Appendix B

Alternative Analysis

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APPENDIX B: Alternative Analysis

This appendix provides the detailed alternatives analysis for the following:

1. RSA, ROFA, Part 77 and Runway Takeoff Length Alternatives
2. Runway Grade Alternatives
3. ATCT Alternatives.

B.1 RSA, ROFA, Part 77 and Runway Takeoff Length

The needs related to Runway 15-33 were considered in identifying and evaluating alternatives. Alternatives to provide a standard RSA and ROFA, address obstructions to Part 77, and maintain 7,000 feet of runway takeoff length were identified and evaluated.

Potential alternatives were identified based on major physical constraints. For the RSA and ROFA, the major constraints are Eastern Boulevard and the wetlands adjacent to Frog Mortar Creek. Eastern Boulevard is a major physical constraint because the road would have to be relocated in order to increase the length of the RSA and ROFA. The wetlands are a major constraint because they would have to be filled to meet RSA and ROFA grading requirements.

In terms of obstructions to Part 77, the major constraints are the controlling obstacles. The controlling obstacles are those that penetrate Part 77 by the greatest amount. On the Runway 15 end the controlling obstacles are the poles for the Amtrak catenary line, and on the Runway 33 end the controlling obstacles are the 60-foot mast sailboats which traverse Frog Mortar Creek.

In addition to the controlling obstacles which penetrate Part 77 off the runway ends, there are also man-made penetrations to the Part 77 transitional surfaces. All alternatives would include the lowering of approximately 3,700 feet of Taxiway T on the Runway 15 end and a portion of the MANG apron to address a ground penetration to Part 77 transitional surfaces.

Three types of alternatives were explored to address the major constraints:

- Relocate Thresholds Only
- Lower /Remove /Relocate Controlling Constraints and Relocate Thresholds
- Lower/Remove/Relocate Controlling Constraints, and Displace and Relocate Thresholds

The first two alternatives are straightforward. Relocating the runway thresholds equates to moving the physical ends of the runway away from the constraints. Lowering, removing or relocating the controlling constraints could potentially eliminate the penetrations to Part 77. The third alternative is more complex and involves both displacing and relocating runway thresholds as well as removing obstructions. The evaluation of these three types of alternatives is detailed in the following subsections.

B.1.1 Relocate Thresholds Only Alternative

A standard RSA and ROFA could be provided by relocating the ends of the runway. However, as shown in **Figure B-1**, the resulting runway length would be approximately 6,700 feet, less than the needed 7,000 feet. Similarly, the runway thresholds could be relocated such that the controlling obstructions (Amtrak on the Runway 15 end and boat masts in Frog Mortar Creek on the Runway 33 end) would not penetrate Part 77. As illustrated in **Figure B-2**, the resulting runway length would be approximately 3,700 feet, again less than the needed 7,000 feet. Therefore, this type of alternative alone would not provide the needed runway length.

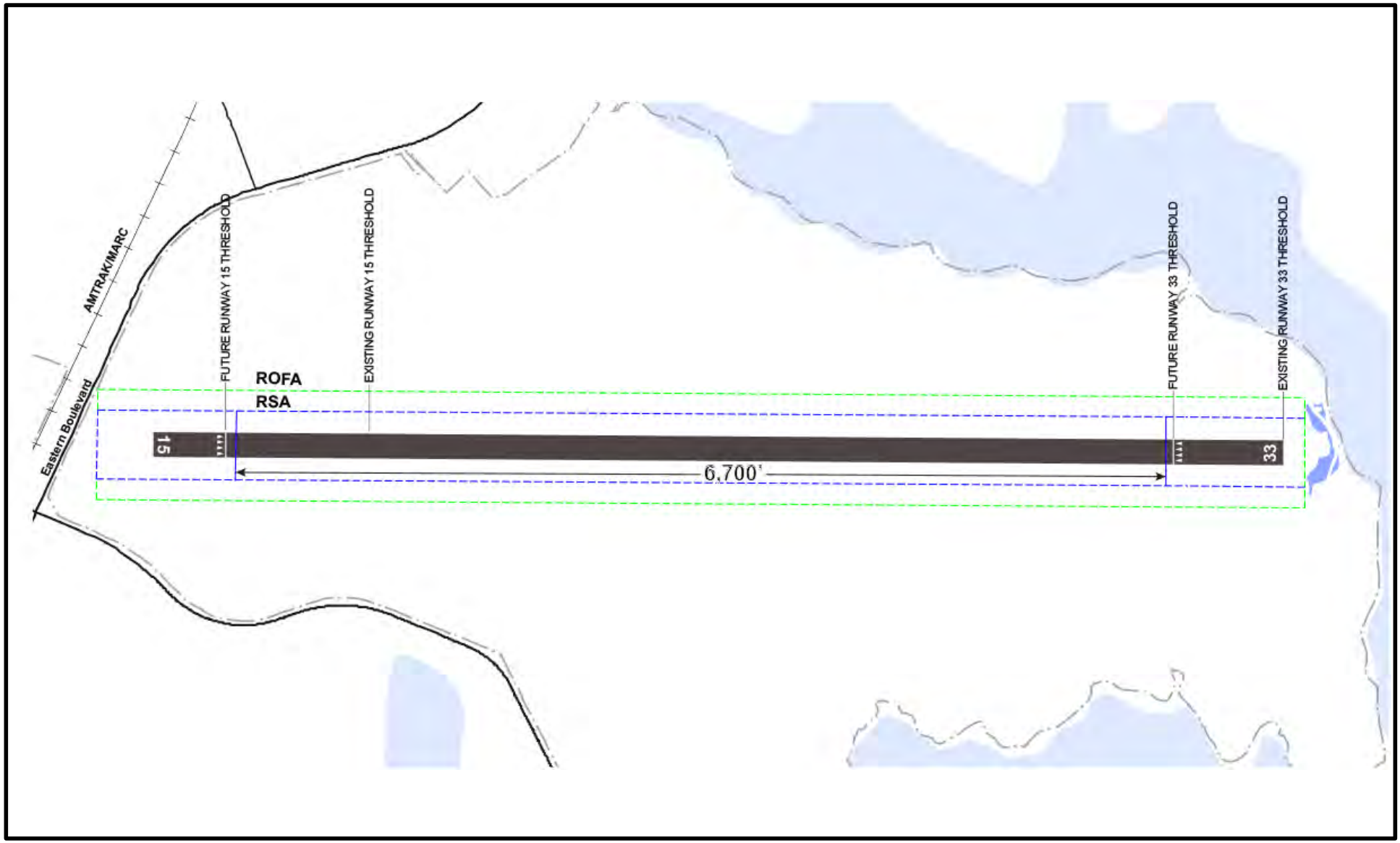
B.1.2 Lower/Remove/Relocate Controlling Constraints and Relocate Thresholds Alternatives

The analysis of this alternative is focused on Part 77 because the evaluation of the relocated threshold alternative illustrated that the controlling Part 77 obstacles limit the runway length to a greater degree than the RSA/ROFA constraints.

The preferred method to address penetrations to Part 77 is to lower/remove/relocate the controlling obstacles such that they would no longer penetrate the Part 77 approach surfaces. Therefore, alternatives to lower/remove/ relocate the controlling obstacles were explored.

Amtrak was consulted to assess the potential to relocate/lower the controlling obstacles on the Runway 15 end. AMTRAK representatives indicated that the poles for the catenary lines could be lowered to 30 feet above ground.[1] Lowering the poles to this extent would require burying the transmission lines. The potential to relocate the AMTRAK tracks was also considered. Since the subject tracks serve high speed trains, the associated design standards for horizontal curves would require track relocation to extend well beyond the Airport proximity and would be very costly.[2] Furthermore, the affected area would increase as would the potential for environmental impacts. Therefore, while lowering the Amtrak poles was retained for further consideration, relocating the tracks was not.

Methods to lower/relocate the controlling obstacles on the Runway 33 end were also considered. A bathometric survey was conducted to identify a "deep water channel" where the sailboats with 60-foot masts would most routinely traverse Frog Mortar Creek. The location of the deep water channel is shown on **Figure B-3** Also, the U. S. Coast Guard (USCG), U. S. Army Corps of Engineers (USACE) and FAA were consulted regarding the viability of restricting the height or the path of boats in Frog Mortar Creek. The height could be restricted such that sailboats with masts exceeding a specified height would have to coordinate with the ATCT before traversing the runway approach area. However, the FAA rejected this proposal because enforcement would be difficult.[3] The USCG agreed that a boat exclusion area could be established.[4] However, both the USCG and USACE indicated that the limits of the boat exclusion area should not constrict the waterway to the extent that significant congestion is generated. Therefore, the only method retained for further consideration was to limit sailboats to the deep water channel by creating a boat exclusion area.



LEGEND

- Runway Object Free Area
- Runway Safety Area
- Airport Property
- Railroad
- Road

Figure B-1
Runway Thresholds Relocated for RSA/ROFA

Sources: ESRI, MDOT MAA

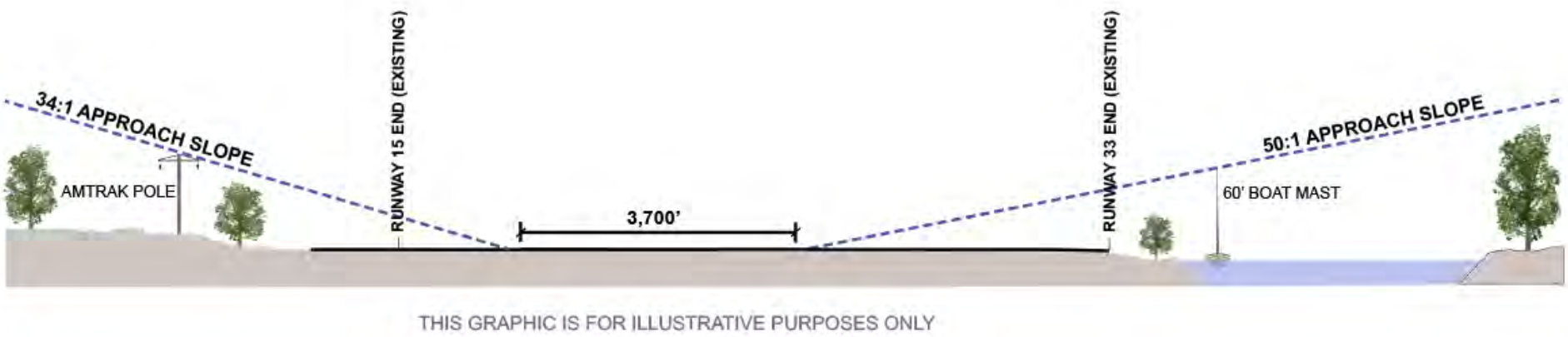


Figure B-2
Runway Thresholds Relocated for Part 77

Source: MDOT MAA

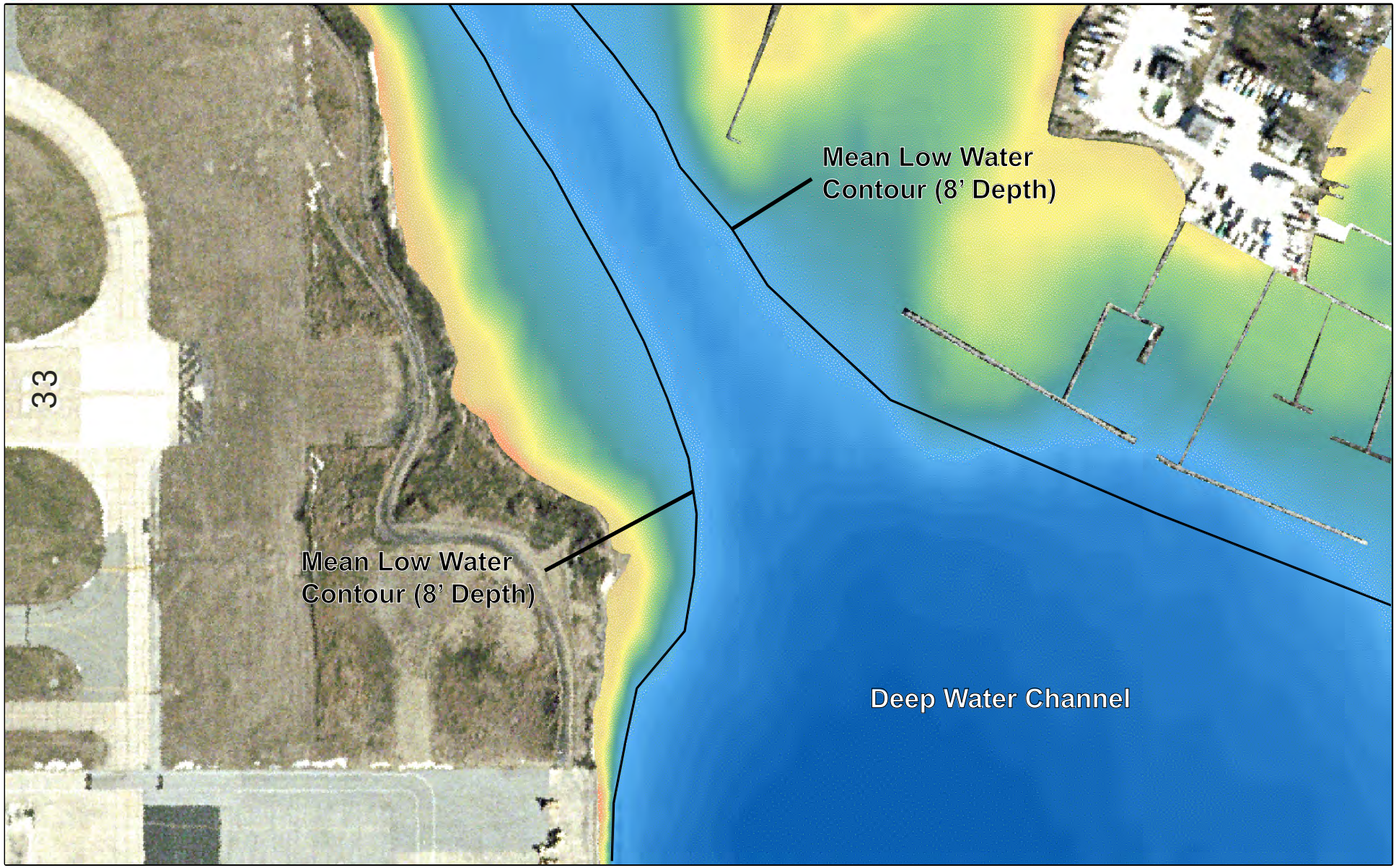


Figure B-3
Deep Water Channel

Not to Scale

An alternative was developed based on lowering the Amtrak poles and restricting high-masted sailboats from operating in the area between the Airport and the deep water channel. For this alternative, the runway ends were relocated such that the lowered Amtrak poles and a 60-foot tall sailboat within the deep water channel would not penetrate Part 77. As illustrated in **Figure B-4**, the resulting runway length would be approximately 5,000 feet. Therefore, this type of alternative alone would not provide a runway takeoff length of 7,000 feet.

B.1.3 Lower/Remove/Relocate Controlling Constraints, and Displace and Relocate Thresholds Alternatives

While the previous alternatives addressed RSA, ROFA, and Part 77 related needs, none of the previous alternatives provided sufficient runway length. Therefore, two methods of obtaining more usable runway length were considered: obstacle clearance surfaces (OCSs) and declared distances.

With this type of alternative, the controlling constraints would be lowered and relocated as described for the previous alternative. However, unlike the previous alternative, the thresholds would not be relocated based on Part 77. Instead, the landing thresholds would be displaced by using OCSs and the runway ends would be relocated by applying declared distances.

Obstacle Clearance Surfaces

The landing threshold is ideally located at the physical runway end. However, when it is beyond the Airport's power to remove obstructions to Part 77, the landing threshold may be displaced by applying OCSs.[5] Since it is not possible for the MDOT MAA to further lower the Amtrak catenary lines or restrict sailboats from Frog Mortar Creek, the landing threshold may be displaced such that OCSs are clear of obstructions. The OCSs are generally less restrictive than the applicable Part 77 approach surface.

Typically, the landing threshold is displaced using the Threshold Siting Surface (TSS) OCS. The dimensions and slope of this approach surface are based on the type of approach and the associated visibility minimums. The TSS for Runway 15 would begin 200 feet from the threshold where it is 800-feet wide, and extends 10,000 feet outward to a width of 3,800 feet. The slope of the TSS for the approach to Runway 15 would be 20:1. The TSS for the Runway 33 approach would begin at the threshold and have the same dimensions. However, because the Runway 33 approach has an Instrument Landing System (ILS), the applicable slope would be 34:1.

Another more restrictive OCS applies to Runway 33 because it has a precision approach that provides lateral and vertical guidance to pilots. In order to maintain the precision approach, no objects, temporary or permanent, may penetrate the Glidepath Qualification Surfaces (GQS). For Runway 33, the GQS obstruction clearance surface starts at the Runway 33 landing threshold and slopes at a 28.6 to 1 ratio.

Thus, the Runway 15 landing threshold can be displaced such that the lowered Amtrak poles would not penetrate the TSS. Similarly, the Runway 33 landing threshold can be displaced such that a 60-foot boat mast in the deep water channel would not penetrate the GQS. **Figure B-5** shows the proposed displaced landing thresholds.

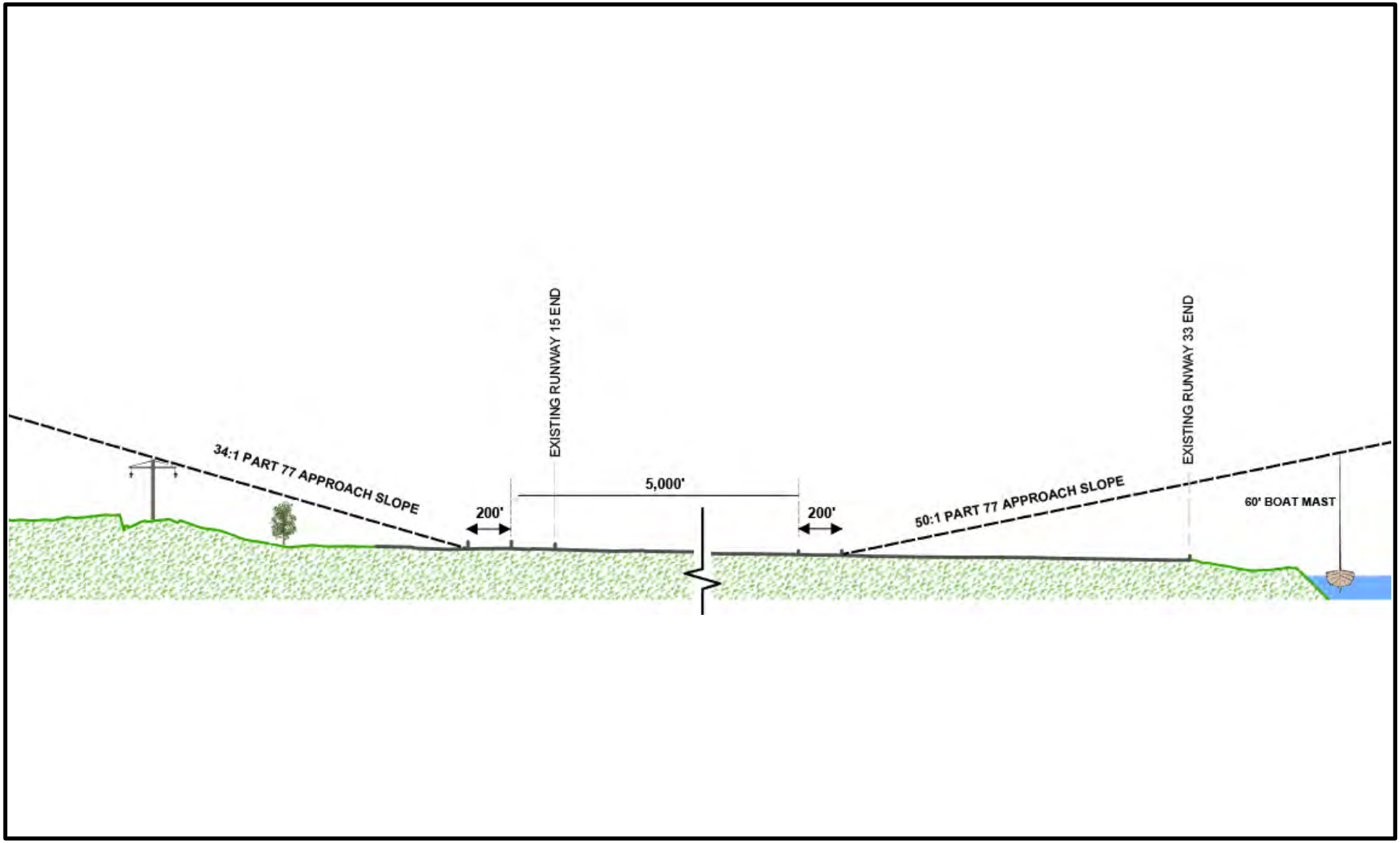


Figure B-4
Lower/Remove/Relocate Controlling Constraints and Relocate Thresholds

Source: MDOT MAA

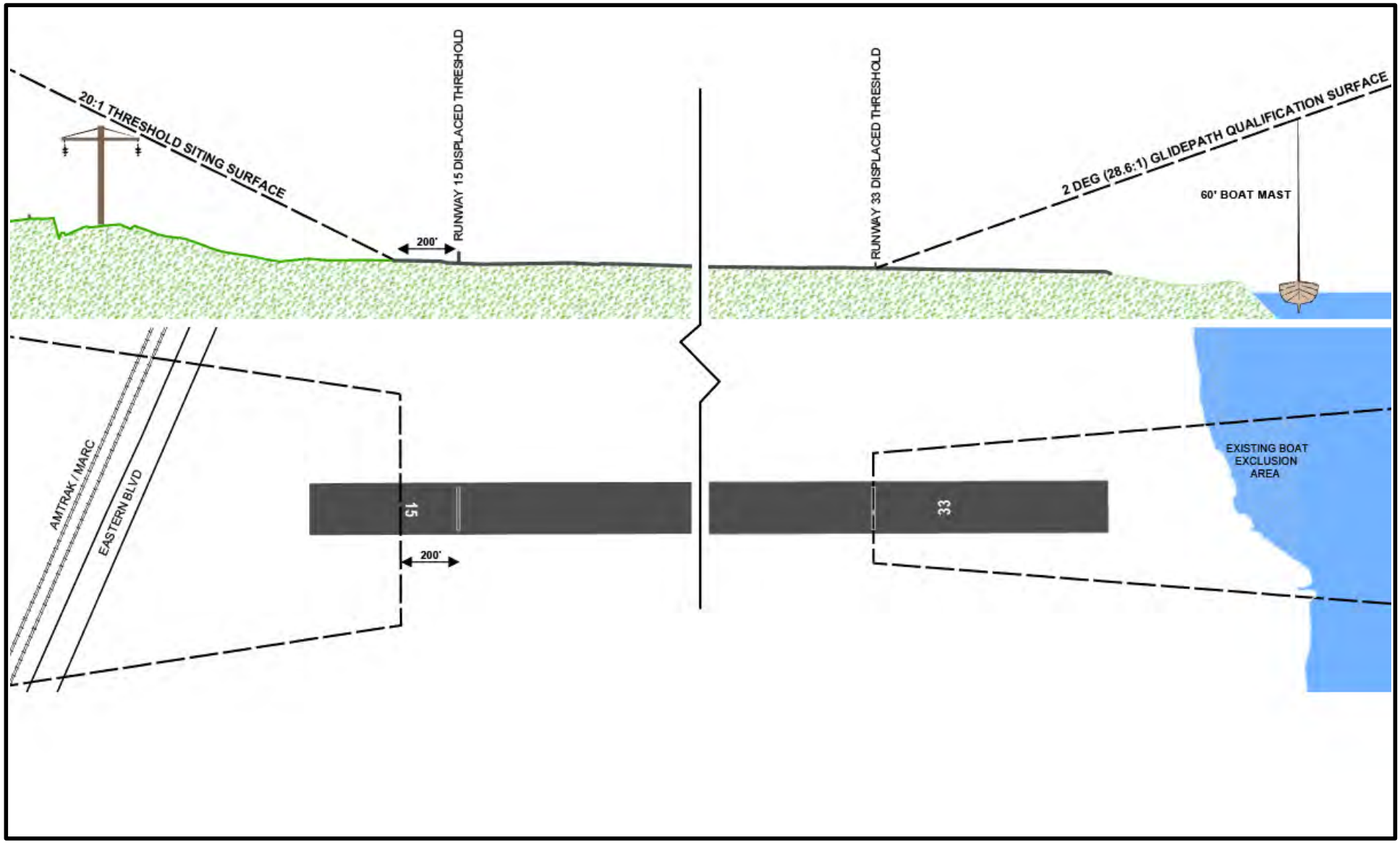


Figure B-5
Displaced Thresholds

Source: MDOT MAA

Displacing the landing thresholds addresses Part 77. However, displacing the landing thresholds alone does not address the RSA/ROFA deficiencies. Therefore, the concept of declared distances was also applied.

Declared Distances

With declared distances, the length of runway available for takeoffs and landings may be different than the actual physical length of the runway. "Declared distances represent the maximum distances available and suitable for meeting takeoff, rejected takeoff, and landing distances performance requirements for turbine powered aircraft. The declared distances are [Takeoff Run Available] TORA and [Takeoff Distance Available] TODA, which apply to takeoff; Accelerate Stop Distance Available (ASDA), which applies to a rejected takeoff; and Landing Distance Available (LDA), which applies to landing." [6] The lengths of the TORA and TODA are calculated to provide three-dimensional takeoff clearance. The length of the ASDA and LDA are calculated to provide two-dimensional clearance for aircraft operating on the runway. With declared distances, the TORA, TODA, ASDA and LDA are calculated for each operational runway direction.

Declared distances may be used to comply with RSA/ROFA requirements only when obtaining a standard RSA/ROFA is not practicable. To determine whether it would be practicable to obtain a standard RSA/ROFA at MTN, realigning, relocating, shifting and/or shortening the runway were considered. MTN is located on a narrow peninsula. Consequently, the runway cannot be relocated or realigned within the existing property. Relocating Eastern Boulevard and the Amtrak tracks to realign/relocate the runway and provide a standard RSA/ROFA would be impractical and extremely expensive. The Relocate Thresholds Only Alternative demonstrated that the runway could be shifted and shortened to provide a fully compliant RSA and ROFA and not require the relocation of Eastern Boulevard and the Amtrak tracks. However, the resulting runway length of approximately 6,700 feet would not meet the need to provide 7,000 feet of runway takeoff length. Therefore, it is not practicable to obtain a standard RSA/ROFA at MTN and it is permissible to apply declared distances to comply with RSA/ROFA requirements.

Only the LDA and ASDA lengths are adjusted to meet the RSA/ROFA requirements. For both, a portion of the runway is used to achieve the required RSA/ROFA. The required RSA/ROFA must be provided prior to the start of the LDA and after the end of the LDA. For the ASDA, the full RSA/ROFA must be provided beyond the end of the ASDA. The TORA and TODA are not adjusted to meet RSA and ROFA requirements and for MTN would be equal to the physical length of the runway.

The ASDA, TORA and TODA apply to takeoff and the LDA applies to landing. Thus, only the ASDA, TORA and TODA must be 7,000 feet or greater in order to provide the needed takeoff length at MTN. The TORA and TODA will be greater than the ASDA because they are not adjusted to meet the RSA/ROFA requirements. Therefore, the ASDA is the critical declared distance and was used to relocate the physical end of the runway.

The physical ends of the runway were established to provide an ASDA of at least 7,000 feet in both operational directions. The start of the ASDA begins at the physical end of the runway. The ASDA extends along the runway to the point where the full RSA/ROFA is provided.

Two sub-alternatives were developed; one with an ASDA of 7,000 feet and one with the maximum achievable ASDA. For both alternatives, the Amtrak poles would be lowered and the boat exclusion area would be established as previously described. The Runway 15 end threshold would be displaced such that the lowered Amtrak poles would not penetrate the 20:1 TSS. Also, the Runway 33 end threshold would be displaced such that sailboats outside the boat exclusion area would not penetrate the 28.6:1 GQS.

B.1.3.1 7,000-Foot ASDA Sub-Alternative

The first sub-alternative was developed to provide ASDAs of 7,000 feet in both directions. With this sub-alternative, the Runway 15 end would be relocated approximately 291 feet from the existing runway end. The Runway 15 landing threshold would be displaced by approximately 225 feet from the relocated runway end. The Runway 33 end would be relocated approximately 480 feet from the existing runway end. The Runway 33 landing threshold would be displaced by approximately 290 feet from the relocated runway end. The resulting sub-alternative is illustrated in **Figure B-6**.

B.1.3.2 Maximum ASDA Sub-Alternative

The second sub-alternative was developed to result in the longest ASDA possible provided the boats at the marina under the Runway 33 approach would not penetrate Part 77. Under this condition, the maximum ASDA from the Runway 33 end would be 7,100 feet. With this sub-alternative, the Runway 15 end would be relocated and the landing threshold would be displaced in the same manner as the first sub-alternative. However, the Runway 33 end would be relocated approximately 380 feet from the existing runway end. The Runway 33 landing threshold would be displaced by approximately 390 feet from the relocated runway end. The resulting sub-alternative is illustrated in **Figure B-7.**

B.1.3.3 Related Actions

To fully define the 7,000-foot ASDA and Maximum ASDA Sub-Alternatives, the actions needed to implement them were identified. The sub-alternatives are based on lowering/relocating the controlling obstacles, the Amtrak poles and the 60-foot mast sailboats. Therefore, both sub-alternatives would include burying the Amtrak transmission lines to allow the poles to be lowered to clear the approach and departure OCSs. The approach OCS would be the TSS. The departure OCS would begin at the end of the runway with a width of 1,000 feet, and extend 10,000 feet outward to a width of approximately 6,400 feet. The slope of the departure surface beyond the Runway 15 and 33 ends would be 18:1 and 16:1, respectively.

The sub-alternatives are also based on a boat exclusion area in Frog Mortar Creek. In this case, no action is needed because the boat exclusion area has already been established. The boat exclusion area was established in order to maintain the precision approach to the Runway 33 end. The Maryland Department of Natural Resources (MDNR) permanently codified the Boat Exclusion Area into Code of Maryland Regulations (COMAR), Title 08 in 2011. The limits of the boat exclusion area were established to correspond with the GQS, departure OCS and the boundaries of the deep water channel in Frog Mortar Creek, per the 2013 FAA-approved ALP. The boat exclusion area is illustrated in **Figure B-8**.

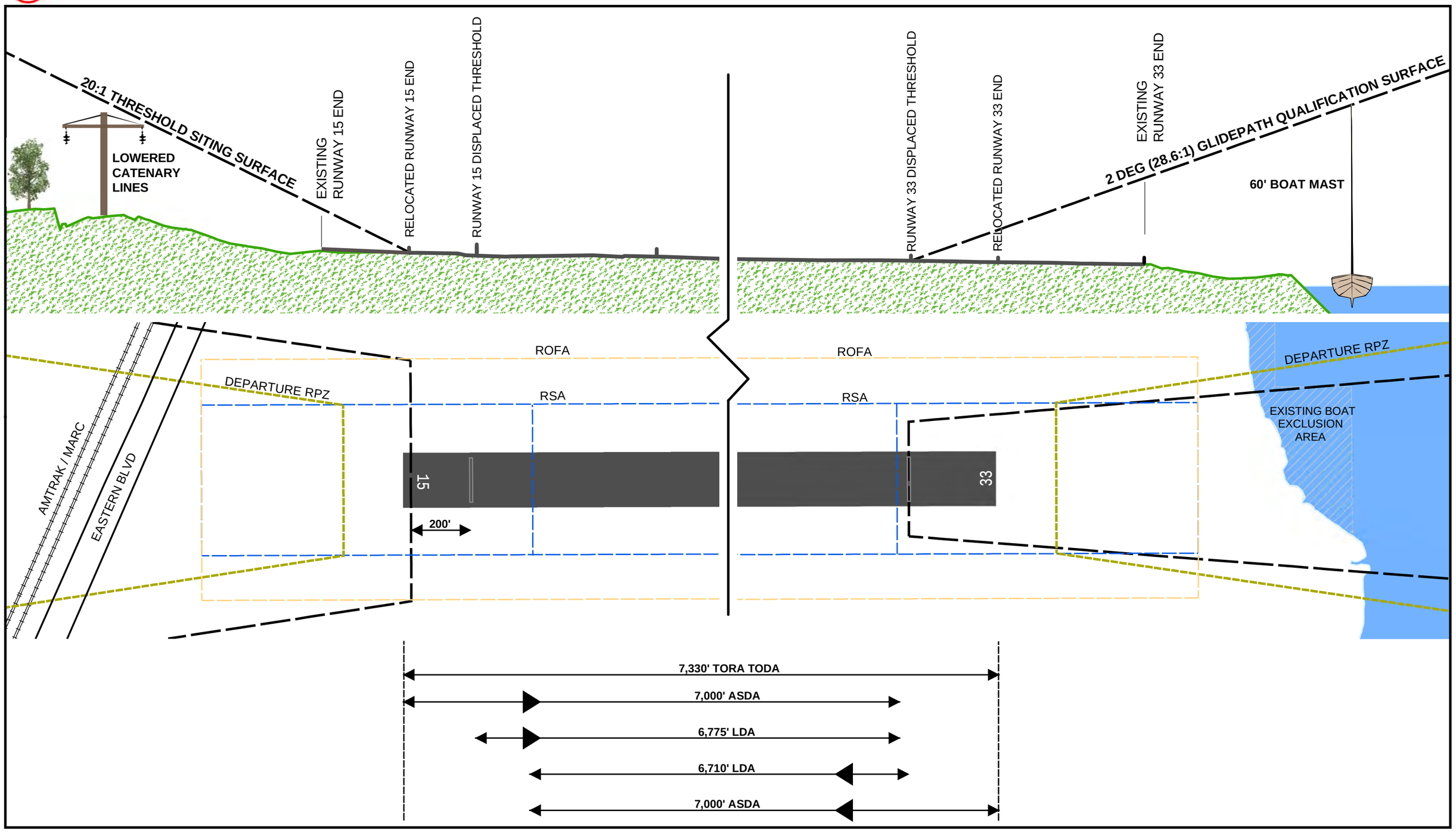


Figure B-6
7,000 foot ASDA Alternative

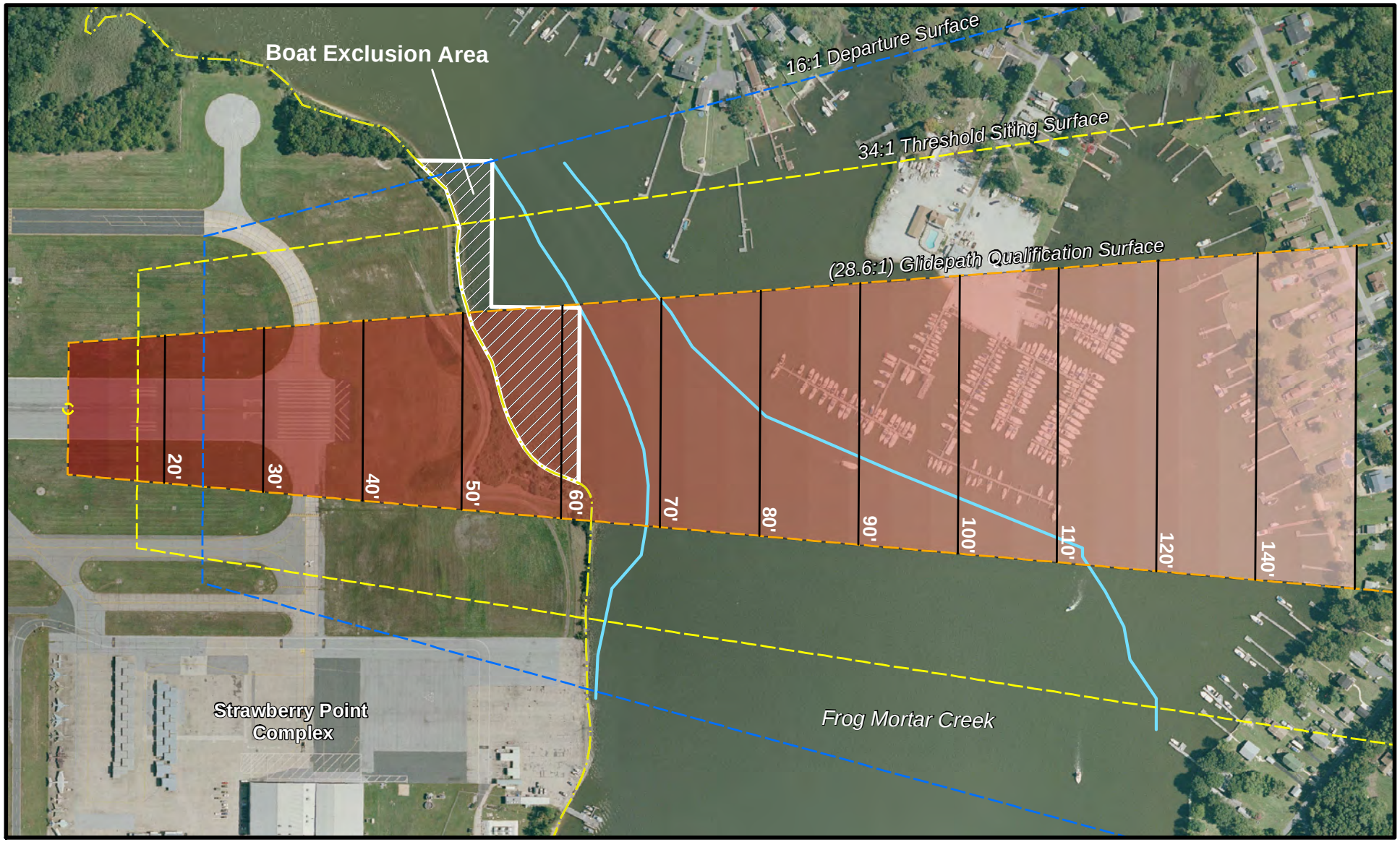
N

0 75 150 300 Feet

20:1 THRESHOLD SITING SURFACE
LOWERED CATENARY LINES
EXISTING RUNWAY 15 END
RELOCATED RUNWAY 15 END
RUNWAY 15 DISPLACED THRESHOLD
RUNWAY 33 DISPLACED THRESHOLD
RELOCATED RUNWAY 33 END
EXISTING RUNWAY 33 END
2 DEG (28.6:1) GLIDEPATH QUALIFICATION SURFACE
60' BOAT MAST
50:1 PART 77 APPROACH SLOPE
ROFA
RSA
DEPARTURE RPZ
AMTRAK / MARC
EASTERN BLVD
15
33
200'
EXISTING BOAT EXCLUSION AREA
7,430' TORA TODA
7,000' ASDA
6,775' LDA
6,710' LDA
7,100' ASDA

Figure B-7
Maximum ASDA Alternative

N
0 75 150 300 Feet



LEGEND

- Airport Property Line
- Boat Exclusion Area
- Deep Water Channel
- GQS Allowable Heights (MSL)

Figure B-8
Existing Boat Exclusion Area

Sources: ESRI, MDOT MAA

N

0 125 250 500 Feet

The remaining obstructions to Part 77 must also be addressed. Therefore, both sub-alternatives would also include removing/lowering obstructions. In general, where the property is under MDOT MAA control, obstructions to the Part 77 approach surfaces would be removed/lowered. For off-airport property, obstructions would be removed/lowered to clear the approach and departure OCSs.

Also, several actions would be required because the locations of the runway ends and landing thresholds would change. The runway would be re-marked and the runway lighting, threshold exit/entrance taxiways and NAVAIDs would be relocated. In addition, existing runway pavement beyond the relocated runway ends, referred to as an aligned taxiway, would be removed because the FAA prohibits the use of this pavement as a taxiway.[7] A detailed discussion of the associated NAVAID relocations and taxiway realignments are discussed later in the NAVAIDs and Taxiway sections, respectively.

Finally, because the Runway 15 end displacement and relocation would shift the runway closer to the Airport property limits, the departure runway protection zone (RPZ) would extend onto property outside the Airport property limits. "The RPZ's function is to enhance the protection of people and property on the ground. This is best achieved through airport-owner control over RPZs. Control is preferably exercised through the acquisition of sufficient property interest in the RPZ and includes clearing RPZ areas (and maintaining them clear) of incompatible objects and activities."[8] Therefore, both sub-alternatives would include acquiring property interest within the Runway 15 end departure RPZ.

Both sub-alternatives would address the deficiencies related to the RSA, ROFA and Part 77, and provide 7,000 feet of runway takeoff length.

However, both sub-alternatives would require extensive vegetative obstruction removal, approximately 111 acres, to clear Part 77 on-airport and the OCSs off-airport. The detailed list of actions that would be included in 7,000-foot ASDA and Maximum ASDA Alternatives is provided in **Table B.1**. Of the 111 acres, approximately 47 acres are within the Chesapeake Bay Critical Area (Critical Area) and approximately 34 acres are within environmentally sensitive areas (ESAs). Therefore, MDOT MAA met with stakeholder agencies to discuss the impacts of the proposed vegetation removal and potential mitigation. The stakeholder agencies expressed concern and the Critical Area Commission indicated that even with mitigation the vegetation removal would result in a significant impact. Therefore, both the 7,000-Foot ASDA and Maximum ASDA Alternatives were eliminated from further consideration due to the significant vegetation removal impacts.

Table B.1

Actions Required for 7,000-Foot ASDA and Maximum ASDA Alternatives

Primary Action	Related Actions	
Address Remaining Part 77 Obstructions	Clear Part 77 (on-airport)	• Remove vegetative obstructions to clear Part 77 surfaces. • Address man-made obstructions in accordance with the ALP.

	Clear Runway 15 off-airport approach and departure surfaces	• Remove off-airport vegetative obstructions to clear the 20:1 TSS and the 18:1 departure OCS. Any tree replacement will be completed with low growth species.
		• Clear off-airport non-vegetative obstructions such that all will be clear of the 20:1 TSS. Some non-vegetative obstructions will remain penetrations to the Part 77 34:1 approach surface. [See the ALP for the disposition on each obstruction.]
		  ○ Lower the Amtrak catenary lines/poles to approximately 30 feet above ground level.
		  ○ Remove or lower all other non-vegetative obstructions south of Amtrak to be clear of the 20:1 approach TSS.
		  ○ Relocate or lower street lights and signs as specified in Sheet 9 of the ALP set to clear Part 77 (34:1) where possible, and if unachievable, lower to clear the 20:1 approach TSS.
		• Acquire easements for vegetative and non-vegetative obstruction removal.

	Clear Runway 33 off-airport approach surfaces	• Remove off-airport vegetative obstructions to clear the 34:1 approach TSS. Any tree replacement will be completed with low growth species. • Acquire easements for vegetative obstruction removal.

Relocate Runway Ends (Relocate Runway 15 end 291' and Runway 33 end 480')	Adjust Runway	• Relocate Runway 15 end 291'
		• Relocate Runway 15 threshold 225'
		• 7,000' ASDA:
		  ○ Relocate Runway 33 end 480'
		  ○ Relocate Runway 33 threshold 290'
		• Maximum ASDA:
		  ○ Relocate Runway 33 end 380'
		  ○ Relocate Runway 33 threshold 390'
		• Re-mark runway pavement.
		• Relocate runway lighting.
		• Construct blast pads.

	Relocate NAVAIDs	Relocate the PLASIs, REILs and Runway 33 Glide Slope.
	Relocate Taxiways	• Relocate Taxiway A to align with the relocated Runway 15 end. • Relocate Taxiway E to align with the relocated Runway 33 end. • Remove the aligned taxiways at the ends of Runway 15 and 33.
	Acquire Property	Acquire Runway 15 Departure RPZ property interest (easements).

Source: MDOT MAA, 2017.

B.1.3.4 Marking and Lighting Plan

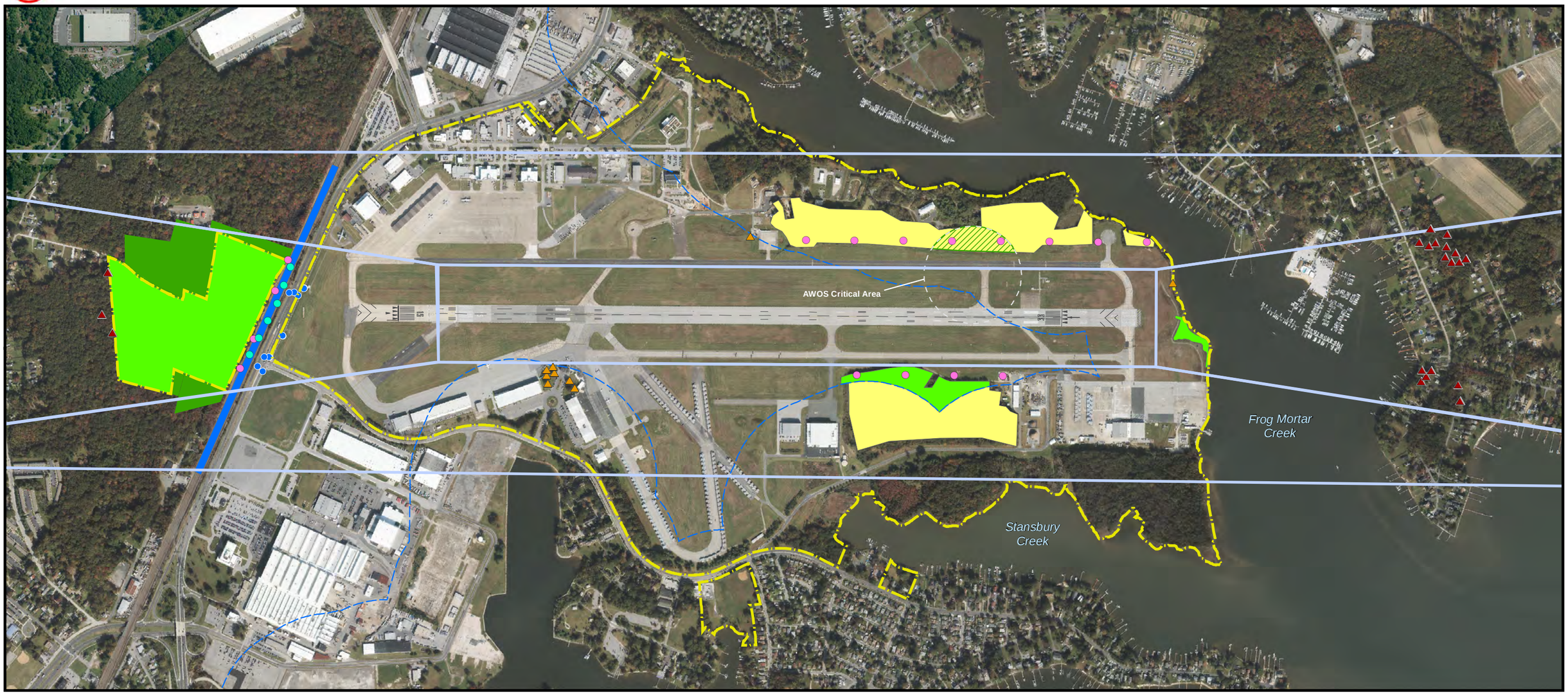
In response to agency concerns, the MDOT MAA worked with the FAA to evaluate potential methods to reduce the vegetation removal required under the 7,000-Foot ASDA and Maximum ASDA Sub-Alternatives described previously. Potential methods included conducting additional detailed obstruction analysis and development and approval of a Marking and Lighting (M&L) Plan.

According to FAA AC 150/5300-13A, Change 1, removal of penetrations to Part 77 surfaces is not required when the FAA determines that the penetrations are not hazards to air navigation. "However, any existing or proposed object, whether man-made or of natural growth that penetrates these surfaces is classified as an "obstruction" and is presumed to be a hazard to air navigation. These obstructions are subject to an FAA aeronautical study, after which the FAA issues a determination stating whether the obstruction is in fact considered a hazard. The Airport operator must conduct a detailed analysis considering the requirements of Order 8260.3B, TERPS [United States Standard for Terminal Instrument Procedures], to ensure all applicable surfaces are captured." [9]

The MDOT MAA completed a targeted TERPS analysis which showed that the vegetative Part 77 obstructions along the sides of the runway would not likely penetrate TERPS surfaces. In response to this analysis the FAA required a M&L Plan be developed for the transitional surface and along MDOT MAA property lines in the approach surfaces.

A M&L Plan was developed to address on-airport and off-airport areas for impacts to the navigational surfaces and NAVAID critical areas, and to develop strategies to minimize the removal of vegetative obstructions through the installation of obstruction lights. Completely removing all obstructions within the Part 77 surfaces was found to be not practicable due to the presence of the AMTRAK catenary poles and the extent of tree removal within the Critical Area and ESAs which would result in a significant impact.

Therefore, the overall goal of the M&L Plan was to minimize the vegetative Part 77 obstruction removal within the Critical Area and ESAs through the use of marking and/or lighting. Generally, removal of on-airport Part 77 vegetative obstructions is required, except when located within the Critical Area or ESAs where they would be mitigated by obstruction lighting. In order to minimize the wildlife attractant concern, the remaining forested areas on-airport property would be confined by an 11-foot fence. The proposed fence is discussed in Section 1.2, Proposed Action and Table 1.2.1. Also refer to Section 2.1.2.4, Wildlife Hazards for discussion of the need for the fence. Off-airport Part 77 vegetative obstructions would remain and be mitigated by obstruction lighting. On- and off-airport vegetative obstructions would be removed completely within the TSS, OCS, and NAVAID critical areas. The detailed list of actions needed to implement the M&L Plan is provided in **Table B.2**. The actions listed in Table B.1 to relocate the runway ends would be combined with those defined in Table 3.2.2 to create 7,000-Foot ASDA and Maximum ASDA sub-alternatives. **Figure B-9** illustrates the M&L plan implementation, including the proposed obstruction removal and location of obstruction lights and marker balls. The obstruction lights and marker balls off the Runway 15 end would be installed on top of AMTRAK poles and along the AMTRAK lines, respectively. The obstruction lights on either side of the airfield would be installed on light poles. While implementation of the M&L Plan will allow Part 77 obstructions to remain within the CBCA



LEGEND

AIRPORT PROPERTY LINE

OBSTRUCTIONS

- ON-AIRPORT VEGETATION REMOVAL
- OFF-AIRPORT VEGETATION REMOVAL
- MAN-MADE OBSTACLE MITIGATION
- ON-AIRPORT ISOLATED TREE REMOVAL
- OFF-AIRPORT ISOLATED TREE REMOVAL
- AWOS VEGETATION REMOVAL
- PART 77 SURFACES
- CHESAPEAKE BAY CRITICAL AREA

MARKING & LIGHTING PLAN

- OBSTRUCTION LIGHT
- LIGHTED SPHERICAL MARKER BALL
- ON-AIRPORT VEGETATION TO REMAIN

Figure B-9
Marking and Lighting Plan

Sources: MAA (Aerials - 2018, June 2020 ALP)

0 500 1,000 2,000 Feet

and ESAs, the marking or lighting of these remaining obstructions will follow design outlined in FAA AC 70/7460-1L, "Obstruction Marking and Lighting," to meet FAA safety requirements.

FAA approved the M&L Plan on April 10, 2018. See *Appendix E, Attachment 6* for the Approved M&L Plan, and FAAs final determination for obstruction marking and lighting. Implementation of the M&L Plan would reduce the total vegetation removal required from approximately 111 acres to 69 acres. The vegetation removal in the Critical Area would be reduced from approximately 47 acres to approximately 5 acres and the vegetation removal in ESAs would be reduced from approximately 34 acres to approximately 21 acres. With the reduction in vegetation removal included through implementation of the M&L Plan, the 7,000-Foot ASDA and Maximum ASDA sub-alternatives are carried forward for further consideration.

Table B.2

Marking and Lighting Plan Actions

Primary Action	Related Actions	
Runway 15 End	On-Airport	• Remove trees that are obstructions to the Part 77 34:1 approach surface, 20:1 TSS and 18:1 departure OCS (replace with low growth trees) ~119 trees[1]
	Off-Airport	• Remove trees that are obstructions to the 20:1 TSS and 18:1 departure OCS (replace with low growth trees) ~19.7 acres and 3 trees • Lower the AMTRAK catenary lines/poles to the 20:1 TSS (lower 25' to 63' MSL) • Mitigate off-airport Part 77 34:1 approach surface obstructions through use of obstruction lighting o Install 4 lights on top of the lowered AMTRAK catenary poles o Install 6 spherical marker balls on the lowered AMTRAK catenary lines.
On-Airport Transitional Surfaces	MDANG Side	• Remove all trees within the AWOS critical area (clear cut) ~ 3.6 acres • Outside CBCA: No obstructions present. • Inside CBCA: Mitigate Part 77 7:1 transitional surface obstructions through use of obstruction lighting o Install 8 lights on the same horizontal plane as the highest edge of the prominent obstruction closest to the landing area
	Civilian Side	• Outside CBCA: Remove trees that are obstructions to the Part 77 7:1 transitional surface ~ 5.9 acres and 7 trees • Inside CBCA: Mitigate Part 77 7:1 transitional surface obstructions through use of obstruction lighting o Install 4 lights on the same horizontal plane as the highest edge of the prominent obstruction closest to the landing area
Runway 33 End	On-Airport	• Remove trees that are obstructions to the Part 77 50:1 approach surface, 34:1 TSS, and 16:1 departure OCS ~11 trees (1.1 acres)
	Off-Airport	• Remove trees that are obstructions to the 34:1 TSS or the 16:1 departure OCS ~17 trees • Obstructions to the Part 77 50:1 approach surface are within the CBCA and will remain

[1] Trees which are projected to be lesser penetrations to Part 77 than the lowered AMTRAK catenary poles and trees within wetlands could be mitigated with obstruction lighting rather than be removed completely, if allowed by the FAA.

B.2 Runway Grade

The existing Runway 15-33 longitudinal centerline grade does not meet FAA standards. In order to meet FAA standards, the grade of the runway would be adjusted by adding asphalt overlays. The depth of the overlays along the runway would vary. Two alternatives were developed to minimize the average depth of the overlays based on the following FAA standards:

- Longitudinal grades in the first and last quarter of the runway are less than ±0.80 percent. [10]
- No grade changes in the first and last quarter of the runway. [11]
- The longitudinal grade for the first 200 feet of the RSA beyond the runway ends is between 0 and 3.0 percent, with any slope being downward from the ends. [12]

The difference between the alternatives is the grade for the portion of runway located within the RSA. For Alternative 1, illustrated in **Figure B-10**, the runway grade standards were used to develop the runway profile for the Runway 15 pavement within the RSA. The average overlay depth with this alternative would be 6.5 inches.

For Alternative 2, illustrated in **Figure B-11,** the RSA grade standards were used to develop the runway profile for the Runway 15 pavement within the RSA. This alternative would require a break in runway grade at the beginning of the RSA because the runway slopes up and the first 200 feet of RSA must be flat or slope down no more than 3.0 percent. A modification of standards (MOS) would be required to allow for the grade break within the first quarter of the Runway. The average overlay depth with this alternative would be 11.5 inches.

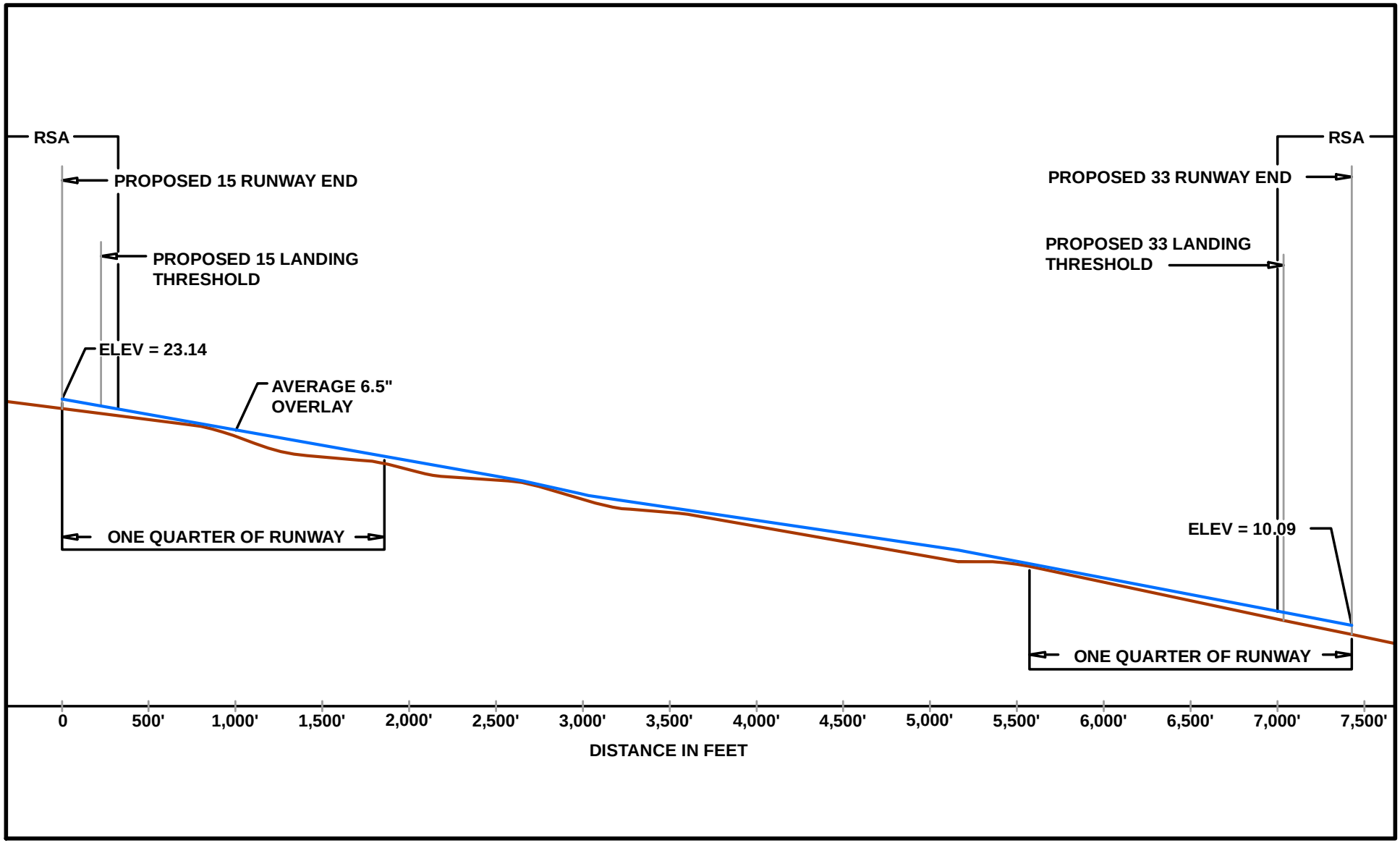
Alternative 1 would require less additional pavement than Alternative 2. Also, while Alternative 2 requires a MOS, Alternative 1 does not. Therefore, Alternative 1 was the only runway grade action alternative carried forward for further consideration.

Sub-alternatives for Alternative 1 were considered. The sub-alternatives consisted of variations on the runway typical section.

The typical section includes the runway and runway shoulders, if provided. The existing runway section at MTN consists of 180 feet of full strength pavement and no runway shoulders. The previous ALP approval letter from the FAA states, “The FAA has also determined that future AIP funding is limited to a runway with a 100 foot width…” [13] Therefore, the MDOT MAA considered alternatives to provide a 100-foot wide runway.

Several factors were considered in identifying runway section sub-alternatives:

- The existing runway pavement is in good condition.
- Pavement removal is costly.
- Paved shoulders are not required but are recommended for runways accommodating ADG-III aircraft. [14] Since paved shoulders are recommended they would be eligible for AIP funding.



LEGEND

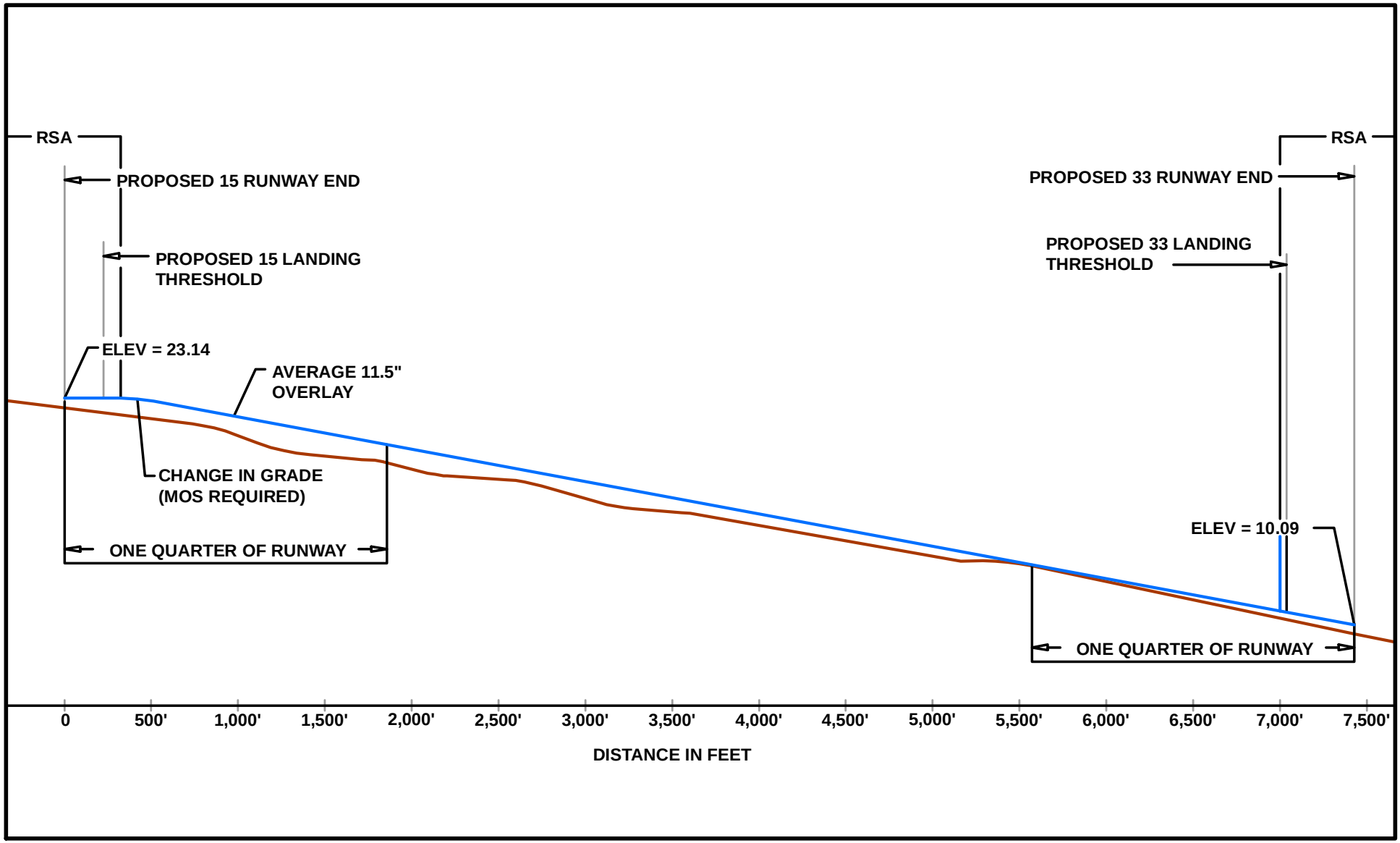
- Existing Ground
- Future Grade

Figure B-10
Alternative 1 Runway Profile

Sources: ESRI, MDOT MAA

N

0 200 400 800 Feet



LEGEND

- Existing Ground
- Future Grade

Figure B-11
Alternative 2 Runway Profile

Sources: ESRI, MDOT MAA

0 200 400 800 Feet

- The recommended shoulder width for the Gulfstream V, the MTN design aircraft, is 20 feet.[15]
- The MANG needs 150-foot wide runway to accommodate their aircraft fleet.

As a result of considering these factors, three runway section sub-alternatives were identified:

- a 100-foot wide runway with 20-foot wide paved shoulders (remove 40 feet of pavement);
- a 100-foot wide runway with 20-foot wide turf shoulders (remove 80 feet of pavement); and
- a 150-foot wide runway with 15-foot wide paved shoulders (no pavement removal required).

The runway section sub-alternatives with the paved shoulders are preferred because they would likely require less pavement removal. The runway sections alternatives are illustrated in **Figure B-12**. All three runway section sub-alternatives were carried forward for further consideration.

B.3 ATCT

Several alternatives were considered to address the need to provide improved visibility from the ATCT to the Runway 33 threshold. Alternatives included modifying the existing ATCT and constructing a replacement ATCT.

B.3.1 Modify the Existing ATCT Alternative

The tower cab of the existing ATCT would have to be raised to provide improved visibility of the Runway 33 threshold. The tower structure, constructed in the 1940s, has outlived its useful life.[16] Thus, the existing ATCT would not likely be structurally capable of supporting additional height. Furthermore, the existing ATCT is a historic resource and physically altering it may result in an adverse environmental impact. Therefore, the alternative to modify the existing ATCT was eliminated from further consideration.

B.3.2 Replace the ATCT Alternative

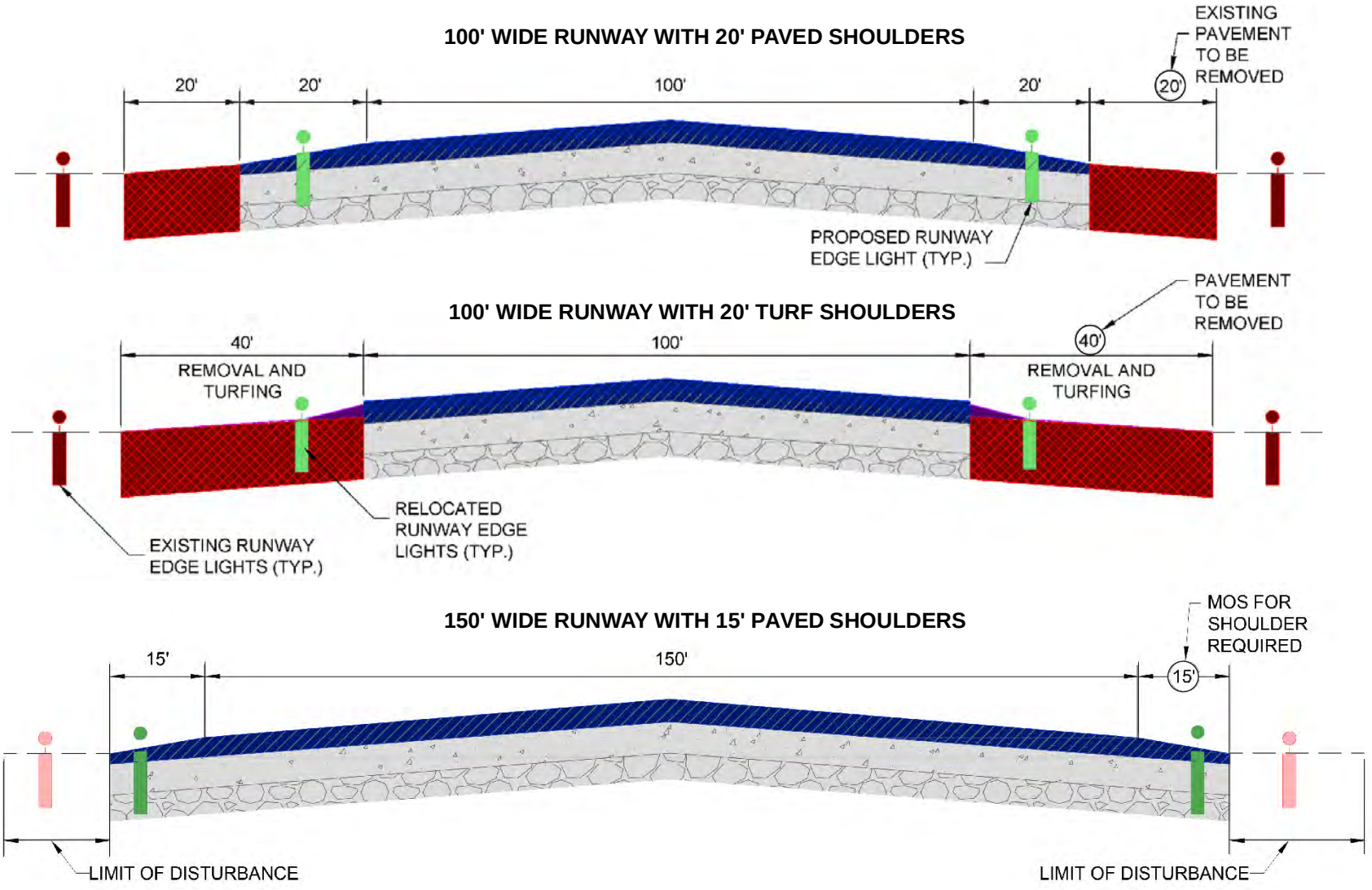
Sites for a replacement ATCT were evaluated in an ATCT Site Selection Study completed in 2003 (2003 ATCT Study); a supplemental ATCT Executive Summary Site Selection Report completed in 2004 (2004 ATCT Study); and an ATCT Other Site Study completed in 2017 (2017 ATCT Study). See *Appendix A, Attachments 3, 4 and 5 for these ATCT reports.*

B.3.2.1 2003 ATCT Study

The objectives of the 2003 ATCT Study were to:

- provide an ATCT that meets the basic controller requirements; and
- improve the visibility of the runway approaches with preference to the Runway 33 approach because it is the predominant landing approach and has a precision instrument approach procedure for landing when visibility is reduced.[17]

Nine preliminary ATCT sites were identified in the 2003 ATCT Study. The locations of the nine sites are shown on **Figure B-13.** The ATCT sites were evaluated by applying the siting



LEGEND

- Pavement Overlay
- Existing Pavement
- Pavement to be Removed

Figure B-12
Alternative Runway Sections

Source: ADCI

LEGEND

1 ATCT Alternative Site

Airport Property Line

Figure B-13
ATCT Alternative Sites

Sources: MDOT MAA (Aerials - 2011, ALP - October, 2015)

0 250 500 1,000 Feet

requirements in FAA Order 6480.4, *Airport Traffic Control Tower Siting Criteria*. The results of the siting requirements evaluation are summarized in **Table B.3**. Based on the siting requirements evaluation, five of the nine sites were eliminated from further consideration.

More detailed evaluations were conducted for the four remaining sites (Sites 2, 3, 5 and 9), including minimum tower height assessment, line-of-sight studies, preliminary environmental impact analysis and cost estimates. Results of the evaluation for the differentiating evaluation criteria are provided in **Table B.4.**

At the conclusion of the 2003 Study, Site 3 was identified as the preferred site because:

- it is closer to the Runway 33 end than Sites 5 and 9;
- it has less environmental impacts than Sites 2 and 5;
- it has a required tower height that is less than that for Sites 2 and 5 and thereby development costs are reduced; and
- unlike Site 9, it avoids:
  - providing a south/southwest tower orientation which is the least desirable direction for ATCTs in the northern hemisphere;
  - having civilian facilities /personnel in the MANG leasehold area; and
  - relocating control cables across the airfield. [18]

Table B.3
Evaluation of Preliminary ATCT Sites

Site	General Location	Results of Siting Requirements Evaluation	
1	Midfield	Dismissed	Set back too far from the airfield to provide optimum visibility.
2	Midfield	Retained	292 feet closer to the runway than SIte 1. Airfield visibility is better than SIte 1.
3	Midfield	Retained	140 feet closer to the runway than SIte 2. Airfield visibility is improved compared with SItes 1 and 2.
4	Midfield T-Hangar Area	Dismissed	Site is not vacant. Greatest negative impact on the future development of the midfield area.
5	Adjacent to Existing Tower	Retained	Airfield lighting control cables are nearby.
6	Behind Existing Tower	Dismissed	Further from Runway 33 than Site 5.
7	Near Strawberry Point	Dismissed	Not centrally located. Insufficient visibly to Runway 15. Forested wetlands impacts.
8	Near Strawberry Point	Dismissed	Not centrally located. Insufficient visibly to Runway 15.
9	MANG	Retained	Only site on the north side of the Airport. Provides clear line-of-sight

Source: Maryland Aviation Administration, Martin State Airport, Airport Traffic Control Tower Site Selection Report, December 2003.

Table B.4

Detailed Evaluation of ATCT Sites

Evaluation Criteria	Evaluation Results			
	Site 2	Site 3	Site 5	Site 9
Site Conditions	Undeveloped, level, maintained, on airport property.	Undeveloped, level, maintained, on airport property.	Displaces a portion of the terminal ramp that is used for parking aircraft.	Undeveloped, level, and regularly maintained. Site is on airport property leased to the MANG.
Visibility from Site	Very good visibility of the designated aircraft movement areas - all but small segments of TWs E and F. Neither Strawberry Point nor the West Corporate hangars/apron is visible.	Very good visibility of the designated aircraft movement areas. The last 750 feet of TW F and most of TW E are obstructed. Strawberry Point hangars and apron area, TW A, and the West Corporate hangars/apron area are also obstructed.	Very good visibility of the designated aircraft movement areas. The Strawberry Point hangars and apron area are not visible because of the trees.	Overall, excellent visibility of the entire airfield.
Controller (ATCS) Eye Height	95 feet AGL	63.5 feet AGL (2003)/ 124 feet AGL (2004)	74.5 feet AGL	63.5 feet AGL
Tower Height	105 feet AGL	73.5 feet AGL (2003)/ 134 feet AGL (2004)	84.5 feet AGL	73.5 feet AGL
Tower Cab Orientation(1)	north/northeast	north/northeast	north/northeast	southwest
Visibility of Non-Movement Areas	Strawberry Point, terminal apron and West Corporate Ramp/tie-down ramps obstructed/partially obstructed.	Overall, visibility not appreciably different than Site 2.	Strawberry Point obstructed by trees.	Strawberry Point partially obstructed by hangars.
Weather Phenomena	Improved - closer to RW 33.	Improved - closer to RW 33.	No improvement.	Improved - closer to RW 33.

Table B.4

Detailed Evaluation of ATCT Sites

Evaluation Criteria	Evaluation Results			
	Site 2	Site 3	Site 5	Site 9
Compatibility with Existing and Future Development	No existing or potential land use conflicts.	No existing or potential land use conflicts.	No existing or potential land use conflicts.	No existing or potential land use conflicts. Agreements with MANG needed for the location, construction, operation of and routine access to the ATCT.
Environmental(2)	Clear 2.7 acres of trees.	Clear 1.9 acres of trees.	Potential adverse effect on historic resource.	None.
Airfield Electrical Control Cables	Major re-routing and modifications required.	Major re-routing and modifications required.	No major modifications required.	Major modifications required.
Development Cost	$6.2 million	$4.0 million (2003)/ $6.2 million (2004)	$3.3 million	$5.0 million

Notes:

(1) Southwest is the least desirable direction for ATCTs in the northern hemisphere.

(2) Permanent impacts only. All sites would involve temporary construction impacts.

Sources: Maryland Aviation Administration, Martin State Airport, Airport Traffic Control Tower Site Selection Report, December 2003 and DMJM Aviation/AECOM, Martin State Airport (MTN) Baltimore, Maryland, Airport Traffic Control Tower (ATCT) Site Selection Report Executive Summary, April 5, 2004.

B.3.2.2 2004 ATCT Study

In 2004, FAA concurred with the Site 3 location at a tower height of 134 feet AGL, per the supplemental 2004 ATCT Executive Summary Site Selection Report. At this elevation the ATCT afforded a clear line-of-sight to all aircraft movement areas as opposed to the tower height of 73.5 feet AGL proposed in the 2003 ATCT Study.[xix]

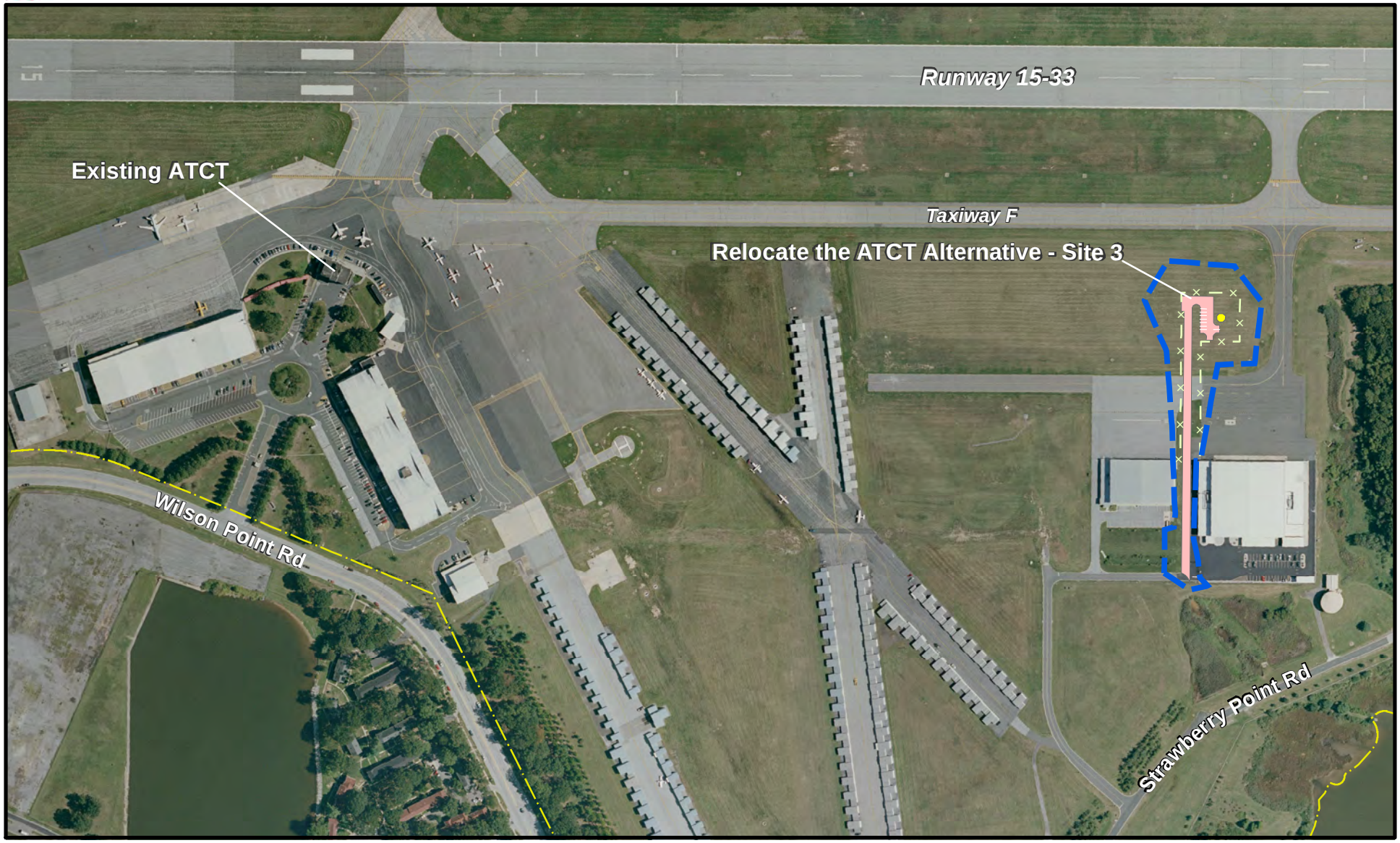
B.3.2.3 2017 ATCT Study

The 2017 ATCT Study analyzed three of the potential ATCT sites analyzed in the 2003 ATCT Study: Sites 3, 5 and 9. Through a Siting analysis, Site 5 was eliminated from consideration, and ultimately Site 3 was recommended for development. The Safety Risk Management Document (SRMD) performed as part of the 2017 ATCT Study determined it would not be necessary to see over the existing ATCT (as assumed it in the 2004 ATCT Study). Therefore, Site 3 was evaluated at a tower height of 83 feet AGL, lower than the 2004 ATCT Study eye height of 134 feet AGL. The 2017 ATCT Study identified the following impacts resulting from the construction of an ATCT at Site 3:

- ATCT penetrates the FAR Part 77, 7:1 transition surface by 78'. ATCT will be marked and lighted with obstruction lights.
- Existing ATCT and trees limit visual performance.
    - North extension of Taxiway F to T/W A to be constructed.
    - Trees along the southern part of Taxiway F are obstructions to the Part 77 transitional surface and will be removed.
- ATCT will require double transparent shades in the cab on East and South windows (4) due to the effects of sunrise and sunset.[xx]

Site 3 meets all FAA siting criteria and was deemed preferred under the Safety Management System (SMS). The proposed tower would provide completely unobstructed views of all controlled airport surface areas and maximum visibility of airborne traffic.

As a result of the recommendations in the three ATCT studies, as well as the FAA concurrence with Site 3 in 2004, Site 3 is retained for detailed environmental study, as shown in **Figure B-14**.



LEGEND

- Airport Property Line
- Limit of Disturbance
- Proposed ATCT
- New Pavement
- New Fence

Figure 3.5-1
Relocate the ATCT Alternative - Site 3

Sources: ESRI, MDOT MAA

0 100 200 400 Feet

Endnotes

[1] HNTB Corporation and Wilbur Smith Associates, *Martin State Airport, Airport Layout Plan Update*, February 8, 2011, p. 4-6.

[2] HNTB Corporation and Wilbur Smith Associates, *Martin State Airport, Airport Layout Plan Update*, February 8, 2011, p. 4-6.

[3] HNTB Corporation and Wilbur Smith Associates, *Martin State Airport, Airport Layout Plan Update*, February 8, 2011, p. 4-9.

[4] HNTB Corporation and Wilbur Smith Associates, *Martin State Airport, Airport Layout Plan Update*, February 8, 2011, p. 4-8.

[5] FAA, AC 150/5300-13A, Change 1, *Airport Desig*n, 2/26/14, p. 47.

[6] FAA, AC 150/5300-13A, Change 1, *Airport Design*, 2/16/14, p. 96.

[7] FAA, AC 150/5300-13A, Change 1, *Airport Design*, 2/26/14, p. 159.

[8] FAA, AC 150/5300-13A, Change 1, *Airport Design*, 2/26/14, p. 71.

[9] FAA, AC 150/5300-13A, Change 1, *Airport Design*, 2/26/14, p. 58.

[10] FAA, AC 150/5300-13A, Change 1, *Airport Design*, 2/26/14, p. 80.

[11] FAA, AC 150/5300-13A, Change 1, *Airport Design*, 2/26/14, p. 80.

[12] FAA, AC 150/5300-13A, Change 1, *Airport Design*, 2/26/14, p. 82.

[13] FAA, Terry J. Page, Martin State Airport, Airport Layout Plan letter to Mr. Wiedefeld (MAA) dated 7/7/11.

[14] FAA, AC 150/5300-13A, Change 1, *Airport Design*, 2/26/14, p. 54.

[15] FAA, AC 150/5300-13A, Change 1, *Airport Design*, 2/26/14, p. 94.

[16] HNTB Corporation and Wilbur Smith Associates, *Martin State Airport, Airport Layout Plan Update*, February 8, 2011, p. 3-25.

[17] Maryland Aviation Administration (MAA), *Martin State Airport (MTN) Baltimore Maryland Airport Tower Traffic Control Tower (ATCT) Site Selection Report*, December 2003, p. 9-1.

[18] MAA, *Martin State Airport (MTN) Baltimore Maryland Airport Tower Traffic Control Tower (ATCT) Site Selection Report*, December 2003, p. 9-2.

[xix] MAA, *Martin State Airport (MTN) Baltimore Maryland Airport Tower Traffic Control Tower (ATCT) Site Selection Report Executive Summary*, April 2004, p. 2.

[xx] MAA, *MTN ATCT Other Site Study, Safety Risk Management Document, Executive Summary*, December 20, 2017, p. 2.