ORDER

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

8260.36A

1/19/96

SUBJ: CIVIL UTILIZATION OF MICROWAVE LANDING SYSTEM (MLS)

1. PURPOSE. This order provides criteria for establishing time reference-scanning-beam MLS approaches at airports in conjunction with Order 8260.3B, United States Standard for Terminal Instrument Procedures (TERPS). In addition to basic straight-course procedures, these criteria provide guidance for MLS area navigation (RNAV), including computed straight and curved path procedures. Also, guidance for azimuth-only landing minimums and azimuth-only approaches to secondary runways is included. These criteria are the result of data collected from the MLS Flight Test Program and are consistent with many years of data collection for the existing instrument landing system (ILS) conducted both by the United States and the international aviation community. Criteria in this order and Order 8260.3B shall be applied to develop MLS standard instrument approach procedures.

2. DISTRIBUTION. This order is distributed to the branch level in the offices of System Safety; Aviation Policy and Plans; Air Traffic Systems Development; Aviation Research; Communication, Navigation, and Surveillance Systems; Airport Safety and Standards; Aviation System Standards; Air Traffic Rules and Procedures; and in the Services of Flight Standards, and Airway Facilities; to the National Airway Systems Engineering Division; to the National Flight Procedures Office; to the Regulatory Standards and Compliance Division at the Mike Monroney Aeronautical Center; to the branch level in the regional Flight Standards, Air Traffic, Airway Facilities, and Airports divisions; to all Flight Inspection Area Offices, and the International Flight Inspection Office; to the Europe, Africa, and Middle East International Area Office; to all Flight Standards District Offices; to all Airway Facilities Sectors, and Sector Field Offices; and to all addresses on special distribution lists ZVN-826, ZVS-827, and ZAT-423.

3. CANCELLATION. Order 8260.36, Civil Utilization of Microwave Landing System, dated November 7, 1988, is canceled.

SECTION 1. GENERAL CRITERIA

4. GENERAL. The obstacle free zones (OFZ), as outlined in Advisory Circular 150/5300-13, Airport Design, shall be considered when applying the criteria of this order. In addition to the application of the MLS obstacle clearance surfaces, the limitations described in paragraph 20 shall be met. For procedures located in an obstacle-rich environment, as defined in paragraph 7 dd, see section 5, paragraphs 33 and 34.

Distribution: A-W(SY/PO/UA/AR/ND/AS/VN/TP/FS/AF)-3; AOS-200(10CYS); AVN-100(150CYS); AMA-200(80CYS); A-X(FS/AT/AF/AS)-3; A-FFS-4(ALL); AEU-1(10CYS); A-FFS-7(STD); A-FAF-2/3/7(STD); ZVN-826; ZVS-827; ZAT-423

Initiated By: AFS-400

The MLS reference datum point (RDP) may be determined after the procedure has been developed following compliance with paragraph 11. When constructing the geometry of an approach procedure (e.g., location, height and elevation of the PFAF, and other fixes), the effect of earth curvature shall be taken into consideration. Earth curvature values shall be calculated based on the distance from the RDP direct to the fix, using the following formula:

$$EC = D^2 (0.8833)$$

Where: E = Earth Curvature in Feet
D = Distance in NM

The approach procedure shall be designed to accommodate the highest aircraft category expected to use the procedure. The U.S. civil standard glidepath angle is 3.00°. Angles other than 3.00° shall be established only upon approval of the FAA Flight Standards Service, Washington, D.C.

5. DEFINITION OF APPROACH TYPES.

a. MLS Category I. MLS category I (CAT I) is an approach procedure which provides for an approach to a DH of not less than 200 feet HAT.

b. MLS Category II. Reserved.

c. MLS Category III. Reserved.

6. SYSTEMS COMPONENTS.

a. Azimuth (Course Guidance). Final straight course (FSC) lateral guidance is normally provided by the 0° bore-sight azimuth signal emanating from the center of the azimuth antenna and is normally aligned along the final approach course. The magnetic final approach course is automatically transmitted to the airborne receiver or manually set by the pilot in an appropriately equipped aircraft. Along RNAV paths, course guidance is provided by the output of an airborne computer, based on the input of the MLS sensor.

b. Elevation (Vertical Guidance). FSC vertical guidance is provided by a signal emanating from the elevation antenna phase center. The glidepath for the procedure is automatically transmitted to the airborne receiver by the ground system or manually selected by the pilot, depending on the aircraft equipment. RNAV vertical guidance is normally based on the output of an airborne computer which uses signals from the ground system. Barometric altimeter input to the airborne computer may be used in lieu of ground system elevation input for certain operationally necessary procedures such as missed approach or departure segments, when only back azimuth course guidance is available.

c. Distance Measuring Equipment/Precision (DME/P). The DME/P is a distance measuring system normally installed with the MLS, which provides an accuracy within ±800 feet when the airborne system is in the initial approach mode within ±279 feet when in the approach mode. The selection of initial or approach mode is accomplished automatically by the airborne system based on proximity to the

DME/P antenna (normally 7 NM). MLS installations supporting MLS area navigation (MLS/RNAV) shall include DME/P.

d. Distance Measuring Equipment/Conventional (DME/N). The DME/N is a distance measuring system normally associated with VOR and ILS systems. DME/N equipment may be utilized in lieu of DME/P to support other than curved path RNAV MLS procedures.

7. DEFINITIONS.

a. Alongtrack Distance (ATD). The distance measured along the prescribed flight course.

b. Approach Surface Baseline (ASB). A line tangent to the earth at threshold elevation.

c. Basic MLS Procedure. A precision approach procedure using lateral guidance provided directly by the azimuth transmitter and vertical guidance provided by the elevation transmitter.

d. Below Path Clearance Angle (BPCA). An angle below the glidepath angle equal to 70% of the glidepath angle which is used in the computations associated with the adjustment of decision height (DH). See paragraph 20.

e. Collocated Azimuth and DME. Azimuth and DME are considered to be collocated when their antennas are installed within 400 feet of one another.

f. Critical Point (CRP). That point having the shortest distance to the obstacle using a 15° splay, with respect to the course centerline.

g. DH. The altitude, specified in mean sea level (MSL), at which a missed approach shall be initiated if the required visual references are not established.

h. DH Point. The point where the altitude of the DH intersects the glidepath angle on azimuth centerline.

i. Final Approach Fix/Precision (PFAF). A point where the glidepath intercepts the intermediate altitude. This point is the beginning of the precision final approach segment. For basic MLS, it shall be the point of glidepath intercept. It shall be an ATD fix for type A RNAV procedures and a waypoint for types B through D. See paragraphs 23 and 24.

j. Final Straight Course (FSC). That portion of the approach (beginning at the last rollout point prior to DH and ending at the DH point) where no further course changes shall be required. (Applies to MLS/CP RNAV criteria only.)

k. First Maneuvering Point (FMP). The point located inside the MLS coverage area that meets the required first maneuvering distance established in table 5 of appendix 1.

l. First Maneuvering Point Distance (FMPD). The distance inside the MLS coverage area required to transition to MLS guidance and establish the aircraft on an MLS course prior to any turn or interception of the glidepath. (See appendix 1, table 5.)

m. First Maneuvering Waypoint (FMWP). A waypoint established at the FMP.

n. Glidepath (GP) Angle. The angular displacement of the vertical guidance path from a horizontal plane that passes through the elevation antenna phase center. This angle is published on approach charts (e.g., 3.00°, 3.10°, 3.20°, etc.). For RNAV procedures, types B through D, the vertical path is computed, based on the MLS sensors.

o. Ground Point of Intercept (GPI). A point on the vertical plane on azimuth centerline at which a straight line extension of the glidepath intersects the ASB.

p. Height above Approach Surface Baseline (HASB). The height of any point, glidepath, or obstacle above the ASB. Because the elevation of the ASB is always the same as the elevation of the GPI, the HASB is used to determine whether an adjustment of DH is appropriate when obstacles penetrate the OCS. (See paragraph 20d.)

q. Height of the BPCA (HBPCA). The height of the BPCA above the ASB at a given distance from the GPI in the MLS final approach segment. (See paragraph 20 and appendix 1, figure 4.)

r. Initial Approach Waypoint (IAWP). Waypoint at the initial approach fix.

s. Intermediate Waypoint (IWP). Waypoint at the intermediate fix (IF).

t. Minimum IFR Altitudes (MIA). Minimum altitudes for IFR operations, as described in FAR 91.

u. Minimum Vectoring Altitude (MVA). The lowest MSL altitude at which an IFR aircraft will be vectored by an ATC radar controller.

v. MLS Area Navigation (MLS/RNAV). Navigation derived by an MLS airborne RNAV computer using the MLS azimuth, elevation, and DME/P signal information transmitted from MLS ground facilities.

w. MLS Fixes. Fixes formed by the MLS azimuth and DME signals.

x. MLS Reference Datum Point (RDP). The point on the runway centerline abeam the elevation antenna.

y. Nautical Mile (NM). For the purpose of this order, a nautical mile is 6076.11548 feet.

z. Non-Final Straight Course (NFSC). Any straight portion of an approach other than the final straight course. The length of the NFSC is either the distance between the point of entry into MLS coverage and the first TRWP, or the straight distance between the ROWP of a preceding turn and the TRWP of the next turn.

aa. Non-Final Curved Course (NFCC). Any curved portion of an approach. The length of the NFCC is the distance between the TRWP and the ROWP.

bb Obstacle Clearance Surface (OCS). An obstacle identification surface associated with the glidepath angle. The associated "W" surfaces for specific glidepath angles are listed in appendix 1, table 3. Appendix 1, figures 2 and 3, depict the OCS for the final approach segment.

cc. Obstacle Free Zone (OFZ). The airspace defined as the runway OFZ and the inner approach OFZ, which is clear of object penetrations other than frangible NAVAIDS.

dd. Obstacle-Rich Environment (ORE). An environment is obstacle rich when it is not possible to construct an unguided, discontinued approach using procedural means; i.e., without incurring obstacle penetrations of the 40:1. Approach operations in an ORE require supplementary guidance to proceed along the published course to the missed approach point and achieve a climb to the MVA or MIA.

ee. Pseudo Threshold. Phantom location abeam the runway threshold, when the final approach course is offset. Elevation of the pseudo threshold is the same as the runway threshold. For the purpose of this order, the word threshold includes the pseudo threshold. (See appendix 1, figure 13A.)

ff. Pseudo Ground Point of Intercept. Phantom location abeam the GPI, when the final approach course is offset. Elevation is the same as the runway threshold and the ASB. (See appendix 1, figures 13A and B.)

gg. Rollout Waypoint (ROWP). The point in an MLS/CP procedure (types C and D), where a turn is completed.

hh. Required Obstacle Clearance (ROC). The minimum vertical separation allowed between an obstacle and an authorized flight altitude, glidepath, or MDA when azimuth minimums are published with a precision procedure or the MDA of an azimuth-only procedure.

ii. Section. A section is the flight course defined between two waypoints.

jj. "S" Turn Waypoint (STWP). WP located in the middle of an "S" turn. (See appendix 1, figure 15.)

kk. Threshold Crossing Waypoint (TCWP). Waypoint at the TCH. (See appendix 1, table 2.)

ll. Touchdown Zone Elevation (TDZE). The highest runway centerline elevation in the first 3,000 feet of the landing surface.

mm. Transitional Waypoint (TWP). Waypoint established as a transition point from a non-MLS navigation system such as terminal radar, a VOR, or a VORTAC to MLS/RNAV navigation.

nn. Turn Waypoint (TRWP). The waypoint designated in an MLS/CP approach procedure where a turn begins.

8. FIXES. All fixes within MLS coverage shall be MLS fixes, except that azimuth-only procedures may have VOR crossing radials (in addition to MLS DME) to identify fixes. Also, where azimuth landing minimums are published for full MLS procedures, VOR crossing radials may be published to back up the MLS/DME for identification of the FAF and missed approach point.

a. Fix Error. DME/P and waypoint fixes are considered to be absolute and, therefore, no fix error calculations or adjustments are required. DME/N fix error is computed using the following formula:

$$0.25 + 0.0125D$$

Where: D is the DME distance from the fix to the DME/N antenna.

b. MLS fix distances shall be published to the nearest 0.01 miles.

c. Final Approach Fix (FAF). The FAF is a nonprecision fix used when azimuth and azimuth-only landing minimums are published. The FAF shall be located at or inside the PFAF.

9. IDENTIFICATION. Order 8260.3B, paragraph 161, applies, except, the procedure is identified in accordance with the following examples:

a. MLS Straight-Course Procedures:
MLS RWY 18; MLS 2 RWY 18; MLS-A (Circling)

b. MLS Straight-Course RNAV Procedures (Types A and B):
MLS/RNAV RWY 18; MLS/RNAV 2 RWY 18

c. MLS Curved-Path RNAV Procedures (Types C and D):
MLS/CP RWY 18, MLS/CP 2 RWY 18

d. Azimuth-Only Procedures (To Secondary Landing Areas Or Runways):
AZ RWY 18; AZ 2 RWY 18; AZ-A (Circling)

10. INOPERATIVE COMPONENTS. A complete MLS installation consists of the components listed in paragraph 6.

a. If the azimuth transmitter fails, the approach is not authorized.

b. If only the elevation transmitter fails, basic MLS approach procedures may revert to an azimuth approach, provided azimuth landing minimums are published on the procedure.

c. If the DME transmitter fails, an MLS approach procedure may be authorized when alternate means of fix identification, in lieu of DME, are published (e.g., VOR crossing radials, radar fix, etc.).

d. MLS RNAV is not authorized when any MLS component fails.

11. ELEVATION ANTENNA PLANNING. Computations of GPI and TCH should be conducted prior to elevation antenna installation. Responsible agencies must make a coordinated effort to attain an installation which will support the best instrument approach procedures that criteria will allow. The following items are suggested as a basic checklist:

a. Consider categories of aircraft expected to use the runway.

b. Select desired TCH.

c. Select glidepath angle (initially 3.00°).

d. Compute the GPI based on the desired TCH.

e. Perform obstruction evaluation, airport/airspace analysis, and TERPS feasibility study, according to the following, in the order of priority:

(1) Removing obstructions.

(2) Relocating the elevation antenna.

(3) Displacing threshold.

(4) Increasing glidepath angle.

(5) Adjusting the DH.

(a) Formulas, paragraphs 17 and 19.

(b) Check TCH limits.

(c) GPI adjustments.

(d) Repeat MLS criteria iterations, as necessary.

Note: Glidepath angles above 3.00° must be approved by Flight Standards Service in Washington, D.C.

f. Select elevation antenna installation site based on the finalized TCH, glidepath, and GPI configuration.

g. Calculate the bearing, distance, and height above the MLS reference datum of all fixes, TRWP's, and ROWP's for entry on MLS procedure publication forms.

12. GROUND POINT INTERCEPT (GPI) AND THRESHOLD CROSSING HEIGHT (TCH). The GPI and TCH are computed relative to the final approach course which might not be along the runway centerline. (See appendix 1, figures 5 and 13B.) The following is an example of computations using a 3.00° GP angle when the elevation antenna geometry is known:

Phase Center of Elevation Antenna		1802.62 feet MSL
Threshold Elevation		1795.81 feet MSL
		6.81 feet
6.81 / Tan 3.00° (Use Actual GP Angle)	=	129.94 feet
Elevation Antenna to Threshold Distance	+	840.00 feet
GPI to Threshold Distance		969.94 feet

TCH = 969.94 (Tan 3.00°) = 50.83 feet (51 feet)

13. PROCEDURE DESIGN LIMITATIONS. Development of MLS procedures should be independent of existing procedures.

a. These criteria do not apply to category II and III approaches.

b. Maximum authorized glidepath angles are aircraft-category-specific, as listed below:

Category	Glidepath Angle (Degrees)
A (80 Knots or Less)	6.4
A (81 - 90 Knots)	5.7
B	4.2
C	3.6
D	3.1

The above angles are based on a no-wind maximum descent rate of approximately 900 feet per minute.

c. Landing Minimums. The lowest precision minimums are specified in appendix 1, table 1.

d. Threshold crossing height shall be established in accordance with Order 8260.34, Glide Slope Threshold Crossing Height Requirements. Where approach light credit is requested, the TCH shall be limited as a function of glidepath angle and HAT, as specified in appendix 1, table 2. Caution should be used in establishing TCH, giving proper consideration to the type of aircraft expected to operate on the runway and the length of runway available for landing.

e. The installation of MLS ground components shall not degrade an existing or planned instrument approach procedure at that airport. The following criteria shall be applied until final facility siting guidance has been issued. Compliance responsibility resides in the appropriate regional office.

(1) Order 6830.5, Criteria for Siting Microwave Landing Systems, applies to elevation antenna installations.

(2) The OFZ serving ILS CAT II and III runway operations shall not be penetrated by MLS equipment.

(3) MLS azimuth and DME components, essential for instrument flight operations, may be sited in an approach light area, in accordance with AC 70/7460-1, Obstruction Marking and Lighting (see appendix 1, figure 9,) provided they are marked and lighted and do not obscure the pilots' view of the lights. The equipment may penetrate the approach light plane, provided the following surfaces are not penetrated: (See FAA Order 6850.2A, Visual Guidance Lighting Systems.)

(a) The interior 800 feet of the approach light plane, measured from runway threshold,

(b) Then a rise of 7:1 until 5 feet above the approach light plane and continuing 5 feet above the approach light plane to 1,500 feet from runway threshold; and,

(c) Then a rise of 7:1 until 10 feet above the approach light plane and continuing 10 feet above the light plane until 200 feet beyond the last approach light stanchion; and,

(d) The 50:1 surface overlying the approach light lane.

(4) MLS antenna obstruction lights and other approved objects may penetrate the surfaces in paragraphs 13e(3)(a), (b), and (c), but not the 50:1 surface in paragraph 13e(3)(d).

SECTION 2. BASIC MLS

14. FEEDER ROUTES AND INITIAL APPROACH SEGMENTS. The criteria for feeder routes and initial approach segments contained in Order 8260.3B, sections 2 and 3, apply; except that the primary and secondary obstacle clearance areas are ±2 NM (primary) and 1 NM (secondary) in width, prior to reaching the FMP. (See appendix 1, figures 1A and 1B.)

15. INITIAL APPROACH SEGMENT. The initial approach segment may begin outside of the MLS coverage area at a non-MLS-defined fix and ends at the intermediate fix. The IF may be an ATD fix when the approach course in the initial segment is an extension of the intermediate segment. The first MLS-defined fix must be established not less than 1/2 mile inside the MLS coverage area boundary. This fix serves as a transition fix to provide a transition from non-MLS navigation to MLS navigation. If the initial approach fix (IAF) is based on a VOR/DME or TACAN facility, that facility shall be within 25 miles of the IAF. If the initial approach segment is being flown away from the VOR/DME or TACAN facility, the point where the course intersects the boundary of the MLS coverage area shall not be more than 20 miles from the VOR/DME or TACAN facility. If a VOR/DME or TACAN facility is not available, the initial approach segment shall be based on radar or other approved navigation systems with a maximum lateral fix error 2 NM where the course enters MLS coverage. The angle of intercept between the non-MLS course and the MLS coverage area boundary shall not be less than 30°. (See appendix 1, figures 12A and B.)

16. INTERMEDIATE SEGMENT. The intermediate segment begins at the IF and ends at the PFAF (or FAF for azimuth-only procedures). The area and length are described below:

a. Area. The MLS intermediate segment primary obstacle clearance area is ±1.0 NM, after passing the FMP. The boundary of the intermediate primary area tapers at a 30° angle from abeam the FMP to a width of 1.0 NM. The secondary areas are 2,500 feet wide, after passing the FMP. The outer boundaries of the secondary areas at the FMP taper to intersect the 2,500-foot width abeam (and perpendicular to) the point where the 30° primary taper intersects the ±1.0 NM primary area. (See appendix 1, figure 1A.)

b. Length. The minimum length of the intermediate segment can vary, depending on the angle of turn at the intercept point stated in Order 8260.3B, paragraph 922. For straight-course procedures, Order 8260.3B, paragraph 922, applies, and the angle of intersection with the straight final approach course will determine the minimum length of the intermediate segment prior to interception of the glidepath at the PFAF. The ATD, from the edge of MLS coverage to the IWP, shall not be less than the FMPD. (See appendix 1, table 5.) There is no minimum course change. However, each RNAV procedure must satisfy the minimum length requirements of appendix 1, table 4.

17. FINAL APPROACH SEGMENT. The final approach segment begins at the PFAF/FAF and ends at the DH point or MAP. When azimuth landing minimums are published, the nonprecision FAF should be coincident with the PFAF, where possible.

a. Alignment. Order 8260.3B, paragraph 930a, applies for final approach straight-course segments, offset up to 3.00° from the runway centerline, extended. Offsets more than 3.00° shall not be established without the approval of FAA Flight Standards Service, Washington, D.C. (See appendix 1, figure 13A.)

b. Area. The precision area considered for obstacle clearance begins at the PFAF and ends at the threshold or pseudo threshold. The primary area consists of two surfaces: the "W" surface and the "X" surface; where "X" is attached to either side of the "W" surface. The "Y" surface is a transitional surface, which is attached to the "X" surface on either side of the primary area. (See appendix 1, figure 2.) For nonprecison minimums, there is no “W” area. The primary area is the entire “X” area and the “Y” area becomes the secondary area. (See appendix 1, figure 16.) For offset approach courses, the final approach segment ends at the end of the pseudo 200-foot clear section (on the FSC). (See appendix 1, figure 13A.)

(1) Length. The length of the final approach obstacle clearance area begins at the PFAF/FAF and ends at the landing threshold (or pseudo threshold). (See appendix 1, figures 2, 5, and 13A.)

(a) Clear Section. This section begins at the threshold (or pseudo threshold) and extends outward 200 feet. (See appendix 1, figures 5 and 13A.)

(b) "W" Surface (Appendix 1, Table 3). The "W" surface originates at the end of the clear section and extends outward to the PFAF.

(c) "X" Surface (4:1). The "X" surface always originates 200 feet from the threshold and extends outward to the PFAF.

(d) "Y" Surface (7:1). The "Y" surface is transitional, which always originates 200 feet from the threshold and extends outward to the PFAF.

(2) Width. The final approach area is centered on the final approach course, whether straight, curved, or offset.

(a) Clear Section. The clear section has a constant width of 1,000 feet. (See appendix 1, figures 5 and 13A.)

(b) "W" Surface. The "W" surface has a width of 800 feet at a point 200 feet from the threshold and expands uniformly, in accordance with the formula:

1/2 width = 0.036 X (D - 200 feet) + 400 feet
Where: D is the distance in feet from threshold

(c) "X" Surface. The splay of the "X" areas is determined from the formula:

0.10752 X (D-200) + 700
Where: D is the distance in feet from threshold

(d) "Y"Surface. The splay of the"Y" areas is determined from the formula:

0.15152 X (D-200) + 1000
Where: D is the distance in feet from threshold

c. The primary area (combined "W" and "X" areas) expands to ±1.0 NM at a point 50,200 feet from the threshold or pseudo threshold. The width of the "Y" areas, measured from the outer boundary of the "X" surface areas, shall not exceed 2,500 feet. When the PFAF is located between the 50,200-foot point and the threshold, the splay of the "X" and "Y" areas extend outward, until reaching the 50,200-foot point, to form the intermediate primary and secondary areas in the space between the PFAF and the 50,200-foot point. (See appendix 1, figures 1A, 12A, and B.) When the PFAF is located outside of the 50,200-foot point, the final approach "W," "X," and "Y" obstacle clearance surfaces proceed inbound, parallel to the course from the 50,200-foot point, until reaching the PFAF, where they join the final approach areas described in paragraph 17b(2). (See appendix 1, figures 1B and 12C.)

18. FINAL APPROACH LANDING MINIMUMS. The lowest landing minimums should be based on a 3.00° glidepath angle. Appendix 1, table 1, specifies standard MLS precision minimums for angles 3.00° and above. These landing minimums may be applied when:

a. No obstacle penetrates the clear section at the elevation of the ASB.

b. No obstacle penetrates the OFZ.

c. The appropriate, associated OCS (W, X, and Y) is not penetrated by an obstacle; except that penetrations of the 7:1 transition surfaces (Y) by existing obstacles may be exempt, in accordance with Order 8260.3B, paragraph 938b(2). Proposed obstacles shall not penetrate the 7:1 transition surface.

19. FINAL APPROACH OCS AND ROC.

a. The heights of the OCS above the ASB can be determined using the following formulas: (See appendix 1, table 3, and figures 2 and 5.)

b. The formulas for determining the "X" and "Y" surfaces are as follows. In this example, the obstacle is located 3,000 feet ATD from the landing threshold and 1,200 feet perpendicular to the course centerline. This is a standard situation with a glidepath angle of 3.00° and the GPI exactly 954 feet from the threshold (1,154 feet to the start of the final approach obstacle clearance areas) and a 50-foot TCH.

(1) First, calculate the outer boundaries of the "W," "X," and "Y" surface areas:

"W" surface outer boundary = 0.036 [D - 200] + 400
= 0.036 [3000 - 200] + 400
= 500.8' from the course centerline

"X" surface outer boundary = 0.1075223 [D - 200] + 700
= 0.1075223 [3000 - 200] +700
= 1001.06' from the course centerline

"Y" surface outer boundary = 0.1515223 [D - 200] + 1000
= 0.1515223 [3000 - 200] + 1000
= 1424.26' from the course centerline

(2) Second, calculate the height of the appropriate surface at the obstacle. Using the surface outer boundaries shown above, calculate the height of the appropriate surface at the obstacle. In the example below, the obstacle is located 1,200 feet from the course centerline. Therefore, the obstacle is located within the "Y" surface area because it lies between the 1,001.06-foot and 1,424.26-foot outer boundaries of the "X" and "Y" surfaces. Apply the following formulas:

$$W_{OCS} = [(D - 200)/S]$$
$$X_{OCS} = [(D - 200)/S] + [(D_O - Dw)/4]$$
$$Y_{OCS} = [(D - 200)/S] + [(D_X - D_W)/4] + [(D_O - D_X)/7]$$

Example:

$$OCS = [(D - 200)/S] + [(D_X - D_W)/4] + [(D_O - D_X)/ 7]$$
$$= [(3000 - 200)/34] + [(1001.06 - 500.8)/4] + [(1200 - 1001.06)/7]$$
$$= 82.353 + 125.065 + 28.42$$
$$= 235.838' \text{ HASB at the obstacle (in the "Y" transition area)}$$

Where: D = ATD from the landing threshold abeam the obstacle (3000')
D_O = Perpendicular distance from the course centerline (1200')
Dx = Distance between centerline and "X" outer boundary
D_W = Distance between centerline and the "W" boundary
S = The slope of the "W" surface for a 3.00° angle; appendix 1, table 3

c. GPI Distance Less than 954 Feet from the Threshold. Whenever the GPI-to-threshold distance is less than 954 feet, an additive must be applied to the height of the obstacle in the final approach "W" surface area to compensate for the compressed ROC space between the glidepath and the obstacle clearance surface. This new height becomes the effective height above the approach surface baseline (EHASB). To determine the EHASB of an obstacle, use the following formula:

$$EHASB = HOBST + (954' - gpi)/S$$

Where: EHASB = Effective obstacle HASB
HOBST = Surveyed obstacle HASB
gpi = GPI-to-threshold distance in feet
S = The slope of the "W" surface

Example: HOBST = 50'
gpi = 869'
S = 34:1

$$EHASB = 50' + (954' - 869')/S = 52.50' = 53'$$

20. ADJUSTMENT OF DH FOR OBSTACLE PENETRATIONS OF OCS.

a. Obstacles shall not penetrate the "W" surface. To avoid obstacle penetration of the "W" surface, first, consider removing or adjusting the obstacle to eliminate the penetration. Second, consider relocating the elevation antenna to move the GPI farther away from the threshold without violating the maximum TCH authorized in table 2. Third, displace the threshold. Fourth, consider raising the glidepath angle within the limits of table 1, with the permission of FAA Flight Standards Service, Washington, D.C.

b. When an existing obstacle penetrates the primary "X" surface, the DH may be adjusted, in accordance with Order 8260.3B, paragraph 938b(1). The BPCA shall not be penetrated. (See appendix 1, figure 4.) The height of the BPCA (HBPCA) is determined using the following formula:

$$HBPCA = [\tan(0.7)(GP)]\,D$$

Where: GP = Glidepath angle
D = Distance GPI to abeam obstacle

Example: $HBPCA = [\tan(0.7)(3.0)]10{,}000$
$[0.036668]\,10{,}000 = 367$ feet

Where: GP = 3.0°
D = 10,000 feet

c. When existing obstacles penetrate the "Y" transition surfaces, Order 8260.3B, paragraph 938b(2), applies.

d. An adjusted DH shall not be less than the HASB, as determined by the formula below. This formula applies to all glidepath angles, 3.00° through 6.40°. The application of this method need not require a ROC that is greater than the minimum DH value:

Adjusted DH = GP / 3 (250)
Where: GP = Glidepath Angle

Example: Adjusted DH = 4.5 / 3 (250) = 375'
Where: GP = 4.5°

In the above example, the DH shall not be less than 375 feet HASB, and the ROC above the obstacle need not be more than 375 feet. The DH may be adjusted to prevent obstacles from penetrating the missed approach obstacle clearance surfaces.

e. Obstacles that are the subject of DH adjustments should be marked and lighted, in accordance with AC 70/7460-1, Obstruction Marking and Lighting.

21. MISSED APPROACH. The MLS does not provide a back course unless a back azimuth (BAZ) is available. BAZ coverage is limited to ±40°, and the course sensitivity is broader. BAZ may be used for course guidance in the missed approach segment. When BAZ is not available or where course guidance outside of BAZ coverage is required, fixes and course guidance used beyond the coverage area shall be based on other navigation systems. (See appendix 1, figures 6 and 7.) Order 8260.3B, chapter 9, section 4, applies, except as follows:

a. Straight Missed Approach. The straight missed approach area is used when a course difference of not more than 15° exists between the final approach course and the missed approach course in section 2. Section 1 shall be aligned with the final approach course. (See appendix 1, figure 6.)

(1) Section 1. Section 1 is a straight missed approach area with the final approach course and missed approach courses aligned. Section 1 is comprised of three subsections, beginning at the DH point and continuing to a distance of 1.5 miles.

(2) Section 1a begins at the DH point and overlies the final approach primary area 1,460 feet in the direction of the missed approach. This section is always straight and aligned with the final approach course. (See appendix 1, figure 6.)

(3) Section 1b begins at the end of section 1a and splays to a width of 1 NM (6,076.11548 feet). This section is always straight and aligned with the final approach course. (See appendix 1, figure 6.)

(4) Sections 1c. These are 7:1 secondary areas which begin at the DH point. These sections splay to a point on the edge and at the end of section 1b. (See appendix 1, figure 6.) Obstacles in sections 1c that are adjacent to the "X" surfaces are evaluated using the 7:1 surface, beginning at the elevation of the outer edge of the "X" surfaces. Obstacles in sections 1c, adjacent to section 1b, are evaluated using the 7:1 surface beginning at the elevation of the outer edge of section 1b.

b. Turning Missed Approach. All precision-turning missed approach areas continue straight ahead until reaching the end of section 1, specified above. Sections 1c become part of section 2 on the turn side. (See appendix 1, figure 7.) Turns shall not be specified to commence at an altitude which is less than 400 feet above the elevation of the touchdown zone.

c. Missed Approach Obstacle Clearance. For the lowest landing minimums specified in appendix 1, table 1, no obstacles shall penetrate the following surfaces:

(1) Section 1a. The applicable 1,460-foot portion of the "W" surface, as specified in table 3, and the "X" surface, down to the 1,460-foot point (end of section 1a). (See appendix 1, figures 6 and 7.)

(2) Section 1b. A 28.26:1 inclined plane climbing in the direction of the missed approach. The height of the beginning of section 1b is the same as the height of the final approach "W" surface at the end of section 1a. Obstacles are evaluated along the shortest distance from the beginning of section 1b to the obstacle. (See appendix 1, figures 6 and 7.)

(3) Sections 1c. An inclined plane starting at the DH point and sloping 7:1, perpendicular to the missed approach course. The inner boundaries originate at the elevation of the outer edges of the "W" surface at the beginning of section 1b. The outer boundaries originate at the elevation of the outer edges of the "X" surfaces at the DH point. These inner and outer boundaries converge at the end of section 1b (1.5 NM from the DH point). Obstacles in sections 1c, adjacent to the "X" surfaces, are evaluated with a 7:1 slope from the elevation of the outer boundaries of the "X" surfaces. Obstacles in sections 1c, adjacent to section 1b, are evaluated using the 7:1 slope, beginning at the elevation at the outer edge of section 1b. (See appendix 1, figures 6 and 7.)

(4) Section 2. This section is a 40:1 surface, measured from the boundary of section 1 (depicted by the end of sections 1b and 1c), the shortest distance to the obstacle. The surface begins along this boundary at a height equal to the height at the end of section 1b. (See appendix 1, figures 6 and 7.)

(5) Section 2 for Turning Missed Approach. For evaluations of obstacles in section 2 of a turning missed approach, the elevation of the boundary of section 1 on the turn side is the same height as the height of the missed approach surface at the end of section 1b on the course centerline.

22. OBSTACLE FREE ZONES. Figures 8 and 9 illustrate the OFZ criteria of AC 150/5300-13, paragraphs 306a, b, and c (for precision approaches). For the purpose of this order, there are two OFZ's that apply; the runway OFZ and the inner approach OFZ. The runway OFZ parallels the length of the runway and extends 200 feet beyond the runway threshold. The inner OFZ overlies the approach light system from a point 200 feet from the threshold to a point 200 feet beyond the last approach light. If approach lights are not installed or not planned, the inner approach OFZ does not apply. When obstacles penetrate the specified OFZ, the lowest landing minimums that can be authorized are changed as follows, visibility credit for lights is not authorized, and paragraph 332 of TERPS does not apply:

a. For glidepath angles through 4.2°: 300-3/4

b. For glidepath angles above 4.2°: 400-1

Where there are no obstacle penetrations, the lowest landing minimums that can be authorized are found in appendix 1, table 1.

SECTION 3. MLS STRAIGHT-COURSE RNAV

23. GENERAL. MLS straight-course RNAV procedures are based on MLS-computed straight courses. There are two types of a straight-course procedures, type A and type B (See appendix 1, figure 10). When entering MLS/RNAV approach procedures data on FAA source documents, all MLS waypoints (WP), turn waypoints (TRWP), and rollout waypoints (ROWP) shall be defined by the magnetic bearing and the distance from the threshold (to the nearest .01 of a degree and the nearest .001 of a mile), and by the height above the MLS reference datum (to the nearest foot).

a. Type A Features:

(1) Computed azimuth only
(2) Basic glidepath only
(3) Straight intermediate segments
(4) Straight final (RWY C/L) segments
(5) One waypoint (at threshold)
(6) DME fixes, including the PFAF (DME/N authorized)
(7) RADAR vectors or VOR radials to intercept the MLS segments

b. Type B Features:

(1) Computed azimuth and glidepath
(2) Straight intermediate segments
(3) Straight final (RWY C/L) segments
(4) Two waypoints, PFAF and threshold
(5) DME/N authorized
(6) RADAR vectors VOR radials to intercept the MLS segments

All paragraphs in sections 1 and 2 apply.

SECTION 4. MLS CURVED-PATH RNAV

24. GENERAL. Unlike straight-course MLS/RNAV procedures, curved-path RNAV procedures feature precision curved paths formed by TRWP's and ROWP's. The on-board computer enables the aircraft to fly a precise track, based on predetermined radii. (See appendix 1, tables 4, 5, and 6.) The guidance for MLS/RNAV procedures of this order, outlined in sections 1 and 2, applies. There are two types of curved-path RNAV procedures:

a. Type C Features:

(1) Computed azimuth and glidepath
(2) A flight director
(3) One or more curved paths in the procedure
(4) Computed "S" turns when operationally advantageous
(5) Aligned, nonaligned, or offset final approach course
(6) DME/P only

b. Type D Features (ORE only):

(1) All features of Type C
(2) Supplemental navigation system(s) e.g. FMS or GPS
(3) Operators use shall be approved on an individual basis by Flight Standards Service, Washington, D.C.

Criteria in this section apply to all MLS curved-path (MLS/CP) procedures developed for types C and D, above. The final approach segment of an MLS/CP is flown using an on-board, continuous computed path (both vertical and lateral), beginning at the PFAF and ending at the landing threshold. (See figures 12A, B, and C.)

When a curve is contained within the final approach segment, the “W,” “X,” and “Y” surface areas splay in a spiral (outbound) around the curve using the spiral formula found in appendix 1, figure 12D. The construction criteria in paragraph 17c, for joining the final and intermediate segments, apply. (See figures 12B and C.) When a curve is contained in the initial or intermediate segments, the primary and secondary area widths remain constant around the curve. (See appendix 1, figure 12A.)

When a curve is associated with a PFAF, the PFAF shall not be located between the TRWP and the ROWP. Instead, its location shall meet the distance requirements (PFAF to TRWP and ROWP to PFAF) as set forth in appendix 1, table 6.

MLS/CP procedures may be designed for secondary runways where MLS is not installed, provided the intermediate and final approach segments are contained entirely within the azimuth and elevation coverage of the parent MLS facility. The 3-dimensional position in space is computed from the received azimuth, DME, and elevation sensor data.

The final straight course should be aligned with the runway centerline extended and shall be based on azimuth, elevation, and DME/P sensor input to the airborne computer. Turning radii for the curves shall be as authorized in appendix 1, table 4, for the highest published approach category. Distances shall be based on the alongtrack distance from each waypoint to the runway threshold waypoint, as well as the distance between waypoints. The published minimum altitudes for the initial and intermediate segments shall be based on barometric altimetry, not on MLS derived altitudes.

25. FEEDER ROUTES. Paragraph 14 applies.

26. INITIAL APPROACH SEGMENT. The initial approach segment may begin outside of the MLS coverage area at a non-MLS-defined fix or waypoint or, when within the MLS coverage area, at an MLS/RNAV waypoint and ends at the MLS/RNAV intermediate waypoint or ATD fix. The IF may be an ATD fix when the approach course in the initial segment is an extension of the intermediate segment. The first MLS-defined waypoint must be established not less than 1/2 mile inside the MLS coverage area boundary. This waypoint serves as a transition waypoint (TWP) to provide a transition from non-MLS navigation to MLS/RNAV. This waypoint is normally established with MLS/RNAV and is coincident with a fix or course established from the non-MLS navigation system used to enter MLS coverage; except, when entry into coverage is straight to the FMWP (to or from a VOR or VORTAC), the TWP may be deleted.

Paragraphs 14 and 15 apply, except, if the initial approach fix (IAF) is based on a VOR/DME or TACAN facility, that facility shall be within 25 miles of the IAF. If the initial approach segment is being flown away from the VOR/DME or TACAN facility, the point where the course intersects the boundary of the MLS coverage area shall not be more than 20 miles from the VOR/DME or TACAN facility. If a VOR/DME or TACAN facility is not available, the initial approach segment shall be based on radar or other approved navigation systems with a maximum lateral fix error of 2 NM where the course enters MLS coverage. An IAF located within the 20 NM MLS coverage shall be a WP. (See appendix 1, figures 12A, B, and C.)

Initial approach segments within MLS coverage may contain curved segments, provided the TRWP is not closer to the edge of coverage than the FMPD specified in table 5. The angle of intercept between the non-MLS course and the MLS coverage area boundary shall not be less than 30°. (See appendix 1, figures 12A, B, and C.) The initial approach segment may contain one or more straight or curved sections. Each curved section of a segment within MLS coverage shall begin and end with an MLS-defined waypoint. The maximum course change within an intermediate curved segment is 270°.

a. Area. Paragraphs 14 and 15 apply, except:

(1) Length. Straight course lengths between curved segments/sections shall not be less than the minimum nonfinal straight course distance (NFSCD) established in appendix 1, table 4. The turn radii in table 4 shall be used to establish the TRWP and ROWP for determining curved segment/section distances.

(2) Width. The width of the primary area of initial approach segments within MLS coverage is a constant ±2 NM each side of course. When a portion of the initial segment extends inside the FMPD, the 30° taper to ±1.0 NM, described in paragraph 15, may be applied after reaching the FMPD. (See figure 1A.) However, this ±1.0 NM primary area shall not begin closer to the threshold (ATD) than the point where the splay of the extended portion of the final approach trapezoid reaches ±1 NM (50,200 feet from the threshold). Initial segments outside of MLS coverage have the same width, but must comply with the maximum distance from and to the VOR/DME or TACAN facilities, or use other means of navigation, as stated above.

b. Obstacle Clearance. Order 8260.3B, paragraphs 232c and 288b, apply.

c. Descent Gradient. Order 8260.3B, paragraph 232d, applies.

d. Secondary Areas. Secondary areas extend 1 mile each side of the primary area.

27. INTERMEDIATE SEGMENT. Paragraph 16 applies, except as detailed below. The ATD from the edge of MLS coverage to the IWP shall not be less than the FMPD specified in table 5 and the turn radii specified in table 4. (See appendix 1, figures 12A, B, and C.)

a. Area.

(1) Length. The minimum length of the intermediate segment shall not be less than specified in table 4 for the NFSCD; except, the segment shall be long enough to accommodate the minimum descent gradient specified in Order 8260.3B, paragraph 242d.

(2) Width. Paragraph 16 applies.

b. Obstacle Clearance. Order 8260.3B, paragraph 242c, applies.

c. Descent Gradient. Paragraph 27a (1), above, applies.

d. Secondary Areas. Paragraph 16 applies.

28. FINAL APPROACH SEGMENT. Paragraph 17 applies. The location of the PFAF shall be subject to the following conditions: The preferred location of the PFAF is on the final centerline straight course after all turns are completed. The PFAF shall not be located farther along the approach track from the runway threshold than the FMPD. The final approach segment may contain one or more curved or straight sections, including "S" turns and must end with a FSC. (See appendix 1, figure 15.) The final straight course distance (FSCD) shall not be less than the minimum length, specified in table 4. When meeting the requirements of appendix 1, table 4, the minimum FSCD may be farther from the threshold than the PFAF (i.e., extended into the intermediate segment). When the TRWP is not coincident with the PFAF or the PFAF is located after the completion of the curve, the minimum distance of the PFAF from a TRWP or ROWP are as shown in appendix 1, table 6. The PFAF may be coincident with a TRWP, but shall not be coincident with a ROWP.

a. Alignment. The FSC should normally be aligned with the runway centerline, except, it may be offset up to 3.00°, in accordance with Order 8260.3B, paragraph 930a. (See paragraph 17 and figures 13A and B.)

b. Area.

(1) Straight. Paragraph 17 applies.

(2) Curved. The turning radii for curved sections are specified in table 4. The width of the obstacle clearance area each side of the course is the same as the straight final approach course, except, the trapezoid spirals around the curve and continues until the combined "W" and "X" areas reach ±1 NM. Thereafter, this width shall not exceed ±1 NM.

(3) Length. Paragraph 17 applies.

(4) Width. Paragraph 17 applies.

29. FINAL APPROACH OCS. Paragraph 19 applies. The distance to an obstacle is determined by measuring along the final approach course to a point abeam the obstacle.

30. TRANSITION AREAS AND SURFACES. Paragraph 19 applies. The width of the "Y" transition area expands to a maximum of 2,500 feet, when measured from the outer edge of the "X" area.

31. LANDING MINIMUMS. Paragraphs 18, 19, and 20 apply. The lowest landing minimums that can be authorized are established in appendix 1, table 1.

32. MISSED APPROACH. Paragraph 21 applies, except, WP's and curved paths may be used for RNAV procedures.

SECTION 5. OBSTACLE-RICH ENVIRONMENT (ORE)

33. GENERAL. This section applies to MLS/CP procedures only. Not all airborne avionics certified for curved path approach procedures qualify for flight in an obstacle-rich environment (ORE). Consequently, an additional assessment must be made to determine whether the approach environment is obstacle-rich. Where there is an ORE in a final approach curved segment, a supplementary means of lateral navigation, such as a flight management system (FMS) or a global positioning system (GPS), is required to proceed along the published course to the missed approach point and achieve a climb to the MVA or MIA in the event of an MLS system anomaly. (See paragraph 34 and figure 14.)

Type D airborne equipment, as described in paragraph 24, shall be required to fly ORE procedures. "Obstacle-Rich Environment" shall be noted on all applicable procedures.

34. EVALUATION. Whenever a minimum altitude in a curved-path procedure falls below the height of obstacles located within 6 miles of the course centerline, an ORE assessment shall be made. When the ORE 40:1 assessment surface is penetrated by an obstacle, the procedure shall be designated obstacle rich, and a supplementary means of navigation shall be required to permit the aircraft to continue to the MAP, in accordance with the requirements of paragraph 33. (See appendix 1, figure 14.)

a. ORE Assessment Surface. The ORE assessment surface inclines 40:1 along a line originating at the critical point (CRP). The CRP is located at the intersection of a line perpendicular to the course centerline and the outer edge of either the secondary area (for segments other than the final approach segment) or the final approach segment 7:1 transition area. (See appendix 1, figure 14.)

b. Limitations.

(1) For curved-path procedures, the environment is automatically determined to be obstacle rich whenever there is an obstacle penetration of the final approach 7:1 transition areas, except as modified below.

(2) CRP's do not apply inbound from the ROWP of the final straight course. Obstacles with CRP's abeam the FSC, which do not penetrate the 40:1 when the CRP is at the ROWP of the FSC, do not require an ORE assessment.

(3) Obstacles, abeam points on the course centerline, prior to the FMP, do not require an ORE assessment.

c. Method.

(1) Determine whether an obstacle higher than the minimum procedure altitude and located within 6 miles of the course centerline, between the FMPD and the runway threshold, requires an ORE assessment. For the examples shown in figure 14, it is assumed that the "W," "X," and "Y" surfaces and spirals have already been determined, in accordance with the formulas presented in paragraphs 17 and 19.

(2) For each ORE evaluation, the elevation of the CRP on the outer edge of the "Y" surface (or secondary area) must be identified. Because the outer edge of the "Y" or secondary surface might not be parallel to the course centerline (e.g., when the surface is a spiral), the line from the CRP to the obstacle might not be 15° from the edge of the surface. The line from the CRP to the obstacle is always 105° from a line perpendicular to the course centerline. Consequently, the CRP is located by sliding a 105° template along the outer edge of the "Y" or secondary surface (with its origin, or corner, on the outer edge of the surface) until the 105° line touches the closest point of the obstacle. (See appendix 1, figure 14.)

(3) When the 105° line of the template first intersects the closest point of the obstacle, the corner of the template (origin of the 105° angle) becomes the CRP. Determine the elevation of the CRP on the outer edge of the "Y" transition surfaces by applying the formulas in paragraphs 17b(1) and (2). The elevation of the CRP in the initial and intermediate segments is the minimum procedure altitude. Measure the distance in feet between this CRP and the obstacle and divide that distance by 40. The result of this division is added to the elevation of the CRP to arrive at the elevation of the 40:1 at the obstacle. If the elevation of the obstacle is higher than the elevation of the 40:1, the environment is obstacle rich. (See appendix 1, figure 14.)

(4) A single 40:1 penetration is sufficient to make the approach environment obstacle rich. Evaluation of additional obstacles is not necessary.

(5) This method works for both inside and outside of any curved or straight section of a curved-path procedure.

SECTION 6. MLS AZIMUTH MINIMUMS

35. GENERAL. Installation of an azimuth-only MLS ground facility is not authorized. Whenever possible, azimuth landing minimums should be published in conjunction with basic MLS precision minimums. Azimuth-only minimums shall not be published for procedures developed as MLS/RNAV for types C and D, as defined in paragraph 24.

36. ALIGNMENT. The azimuth approach course shall be the same as the precision approach course.

37. AREA. The area considered for obstacle clearance shall be the same for the precision approach course, plus extensions, to include the 200-foot clear section; except, it extends from where the FAF can first be received to the threshold. Also, the nonprecision primary area overlies the combined "W" and "X" surfaces. The splay of the primary area is constructed from the end of the 200-foot clear section, using the following formula:

1/2 Path Width = 0.1075223(D-200)+700'
(Not to exceed 1.0 NM)
Where: D = Distance from threshold

The secondary areas overlay the "Y" surfaces and are constructed using the formula shown in paragraph 19 and depicted in appendix 1, figure 2.

38. OBSTACLE CLEARANCE. The minimum obstacle clearance in the final approach area shall be 250 feet. No obstacle shall penetrate the 7:1 transition surfaces for the azimuth approach, which begins at a height not less than 250 feet below the MDA.

39. DESCENT GRADIENT. The optimum descent gradient for the azimuth approach is 300 feet per mile. The maximum descent gradient is 400 feet per mile. (See Order 8260.3B, paragraph 288a.)

40. MINIMUM DESCENT ALTITUDE (MDA). Order 8260.3B, paragraph 956, applies.

41. MISSED APPROACH SEGMENT. Order 8260.3B, chapter 2, section 7, applies.

SECTION 7. BASIC MLS AZIMUTH-ONLY APPROACH

42. GENERAL. Separate azimuth-only approach procedures may be established for secondary runways and landing areas or other airports not equipped with MLS, where they are located within the coverage of the primary MLS system. (See appendix 1, figures 11, 16, and 17.) These criteria do not apply to MLS/RNAV procedures. Paragraph 21 does not apply. A circling-only approach may be designed. Order 8260.3B, chapter 9, section 5, applies, except as follows:

a. **Feeder Routes and Initial Approach Segments.** Paragraph 14 applies.

b. Intermediate Segment. Paragraph 15 applies; except, there is a FAF in lieu of a PFAF, and there are no computed paths.

c. Final Approach Segment. The final approach segment begins at the FAF and ends at or abeam the landing threshold for straight-in procedures, or at or abeam the first usable landing surface for circling approaches. The MAP should be located at one of these points. (See appendix 1, figures 6, 7, and 16.)

(1) Alignment. Whenever possible, the FSC should be aligned with the centerline of the secondary runway of intended landing. The FSC shall meet the final approach alignment criteria of Order 8260.3B, paragraph 513a(1). Circling approaches are authorized.

(2) Area. Paragraph 37 applies, except, a modified distance "D" is used to determine the width for secondary runways and secondary airports. The distance to determine the width of the primary area at the secondary runway landing threshold (or point abeam), or the MAP, is based on the following:

(a) Determine the distance from the primary MLS azimuth facility to the threshold of the primary MLS runway. This distance is "D_1." (See appendix 1, figure 17.)

(b) Determine the distance from the primary MLS azimuth facility to the secondary approach threshold/MAP to be used in the procedure. This is distance "D_2," a phantom distance originating at a phantom threshold (abeam the primary runway threshold) that is used in the calculation of the splays of the obstacle clearance areas out to and beyond the threshold/MAP of the secondary runway/airport. (See appendix 1, figure 17.)

(c) Subtract distance D_1 from distance D_2. The result is distance "D." (See formula below.) Distance D is the distance between the phantom threshold to the proposed MAP/pseudo threshold at the secondary runway/airport. To determine the width of the primary azimuth area at the MAP/pseudo threshold for the secondary runway/airport, use distance "D" and apply the same splay formula, described in paragraph 37.

$$D = D_1 - D_2$$

Where: D_1 = Distance from azimuth antenna to the primary runway threshold
D_2 = Distance from azimuth antenna to the secondary runway/airport missed point
D = Distance from the phantom threshold to be used to calculate the obstacle clearance areas at the threshold/MAP(and beyond) for the secondary runway/airport procedure

The secondary areas overlay the "Y" surfaces and are constructed using the formula shown in paragraph 19 and depicted in appendix 1, figure 2.

(d) Construct the final, intermediate, and initial areas by using the phantom threshold as the starting point, but begin the obstacle clearance evaluations at the MAP/pseudo threshold of the secondary runway/airport based on the criteria found in section 2.

(3) Obstacle Clearance. Paragraph 38 applies.

43. MISSED APPROACH. Order 8260.3B, chapter 2, section 7, applies; except, the missed approach shall be based on other navigation systems.

SECTION 8. MLS PRECISION MINIMUMS

44. LANDING MINIMUMS. The following chapters and sections of Order 8260.3B apply, in addition to table 1 of appendix 1.

a. Straight-In. Chapter 3.

b. Offset. Chapter 3. The minimums shall be no less than 250 HAT and RVR 2,400.

c. Azimuth Approaches. Chapter 3.

d. Circling Approach. Chapter 2, section 6, and chapter 3.

SECTION 9. DEPARTURE PROCEDURES

45. GENERAL. Order 8260.3B, chapter 12, applies. Departure procedures may be established using MLS positive course guidance (if available) or non-MLS en route navigation.

SECTION 10. DIRECTIVE FEEDBACK INFORMATION

46. INFORMATION UPDATE. Any deficiencies found, clarification needed, or improvements to be suggested regarding the content of this order, shall be forwarded for consideration to:

DOT/FAA
ATTN: Flight Procedures Branch, AFS-440
P.O. Box 25082
Oklahoma City, OK 73125

a. Your Assistance is Welcome. FAA Form 1320-19, Directive Feedback Information, is included at the end of this order, for your convenience.

b. Use the "Other Comments" block of this form to provide a complete explanation of why the suggested change is necessary.

William J. White
Deputy Director, Flight Standards Service

APPENDIX 1. FIGURES AND TABLES

FIGURE 1A. CONSTRUCTION OF PRIMARY AND SECONDARY AREAS OF THE INITIAL AND INTERMEDIATE APPROACH SEGMENTS FOR A STRAIGHT APPROACH FROM OUTSIDE OF THE 20-MILE COVERAGE WHEN DISTANCE, THRESHOLD TO PFAF IS LESS THAN 50,200'

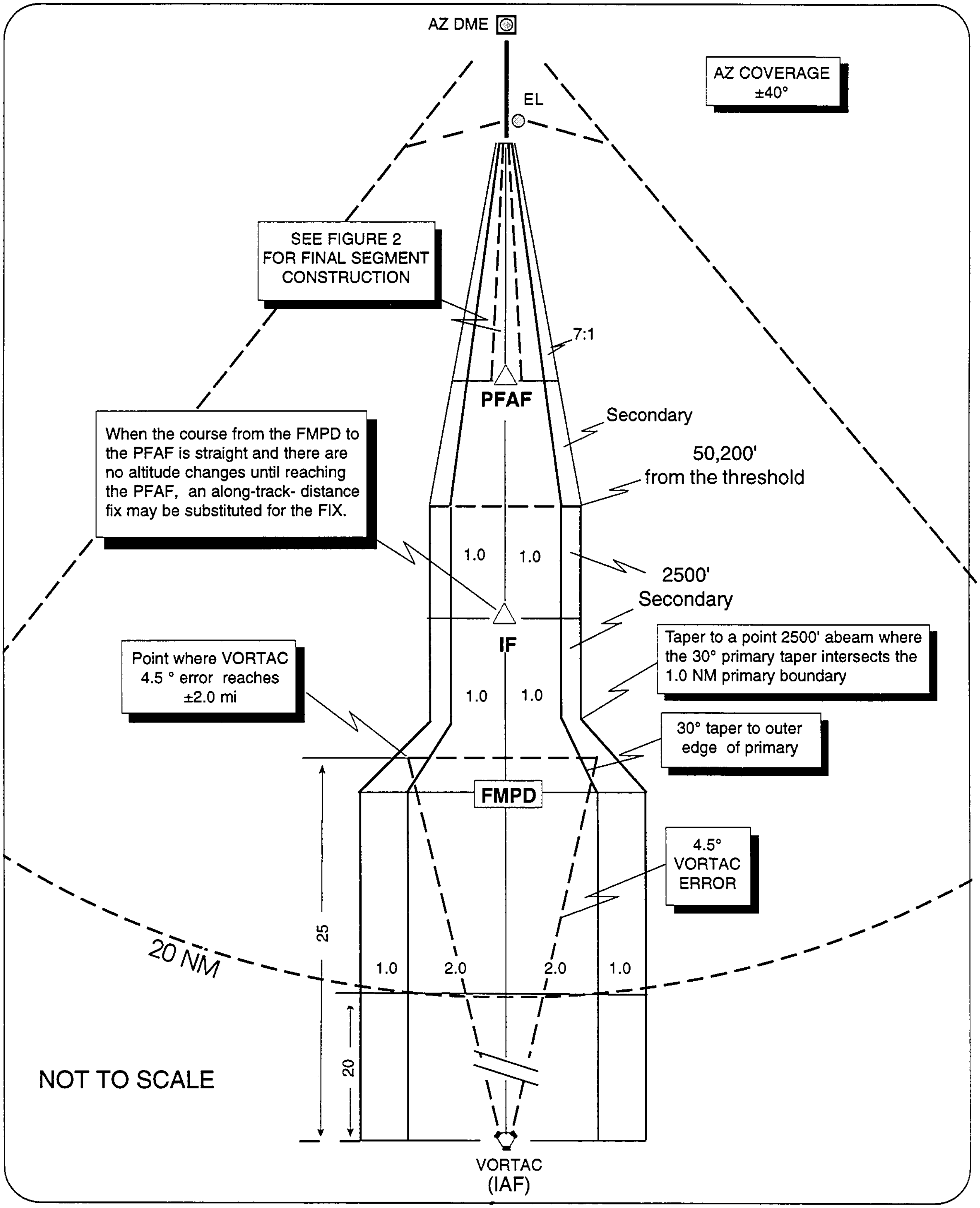


FIGURE 1B. CONSTRUCTION OF PRIMARY AND SECONDARY AREAS OF THE INTERMEDIATE AND FINAL APPROACH SEGMENTS FOR A STRAIGHT APPROACH FROM OUTSIDE THE 20-MILE COVERAGE WHEN THE 50,200' POINT IS REACHED AFTER CROSSING THE PFAF

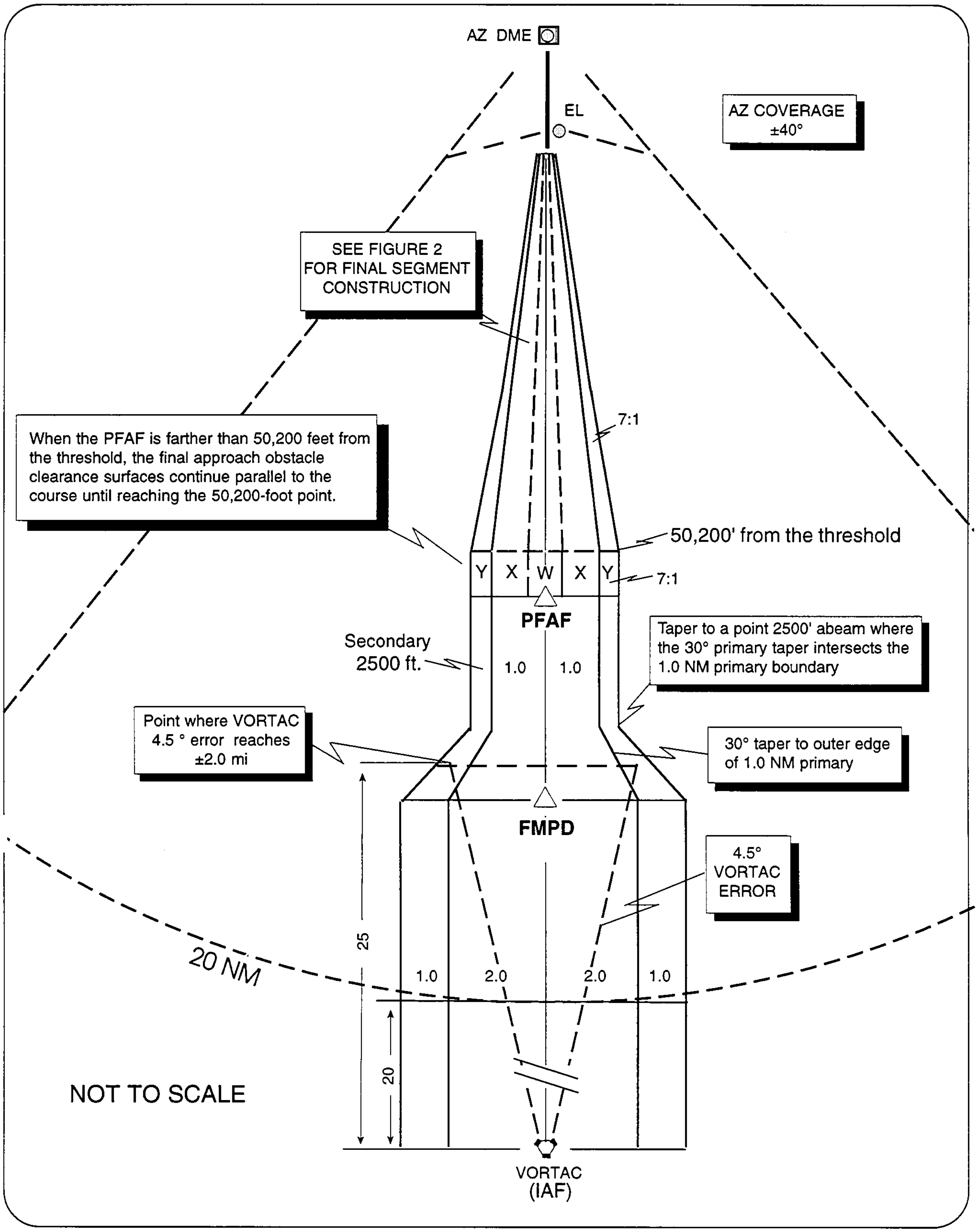


FIGURE 2. FINAL APPROACH SEGMENT AREA CONSTRUCTION

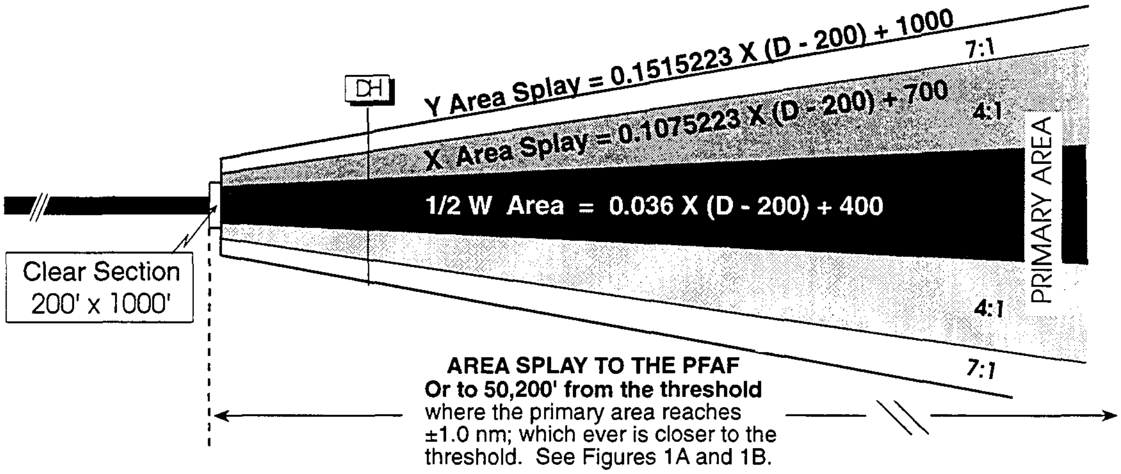
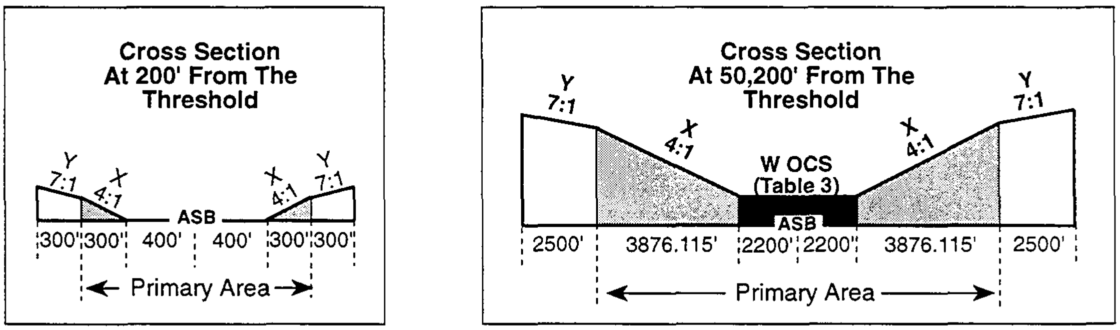


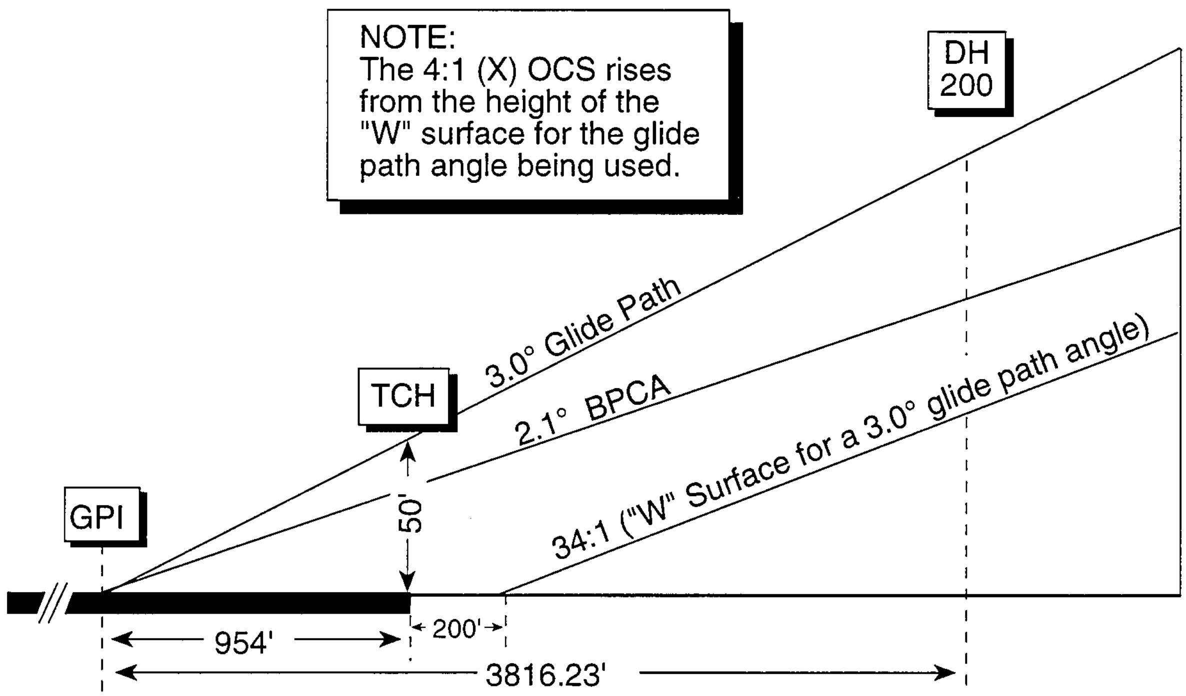
FIGURE 3. FINAL APPROACH SEGMENT AREA CROSS SECTION



At 50,200 feet from the landing threshold, the 1/2 width of the "W" surface is 2200' and the 1/2 width of the 4:1 (X) surface is 1 nautical mile or 6076.11548'. When the 2200' of the "W" surface is subtracted from the 1/2 width of the 4:1 (X) surface, the remaining 4:1(X) area is as shown; 3876.11548' (rounded to 3876.115').

NOT TO SCALE

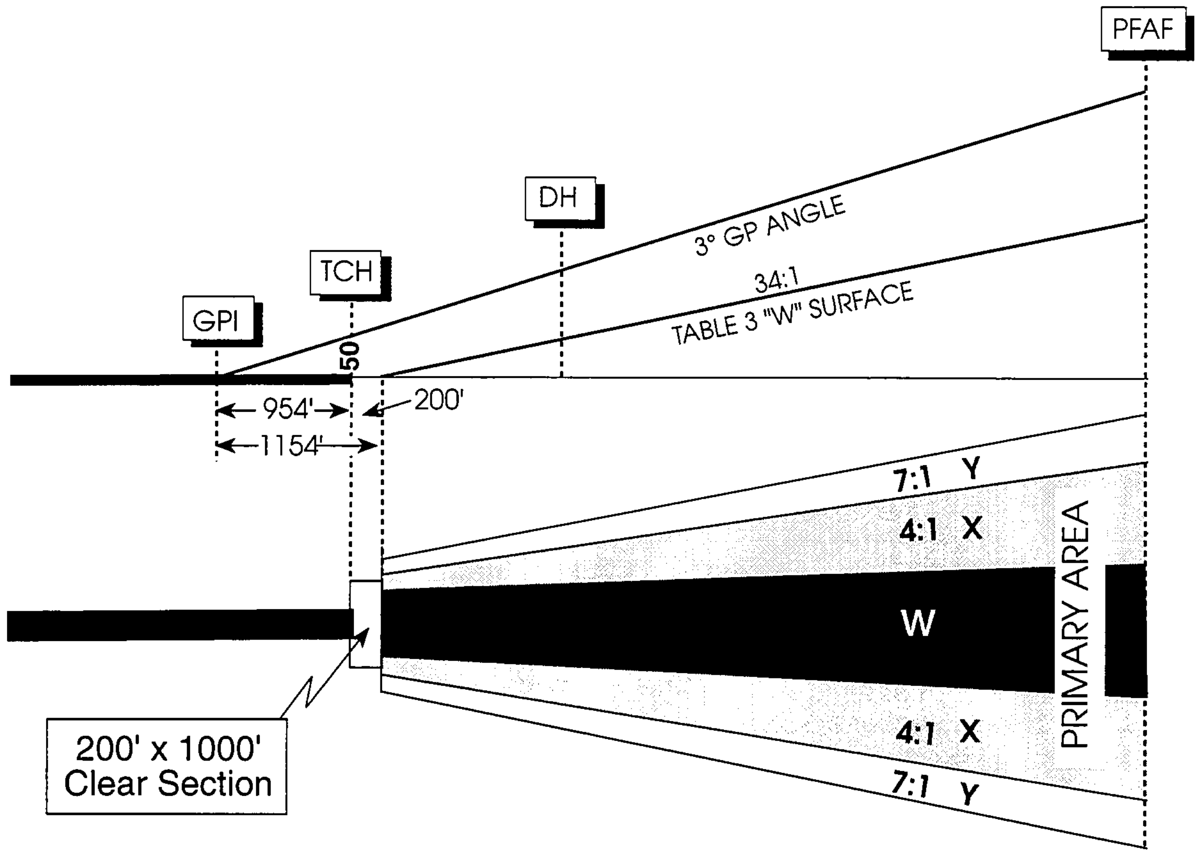
FIGURE 4. ADJUSTMENT OF DECISION HEIGHT DUE TO PENETRATIONS OF THE 4:1 (X) OCS



When an obstacle penetrates the 4:1 (X) OCS, adjustment to the DH may be authorized in accordance with paragraph 20b; except that the obstacle shall not penetrate the BPCA. The BPCA is determined by the formula shown above.

NOT TO SCALE

FIGURE 5. FINAL STRAIGHT COURSE VERTICAL PROFILE



The example above is a standard 3.0° glide path which includes the basic 954' GPI-to-threshold distance and the basic 1154' distance from the GPI to the end of the 200' clear zone. It should be noted that the primary area includes both the "W" and "X" OCS areas. For azimuth-only procedures or when calculating the MDA for azimuth landing minimums in MLS precision procedures, the obstruction clearance is based on the splay of the "X" OCS area which becomes the primary area when there is no glide path.

NOT TO SCALE

FIGURE 6. CONSTRUCTION OF STRAIGHT MISSED APPROACH AREA

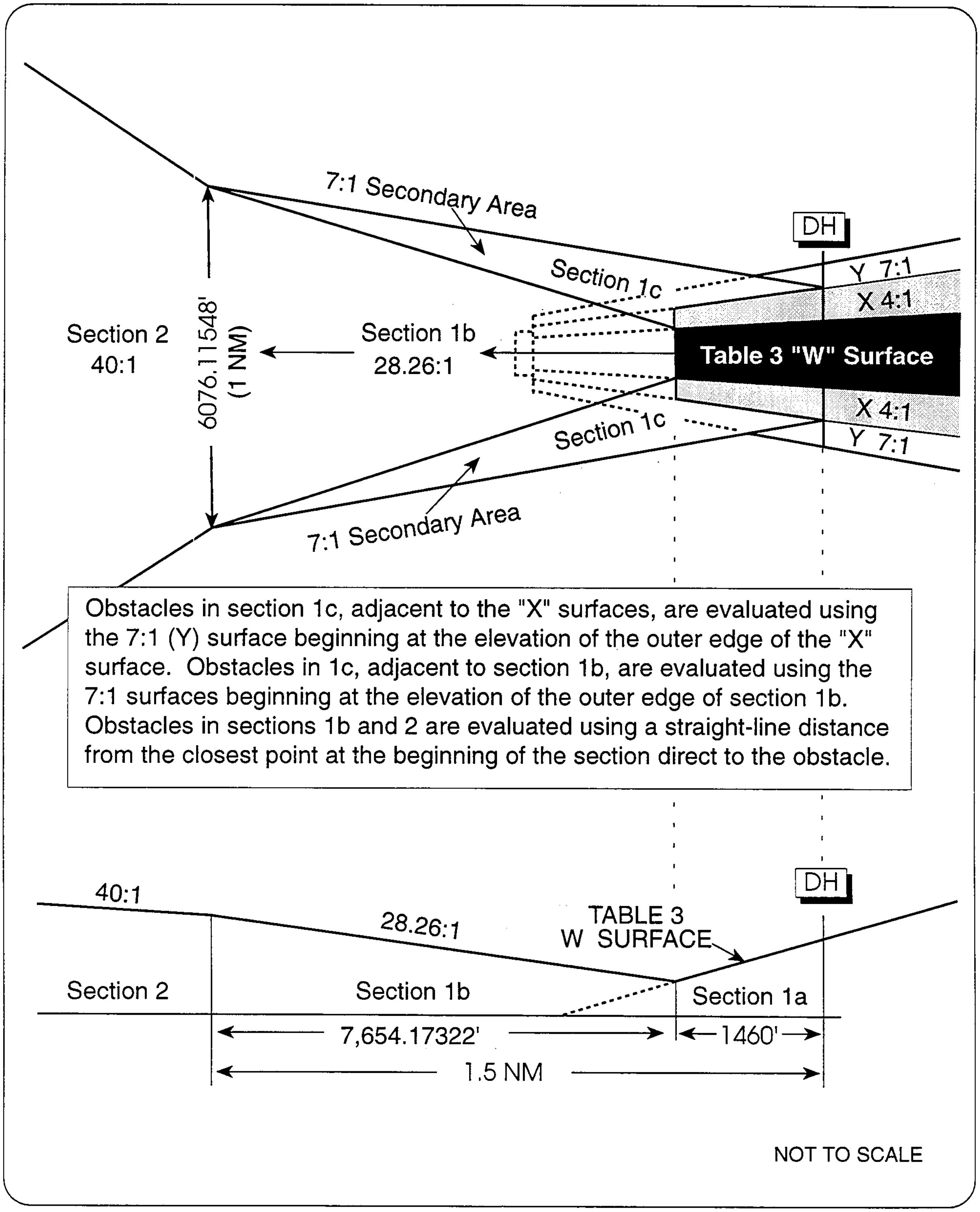


FIGURE 7. CONSTRUCTION OF THE TURNING MISSED APPROACH AREA

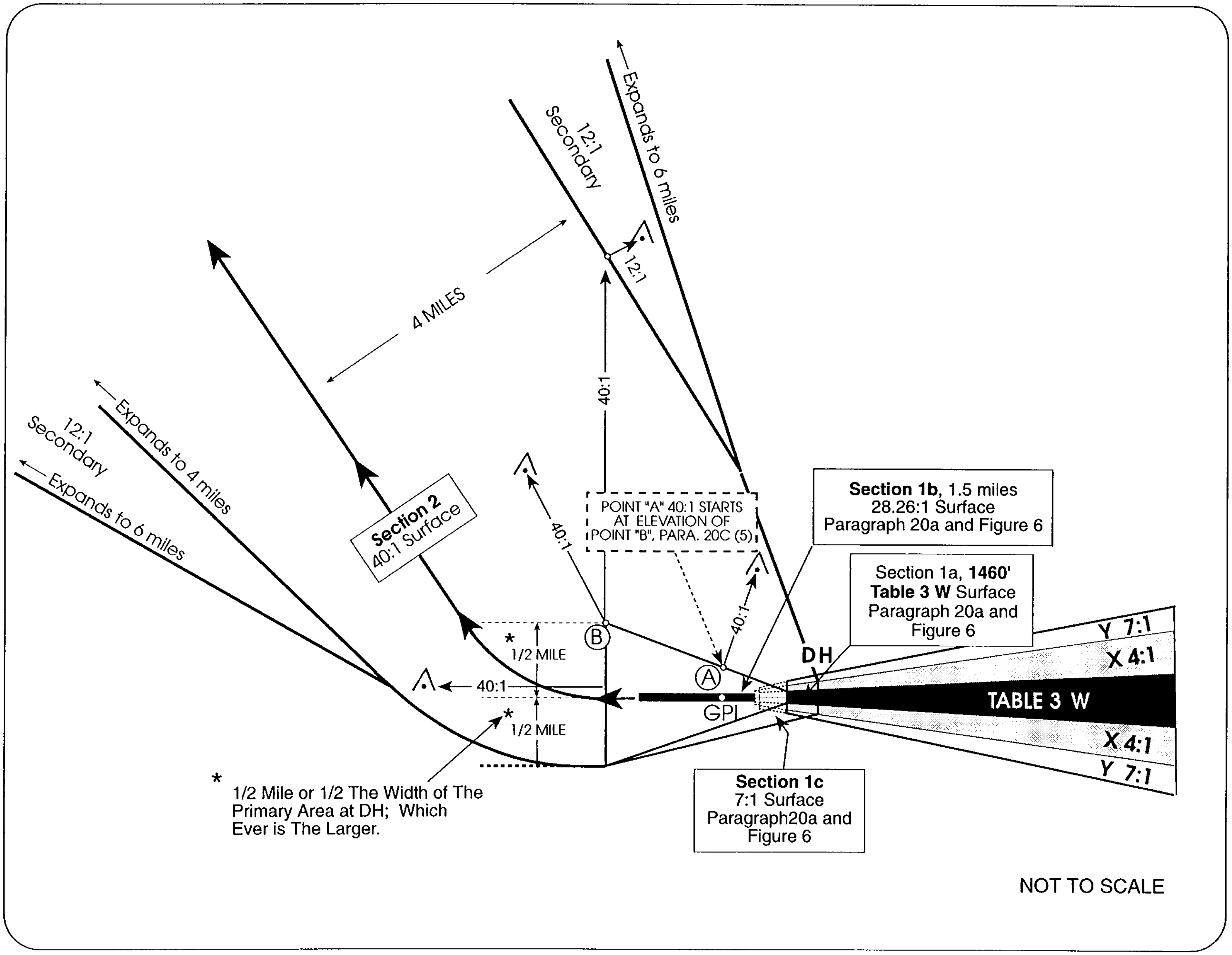
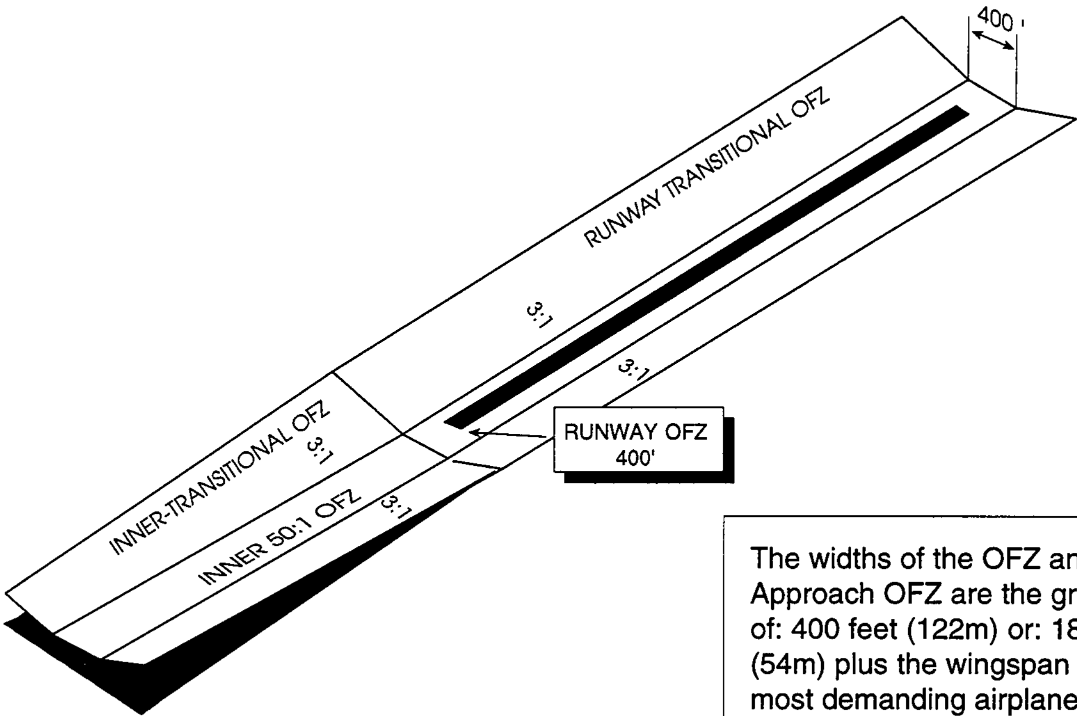
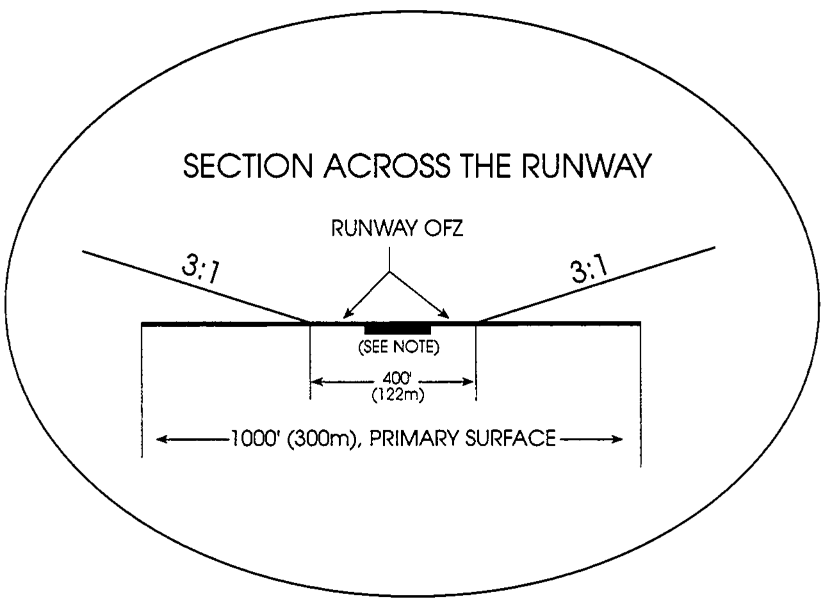


FIGURE 8. MLS PRECISION APPROACH OBSTACLE-FREE ZONES (OFZ)

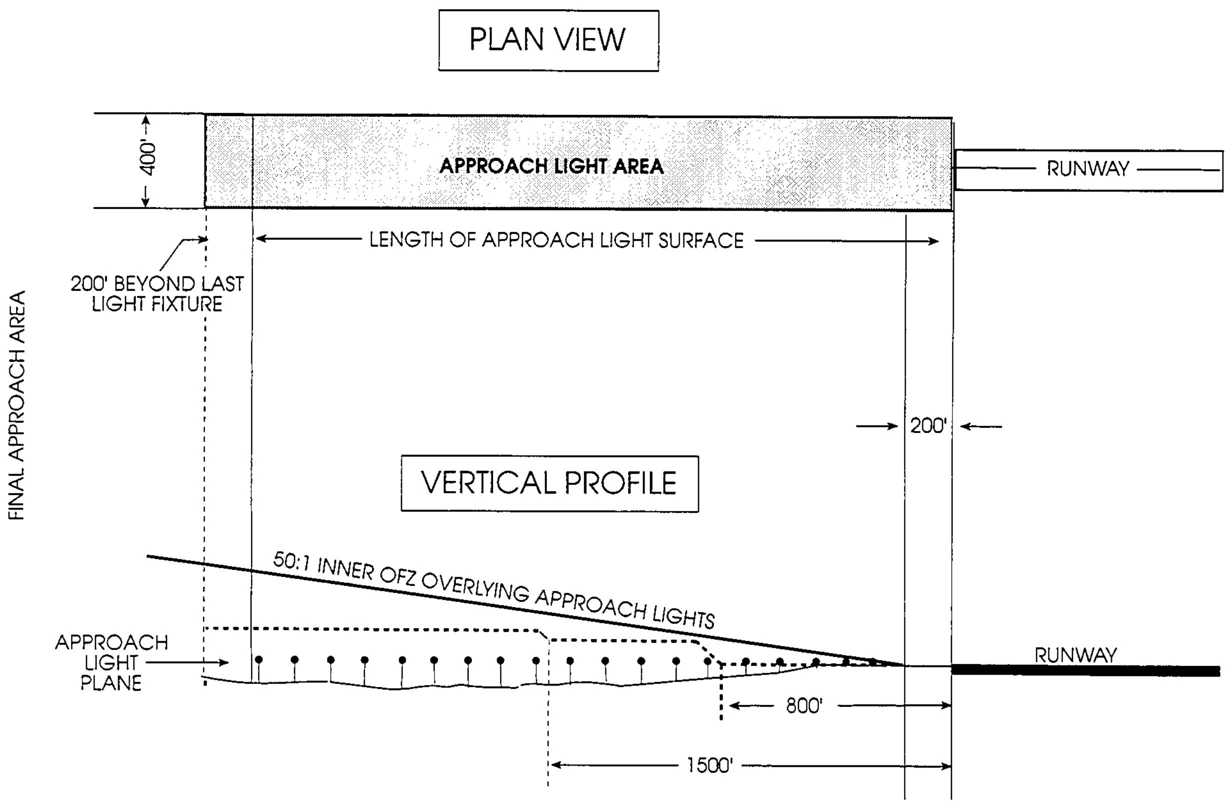


The widths of the OFZ and Approach OFZ are the greater of: 400 feet (122m) or: 180 feet (54m) plus the wingspan of the most demanding airplane expected to use the runway, plus 20 feet (6m) per 1000 feet (300m) of airport elevation.



NOT TO SCALE

FIGURE 9. APPROACH LIGHT AREA WITH 50:1 INNER OFZ SURFACE

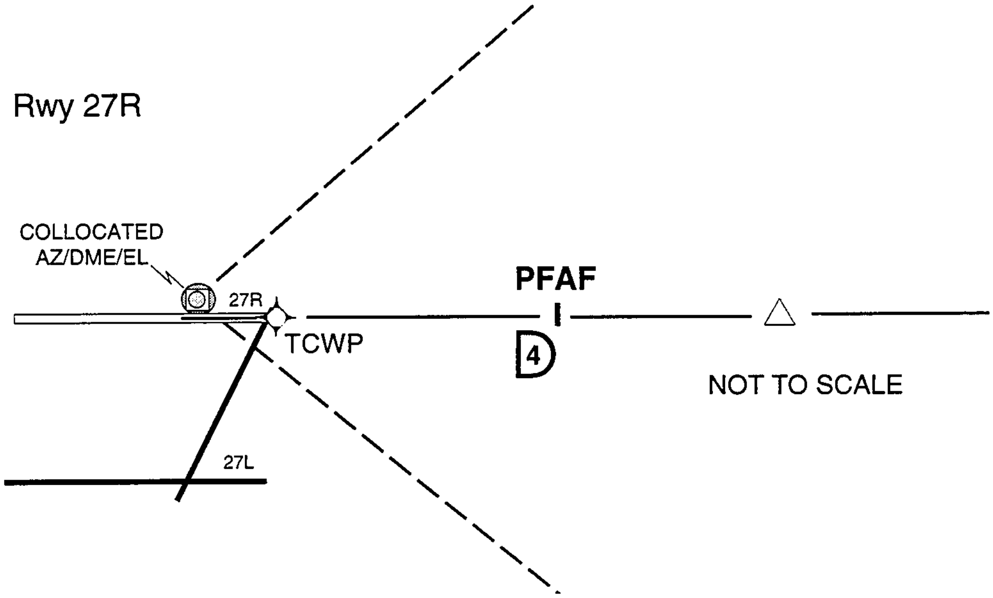


See paragraph 22 for details of application

NOT TO SCALE

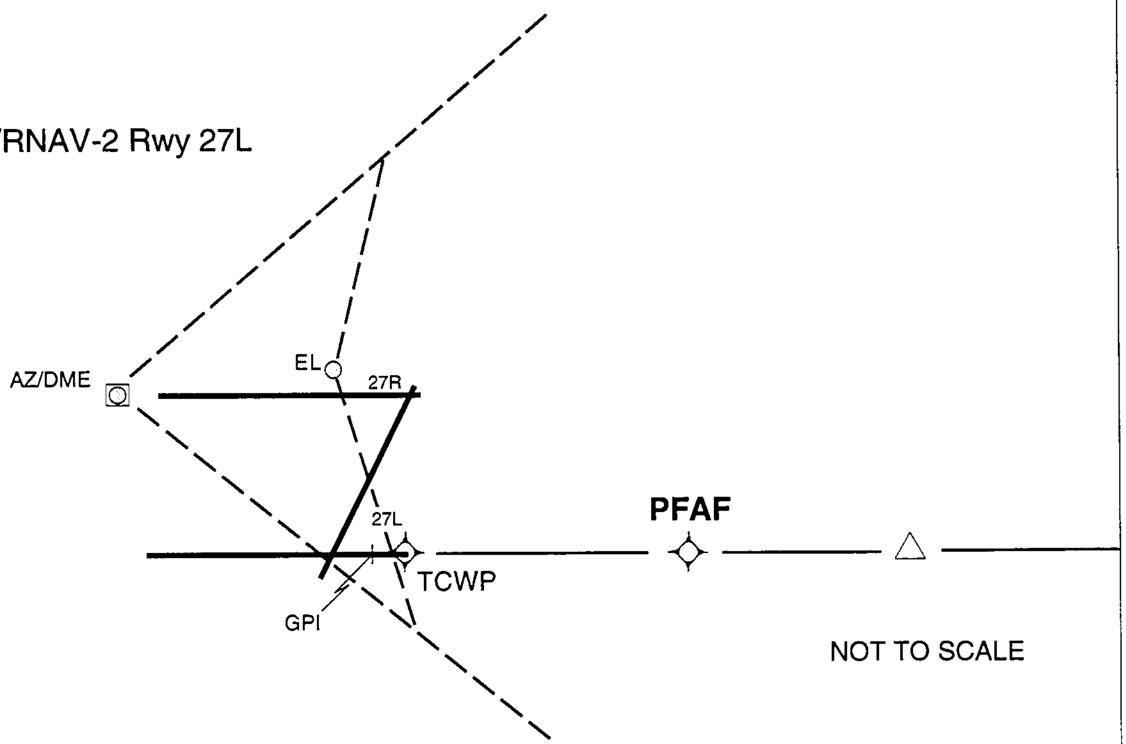
FIGURE 10. EXAMPLES OF MLS TYPES A AND B RNAV CAPABILITIES

MLS/RNAV-1 Rwy 27R



(A) Type A RNAV, Computed Centerline / Non-Aligned Approach
Computed Elevation Not Available; MLS EL and Az colloated.

MLS/RNAV-2 Rwy 27L



(B) Type B RNAV with Computed Centerline
And Computed Elevation (Parallel runways with wide spacing).

FIGURE 11. TYPICAL MLS HORIZONTAL COVERAGE TO 20 NM

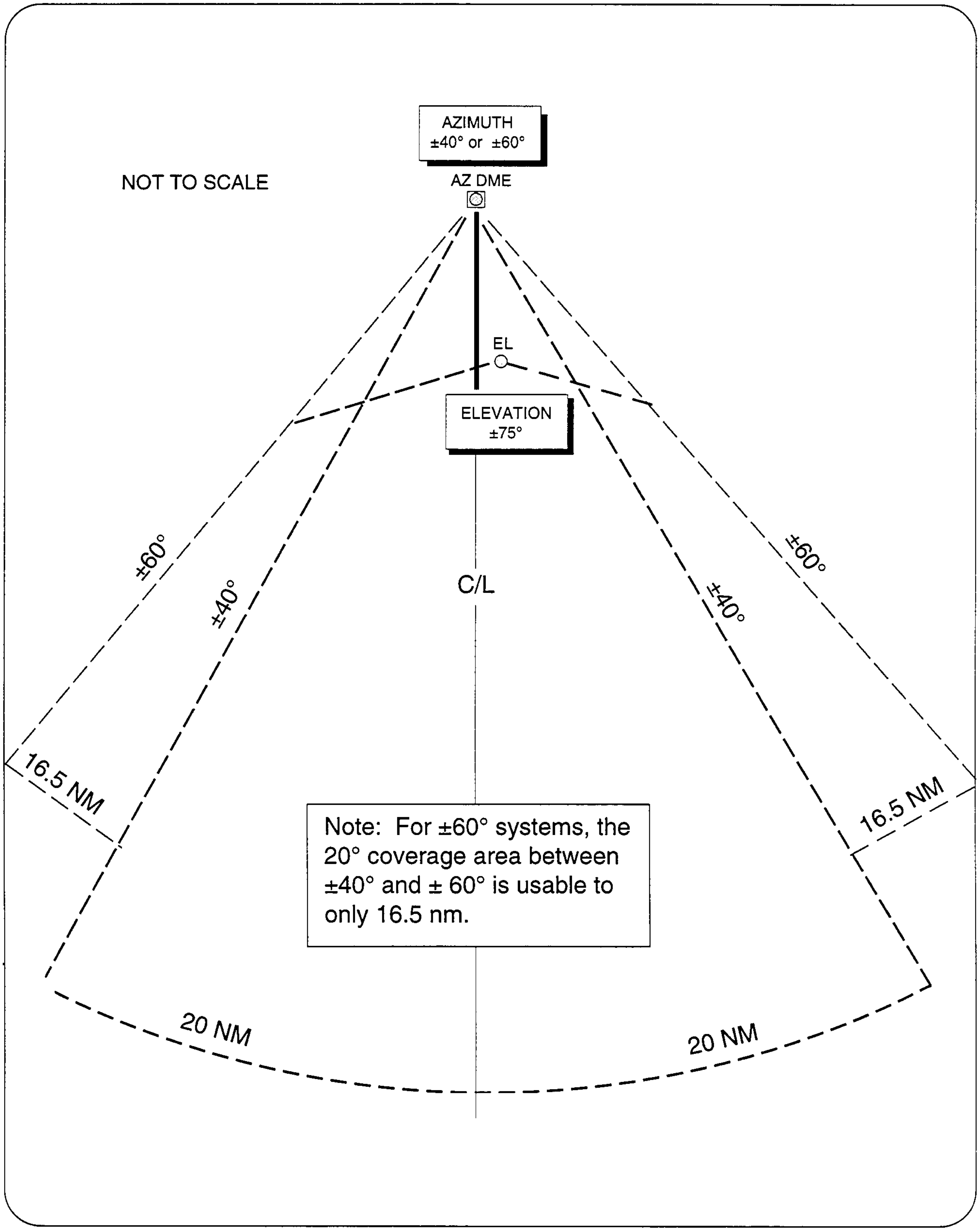


FIGURE 12A. CONSTRUCTION OF PRIMARY AND SECONDARY AREAS FOR THE INITIAL AND INTERMEDIATE APPROACH SEGMENTS WHERE A CURVE IS USED BEFORE REACHING THE PFAF

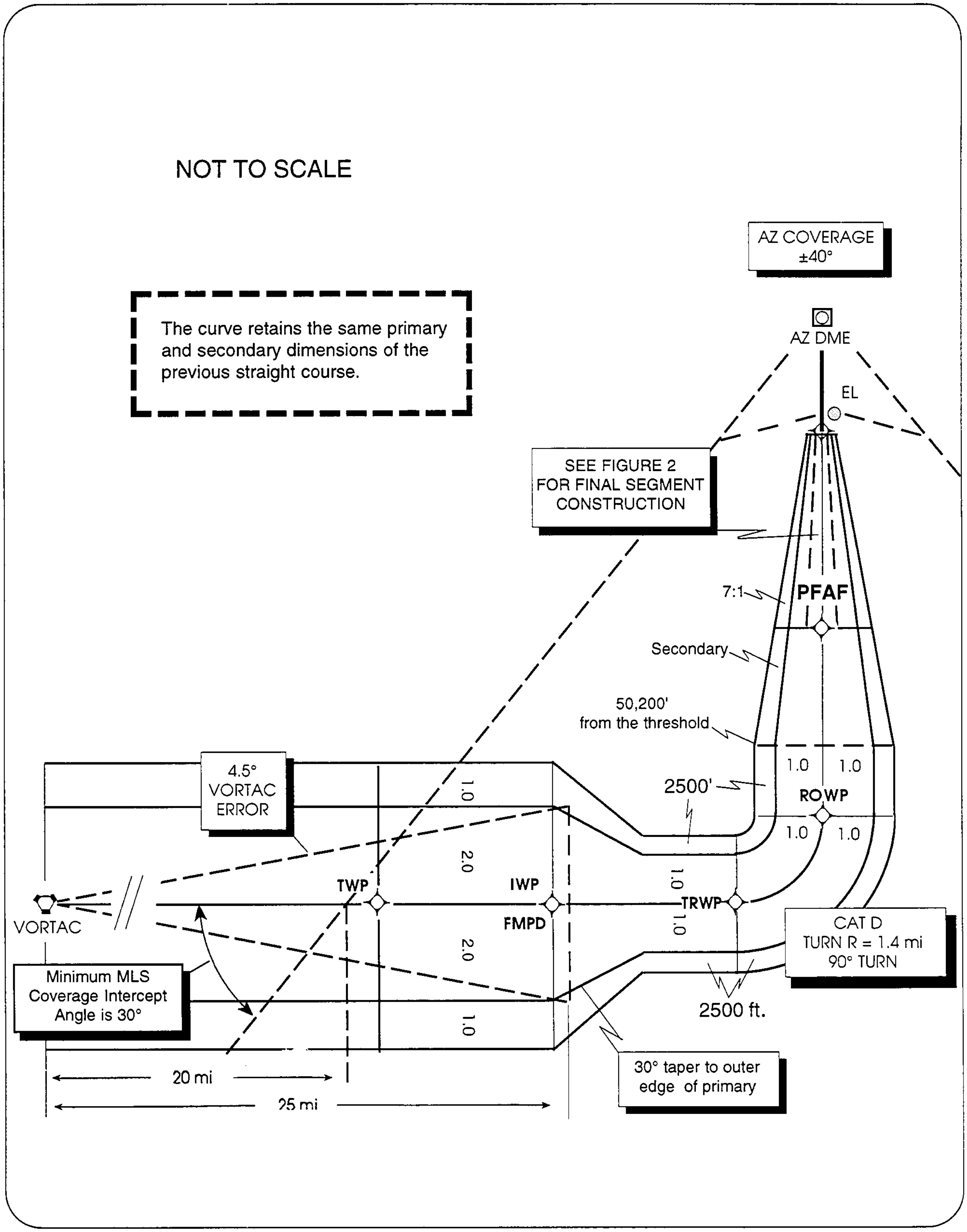


FIGURE 12B. CONSTRUCTION OF THE PRIMARY, SECONDARY, AND TRANSITION AREAS FOR A CURVED-PATH PROCEDURE WHEN THE PFAF OCCURS PRIOR TO THE TURN AND AFTER PASSING A POINT 50,200 FEET FROM THE THRESHOLD

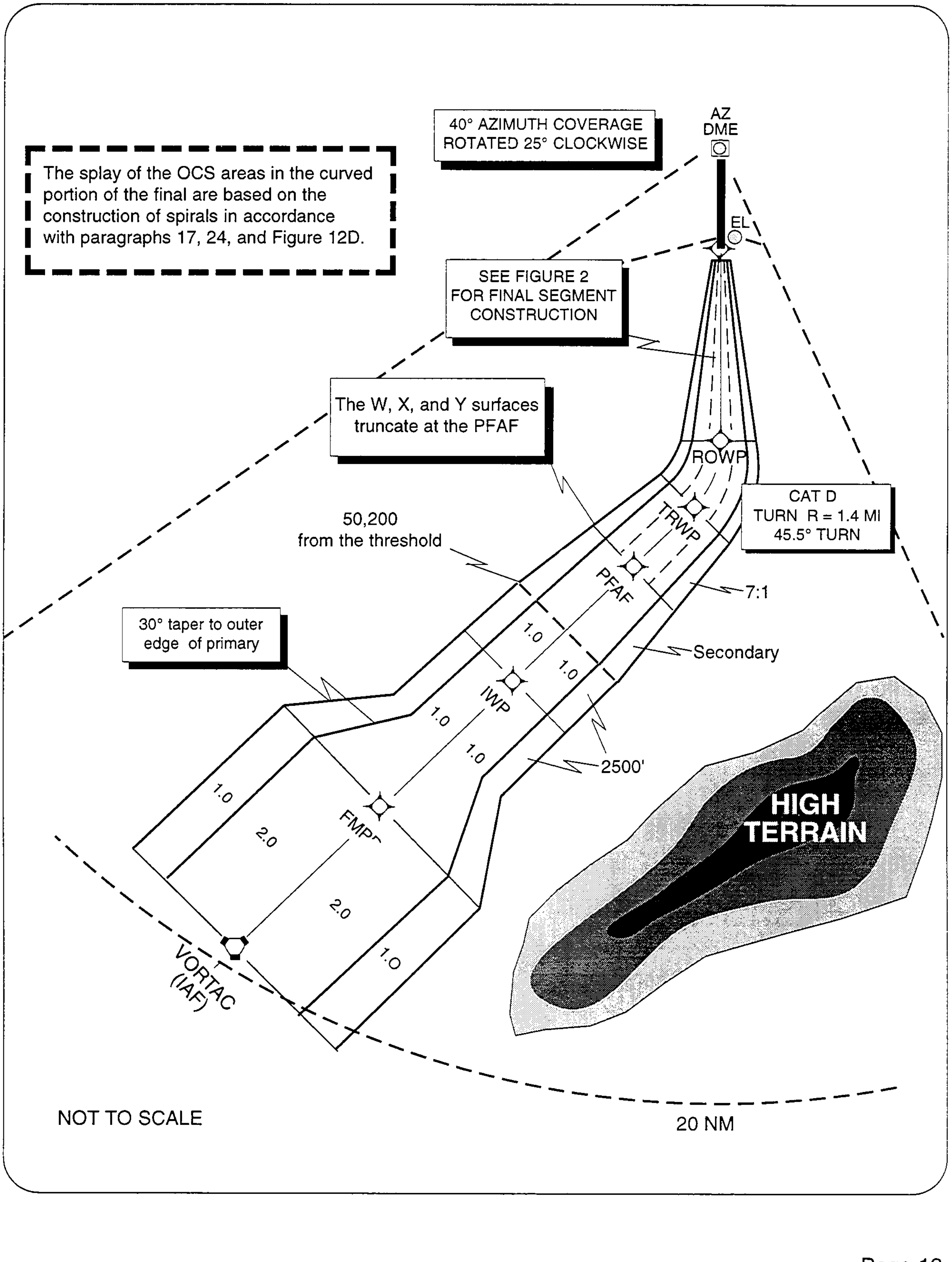


FIGURE 12C. CONSTRUCTION OF THE PRIMARY, SECONDARY, AND TRANSITION AREAS FOR A CURVED-PATH PROCEDURE WHEN THE PFAF OCCURS PRIOR TO THE TURN AND PRIOR TO PASSING A POINT 50,200 FEET FROM THE THRESHOLD

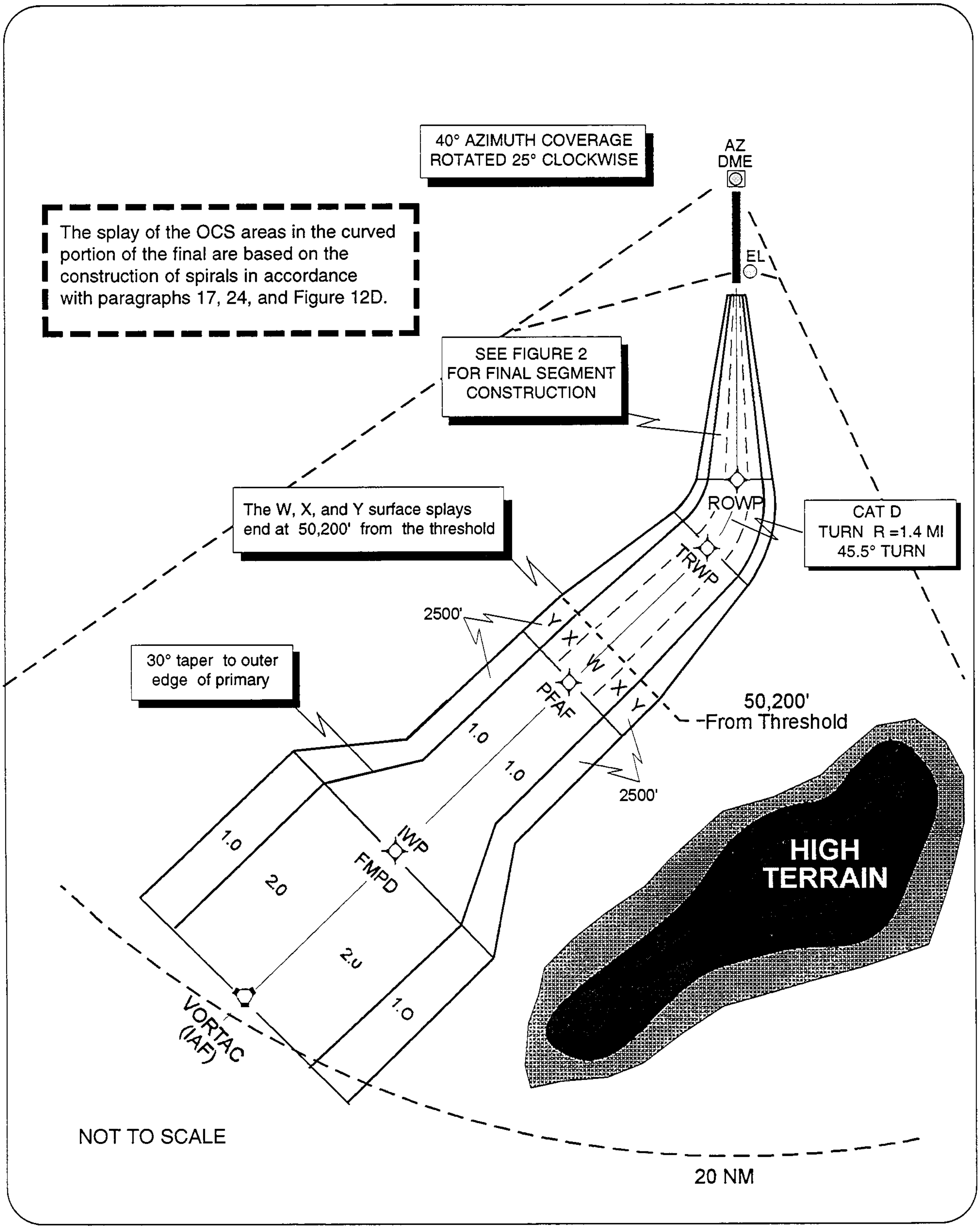
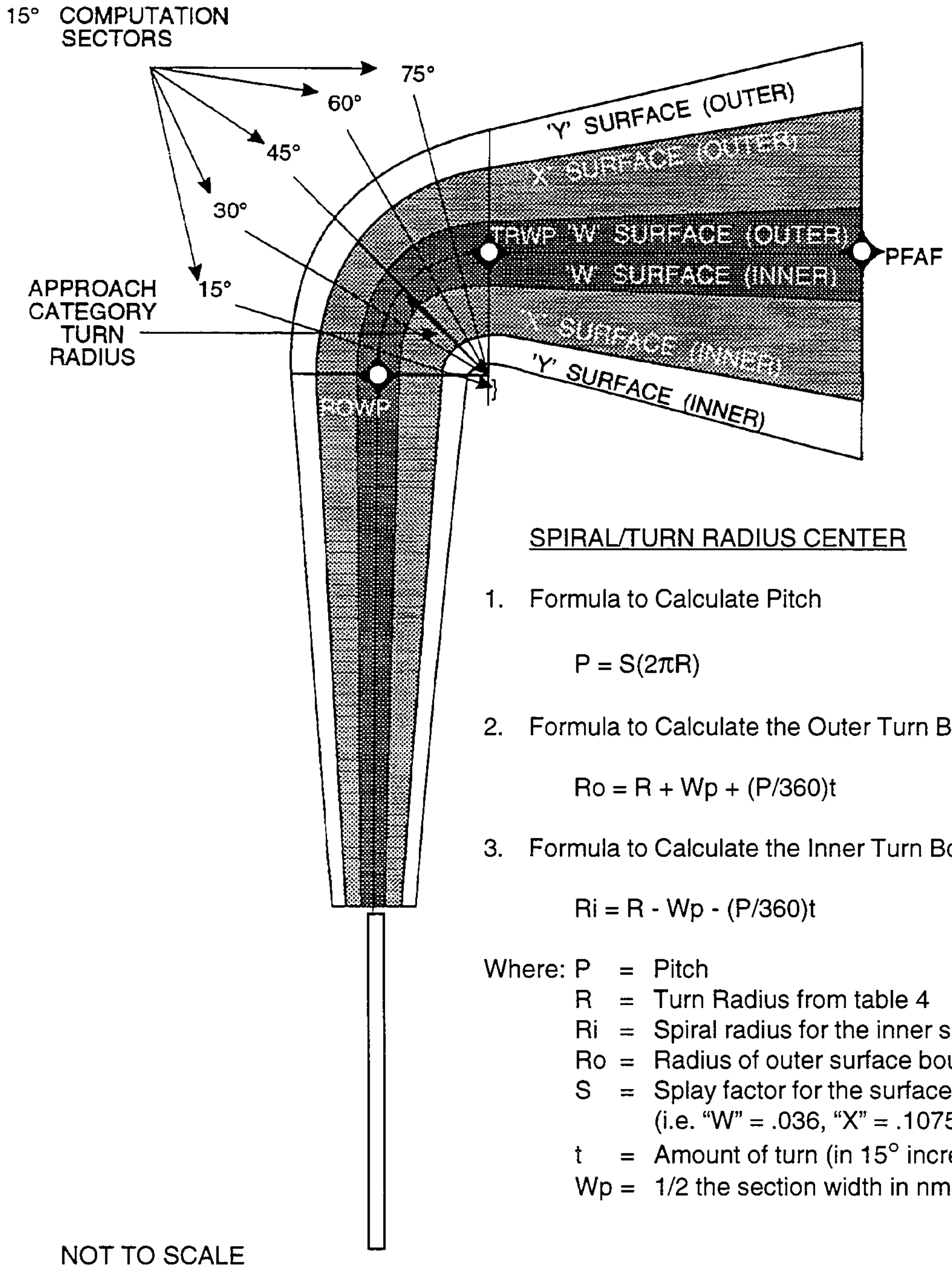


FIGURE 12D. CONSTRUCTION OF CURVED-PATH PRIMARY AND TRANSITIONAL SPIRAL AREAS FOR THE FINAL APPROACH CURVED SEGMENTS, THRESHOLD TO THE 50,200-FOOT POINT OR THE PFAF; WHICHEVER IS CLOSER



<u>SPIRAL/TURN RADIUS CENTER</u>

1. Formula to Calculate Pitch

   $P = S(2\pi R)$

2. Formula to Calculate the Outer Turn Boundaries

   $Ro = R + Wp + (P/360)t$

3. Formula to Calculate the Inner Turn Boundaries

   $Ri = R - Wp - (P/360)t$

Where: P = Pitch
R = Turn Radius from table 4
Ri = Spiral radius for the inner surface boundary
Ro = Radius of outer surface boundary
S = Splay factor for the surface boundary (i.e. "W" = .036, "X" = .10752, "Y" = .15152)
t = Amount of turn (in 15° increments)
Wp = 1/2 the section width in nm at the ROWP

FIGURE 13A. PSEUDO THRESHOLD AND PSEUDO GPI DESIGN FOR OFFSET MLS PROCEDURES

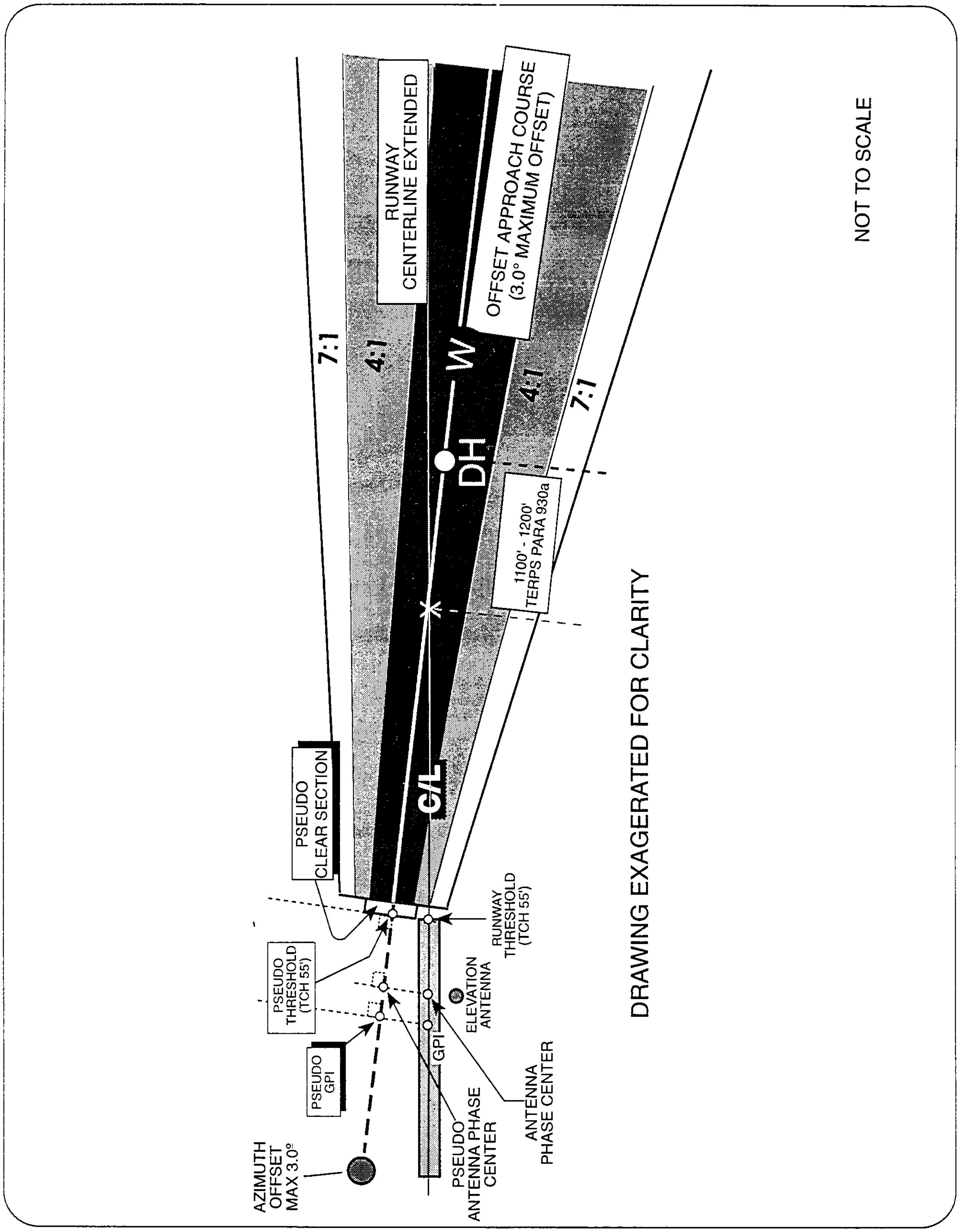
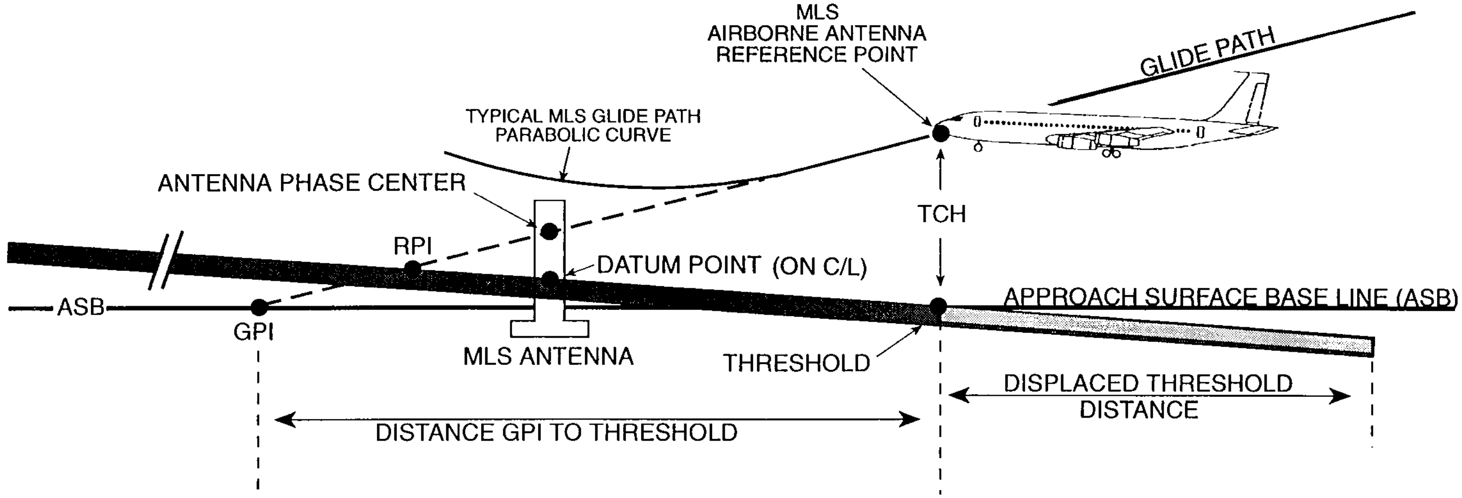
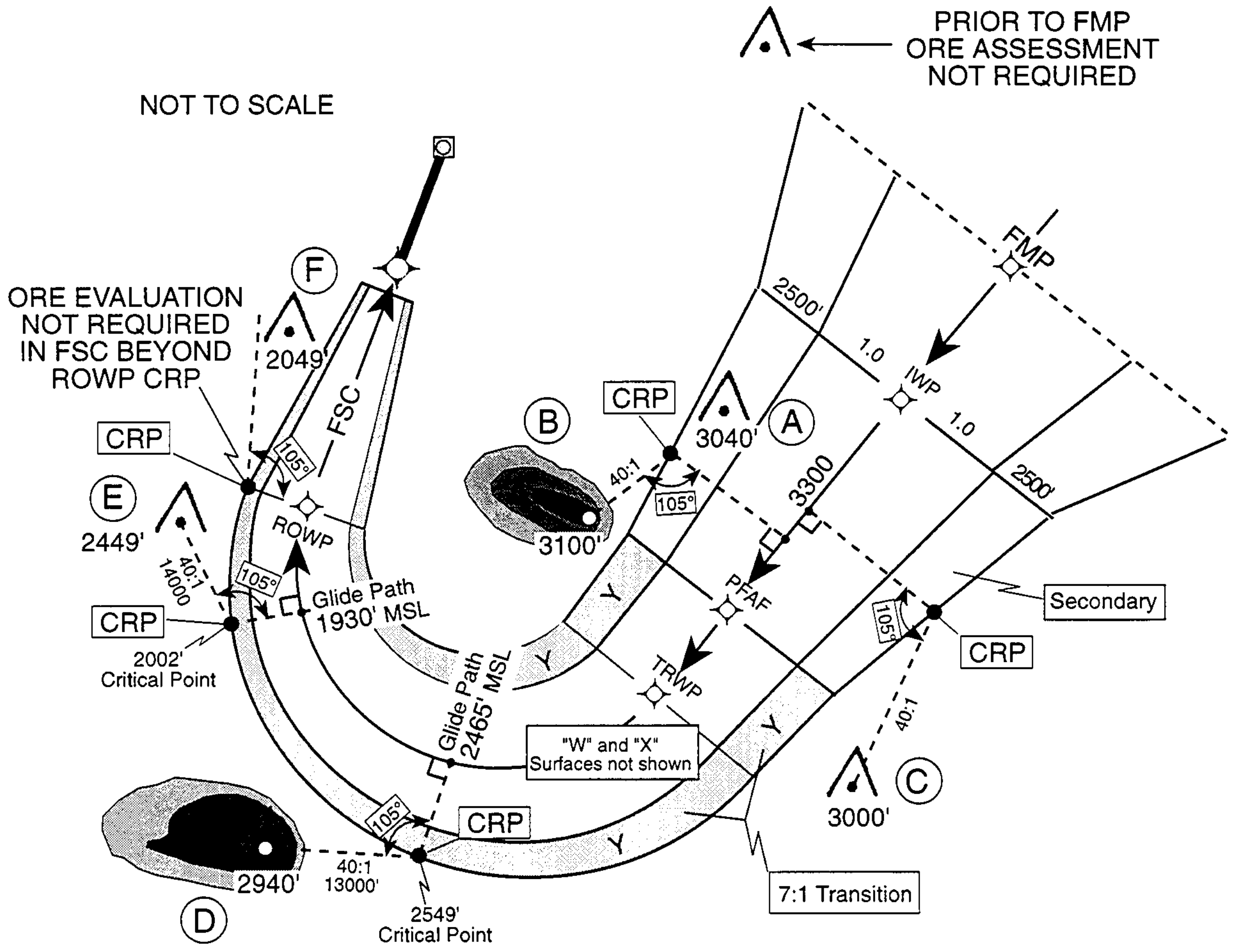


FIGURE 13B. ESTABLISHMENT OF GROUND POINT OF INTERCEPT BASED ON THE THRESHOLD HEIGHT, THE GLIDEPATH PHASE CENTER AND THE REFERENCE DATUM POINT



DRAWING EXAGERATED FOR CLARITY

FIGURE 14. ASSESSMENT OF AN OBSTACLE-RICH ENVIRONMENT



This figure illustrates how the instructions and the formulas contained in Section 5 of this order are applied. Obstacles A through F are evaluated to determine whether they qualify for an ORE determination:

A, B, and C. All three of these obstacles are below the minimum intermediate segment altitude of 3300' at the critical point and, therefore, do not qualify for an ORE assessment. In such cases, the 40:1 ORE surface would always clear the obstacles.

D. The 2940' obstacle qualifies for an ORE assessment because it is above the elevation of the glide path at the critical point. The elevation of the outer edge of the "Y" surface is 2549' at the critical point. The distance from that perpendicular point to the obstacle is 13000' along the 105° line. 13000' ÷ 40 = 325' + 2549' = 2874' which is 66' below the top of the obstacle. The environment is obstacle rich.

E. The 2449' tower qualifies for an ORE assessment because it is above the elevation of the glide path at the critical point. The elevation of the outer edge of the "Y" surface is 2002' at the critical point. The distance from that perpendicular point to the obstacle is 14000' along the 105° line. 14000' ÷ 40 = 350' + 2002' = 2352' which is 97' below the top of the obstacle. The environment is obstacle rich.

F. The 2049' tower lies abeam the FSC and, because the 105° 40:1line from the ROWP CRP does not intersect the 2049' obstacle, the obstacle is exempt from an ORE assessment.

FIGURE 15. MLS/CP RNAV EXAMPLE OF AN "S" TURN SEGMENT

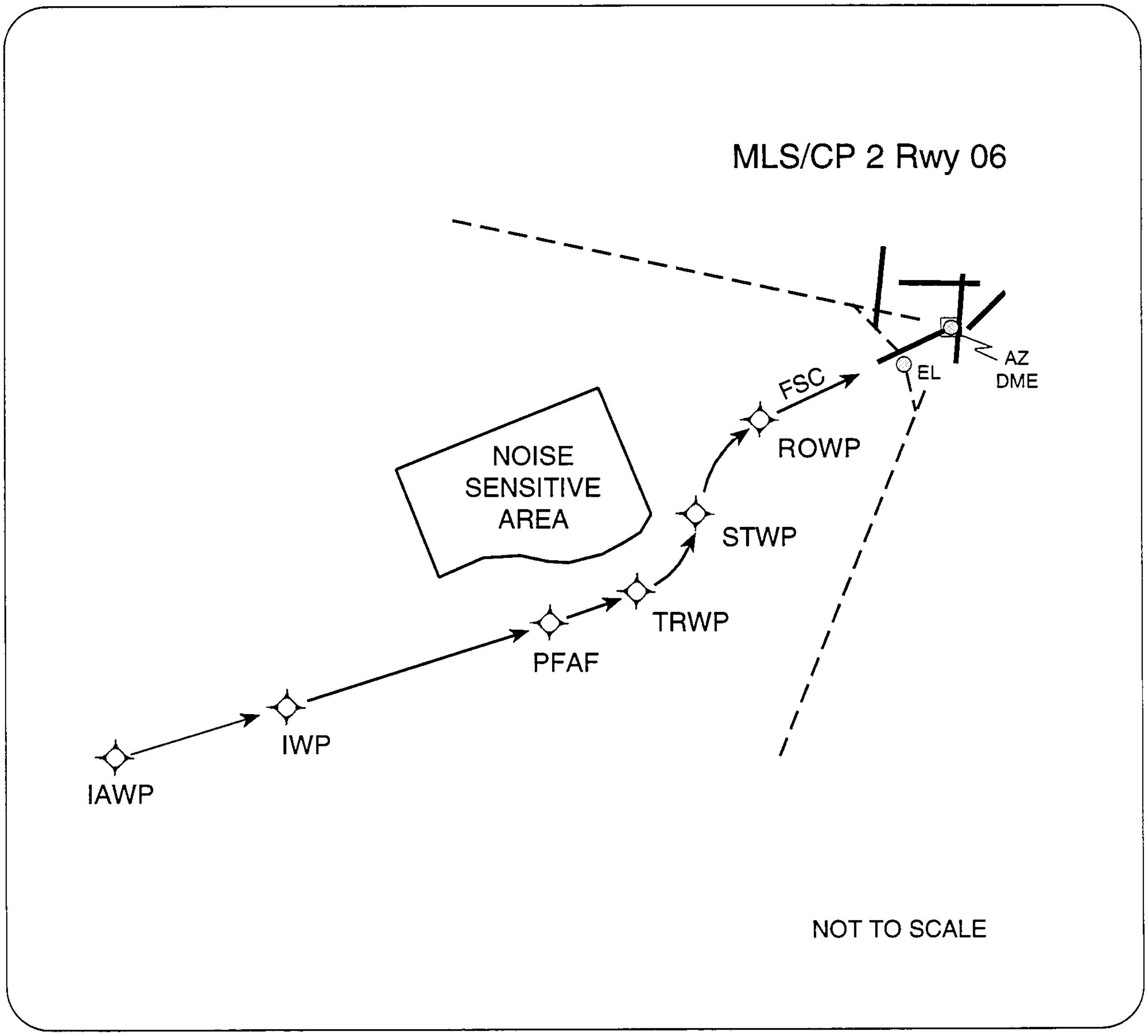
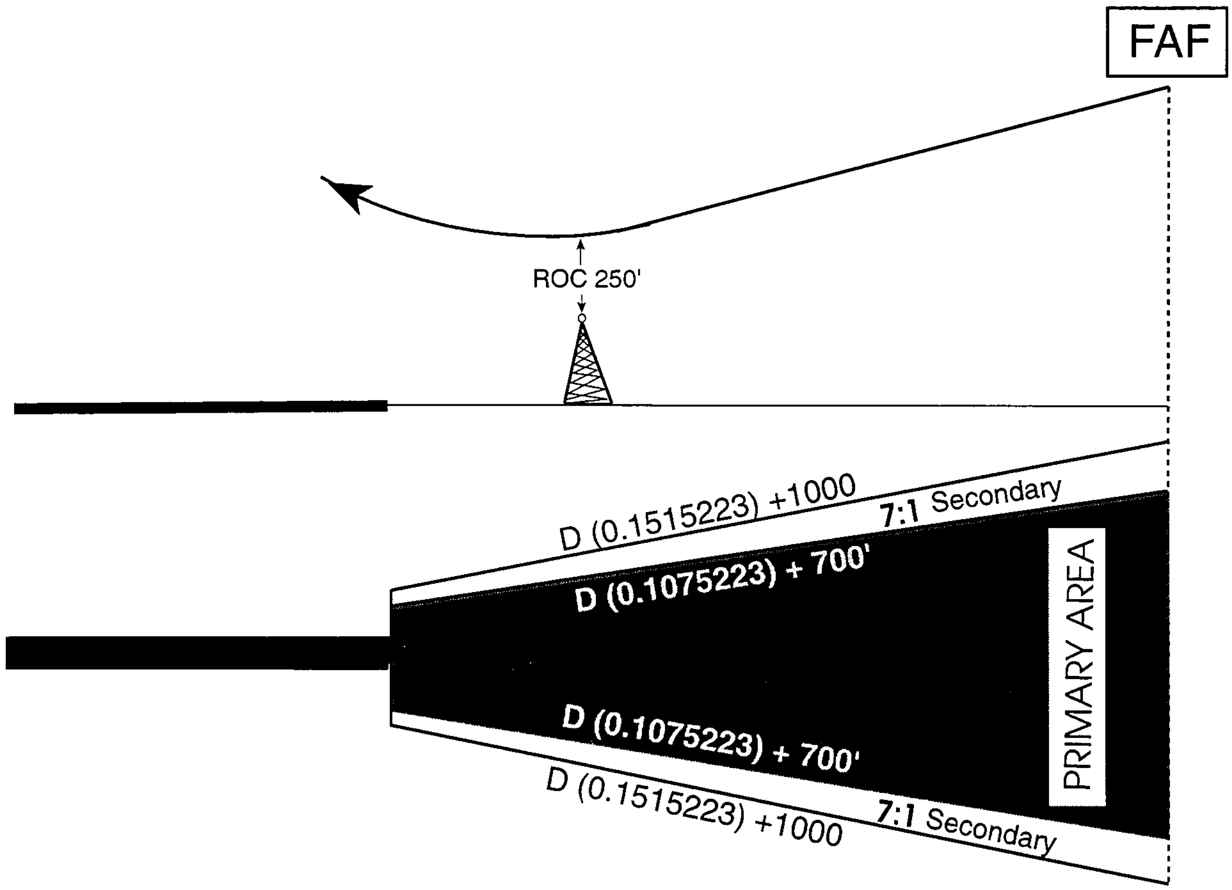


FIGURE 16. CONSTRUCTION OF A BASIC AZIMUTH-ONLY PROCEDURE



MISSED APPROACH IS IN ACCORDANCE WITH CHAPTER 2 OF ORDER 8260.3B AND THERE ARE NO MISSED APPROACH SECTIONS 1A AND 1B.

NOT TO SCALE

FIGURE 17. EXAMPLE OF A BASIC AZIMUTH-ONLY APPROACH TO A SECONDARY AIRPORT OR RUNWAY

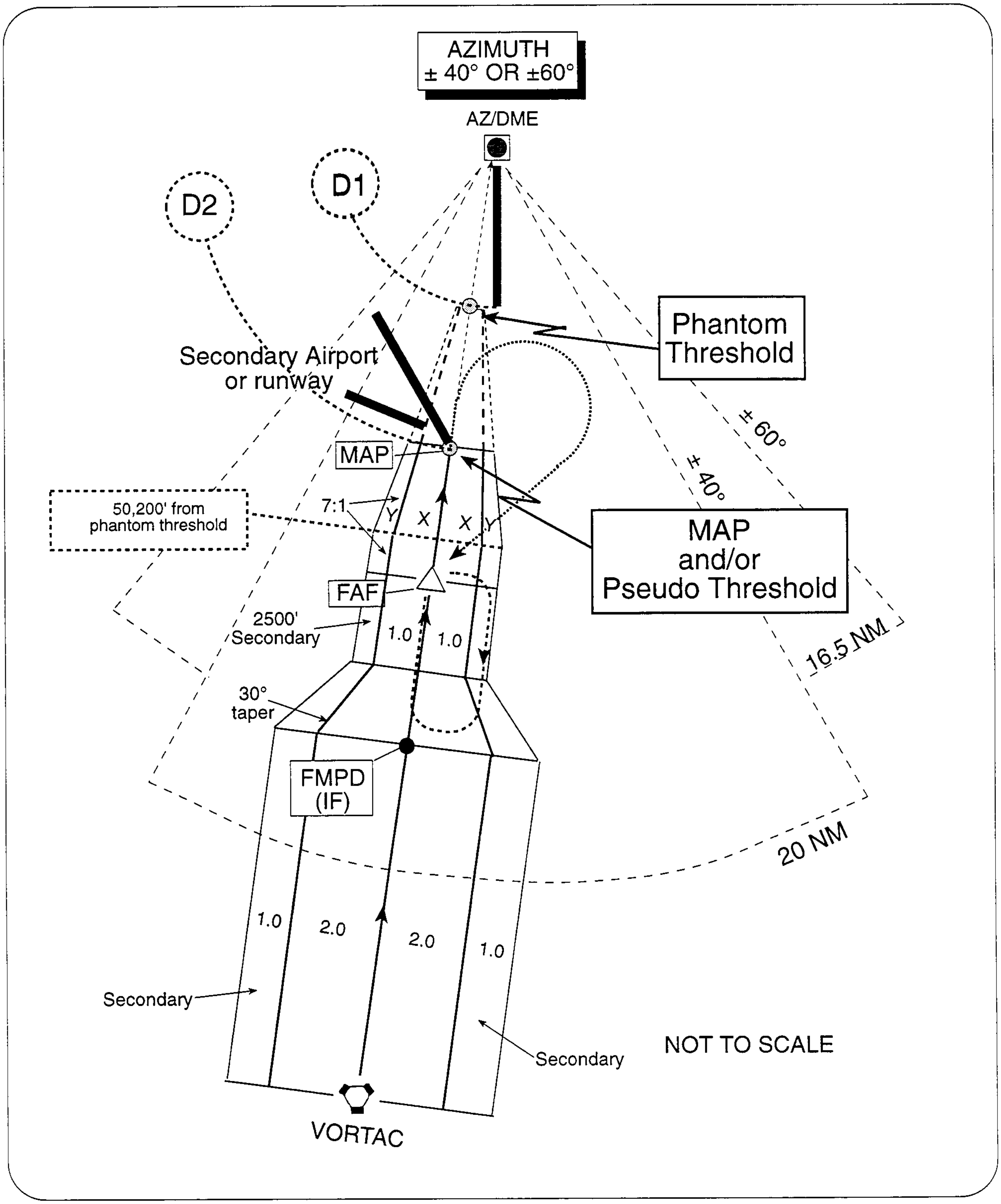


TABLE 1. CIVIL STANDARD MLS PRECISION LANDING MINIMUMS

GLIDEPATH ANGLE (WITH APPROACH LIGHT CONFIGURATION)		MINIMUM HAT	AIRCRAFT CATEGORY A	B	C	D & E
			MINIMUM VISIBILITY			
3.00° — 3,10°	*	200	3/4 4000			
	#	200	1/2 2400			
	$	200	1800			
3.11° — 3.30°	*	200	3/4 4000		NA	
	*	250	3/4 4000		1 5000	NA
	#	200	1/2 2400		NA	
	#	250	1/2 2400		3/4 4000	NA
	$	200	1800		NA	
	$	250	1800		1/2 2400	NA
3.31° — 3.60°	*	200	3/4 4000		NA	
	*	270	3/4 4000		1 5000	NA
	#	200	1/2 2400		NA	
	#	270	1/2 2400		3/4 4000	NA
	$	200	2000		NA	
	$	270	2000		1/2 2600	NA
3.61° — 3.80°	*	200	3/4 4000		NA	
	#	200	1/2 2400		NA	
3.81° — 4.20°	*	200	3/4 4000	NA		
	*	250	3/4 4000	1 5000	NA	
	#	200	1/2 2400	NA		
	#	250	1/2 2400	3/4 4000	NA	
4.21° — 5.00°	*	250	3/4 4000	NA		
	#	250	1/2 2400	NA		
5.01° — 5.70°	*	300	1 5000	NA		
	#	300	3/4 4000	NA		
5.71° — 6.40° AIRSPEED NTE 80 KNOTS	*	350	1 1/4	NA		
	#	350	1 5000	NA		

* = No Lights

\# = MALSR, SSALR, ALSF

$ = # Plus TDZ/CL Lights

NA = Not authorized

NOTE: For a HAT higher than the minimum, the visibility (prior to applying credit for lights) shall equal the distance MAP to threshold, or: (a) 3/4 mile up to 5.00° or, (b) 1 mile 5.01° through 5.70° or, (c) 1 1/4 mile 5.71° through 6.40°; whichever is the greater.

TABLE 2. THRESHOLD CROSSING HEIGHT UPPER LIMITS FOR ALLOWING VISIBILITY CREDIT FOR LIGHTS

HAT (Feet)	GLIDEPATH ANGLE (Degrees)	TCH UPPER LIMIT (Feet)
200	3.00 - 3.20	75
	3.21 - 3.30	70
	3.31 - 3.40	66
	3.41 - 3.50	63
	3.51 - 3.60	59
	3.61 - 3.70	55
	3.71 - 3.80	50
	3.81 - 3.90	47
	3.91 - 4.00	43
	4.01 - 4.10	39
	4.11 - 4.20	35
250	3.00 - 4.10	75
	4.11 - 4.20	71
	4.21 - 4.30	67
	4.31 - 4.40	62
	4.41 - 4.50	58
	4.51 - 4.60	54
	4.61 - 4.70	50
	4.71 - 4.80	45
	4.81 - 4.90	41
	4.91 - 5.00	37
270	3.00 - 4.40	75
	4.41 - 4.50	73
	4.51 - 4.60	68
	4.61 - 4.70	64
	4.71 - 4.80	59
	4.81 - 4.90	55
	4.91 - 5.00	51
300	3.00 - 4.90	75
	4.91 - 5.00	71
	5.01 - 5.10	66
	5.11 - 5.20	61
	5.21 - 5.30	56
	5,31 - 5.40	52
	5.41 - 5.50	48
	5.51 - 5.60	43
	5.61 - 5.70	39
350	3.00 - 5.60	75
	5.61 - 5.70	70
	5.71 - 5.80	65
	5.81 - 5.90	60
	5.91 - 6.00	55
	6.01 - 6.10	50
	6.11 - 6.20	45
	6.21 - 6.30	40
	6.31 - 6.40	35

TABLE 3. OBSTACLE CLEARANCE "W" SURFACES; THRESHOLD TO PFAF

GLIDEPATH ANGLE (Degrees)	W SURFACE (May be interpolated)	GLIDEPATH ANGLE (Degrees)	W SURFACE (May be interpolated)
3.00	34.0:1	4.70	21.7:1
3.10	32.9:1	4.80	21.2:1
3.20	31.9:1	4.90	20.8:1
3.30	30.9:1	5.00	20.4:1
3.40	30.0:1	5.10	20.0:1
3.50	29.1:1	5.20	19.6:1
3.60	28.3:1	5.30	19.2:1
3.70	27.6:1	5.40	18.9:1
3.80	26.8:1	5.50	18.5:1
3.90	26.1:1	5.60	18.2:1
4.00	25.5:1	5.70	17.9:1
4.10	24.9:1	5.80	17.6:1
4.20	24.3:1	5.90	17.3:1
4.30	23.7:1	6.00	17.0:1
4.40	23.2:1	6.10	16.7:1
4.50	22.7:1	6.20	16.4:1
4.60	22.2:1	6.30	16.2:1
		6.40	15.9:1

TABLE 4. MLS/CP RNAV MINIMUM COURSE DESIGN PARAMETERS

INTERMEDIATE AND FINAL APPROACH						INITIAL
Aircraft Categories	A	B	C	D	E	All Categories
Aircraft Speed Groups	≤90	≤120	≤140	≤165	>165	
Turn Radii (NM)	0.8	1.0	1.2	1.4	1.6	1.8
Minimum Final Straight Course Distance (FSCD) MLS/CP RNAV only.	1.1	1.5	1.8	2.1	2.8	
Minimum Non Final Straight Course Distance (NFSCD). MLS/CP RNAV Only.	0.8	1.0	1.2	1.4	1.6	

TABLE 5. MLS/CP RNAV FIRST MANEUVERING POINT DISTANCE (FMPD)

Distance From Outside VOR or TACAN (To beginning of MLS coverage)	FMPD (Inside of MLS coverage)
1	1.0
5	1.9
10	2.5
15	3.0
20	3.3
25	3.5
FMS or GPS	2.3
If distance from VOR or TACAN is not tabulated, interpolate or use next higher value.	

TABLE 6. MINIMUM DISTANCE BETWEEN PFAF AND TURN WAYPOINT (TP) AND BETWEEN ROLLOUT WAYPOINT (RP) AND PFAF

MINIMUM DISTANCE PFAF TO TURN WAYPOINT AND ROLLOUT WAYPOINT TO PFAF		
AIRCRAFT CATEGORIES	PFAF BEFORE TRWP OR ROWP	PFAF AFTER ROWP OR TRWP
A	0.5	0.8
B	0.7	1.0
C	0.8	1.2
D	0.9	1.4
E	1.0	1.6

*U.S. Government Printing Office: 1996 - 405-571/55723

U.S. Department
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**Federal Aviation
Administration**

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Please submit any written comments or recommendations for improving this directive, or suggest new items or subjects to be added to it. Also, if you find an error, please tell us about it.

Subject: Order ______________________________

To: Directive Management Officer, ______________________________

(Please check all appropriate line items)

☐ An error (procedural or typographical) has been noted in paragraph ________ on page ________.

☐ Recommend paragraph ________ on page ________ be changed as follows:
(attach separate sheet if necessary)

☐ In a future change to this directive, please include coverage on the folowing subject
(briefly describe what you want added):

☐ Other comments:

☐ I would like to discuss the above. Please contact me.

Submitted by: ______________________________ Date: ______________

FTS Telephone Number: ________________ Routing Symbol: ________________

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