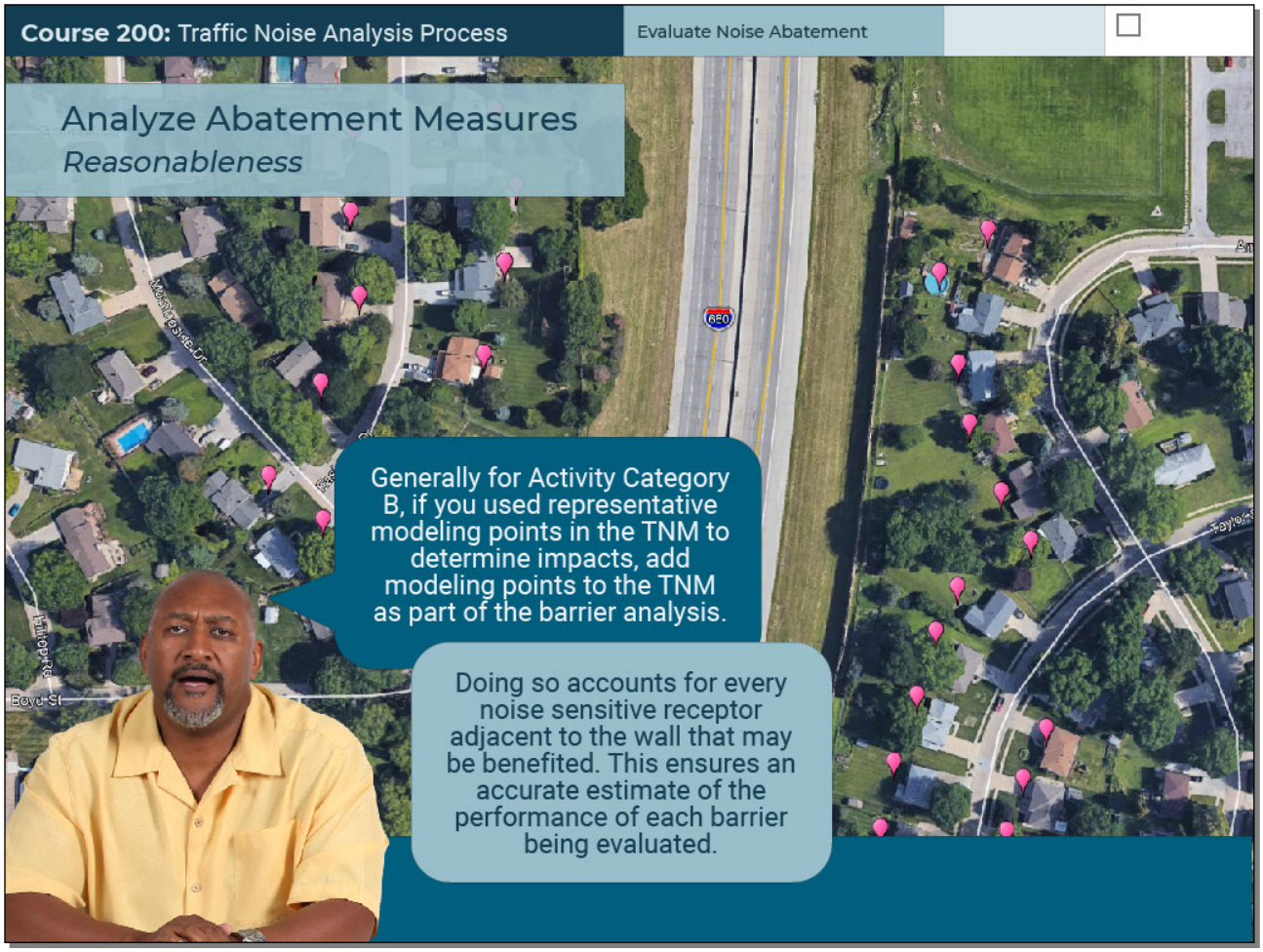
Slide 36 - Slide 36



Audio Script and Notes to Reviewers
Then just add the two calculations you just performed to reach the total barrier cost.

Text Captions
Analyze Abatement Measures
Reasonableness
Note: Drawing not to scale for demonstration purposes.
TOTAL BARRIER COST
$394,800 + $237,600
$632,400
Then just add the two calculations you just performed to reach the total barrier cost.

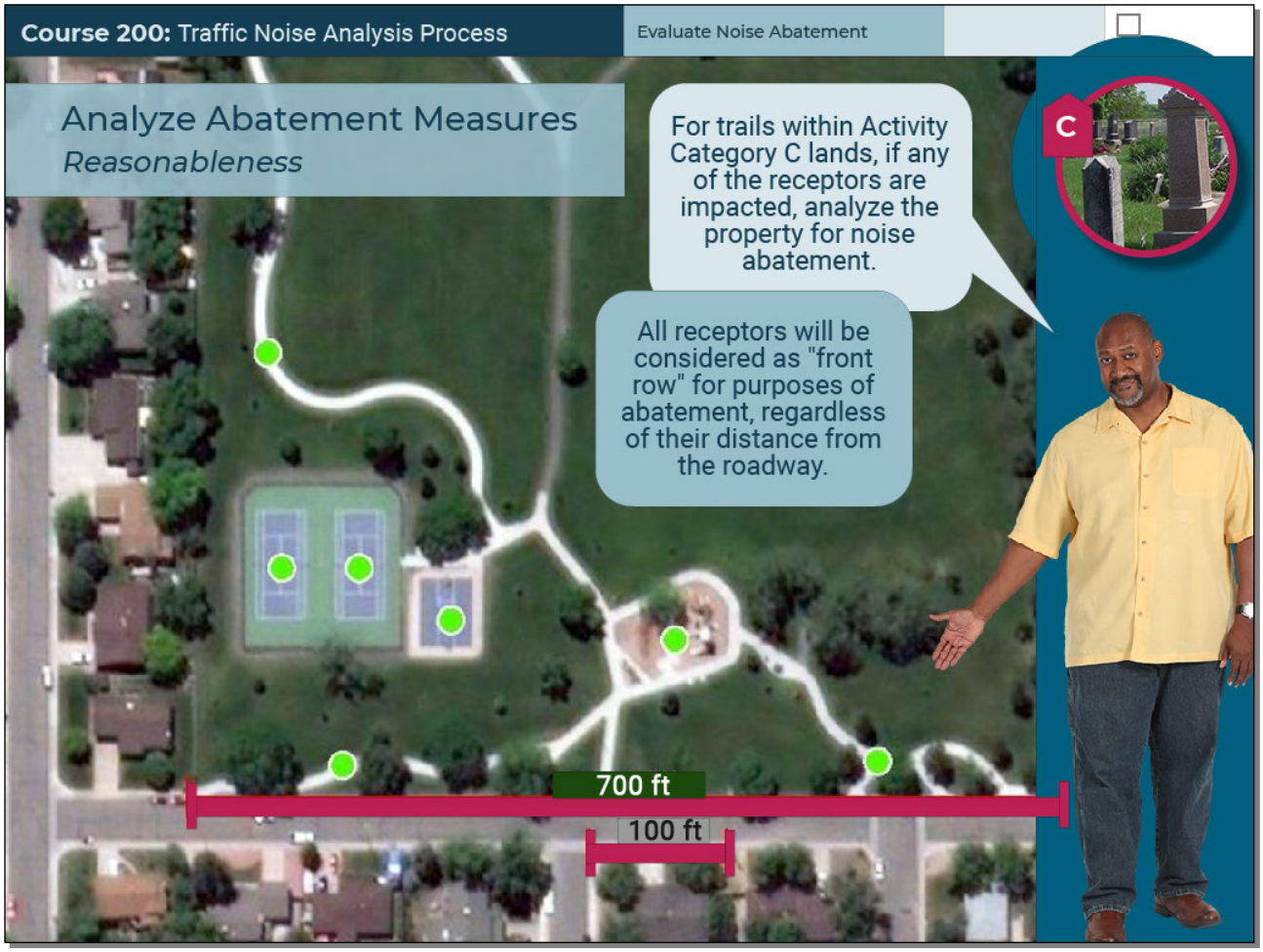
Slide 37 - Slide 37



Audio Script and Notes to Reviewers
Generally for Activity Category B, if you used representative modeling points in the T-N-M to determine impacts, add modeling points to the model as part of the barrier analysis. Doing so accounts for every noise sensitive receptor adjacent to the wall that may be benefited. This ensures an accurate estimate of the performance of each barrier being evaluated.
Reviewer: Should we add the category B icon?

Text Captions
Analyze Abatement Measures
Reasonableness
Generally for Activity Category B, if you used representative modeling points in the TNM to determine impacts, add modeling points to the TNM as part of the barrier analysis.
Doing so accounts for every noise sensitive receptor adjacent to the wall that may be benefited. This ensures an accurate estimate of the performance of each barrier being evaluated.

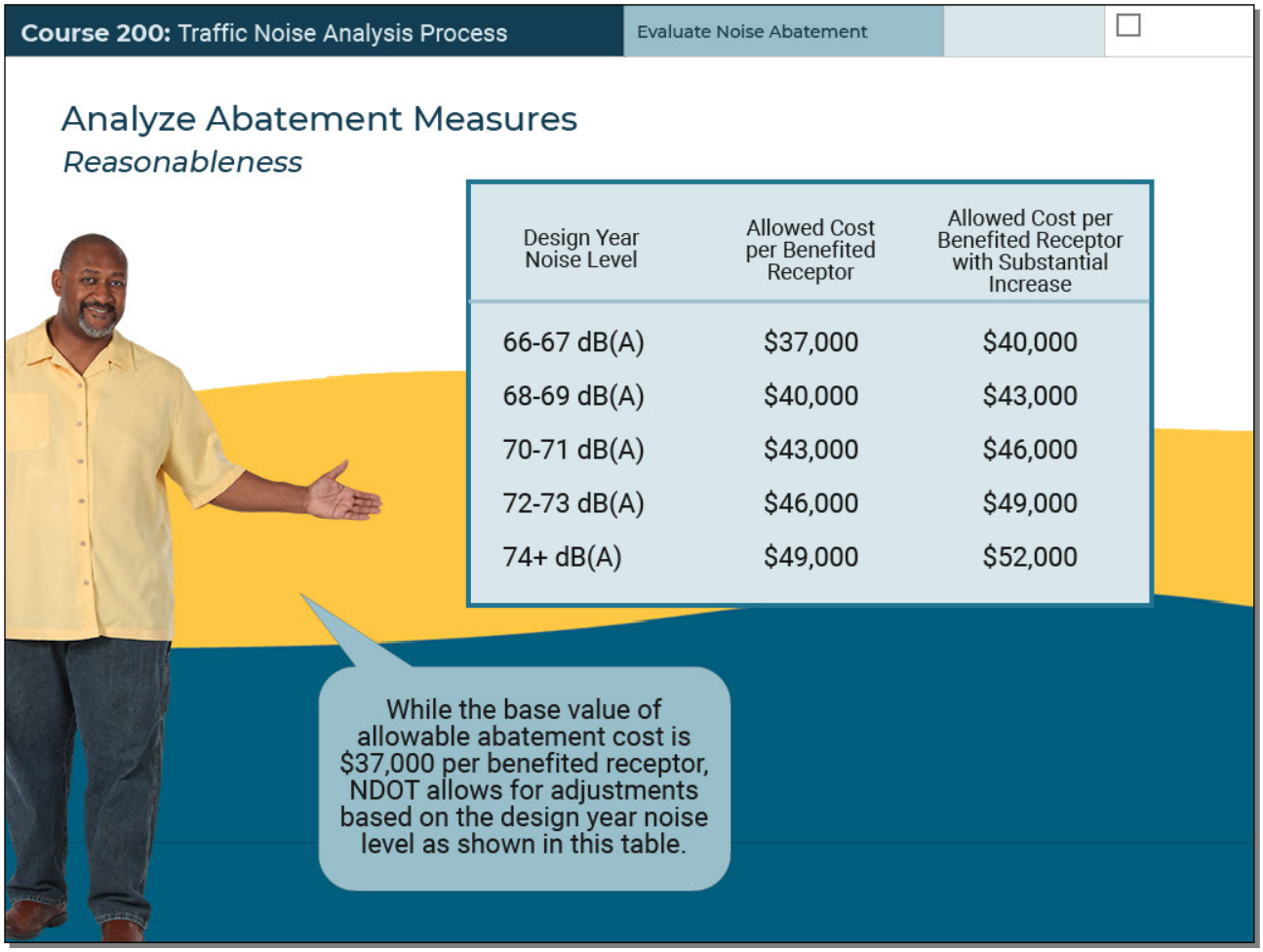
Slide 38 - Slide 38



Audio Script and Notes to Reviewers
For trails within Activity Category C lands, if any of the receptors are impacted, analyze the property for noise abatement. All receptors will be considered as “front row” for purposes of abatement, regardless of their distance from the roadway.

Text Captions
Analyze Abatement Measures
Reasonableness
For trails within Activity Category C lands, if any of the receptors are impacted, analyze the property for noise abatement. All receptors will be considered as "front row" for purposes of abatement, regardless of their distance from the roadway.
700 ft
100 ft

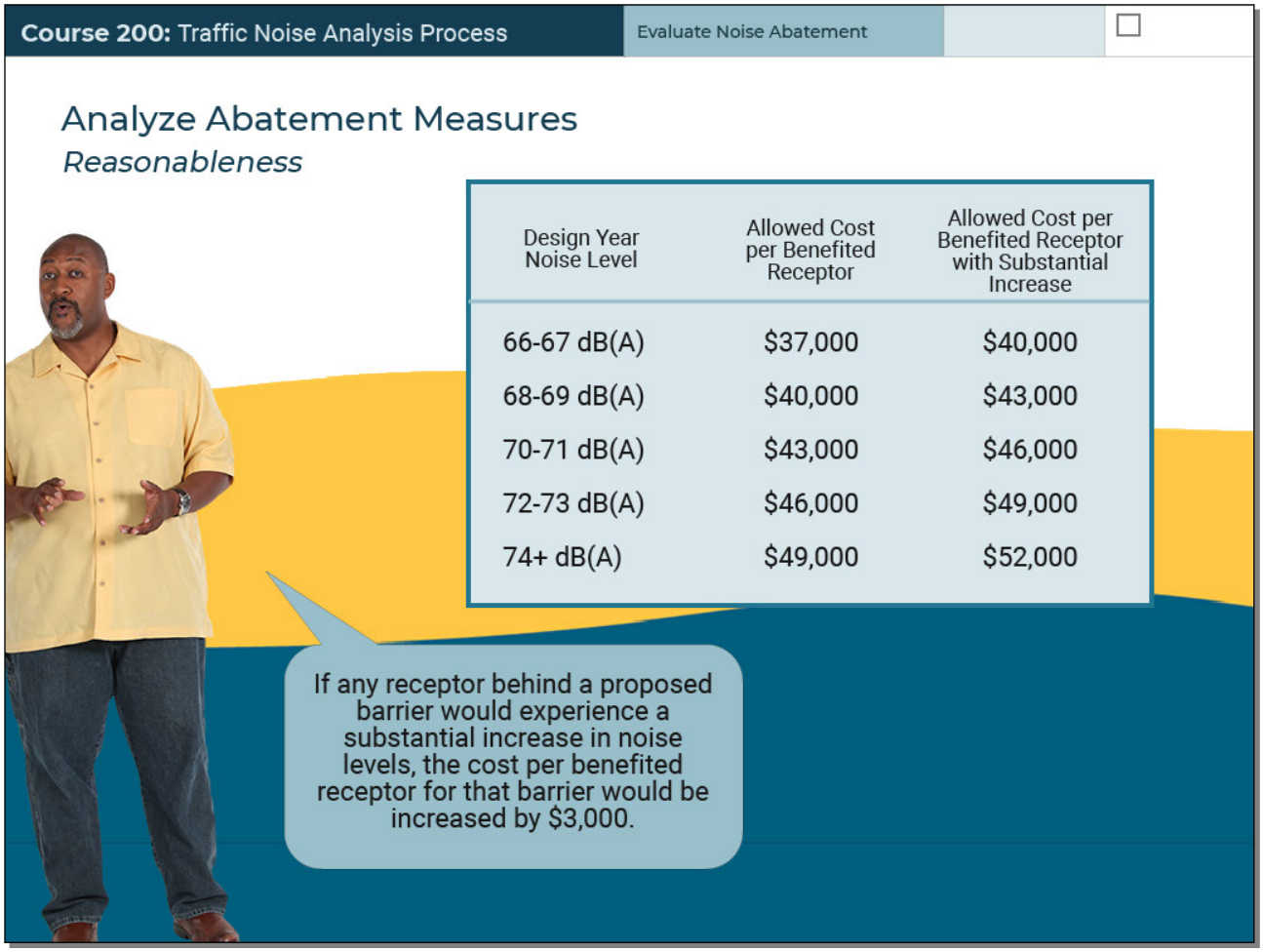
Slide 39 - Slide 39



Audio Script and Notes to Reviewers
While the base value of allowable abatement cost is thirty-seven thousand dollars per benefited receptor, N-dot allows for adjustments based on the design year noise level as shown in this table.

Text Captions
Analyze Abatement Measures
Reasonableness
While the base value of allowable abatement cost is $37,000 per benefited receptor, NDOT allows for adjustments based on the design year noise level as shown in this table.

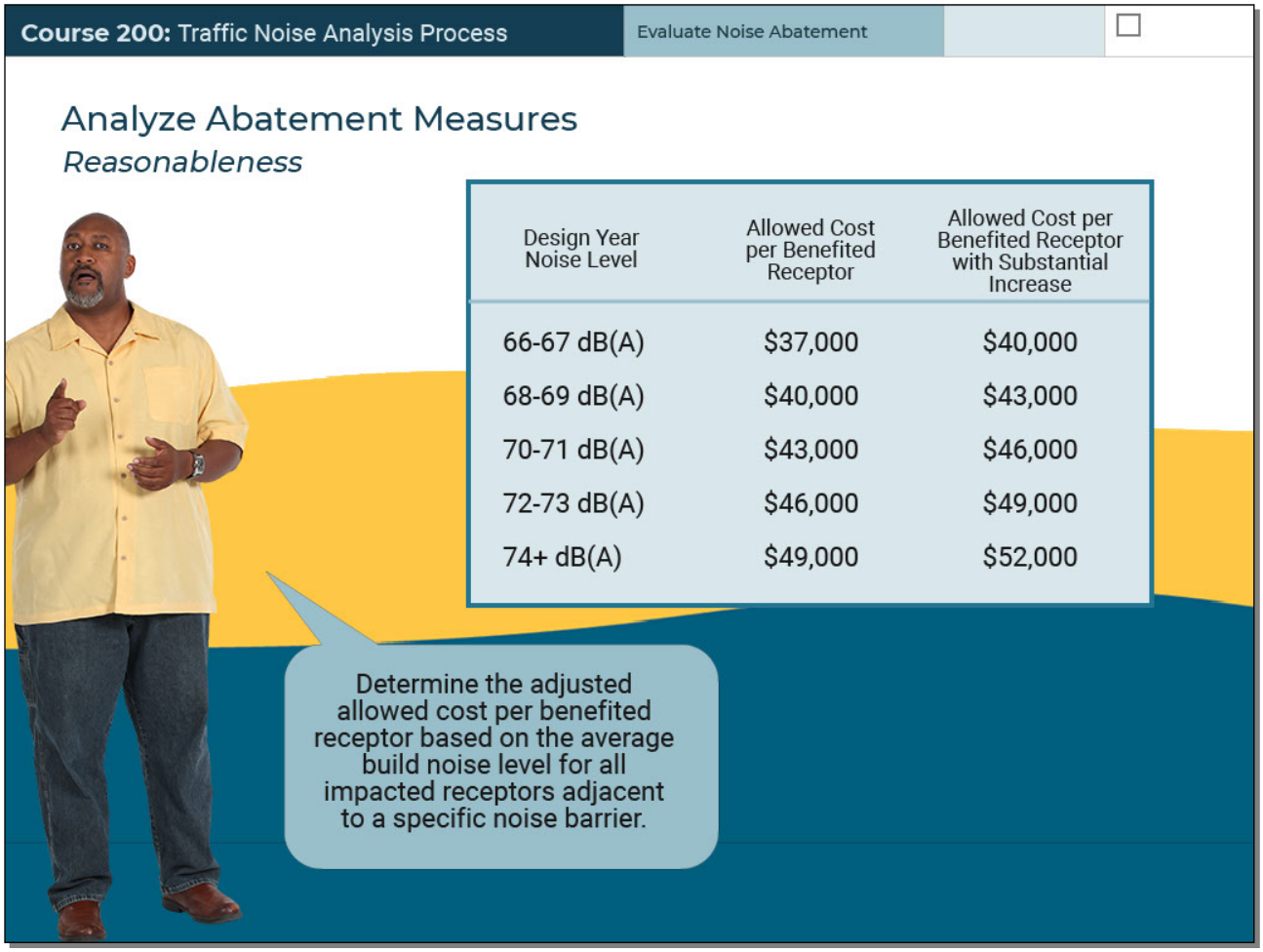
Slide 40 - Slide 40



Audio Script and Notes to Reviewers
If any receptor behind a proposed barrier would experience a substantial increase in noise levels, the cost per benefited receptor for that barrier would be increased by three thousand dollars.

Text Captions
Analyze Abatement Measures
Reasonableness
If any receptor behind a proposed barrier would experience a substantial increase in noise levels, the cost per benefited receptor for that barrier would be increased by $3,000.

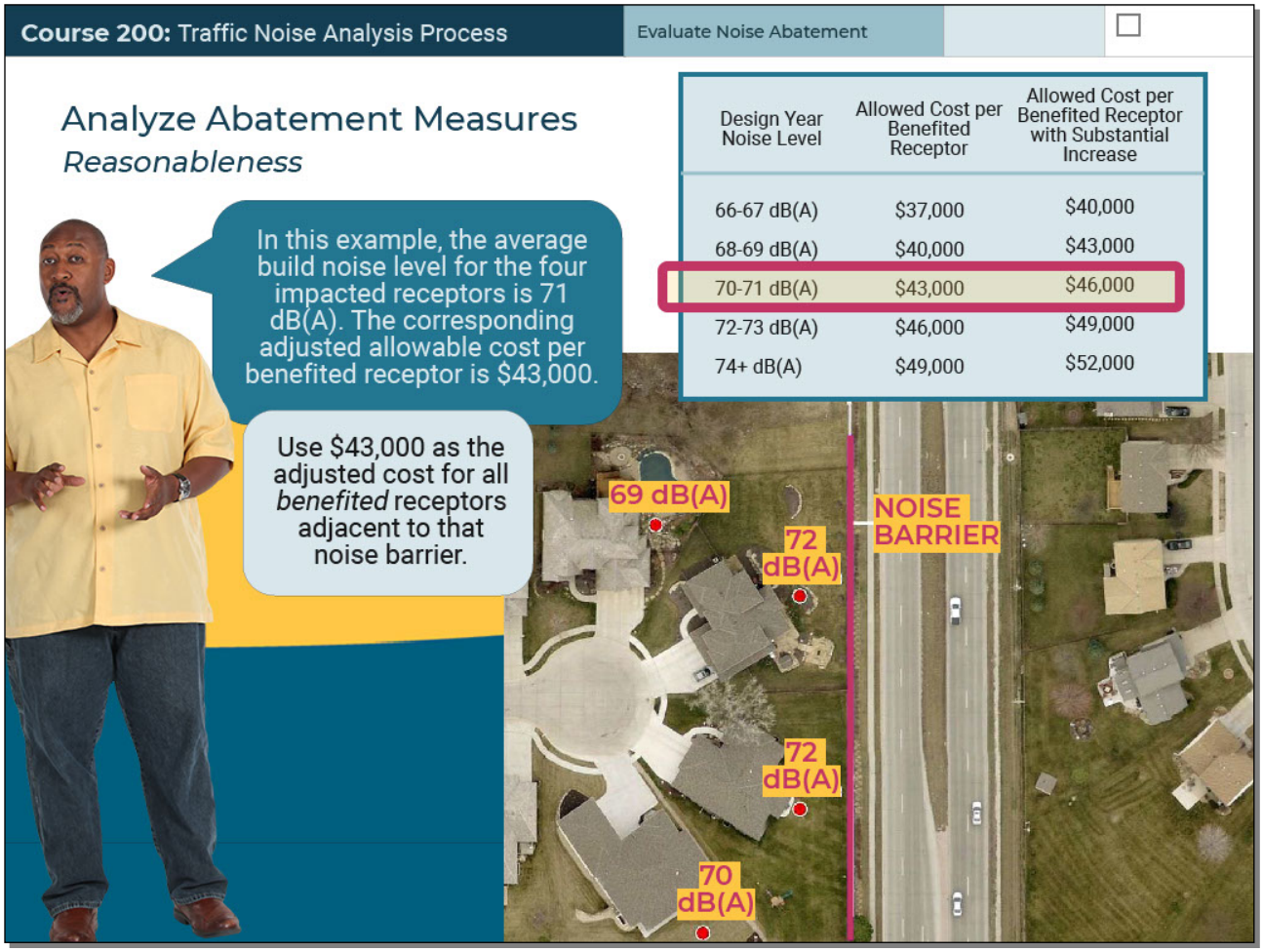
Slide 41 - Slide 41



Audio Script and Notes to Reviewers
Determine the adjusted allowed cost per benefited receptor based on the average build noise level for all impacted receptors adjacent to a specific noise barrier.

Text Captions
Analyze Abatement Measures
Reasonableness
Determine the adjusted allowed cost per benefited receptor based on the average build noise level for all impacted receptors adjacent to a specific noise barrier.

Slide 42 - Slide 42



Audio Script and Notes to Reviewers

In this example, the average build noise level for the four impacted receptors is seventy-one D-B-A. The corresponding adjusted allowable cost per benefited receptor is forty-three thousand dollars. Use forty-three thousand dollars as the adjusted cost for all benefited receptors adjacent to that noise barrier.

Text Captions

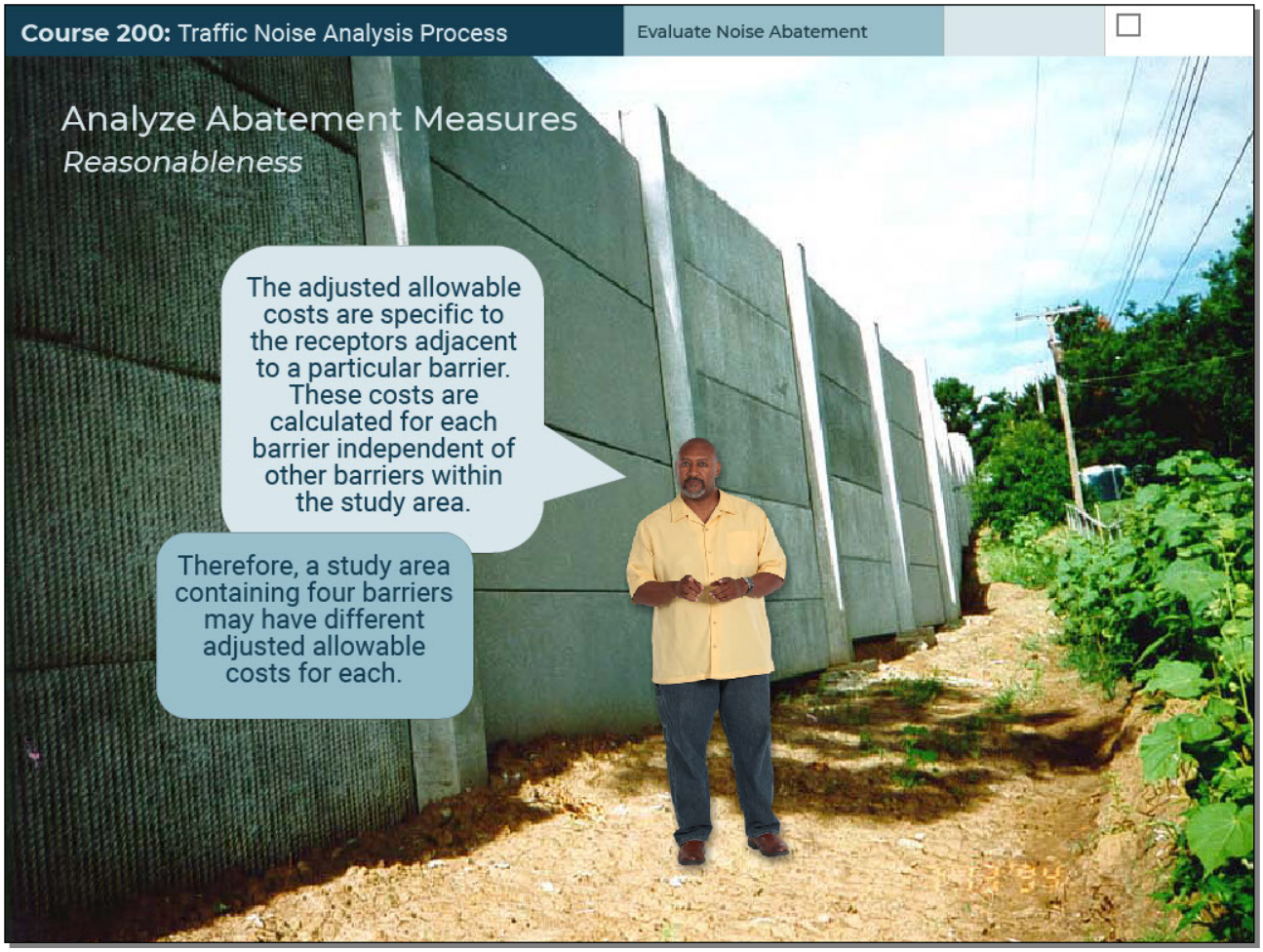
Analyze Abatement Measures

Reasonableness

In this example, the average build noise level for the four impacted receptors is 71 dB(A). The corresponding adjusted allowable cost per benefited receptor is $43,000.

Use $43,000 as the adjusted cost for all *benefited* receptors adjacent to that noise barrier.

Slide 43 - Slide 43



Audio Script and Notes to Reviewers

The adjusted allowable costs are specific to the receptors adjacent to a particular barrier. These costs are calculated for each barrier independent of other barriers within the study area. Therefore, a study area containing four barriers may have different adjusted allowable costs for each.

Text Captions

Analyze Abatement Measures

Reasonableness

The adjusted allowable costs are specific to the receptors adjacent to a particular barrier. These costs are calculated for each barrier independent of other barriers within the study area.

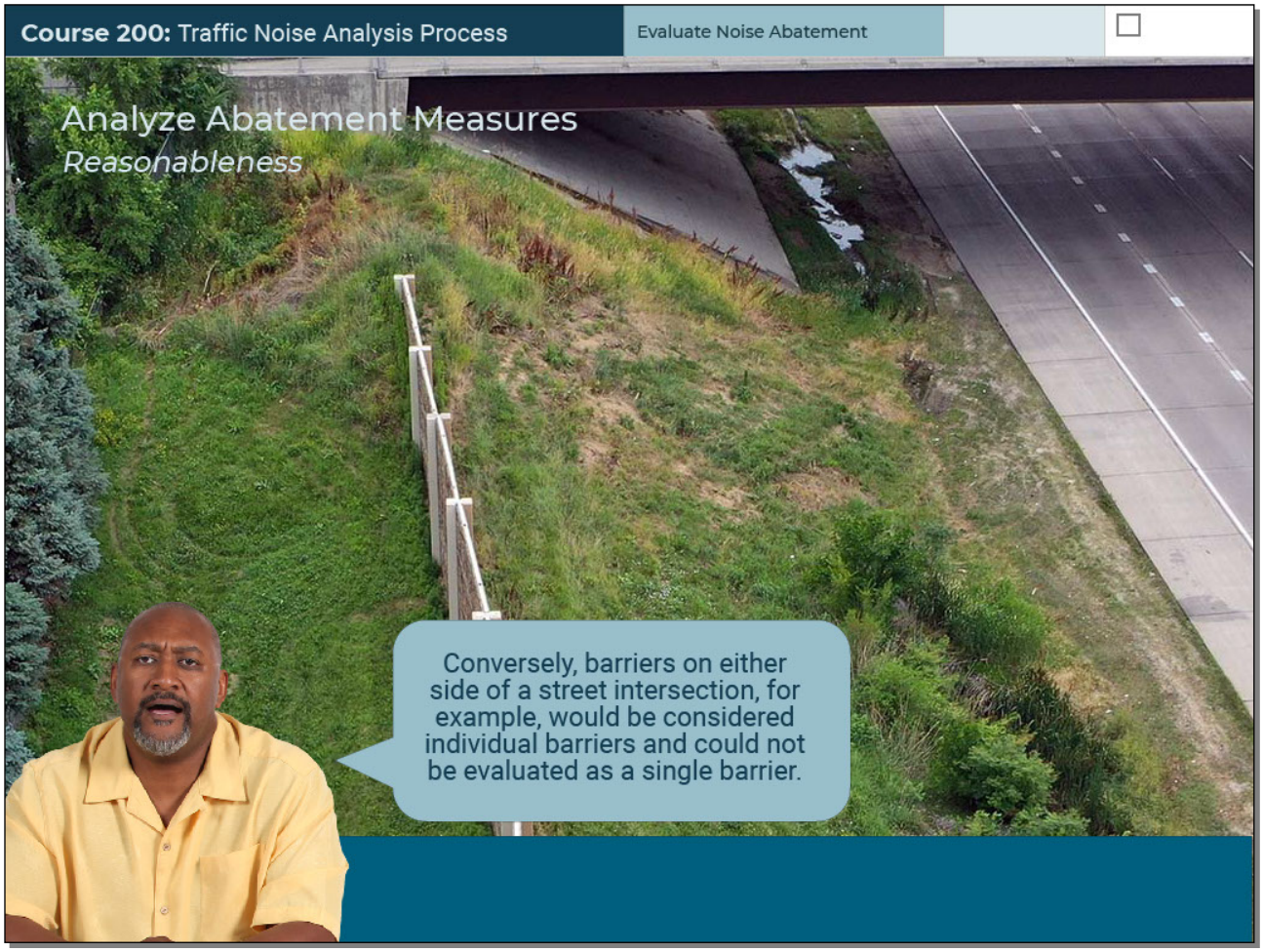
Therefore, a study area containing four barriers may have different adjusted allowable costs for each.

Slide 44 - Slide 44

Audio Script and Notes to Reviewers
Breaks or gaps in a barrier may be required for drainage or access to a residence, etcetera. This would not result in each segment of the barrier being evaluated individually.

Text Captions
Analyze Abatement Measures
Reasonableness
Breaks or gaps in a barrier may be required for drainage or access to a residence, etc.
This would not result in each segment of the barrier being evaluated individually.

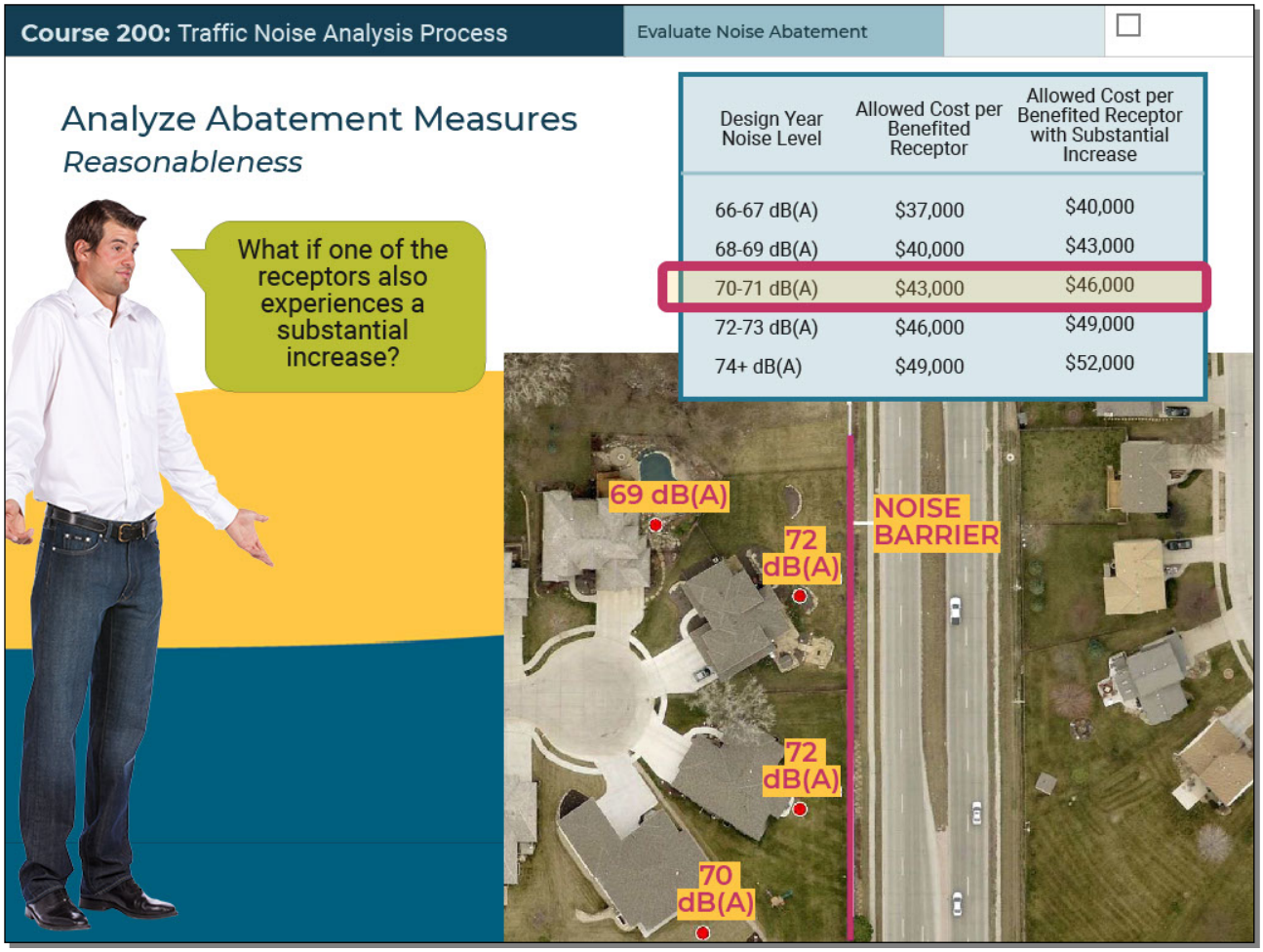
Slide 45 - Slide 45



Audio Script and Notes to Reviewers
Conversely, barriers on either side of a street intersection, for example, would be considered individual barriers and could not be evaluated as a single barrier.

Text Captions
Analyze Abatement Measures
Reasonableness
Conversely, barriers on either side of a street intersection, for example, would be considered individual barriers and could not be evaluated as a single barrier.

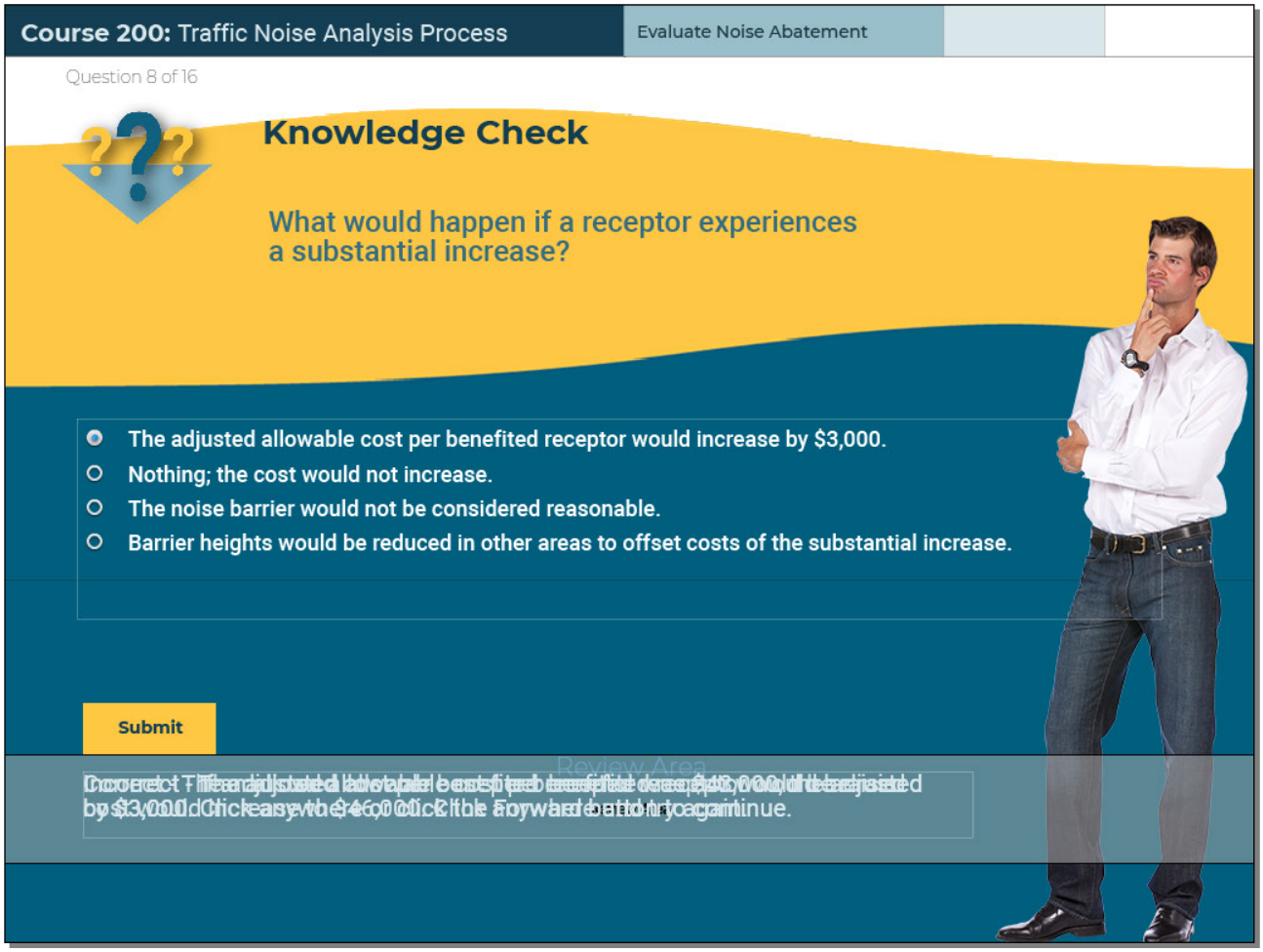
Slide 46 - Slide 46



Audio Script and Notes to Reviewers
What if one of the receptors also experiences a substantial increase?

Text Captions
Analyze Abatement Measures
Reasonableness
What if one of the receptors also experiences a substantial increase?

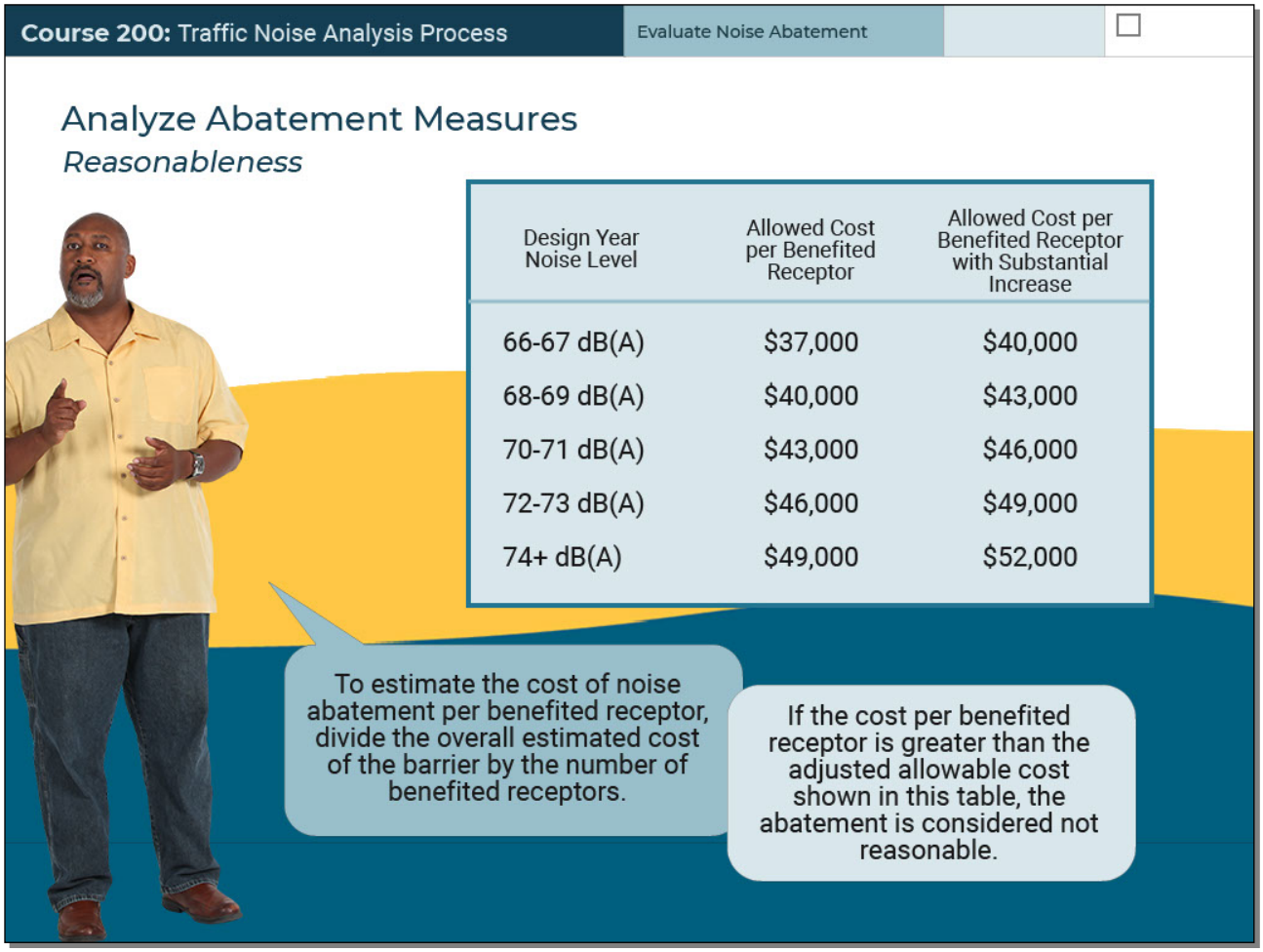
Slide 47 - Slide 47



Audio Script and Notes to Reviewers
What would happen if a receptor experiences a substantial increase?

Text Captions
Knowledge Check
What would happen if a receptor experiences a substantial increase?
Correct feedback: Correct - The adjusted allowable cost per benefited receptor would be raised by $3,000. Click anywhere or click the Forward button to continue.
1st incorrect feedback: Incorrect - If an allowed cost per benefited receptor was $43,000, the adjusted cost would increase to $46,000. Click anywhere and try again.
2nd incorrect feedback: Incorrect - The adjusted allowable cost per benefited receptor would be raised by $3,000. Click anywhere or click the Forward button to continue.

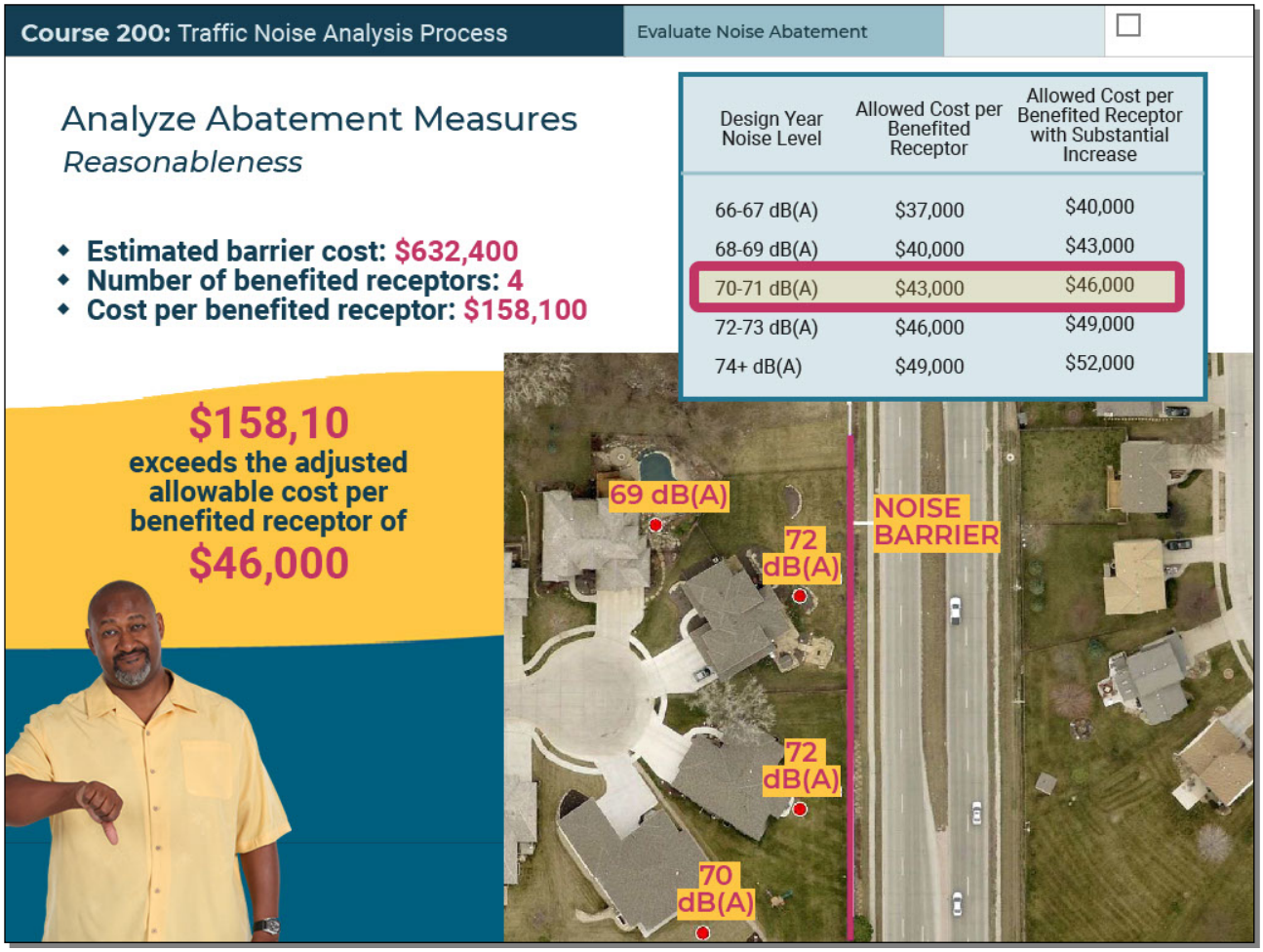
Slide 48 - Slide 48



Audio Script and Notes to Reviewers
To estimate the cost of noise abatement per benefited receptor, divide the overall estimated cost of the barrier by the number of benefited receptors. If the cost per benefited receptor is greater than the adjusted allowable cost shown in this table, the abatement is considered not reasonable.

Text Captions
Analyze Abatement Measures
Reasonableness
To estimate the cost of noise abatement per benefited receptor, divide the overall estimated cost of the barrier by the number of benefited receptors.
If the cost per benefited receptor is greater than the adjusted allowable cost shown in this table, the abatement is considered not reasonable.

Slide 49 - Slide 49



Audio Script and Notes to Reviewers

Let's continue our previous example. Dividing the estimated barrier cost of six-hundred, thirty-two thousand, four hundred dollars by four receptors, equals one-hundred fifty-eight thousand, one hundred dollars as the cost per benefited receptor. That number exceeds the forty-six thousand dollars allowed per benefited receptor. Therefore, the barrier would not be considered reasonable and not recommended for further evaluation.

Text Captions

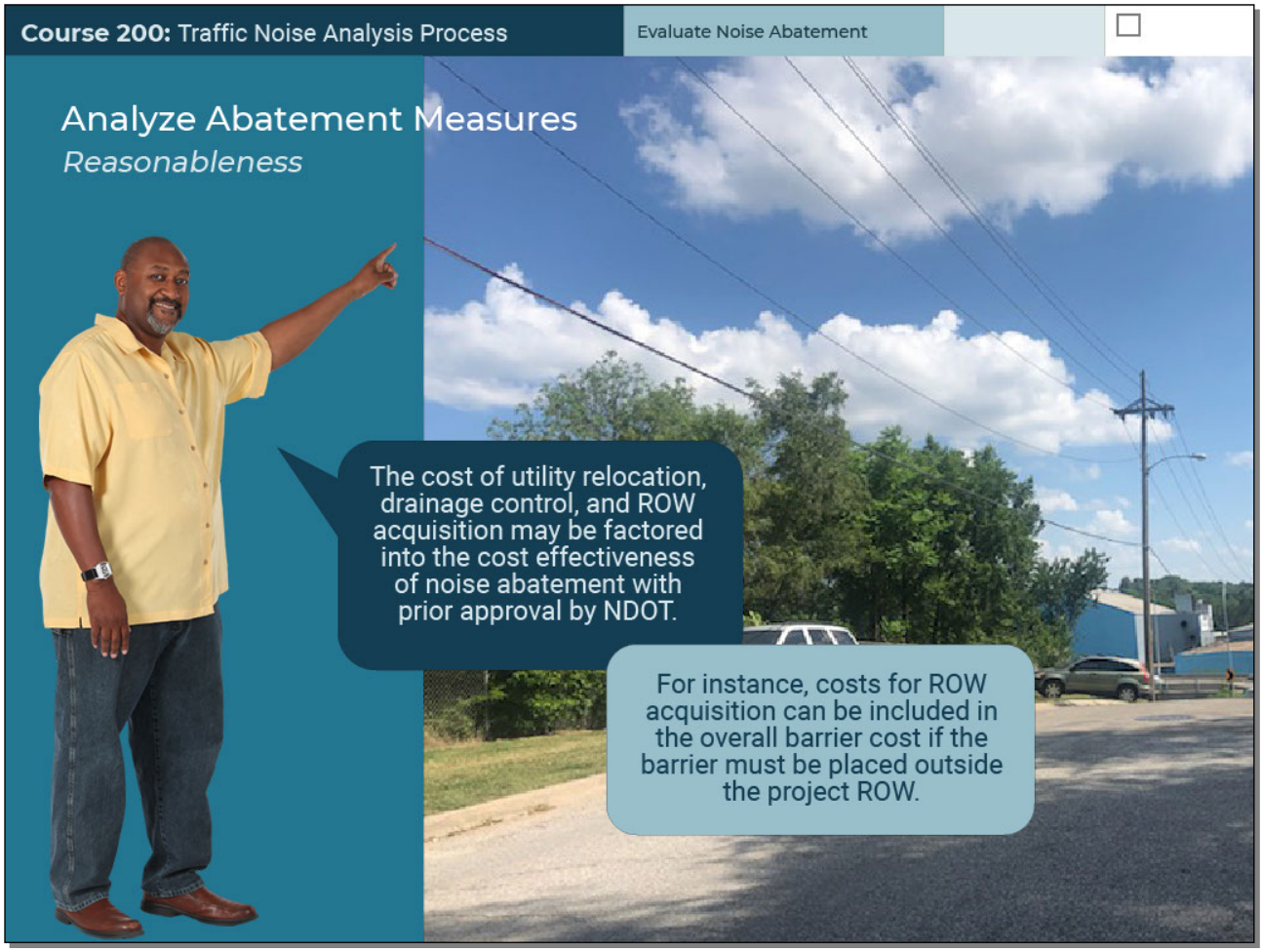
Analyze Abatement Measures

Reasonableness

- Estimated barrier cost: $632,400
- Number of benefited receptors: 4
- Cost per benefited receptor: $158,100

$158,100 exceeds the adjusted allowable cost per benefited receptor of $46,000

Slide 50 - Slide 50



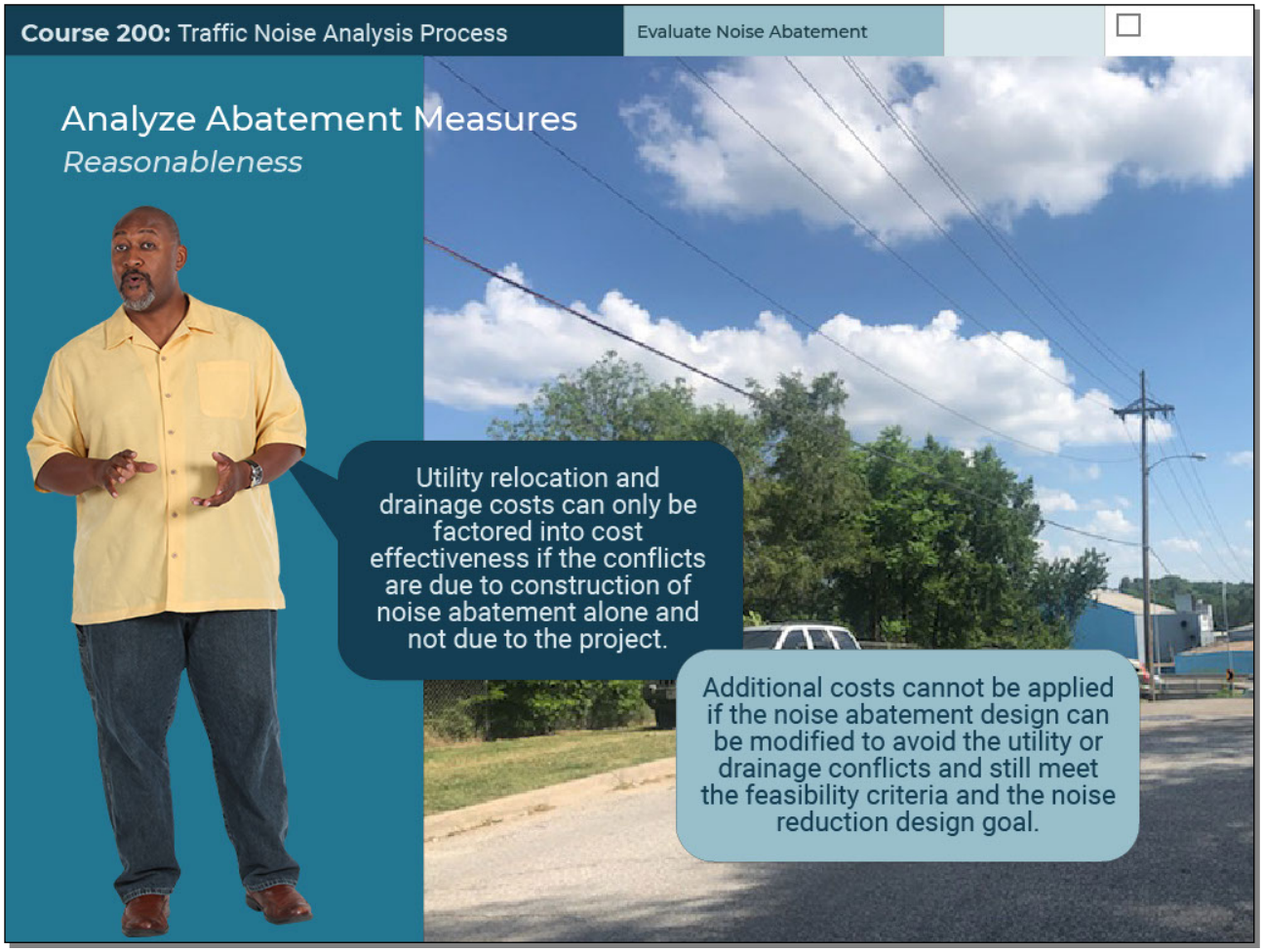
Audio Script and Notes to Reviewers

The cost of utility relocation, drainage control, and right-of-way acquisition may be factored into the cost effectiveness of noise abatement with prior approval by N-dot. For instance, costs for right-of-way acquisition can be included in the overall barrier cost if the barrier must be placed outside the project right-of-way.

Text Captions

Analyze Abatement Measures
Reasonableness
The cost of utility relocation, drainage control, and ROW acquisition may be factored into the cost effectiveness of noise abatement with prior approval by NDOT.
For instance, costs for ROW acquisition can be included in the overall barrier cost if the barrier must be placed outside the project ROW.

Slide 51 - Slide 51



Audio Script and Notes to Reviewers

In addition, utility relocation and drainage costs can only be factored into cost effectiveness if the conflicts are due to construction of noise abatement alone and not due to the project. Additional costs cannot be applied if the noise abatement design can be modified to avoid the utility or drainage conflicts, and still meet the feasibility criteria and the noise reduction design goal.

Text Captions

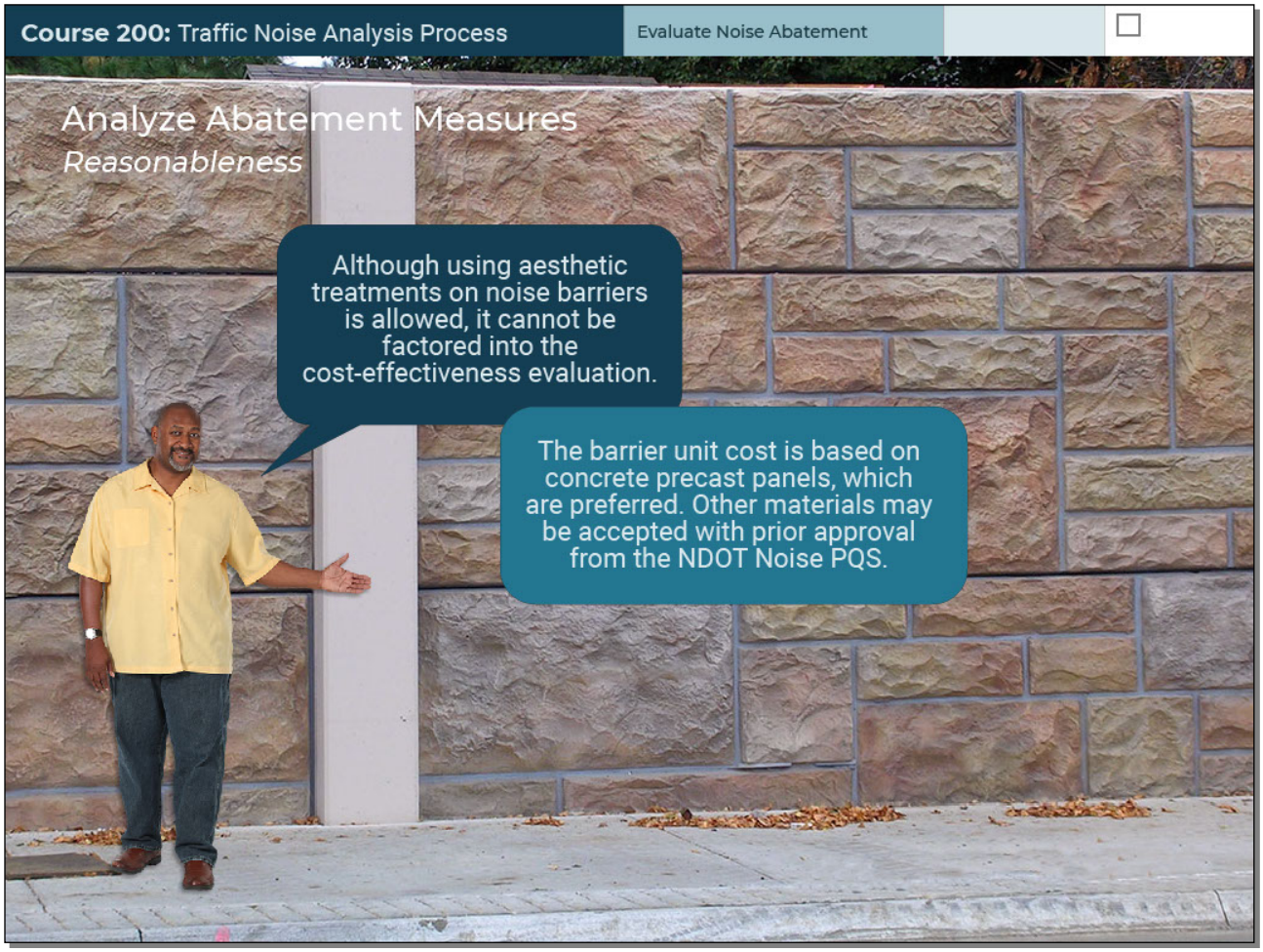
Analyze Abatement Measures

Reasonableness

Utility relocation and drainage costs can only be factored into cost effectiveness if the conflicts are due to construction of noise abatement alone and not due to the project.

Additional costs cannot be applied if the noise abatement design can be modified to avoid the utility or drainage conflicts and still meet the feasibility criteria and the noise reduction design goal.

Slide 52 - Slide 52



Audio Script and Notes to Reviewers

Although using aesthetic treatments on noise barriers is allowed, it cannot be factored into the cost-effectiveness evaluation. The barrier unit cost is based on concrete precast panels, which are preferred. Other materials may be accepted with prior approval from the N-dot Noise P-Q-S.

Reviewer: Does the size of the character look right? I assumed the barrier would be at least 12 feet high, and assume the is just under 6 feet tall. He might still be too big, but making him smaller looked weird.

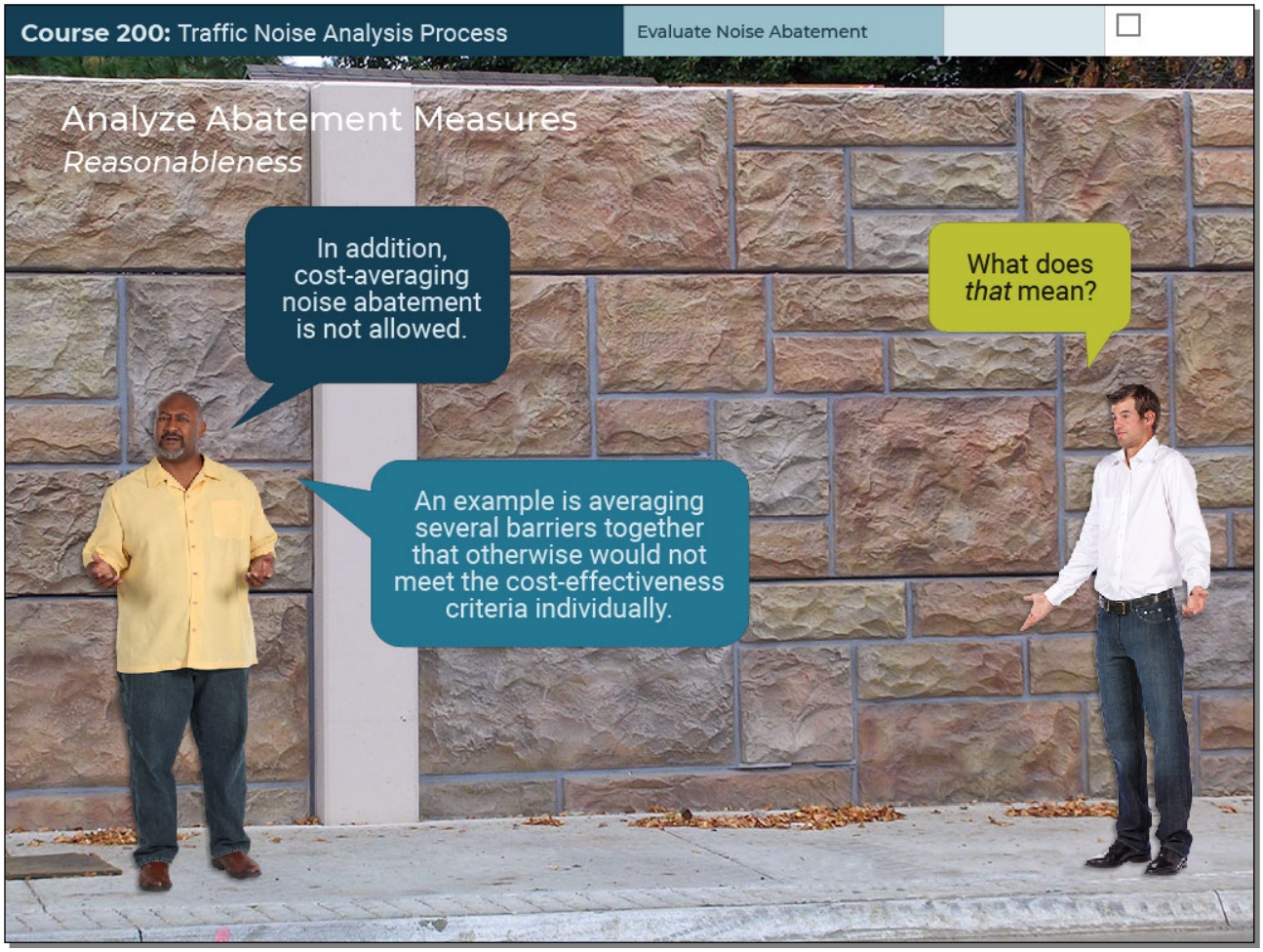
Text Captions

Analyze Abatement Measures

Reasonableness

Although using aesthetic treatments on noise barriers is allowed, it cannot be factored into the cost-effectiveness evaluation. The barrier unit cost is based on concrete precast panels, which are preferred. Other materials may be accepted with prior approval from the NDOT Noise PQS.

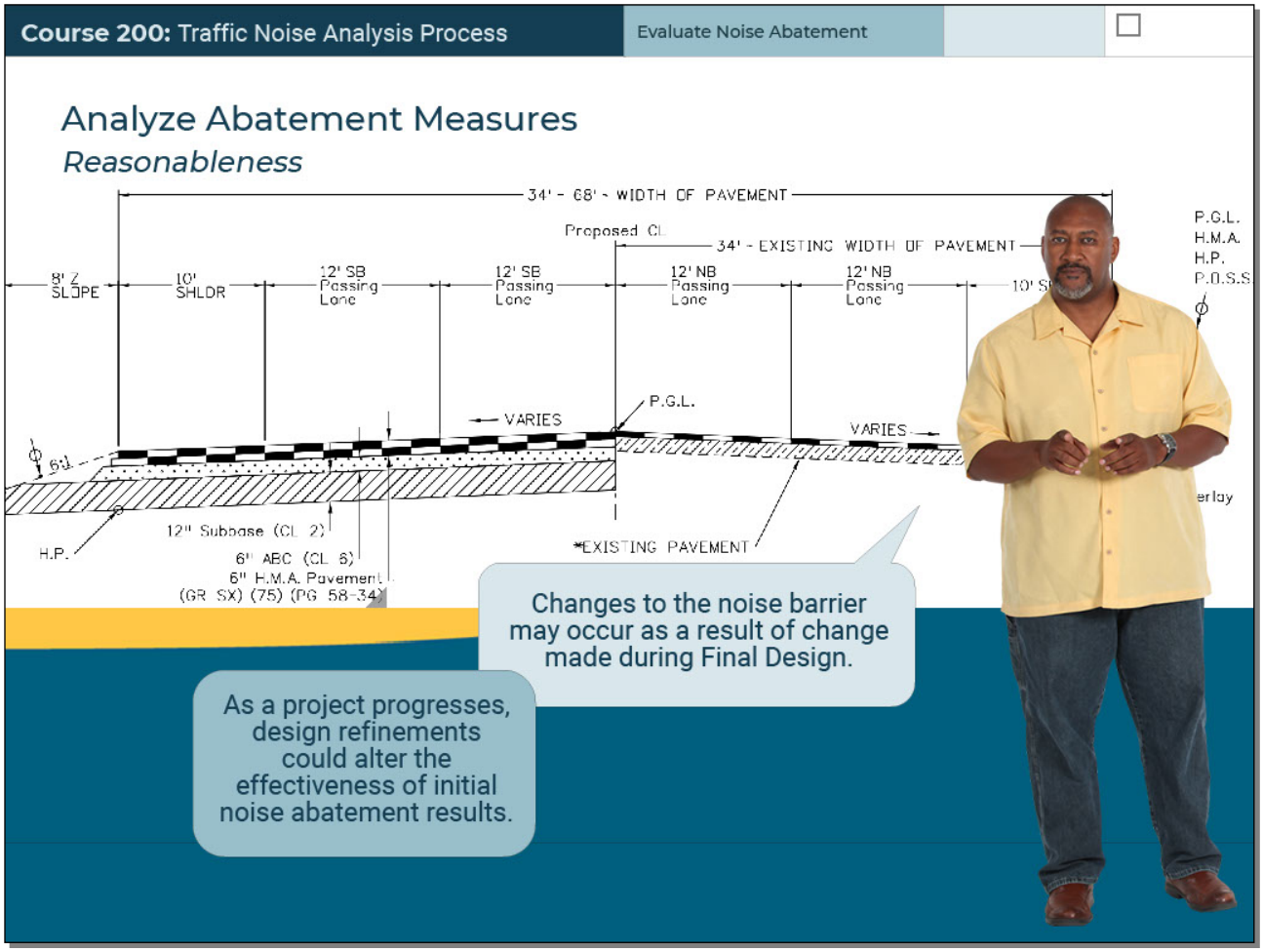
Slide 53 - Slide 53



Audio Script and Notes to Reviewers
In addition, cost-averaging noise abatement is not allowed.
What does *that* mean?
An example is averaging several barriers together that otherwise would not meet the cost-effectiveness criteria individually.
Reviewer: Does the size of the characters look right? I assumed the barrier would be at least 12 feet high, and assume that these guys are just under 6 feet tall. The might still be too big, but making them smaller looked weird.

Text Captions
Analyze Abatement Measures
Reasonableness
In addition, cost-averaging noise abatement is not allowed.
What does *that* mean?
An example is averaging several barriers together that otherwise would not meet the cost-effectiveness criteria individually.

Slide 54 - Slide 54



Audio Script and Notes to Reviewers

Changes to the noise barrier may occur as a result of change made during Final Design. As a project progresses, design refinements to roadway alignments, retaining walls, slope and fill limits, etcetera, could alter the effectiveness of initial noise abatement results.

Text Captions

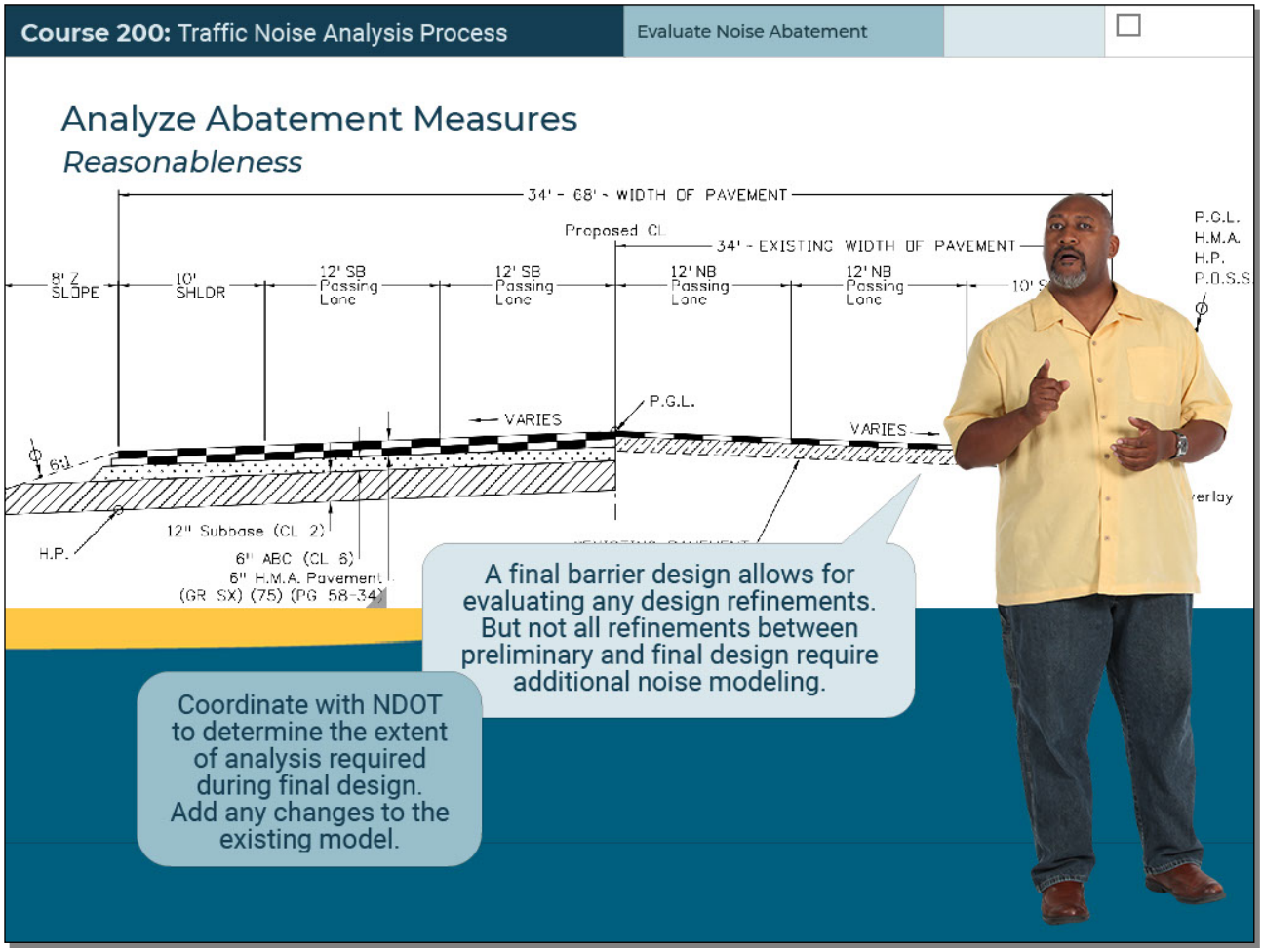
Analyze Abatement Measures

Reasonableness

Changes to the noise barrier may occur as a result of change made during Final Design.

As a project progresses, design refinements could alter the effectiveness of initial noise abatement results.

Slide 55 - Slide 55



Audio Script and Notes to Reviewers

A final barrier design allows for evaluating any design refinements. But not all refinements between preliminary and final design require additional noise modeling. Coordinate with NDOT to determine the extent of analysis required during final design. Add any changes to the existing model.

Text Captions

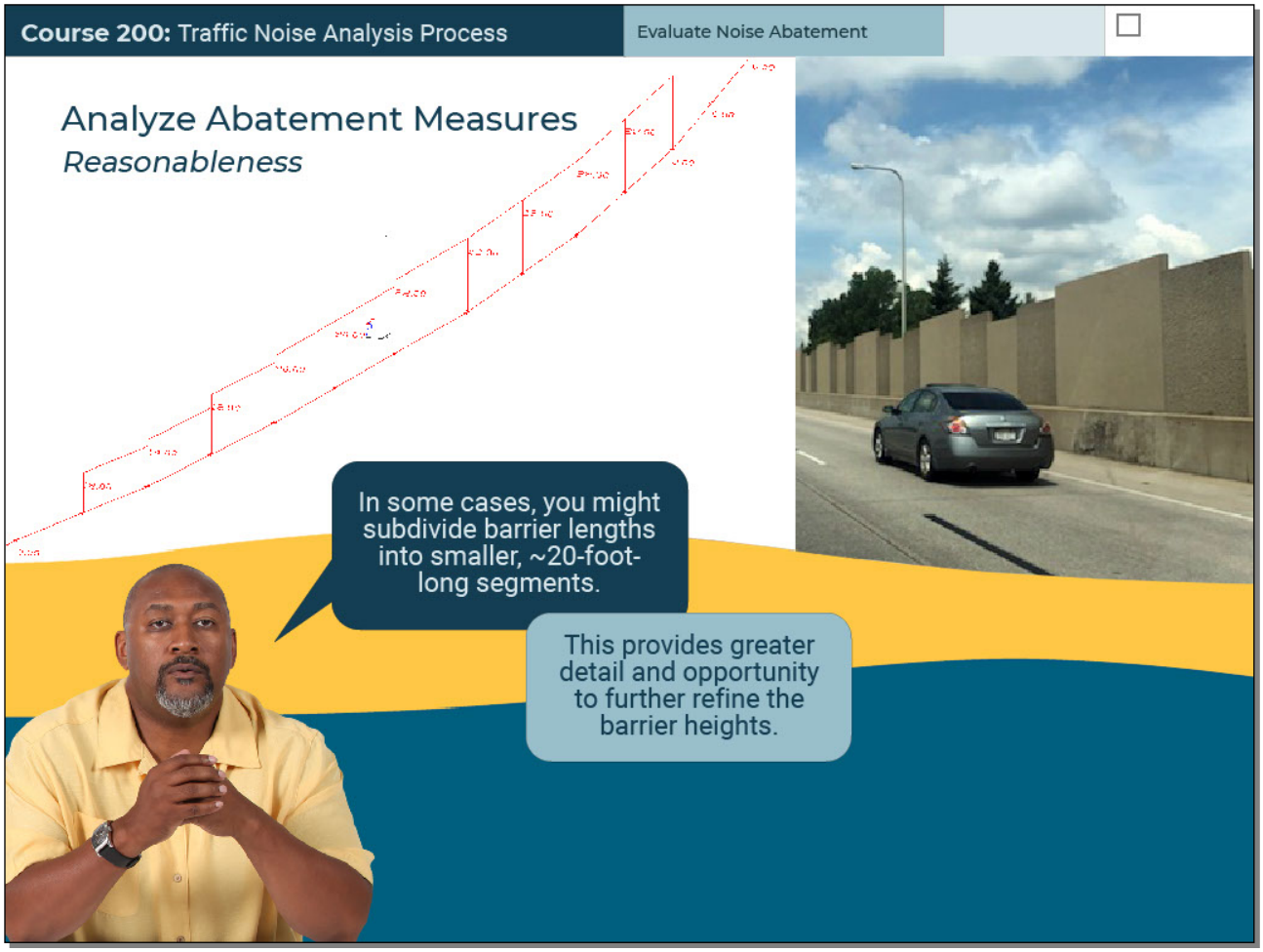
Analyze Abatement Measures

Reasonableness

A final barrier design allows for evaluating any design refinements. But not all refinements between preliminary and final design require additional noise modeling.

Coordinate with NDOT to determine the extent of analysis required during final design. Add any changes to the existing model.

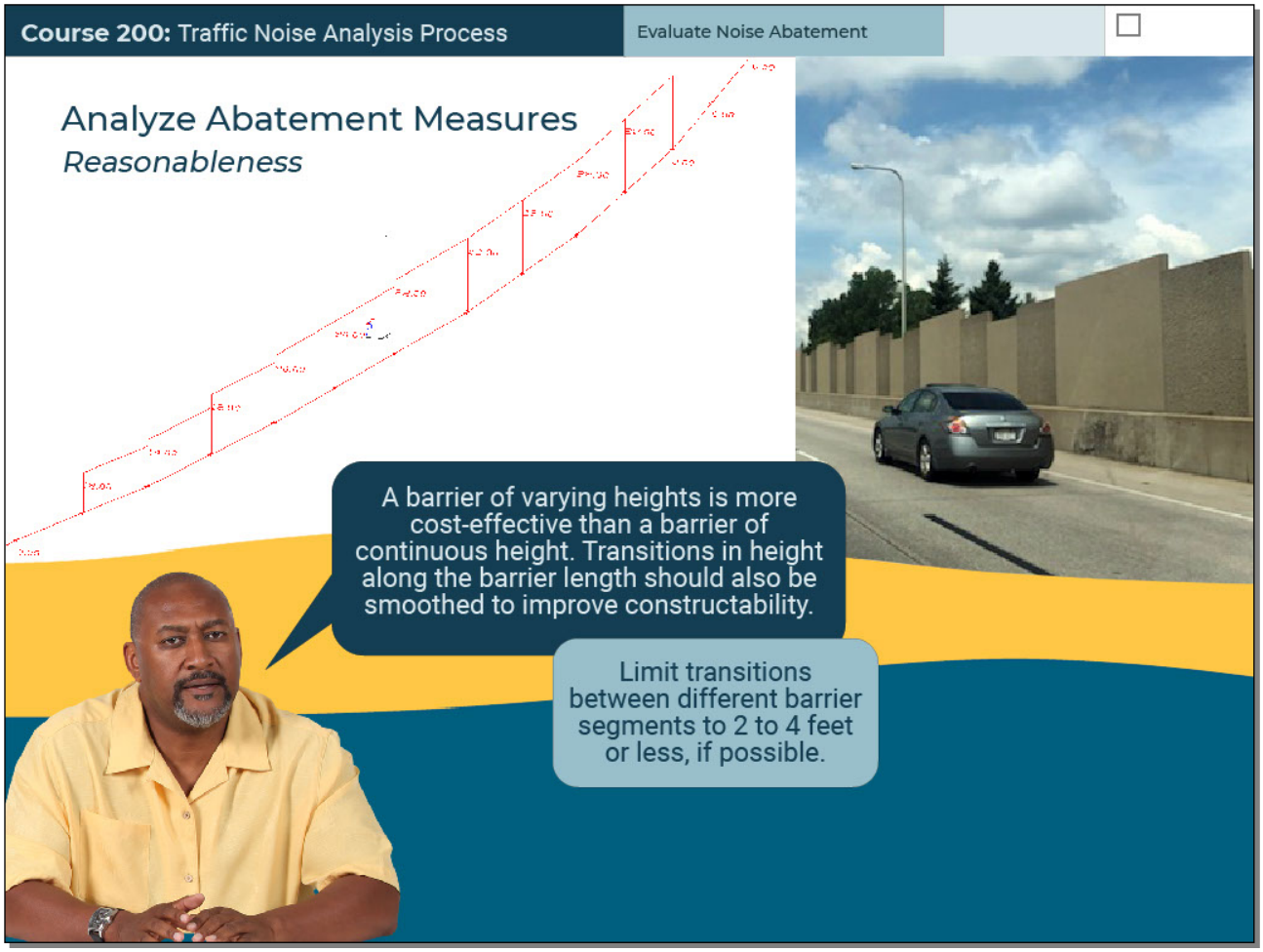
Slide 56 - Slide 56



Audio Script and Notes to Reviewers
In some cases, and in coordination with the N-dot Noise P-Q-S, you might subdivide barrier lengths into smaller, approximately twenty-foot-long segments. This provides greater detail and opportunity to further refine the barrier heights.

Text Captions
Analyze Abatement Measures
Reasonableness
In some cases, you might subdivide barrier lengths into smaller, ~20-foot- long segments.
This provides greater detail and opportunity to further refine the barrier heights.

Slide 57 - Slide 57



Audio Script and Notes to Reviewers

A barrier of varying heights is more cost-effective than a barrier of continuous height. Transitions in height along the barrier length should also be smoothed to improve constructability. Limit transitions between different barrier segments to two to four feet or less, if possible.

Text Captions

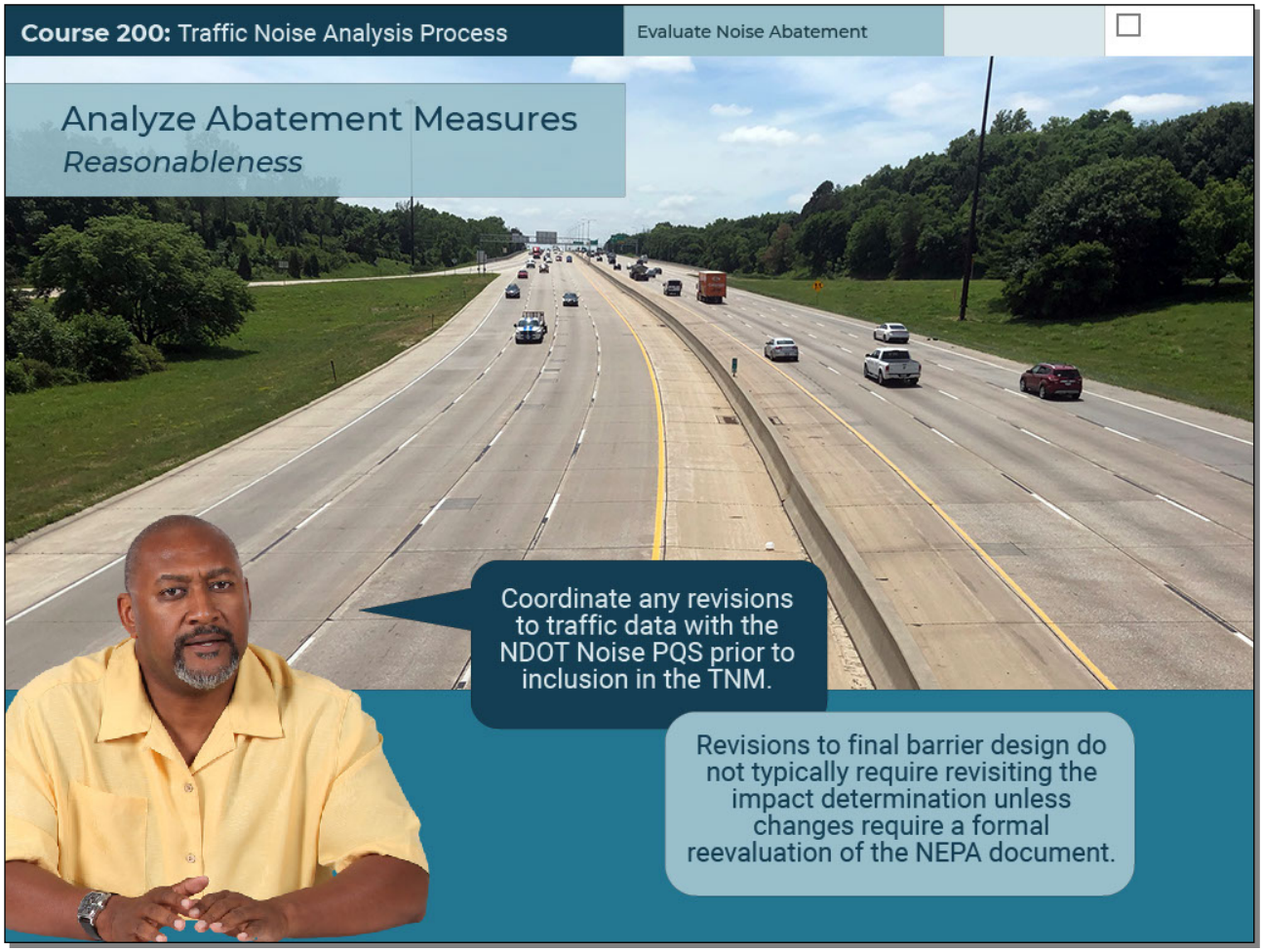
Analyze Abatement Measures

Reasonableness

A barrier of varying heights is more cost-effective than a barrier of continuous height. Transitions in height along the barrier length should also be smoothed to improve constructability.

Limit transitions between different barrier segments to 2 to 4 feet or less, if possible.

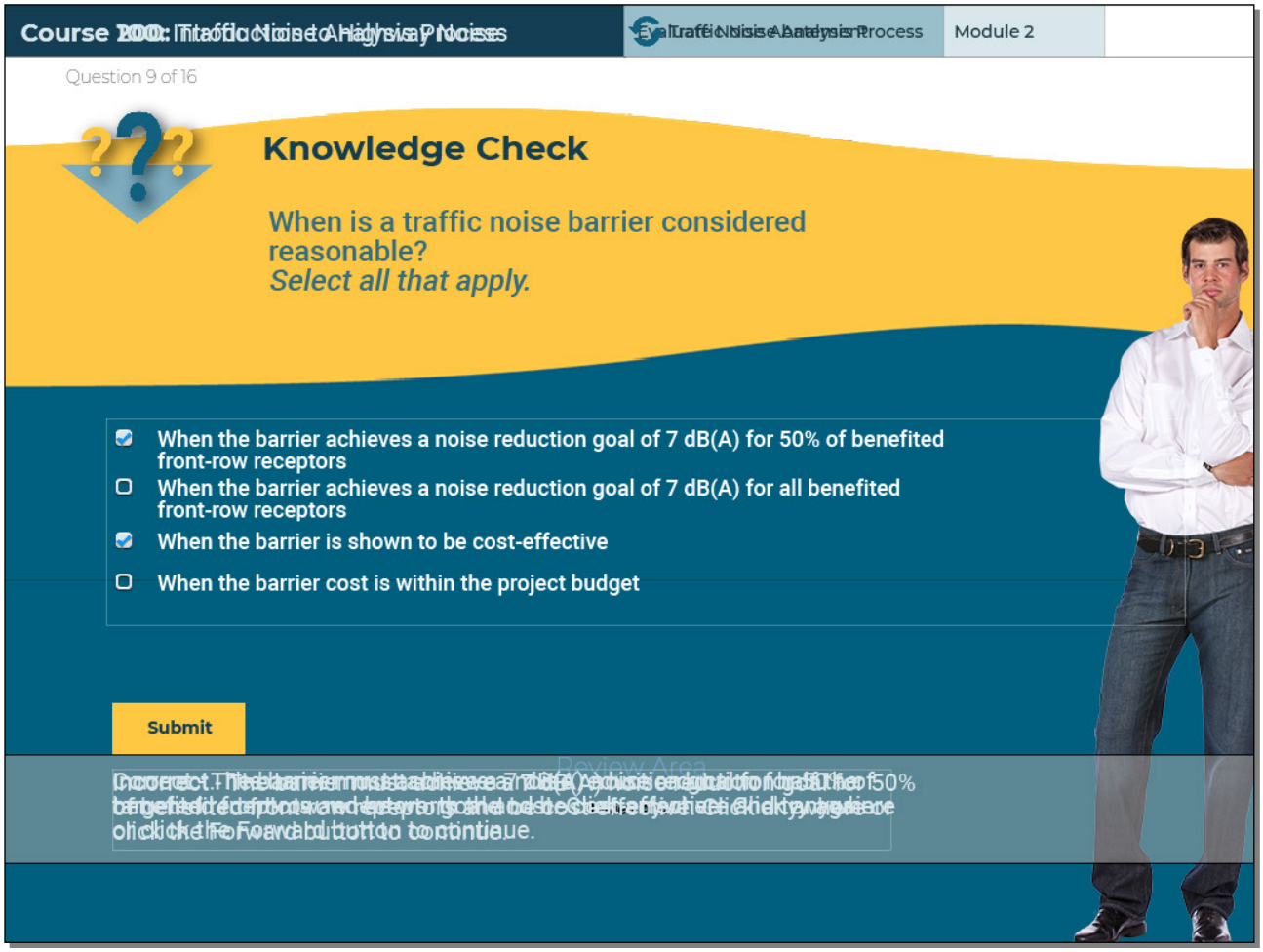
Slide 58 - Slide 58



Audio Script and Notes to Reviewers
Coordinate any revisions to traffic data with the N-dot Noise P-Q-S prior to inclusion in the T-N-M, as such revisions may need to be evaluated in the larger Neepa context. Revisions to final barrier design do not typically require revisiting the impact determination unless changes require a formal reevaluation of the Neepa document.

Text Captions
Analyze Abatement Measures
Reasonableness
Coordinate any revisions to traffic data with the NDOT Noise PQS prior to inclusion in the TNM.
Revisions to final barrier design do not typically require revisiting the impact determination unless changes require a formal reevaluation of the NEPA document.

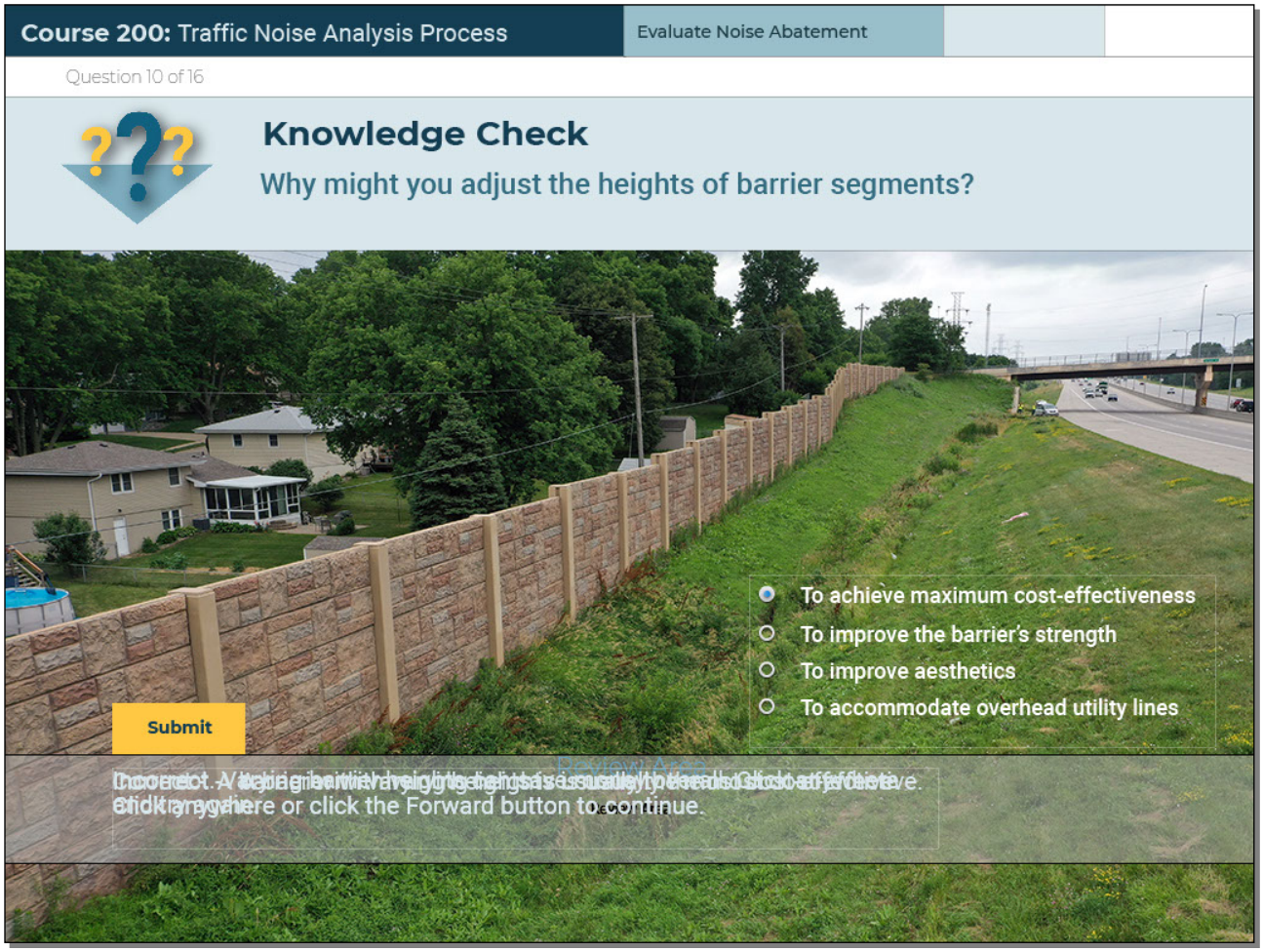
Slide 59 - Slide 59



Audio Script and Notes to Reviewers
When is a traffic noise barrier considered acoustically feasible?

Text Captions
Knowledge Check
When is a traffic noise barrier considered reasonable?
Select all that apply.
Correct feedback: Correct - The barrier must achieve a 7 dB(A) noise reduction for 50% of benefited front-row receptors goal and be cost-effective. Click anywhere or click the Forward button to continue.
1st incorrect feedback: Incorrect. The barrier must achieve a noise reduction goal for half the targeted receptors and be worth the cost. Click anywhere and try again.
2nd incorrect feedback: Incorrect - The barrier must achieve a 7 dB(A) noise reduction goal for 50% of benefited front-row receptors and be cost-effective. Click anywhere or click the Forward button to continue.

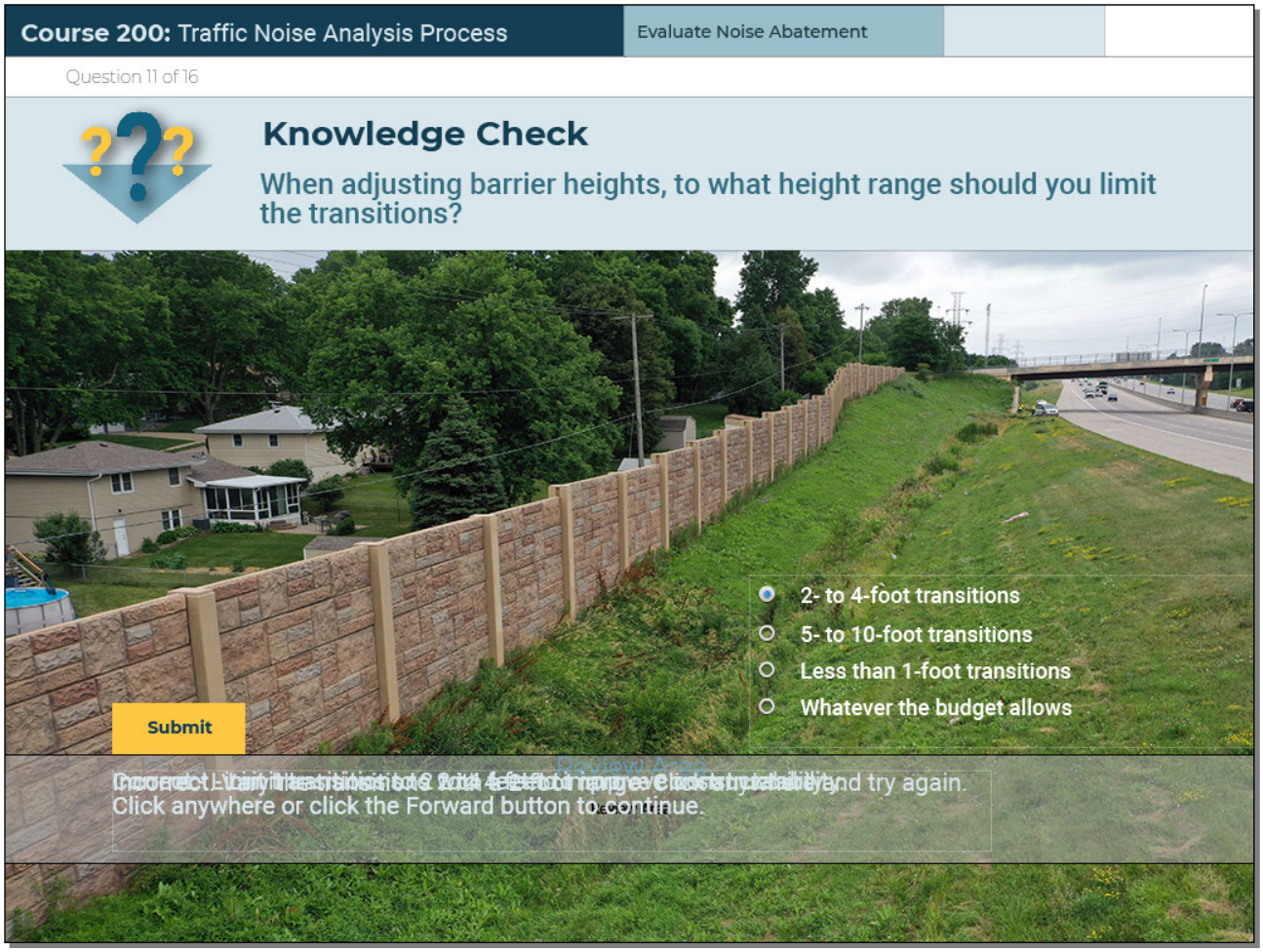
Slide 60 - Slide 60



Audio Script and Notes to Reviewers
Why might you adjust the heights of barrier segments?

Text Captions
Knowledge Check
Why might you adjust the heights of barrier segments?
Correct feedback: Correct - A barrier with varying heights is usually the most cost-effective. Click anywhere or click the Forward button to continue.
1st incorrect feedback: Incorrect. Varying barrier heights can save money overall. Click anywhere and try again.
2nd incorrect feedback: Incorrect - A barrier with varying heights is usually the most cost-effective. Click anywhere or click the Forward button to continue.

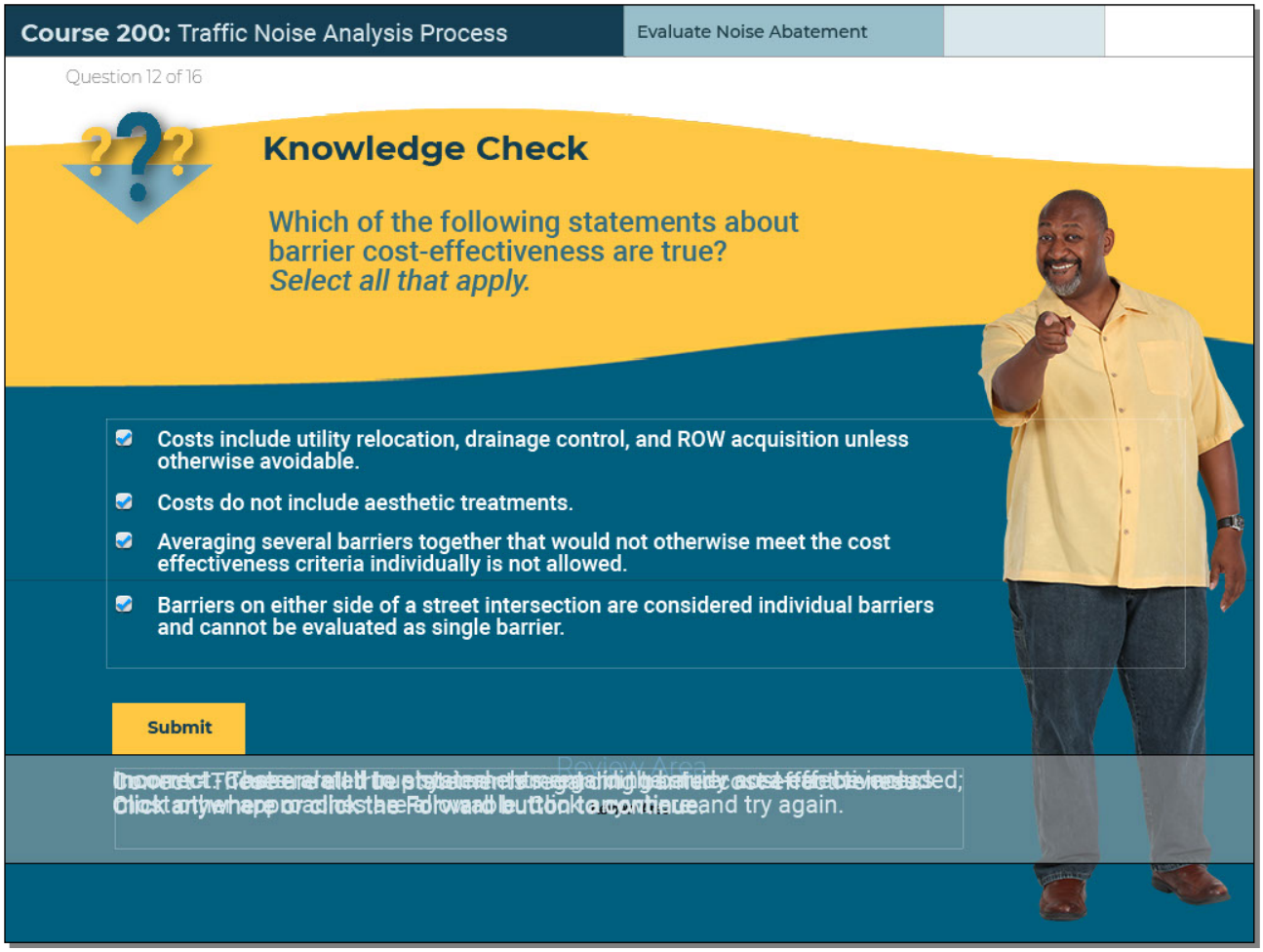
Slide 61 - Slide 61



Audio Script and Notes to Reviewers
Why might you adjust the heights of barrier segments?

Text Captions
Knowledge Check
When adjusting barrier heights, to what height range should you limit the transitions?
Correct feedback: Correct - Limit transitions to 2 to 4 feet to improve constructability. Click anywhere or click the Forward button to continue.
1st incorrect feedback: Incorrect. Vary the transitions with a 2-foot range. Click anywhere and try again.
2nd incorrect feedback: Incorrect - Limit transitions to 2 to 4 feet to improve constructability. Click anywhere or click the Forward button to continue.

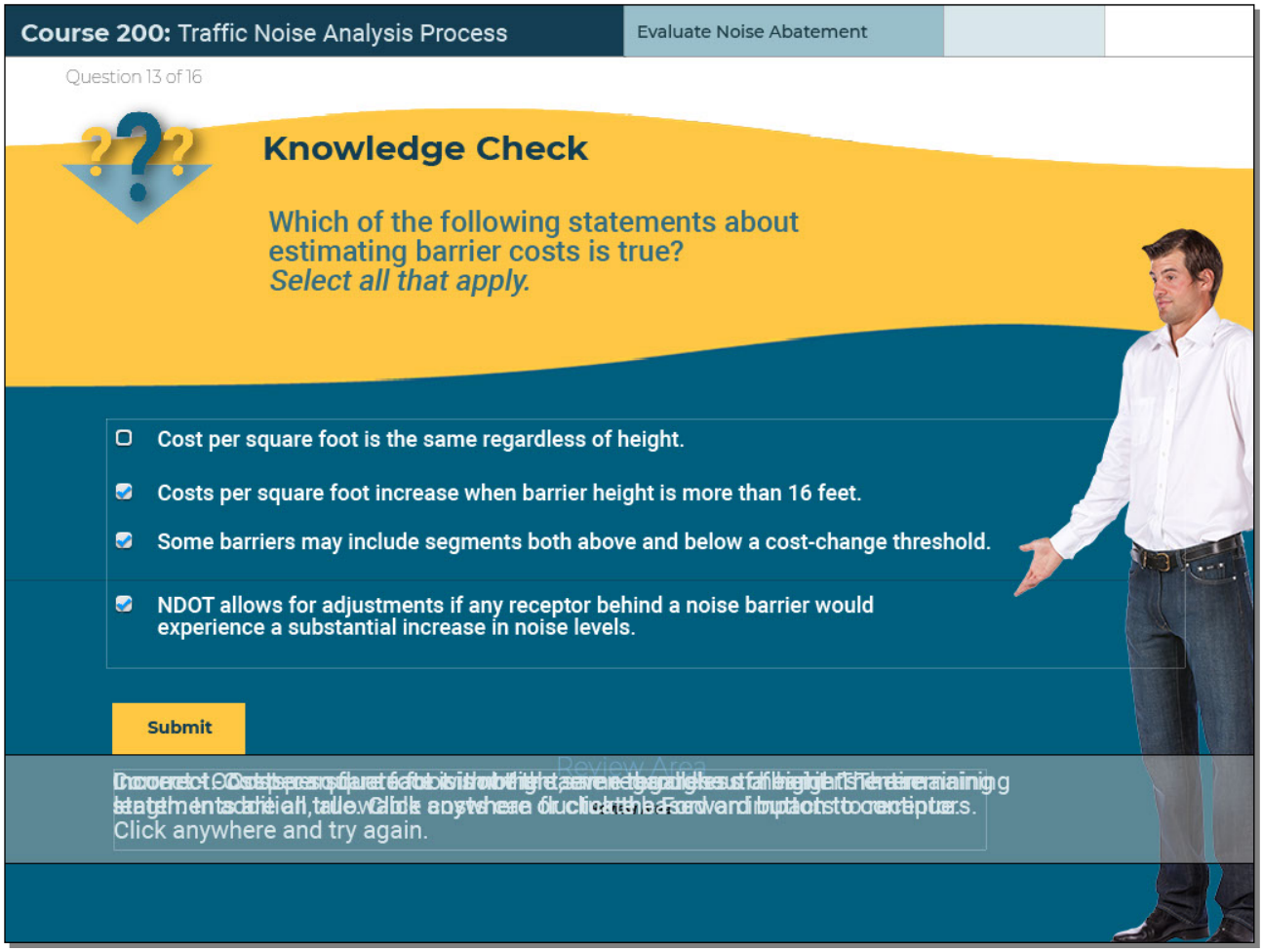
Slide 62 - Slide 62



Audio Script and Notes to Reviewers
Which of the following statements about barrier cost-effectiveness are true?

Text Captions
Knowledge Check
Which of the following statements about barrier cost-effectiveness are true?
Select all that apply.
Correct feedback: Correct - These are all true statements regarding barrier cost-effectiveness. Click anywhere or click the Forward button to continue.
1st incorrect feedback: Incorrect. Costs related to physical elements in the study area can be included; most other approaches are allowable. Click anywhere and try again.
2nd incorrect feedback: Incorrect - These are all true statements regarding barrier cost-effectiveness. Click anywhere or click the Forward button to continue.

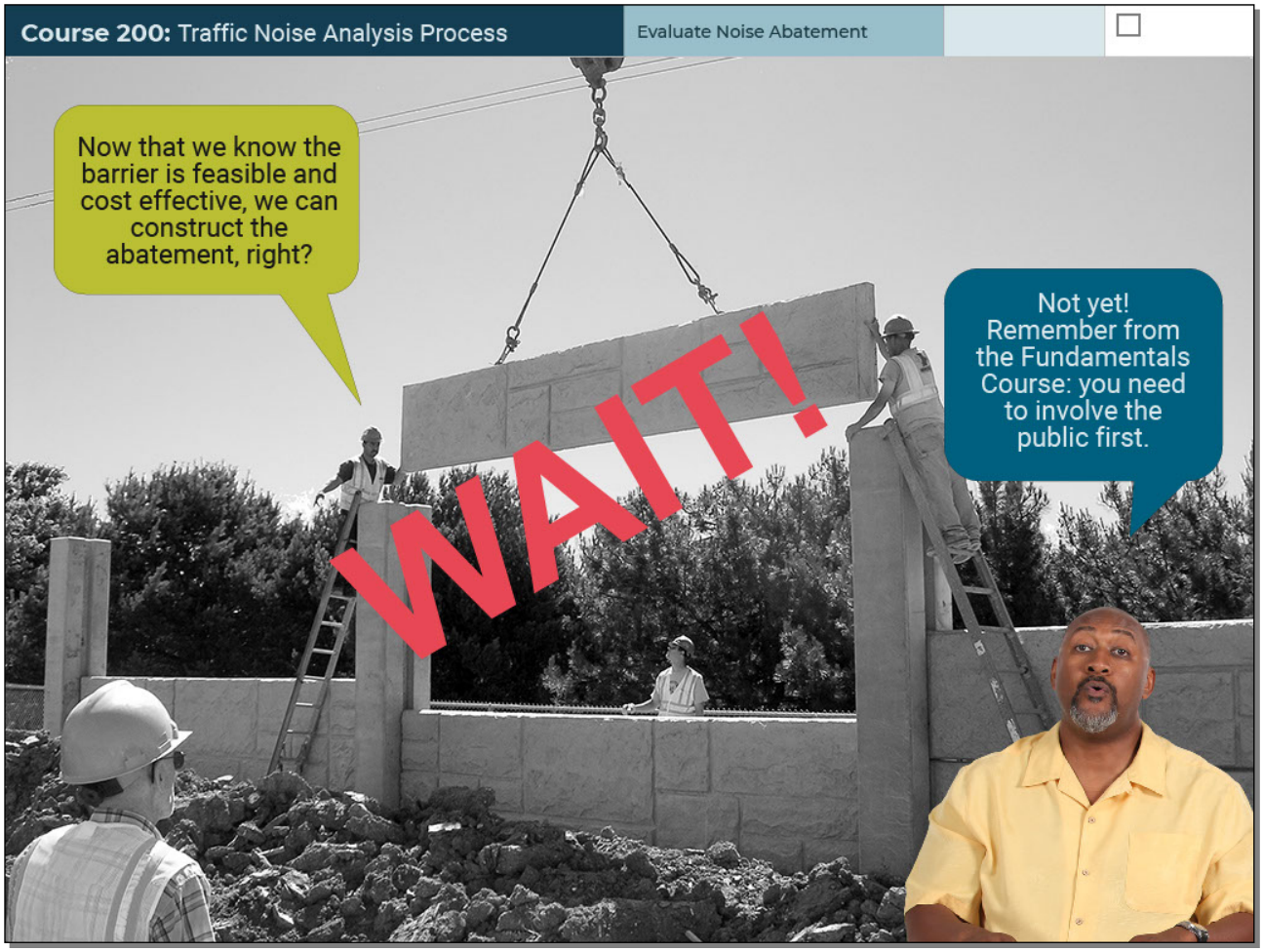
Slide 63 - Slide 63



Audio Script and Notes to Reviewers
Which of the following statements about estimating barrier costs is true?
Reviewer: Didn't have a specific objective about costs, didn't want to get into the details, but seemed like a general cost question was needed. Agree?

Text Captions
Knowledge Check
Which of the following statements about estimating barrier costs is true?
Select all that apply.
Correct feedback: Correct - Cost per square foot is not the same regardless of height. The remaining statements are all true. Click anywhere or click the Forward button to continue.
1st incorrect feedback: Incorrect. Costs can fluctuate with height, even throughout a barrier's entire length. In addition, allowable costs can fluctuate based on impacts to receptors. Click anywhere and try again.
2nd incorrect feedback: Incorrect - Cost per square foot is not the same regardless of height. The remaining statements are all true. Click anywhere or click the Forward button to continue.

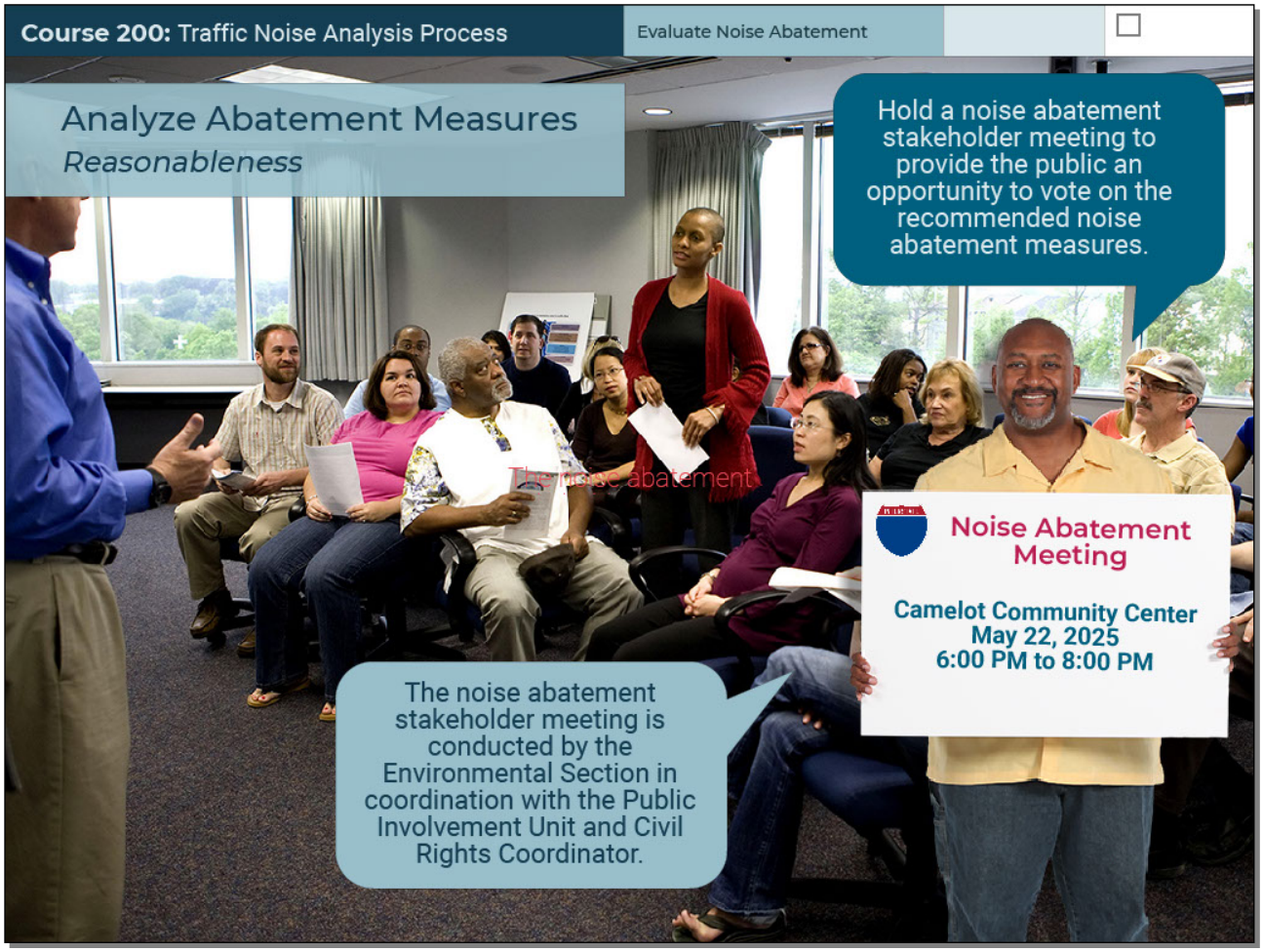
Slide 64 - Slide 64



Audio Script and Notes to Reviewers
Now that we know the barrier is feasible and cost effective, we can construct the abatement, right?
Not yet! Remember from the Fundamentals Course: You need to involve the public first.

Text Captions
Now that we know the barrier is feasible and cost effective, we can construct the abatement, right?
WAIT!
Not yet! Remember from the Fundamentals Course: you need to involve the public first.

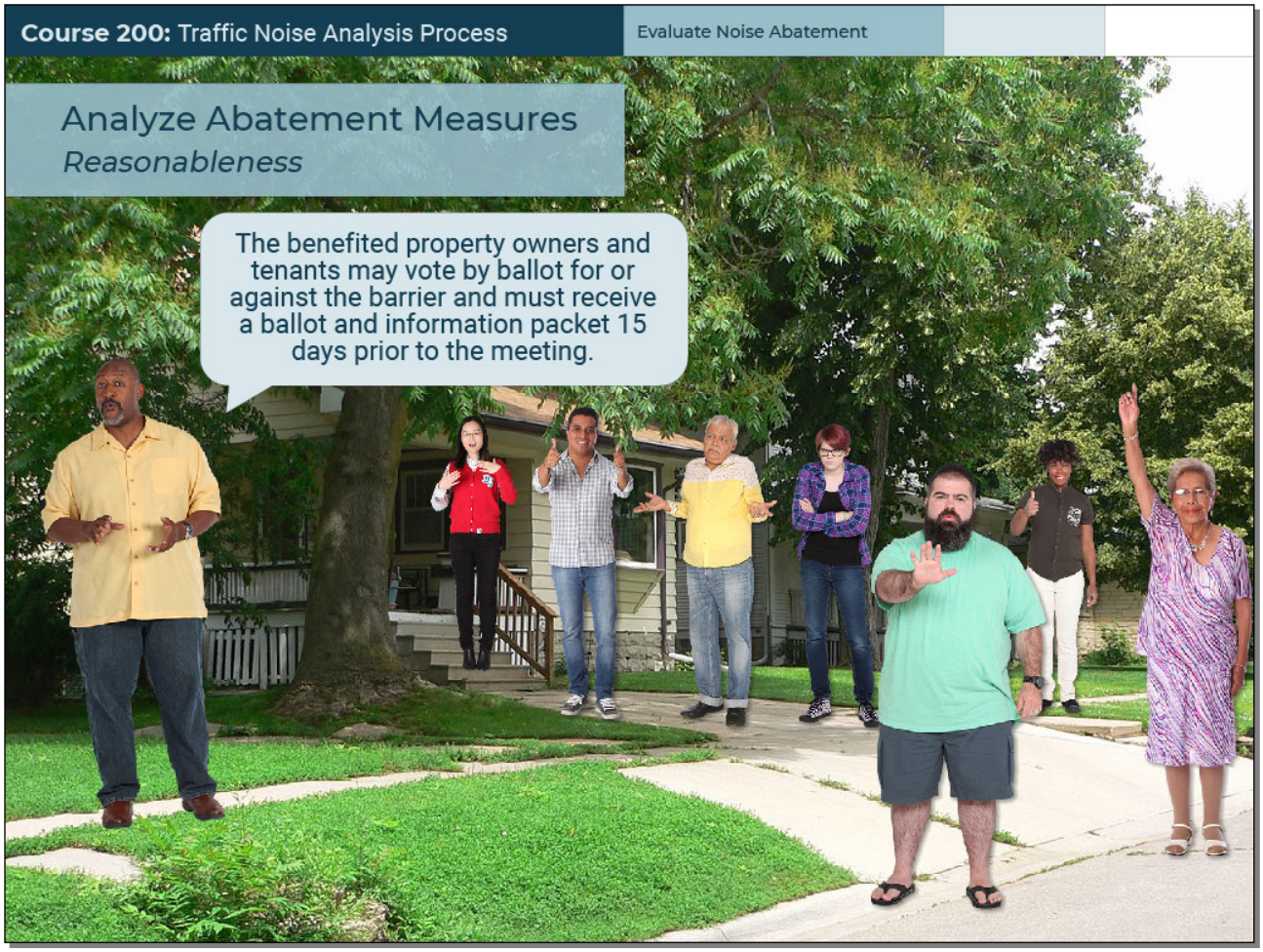
Slide 65 - Slide 65



Audio Script and Notes to Reviewers
Hold a noise abatement stakeholder meeting as part of the reasonableness evaluation to provide the public an opportunity to vote on the recommended noise abatement measures. The N-dot Environmental Section, in coordination with the Public Involvement Unit and Civil Rights Coordinator, conducts the noise abatement stakeholder meeting.

Text Captions
Analyze Abatement Measures
Reasonableness
Hold a noise abatement stakeholder meeting to provide the public an opportunity to vote on the recommended noise abatement measures.
The noise abatement stakeholder meeting is conducted by the Environmental Section in coordination with the Public Involvement Unit and Civil Rights Coordinator.
Noise Abatement Meeting
Camelot Community Center
May 22, 2025
6:00 PM to 8:00 PM

Slide 66 - Slide 66



Audio Script and Notes to Reviewers

The benefited property owners and tenants, if applicable, may vote by ballot for or against the barrier. They will receive a ballot and information packet. The packet will contain map showing the project area and proposed noise wall, a description of the project, and anticipated season and year for start of construction. They must receive the packet at least fifteen days prior to the meeting. You can find a ballot template in the N-dot Traffic Noise Analysis Guidance Manual.

Text Captions

Analyze Abatement Measures
Reasonableness
The benefited property owners and tenants may vote by ballot for or against the barrier and must receive a ballot and information packet 15 days prior to the meeting.

Slide 67 - Slide 67

Audio Script and Notes to Reviewers

Ballots are due fifteen days after the meeting date and can be mailed back or returned in person. If property owners or tenants have not returned a ballot within that time-frame, mail a second ballot will be mailed via certified mail. If the second ballot is not returned within fifteen days after receipt, the property owner or tenant will not have a vote.

Text Captions

Analyze Abatement Measures

Reasonableness

Ballots are due 15 days after the meeting date. If property owners or tenants have not returned a ballot within that time-frame, mail a second ballot via certified mail.

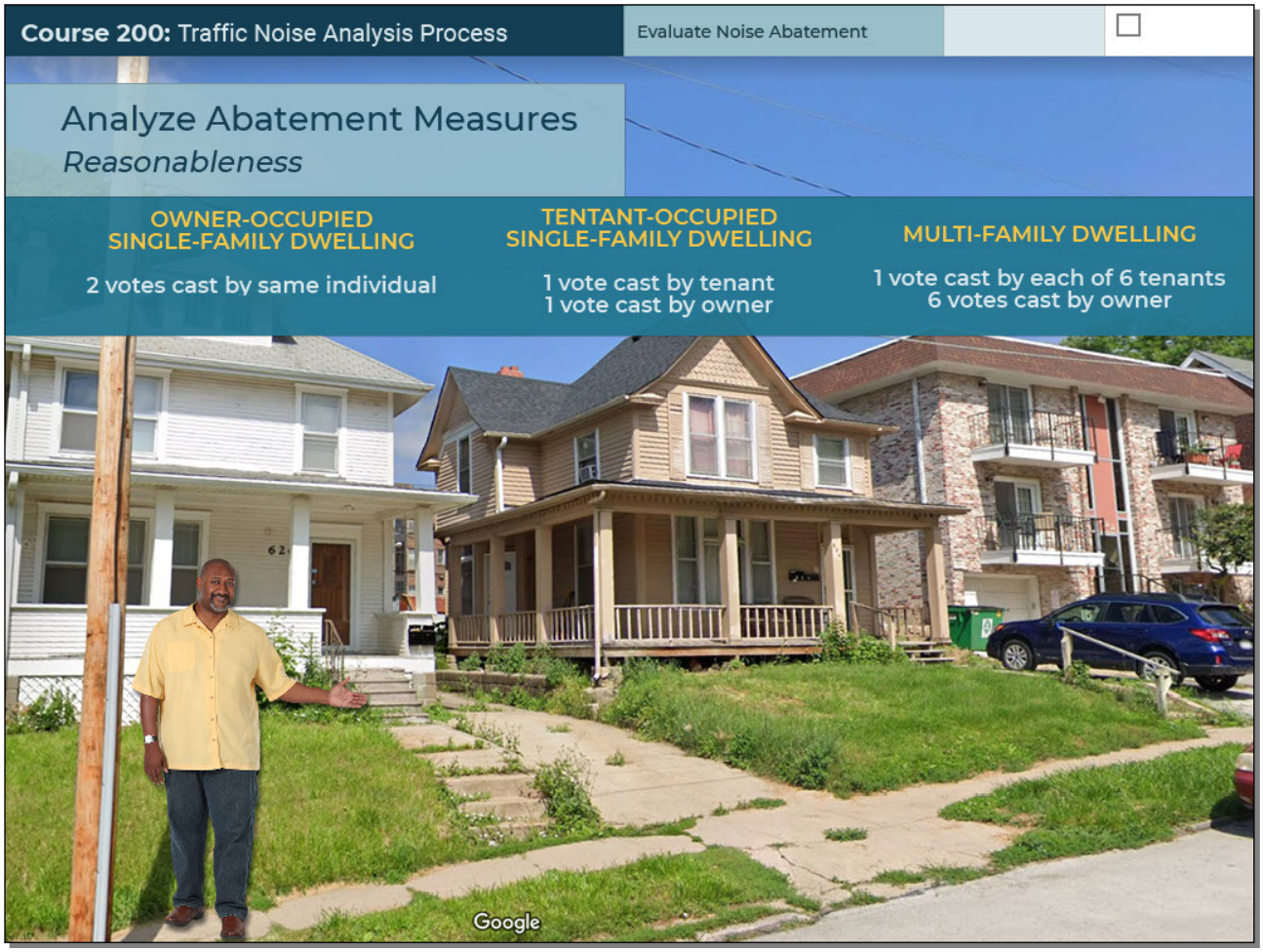
If the second ballot is not returned within 15 days after receipt, the property owner or tenant will not have a vote.

Slide 68 - Slide 68

Audio Script and Notes to Reviewers
Voting is weighted based on owner-occupied versus tenant-occupied receptors. For both residential and commercial uses, the occupant of each benefited dwelling unit, whether owner or tenant, will receive one vote. In addition, the owner of each dwelling unit will also receive one vote.

Text Captions
Analyze Abatement Measures
Reasonableness
RESIDENTIAL AND COMMERCIAL USES
Voting is weighted based on owner-occupied versus tenant-occupied receptors.
The occupant of each benefited dwelling unit, whether owner or tenant, will receive 1 vote.
The owner of each dwelling unit will also receive 1 vote.

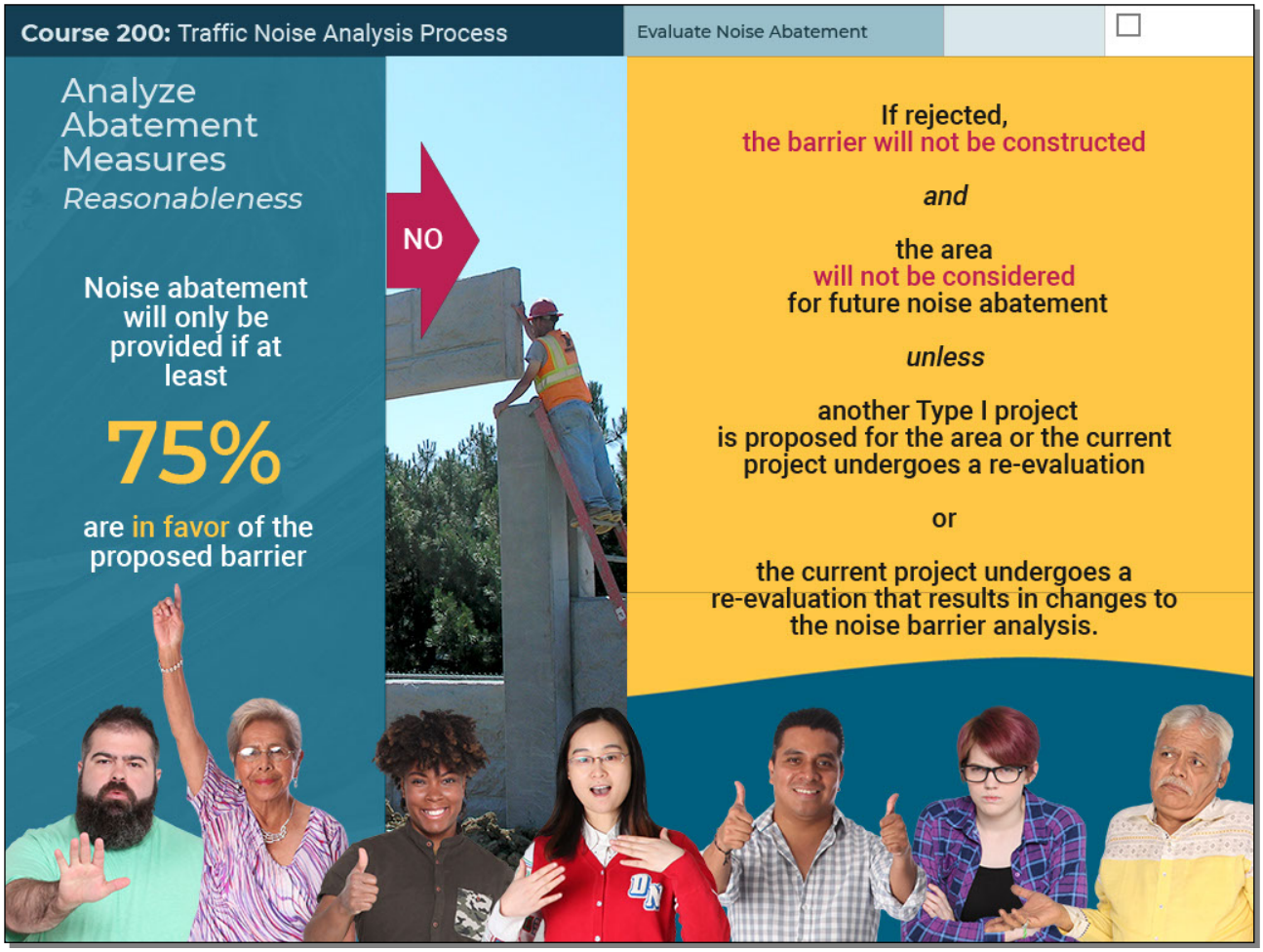
Slide 69 - Slide 69



Audio Script and Notes to Reviewers
Here's an example. For owner-occupied dwelling units, the same individual would cast both votes, as he or she is both the occupant and owner. For a rented dwelling unit, both the owner and the tenant cast one vote each. For multi-family dwelling units, the owner has the same number of votes as the number of units that are benefited.

Text Captions
Analyze Abatement Measures
Reasonableness
OWNER-OCCUPIED SINGLE-FAMILY DWELLING
2 votes cast by same individual
TENTANT-OCCUPIED SINGLE-FAMILY DWELLING
1 vote cast by tenant
1 vote cast by owner
MULTI-FAMILY DWELLING
1 vote cast by each of 6 tenants
6 votes cast by owner

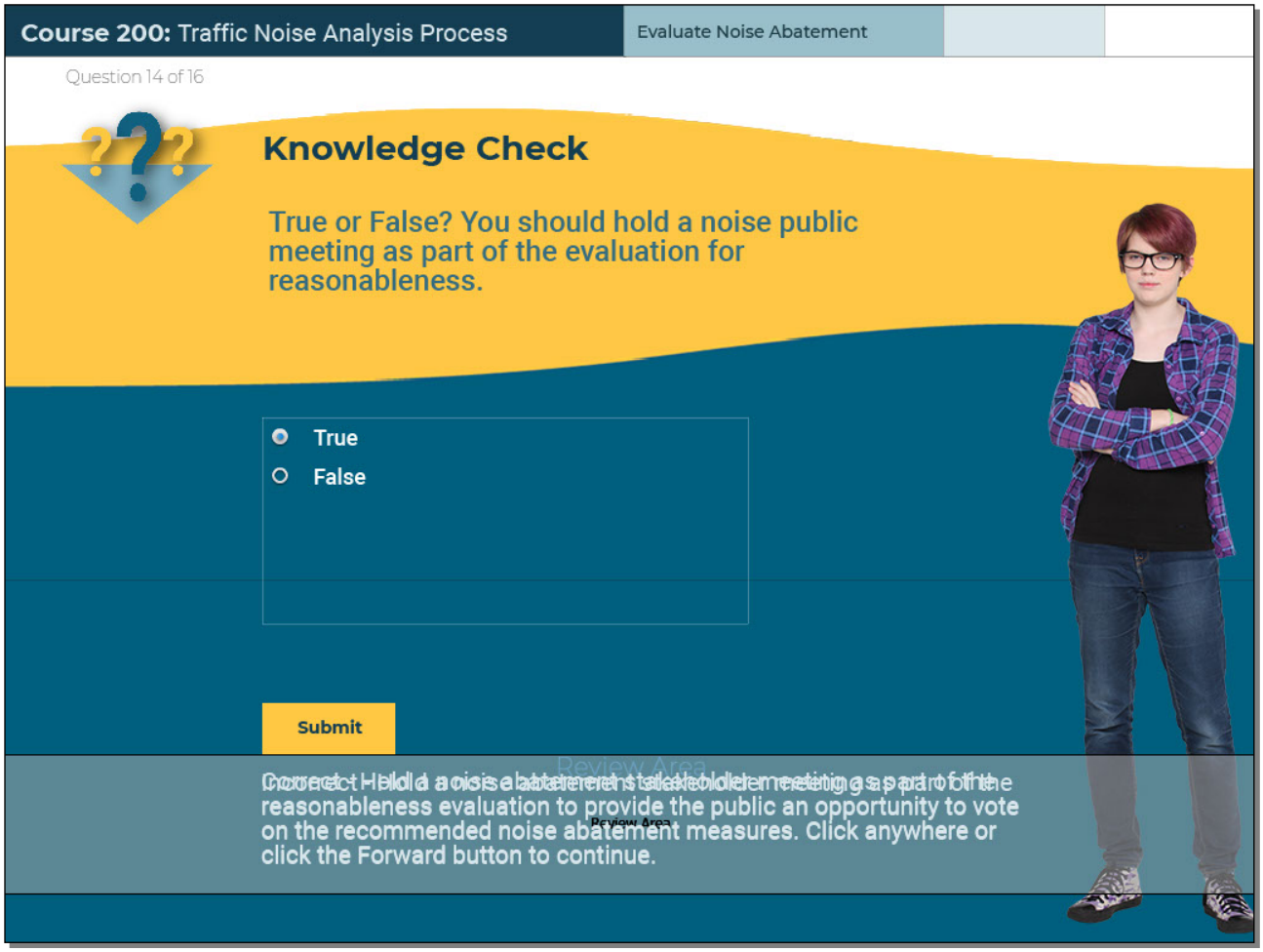
Slide 70 - Slide 70



Audio Script and Notes to Reviewers
Noise abatement will only be provided if at least seventy-five percent of benefited receptors are in favor of the proposed barrier. If the barrier is rejected, the area will not be considered for future noise abatement unless another Type One project is proposed for the area, or the current project undergoes a re-evaluation that results in changes to the noise barrier analysis.

Text Captions
Analyze Abatement Measures
Reasonableness
Noise abatement will only be provided if at least 75% are in favor of the proposed barrier
NO
If rejected, the barrier will not be constructed *and* the area will not be considered for future noise abatement *unless* another Type I project is proposed for the area or the current project undergoes a re-evaluation or the current project undergoes a re-evaluation that results in changes to the noise barrier analysis.

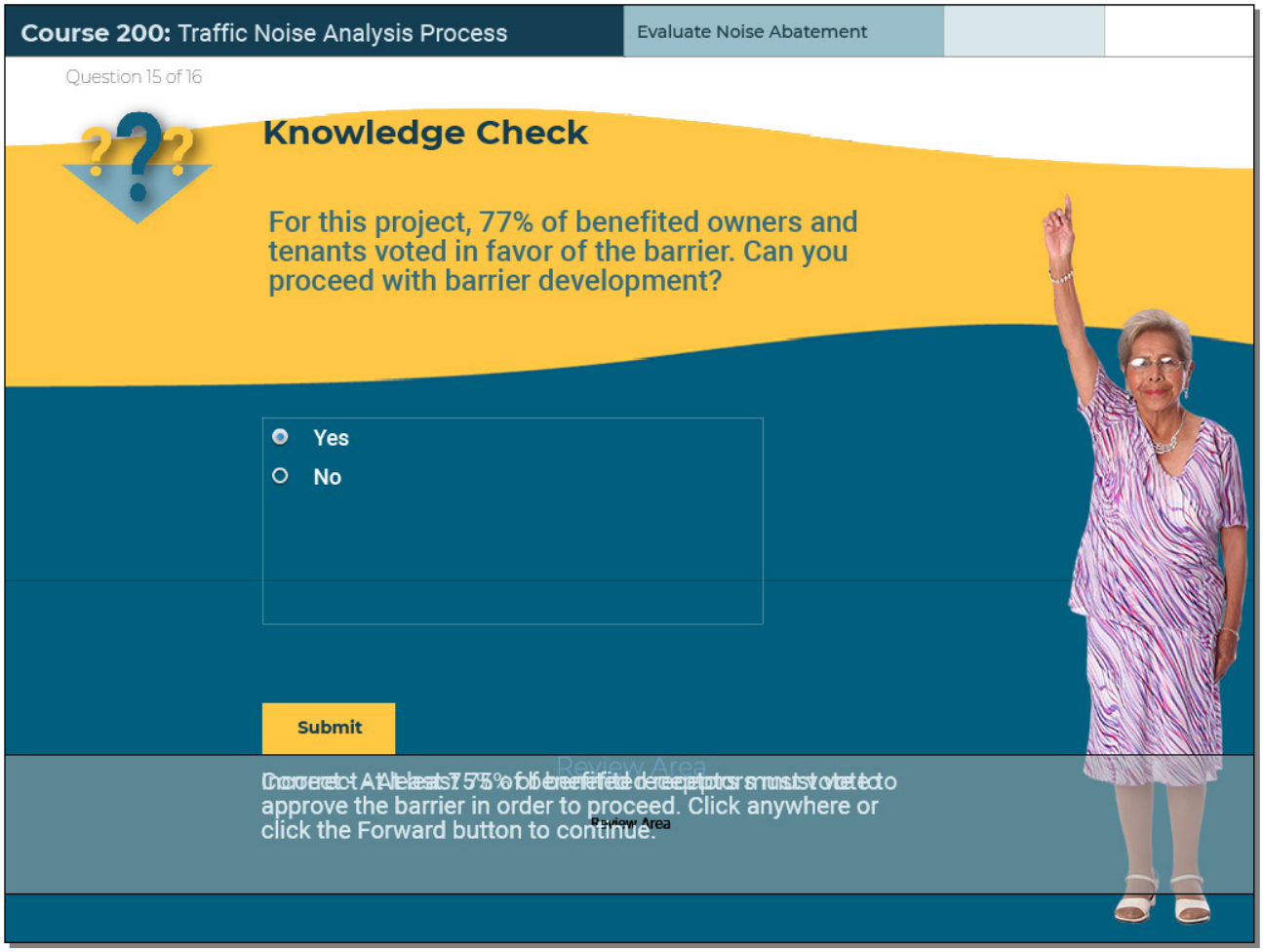
Slide 71 - Slide 71



Audio Script and Notes to Reviewers
True or False? You should hold a noise public meeting as part of the evaluation for reasonableness.

Text Captions
Knowledge Check
True or False? You should hold a noise public meeting as part of the evaluation for reasonableness.
Correct feedback: Correct - Hold a noise abatement stakeholder meeting as part of the reasonableness evaluation to provide the public an opportunity to vote on the recommended noise abatement measures. Click anywhere or click the Forward button to continue.
Incorrect feedback: Incorrect - Hold a noise abatement stakeholder meeting as part of the reasonableness evaluation to provide the public an opportunity to vote on the recommended noise abatement measures. Click anywhere or click the Forward button to continue.

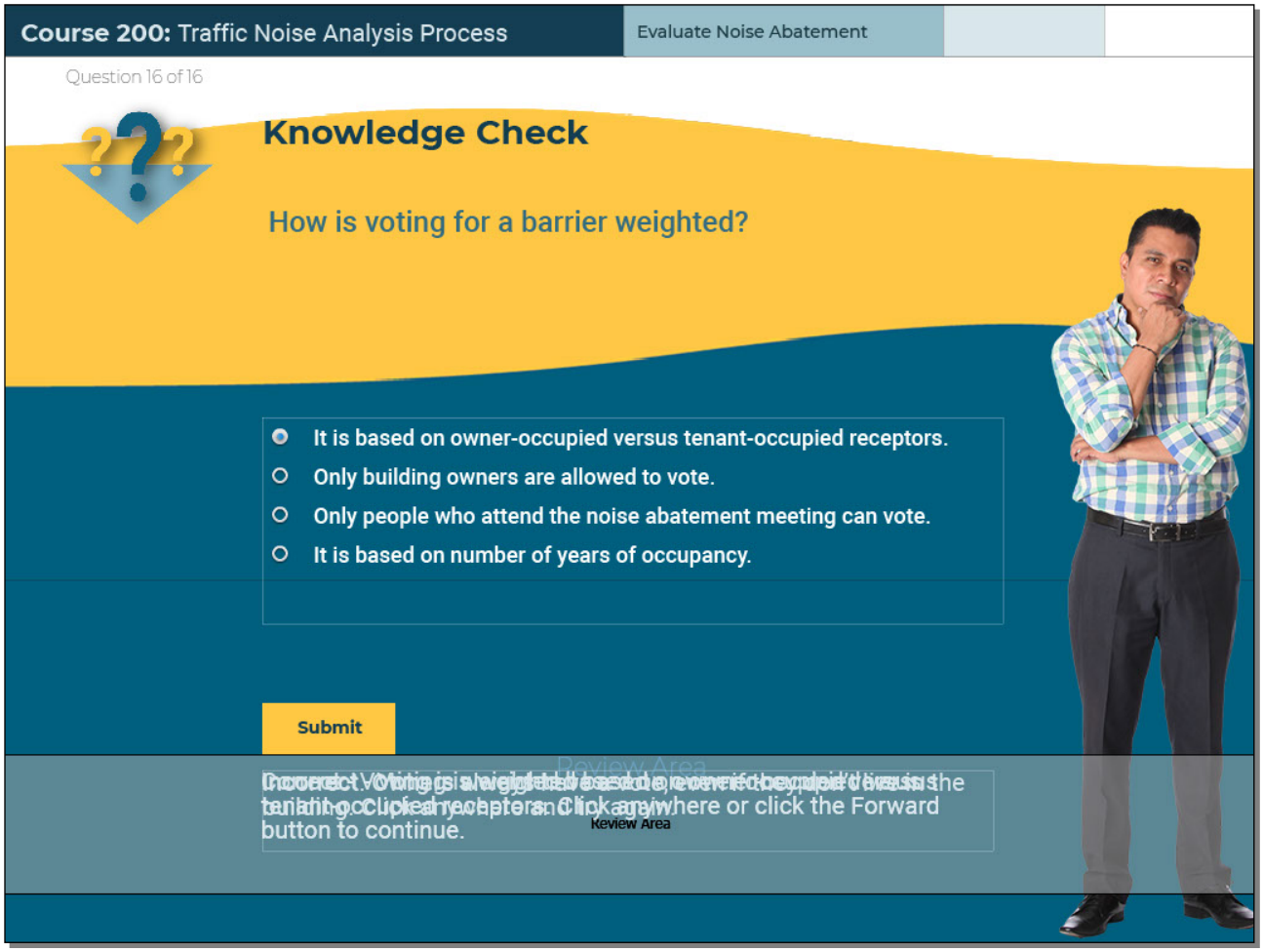
Slide 72 - Slide 72



Audio Script and Notes to Reviewers
For this project, seventy-seven percent of benefited owners and tenants voted in favor of the barrier. Can you proceed with barrier development?

Text Captions
Knowledge Check
For this project, 77% of benefited owners and tenants voted in favor of the barrier. Can you proceed with barrier development?
Correct feedback: Correct - At least 75% of benefited receptors must vote to approve the barrier in order to proceed. Click anywhere or click the Forward button to continue.
Incorrect feedback: Incorrect - At least 75% of benefited receptors must vote to approve the barrier in order to proceed. Click anywhere or click the Forward button to continue.

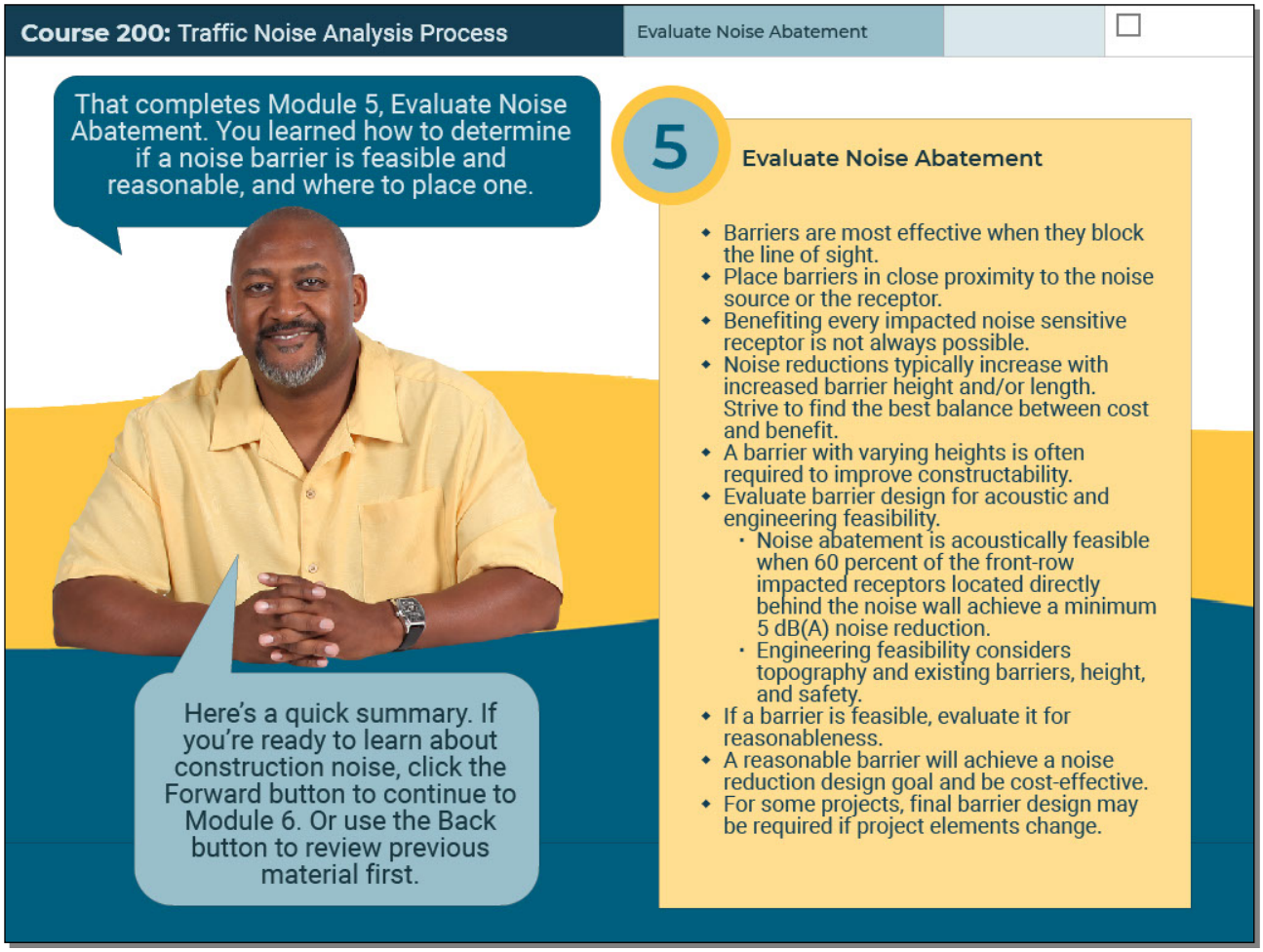
Slide 73 - Slide 73



Audio Script and Notes to Reviewers
How is voting for a barrier weighted?

Text Captions
Knowledge Check
How is voting for a barrier weighted?
Correct feedback: Correct - Voting is weighted based on owner-occupied versus tenant-occupied receptors. Click anywhere or click the Forward button to continue.
1st incorrect feedback: Incorrect. Owners always have a vote, even if they don't live in the building. Click anywhere and try again.
2nd incorrect feedback: Incorrect - Voting is weighted based on owner-occupied versus tenant-occupied receptors. Click anywhere or click the Forward button to continue.

Slide 74 - Slide 74



Audio Script and Notes to Reviewers

That completes Module Five, Evaluate Noise Abatement. In Module Five, You learned how to determine if a noise barrier is feasible and reasonable, and, if so, where to place one. If you're ready to learn about construction noise, click the Forward button to continue to Module Six. Or use the Back button to review previous material first.

Text Captions

That completes Module 5, Evaluate Noise Abatement. You learned how to determine if a noise barrier is feasible and reasonable, and where to place one.
Here's a quick summary. If you're ready to learn about construction noise, click the Forward button to continue to Module 6. Or use the Back button to review previous material first.
Evaluate Noise Abatement

- Barriers are most effective when they block the line of sight.
- Place barriers in close proximity to the noise source or the receptor.
- Benefiting every impacted noise sensitive receptor is not always possible.
- Noise reductions typically increase with increased barrier height and/or length. Strive to find the best balance between cost and benefit.
- A barrier with varying heights is often required to improve constructability.
- Evaluate barrier design for acoustic and engineering feasibility.

- Noise abatement is acoustically feasible when 60 percent of the front-row impacted receptors located directly behind the noise wall achieve a minimum 5 dB(A) noise reduction.
- Engineering feasibility considers topography and existing barriers, height, and safety.
- If a barrier is feasible, evaluate it for reasonableness.
- A reasonable barrier will achieve a noise reduction design goal and be cost-effective.
- For some projects, final barrier design may be required if project elements change.