Transport Canada Transports Canada

TP 1247E

(05/2005)

# Aviation

## Land Use in the Vicinity of Airports

Eighth Edition

TC-1001740

Canada

Previous Edition:
Seventh Edition
Printed in Canada

Please direct your comments, orders and inquiries to:
Transport Canada
Civil Aviation Communications Centre (AARC)
Place de Ville
Tower C, 5th Floor
330 Sparks Street
Ottawa, ON  K1A 0N8

Telephone: 1 800 305-2059
Fax: 613 957-4208
E-mail: services@tc.gc.ca



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# ABSTRACT

This publication describes the operational characteristics of airports which may influence land uses outside the airport property boundary and recommends, where applicable, guidelines for land use in the vicinity of airports.

The publication was prepared by Planning and Operations Requirements division of Air Navigation System Requirements. Enquiries relating to this document's content and suggested amendments should be directed to:

Chief

Transport Canada

Air Navigation Planning and Operational Requirements

Tower C, 7A Place de Ville

Ottawa, Ontario   K1A ON8

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# INTRODUCTION

The compatible land use planning concept was an outgrowth of the focus of attention on the environmental relationship between airports and their community neighbours. This planning concept is relatively simple and the results can be impressive, but the implementation requires careful study and co-ordinated planning.

Some community/airport situations have reached the point where the effect of land use planning guidelines may be minimal. However, there are still instances where their use will result in more compatible airport and community development. Implementation may take the form of aviation system plans, legislation for compatible land uses, easements or land zoning.

This publication is basically designed to assist planners and legislators at all levels of government in becoming familiar with problems related to land use associated with airport development.

Where units of measure are quoted in this document, the memc numbers are to be heeded as the equivalent imperial units are approximations only.

Enquiries relating to the application of these guidelines should be directed to the appropriate Regional Director General, Aviation. Addresses for the Regional offices of Transport Canada Aviation are listed in Appendix A.

# DEFINITIONS

**Aerodrome**

Any area of land, water (including the frozen surface thereof) or other supporting surface used or designed, prepared, equipped or set apart for use either in whole or in part for the arrival and departure, movement or servicing of aircraft and includes any buildings, installations and equipment in connection therewith.

**Aerodrome Reference Point**

The designated point or points on an aerodrome normally located near the geometric centre of the runway complex that:

(a) establishes the geographical location of an aerodrome for charting purposes, and

(b) establishes the locus of the radius or radii of the outer surface (as defined in a Zoning Regulation).

**Graded Area**

An area surrounding the runway which is graded to a specified standard to minimize hazards to aircraft which may accidentally run off the runway surface.

**Obstacle Limitation Surface**

A surface that establishes the limit to which objects may project into the airspace associated with an aerodrome so that aircraft operations at the aerodrome may be conducted safely, and includes a takeoff surface, an approach surface, a transitional surface and an outer surface.

**Runway Strip**

A defined area including the runway and stopway, if provided, intended to reduce the risk of damage to aircraft running off a runway and to protect aircraft flying over it during takeoff or landing operations.

# PART I

# OBSTACLE LIMITATION SURFACES

## 1.1 GENERAL

This part will give the reader some insight into those airport operational factors which can affect land uses outside the airport property boundary. Each factor is considered separately and in enough detail to allow general planning conclusions to be drawn. It is important that any particular land use under consideration be judged from the point of view of all relevant factors. The referenced Manual for Part I is: Aerodrome Standards and Recommended Practices (TP312E).

Obstacle Limitation Surfaces are established to ensure a satisfactory level of safety. These surfaces normally extend beyond the boundary of the airport and therefore require protection by the enactment of Zoning Regulations or Legal Instruments which will prohibit the erection of structures which would violate any of the defined plane surfaces.

Zoning Regulations apply to all the lands, including public road allowances, adjacent to or in the vicinity of an airport, which lands are more particularly described in Part VI of the Schedule. Lands within an airport boundary are therefore not included in a Zoning Regulation; however, all structures within an airport boundary must nevertheless comply with obstacle limitation surface requirements unless such structures are essential for aircraft operations.

For those airports at which Zoning Regulations have been enacted under the Aeronautics Act, details of the registered zoning plans are available from the Chief, Land Surveys, Public Works Canada, Ottawa, Ontario K1A OM2 or from the Land Registry Office for the district within which the airport is located.

## 1.2 OUTER SURFACE

### 1.2.1 General

An outer surface shall be established where required for the protection of aircraft conducting a circling procedure or manoeuvring in the vicinity of an aerodrome.

The outer surface establishes the height above which it may be necessary to rake one or more of the following actions:

(a) restrict the erection of new structures which would constitute an obstruction; or

(b) remove or mark obstacles to ensure a satisfactory level of safety and regularity for aircraft manoeuvring visually in the vicinity of the airport before commencing the final approach phase. (See Figure 1.)

### 1.2.2 Dimensions of Outer Surface

Where an outer surface is established it shall be as follows:

(a) a common plane established at a constant elevation of 45 m above the assigned elevation of the aerodrome reference point; and

(b) when the common plane described in paragraph (a) is less than 9 m above the surface of the ground, an imaginary surface shall be established at 9 m above the surface of the ground. (See Figures 1 and 2.)

NOTE:

When the outer surface elevation cannot be held to 45 m, a semi-circular outer surface may be established permitting a circling procedure on one side of the runway. If this compromise solution is not possible, circling as part of an instrument approach procedure should not be recognized, thus eliminating the need for an outer surface.

The outer surface measured from the designated aerodrome reference point or points, shall extend to a horizontal distance of at least:

(a) 4000 m is recommended where the code number is 1, 2 or 3.

(b) to be determined by an aeronautical study where the code number is 4, but never less than 4000 m.

## 1.3 TAKEOFF/APPROACH AREAS AND SURFACES

### 1.3.1 Delimitation

They are established for each runway direction intended to be used for the takeoff and landing of aircraft.

(a) An inner edge, perpendicular to the runway, begins at the end of the runway strip (normally 60 m from the runway threshold). The length of the inner edge is dependent on the strip width (the full strip width).

(b) Two sides originate at the ends of the inner edge and diverge uniformly at either 10% or 15% from the extended runway centre line (Note: See divergence minima information in paragraph 1.3.2).

(c) Final Width will be the product of the divergence and length of the area, and will be parallel to the inner edge.

### 1.3.2 Dimensions of the Takeoff/Approach Areas and Surfaces

The dimensions of the takeoff/approach areas and surfaces shall be:

(a)

| Precision Approach Runway – Category I and II | |
|---|---|
| Length of inner edge | As per strip width |
| Divergence (min) | 15% |
| Length (min.) | 6 000 m |
| *Slope (max.) | Cat. II Runways, 2% where the code number is 3 or 4.<br>Cat. I Runways, 2% where the code number is 3 or 4.<br>Cat. I Runways, 2.5% where the code number is 1 or 2. |

* Where applicable, for new runways at major aerodromes the slope should be 1.66% for the first 3000 m and 2% thereafter for a total length of 15 000 m.

* For the purposes of registered zoning, the takeoff approach surfaces of Code 3 and 4 Precision Approach Runways shall be defined by using slopes appropriate for a glide path extending for a maximum of 6 KM. If local terrain precludes the use of a glide path, then the lowest usable glide slope should be selected.

(b)

| Non-Precision Approach Runway | | | | |
|---|---|---|---|---|
| Code Number | 1 | 2 | 3 | 4 |
| Length of inner edge | As per strip width | | | |
| Divergence (min.) | 10% | 10% | 15% | 15% |
| Length (min.) | 2 500m | 2 500m | 3 000m | 3 000m |
| *Slope (max.) | 3.33% | 3.33% | 2.5% | 2.5% |

* Where practicable, the slope should be 2%.

(c)

| Non-Instrument Runways | | | | |
|---|---|---|---|---|
| Code Number | 1 | 2 | 3 | 4 |
| Length of inner edge | As per strip width | | | |
| Divergenc e (min.) | 10% | 10% | 10% | 10% |
| Length (min.) | 2 500m | 2 500m | 3 000m | 3 000m |
| Slope (max) | 5% | 4% | 2.5% | 2.5% |

NOTE:

The lengths given in (a), (b) and (c) above, are measured horizontally, unless otherwise specified.
Regardless of the slope specifications in (a), (b) and (c) above, all objects considered by the certifying authority to be hazardous shall be marked and/or lighted.

## 1.4 TRANSITIONAL SURFACE

### 1.4.1 Delimination

Transitional surface is a complex surface along the sides of the runway strip and pan of the approach surface that slopes up to the outer surface. Its purpose is to ensure the safety of aircraft at low altitudes displaced from the runway centre line in the approach or missed approach phase. The slope of a transitional surface measured in the vertical, perpendicular to the runway shall be:

- 14.3% for an Instrument runway and non-Instrument runways, Code 3 and 4
- 20.0% for non-Instrument runways, Code 1 and 2

Where topographical or natural obstructions make it economically unreasonable and in the opinion of the Certifying Authority, an equivalent level of safety will be achieved, the transitional surfaces for runways where the code number is 1 or 2, used in Visual Meteorological Conditions (VMC) may be steepened or eliminated provided the strip width is widened in accordance with the following:

| Strip Width | | | |
|---|---|---|---|
| Code Number | 90 m | 120 m | 150 m |
| 1. Transitional Surface | 33% | Vertical | Vertical |
| 2. Transitional Surface | 33% | 50% | Vertical |

NOTE:

This is intended to provide relief for small aerodromes in mountainous regions, used in VMC, where river valleys, etc. are the only sites, available. At other locations an aeronautical study and Headquarters' approval is required before applying the above criteria.

## 1.5 WIDTH OF STRIP

### 1.5.1 Dimensions of the Runway Strips

(a) Width of Strip - Instrument Runways

The runway strip shall extend the following distances each side of the centre line of the runway.

Precision Approach Runway:

(i) 150 m where the code number is 3 or 4,
(ii) 75 m where the code number is 1 or 2.

Non-Precision Approach Runway:

(i) 150 m where the code number is 4,
(ii) 75 m where the code number is 3,
(iii) 45 m where the code number is 1 or 2.

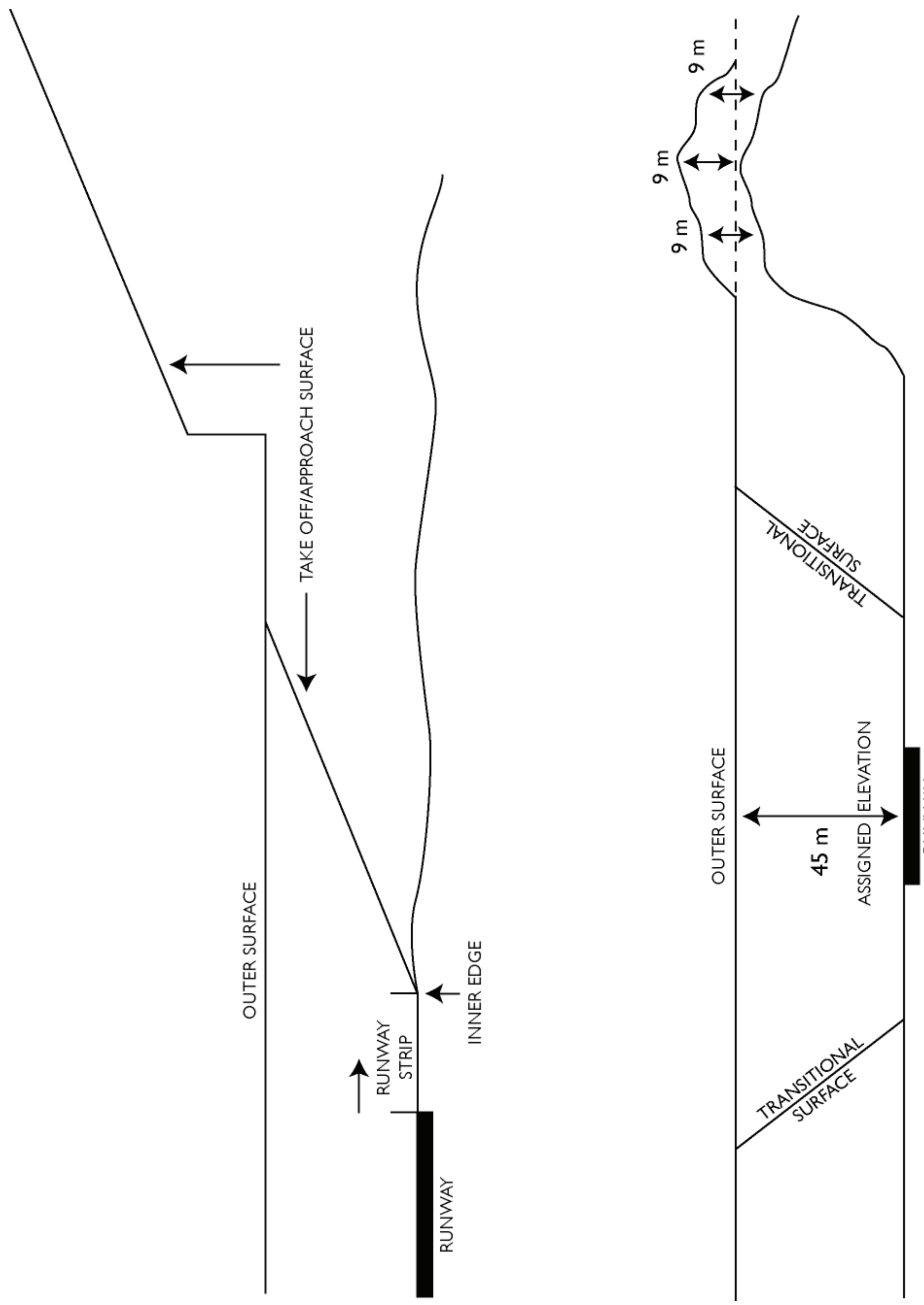
(b) Width of Strip - Non-instrument Runways

Runway strips containing a non-instrument approach runway shall extend each side of the centre line as follows:

(i) 75 m where the code number is 4,
(ii) 45 m where the code number is 3,
(iii) 30 m where the code number is 1 or 2.

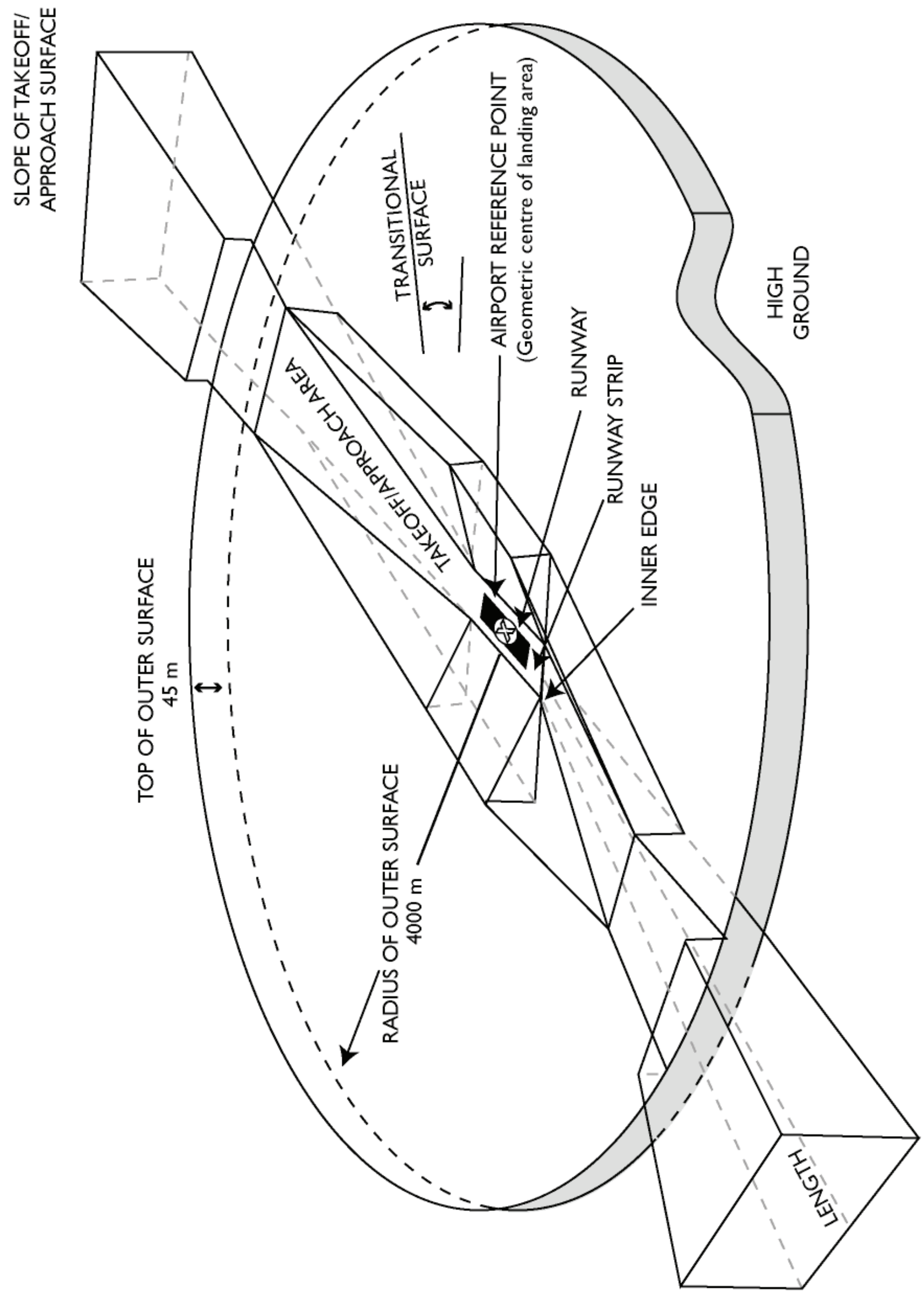
Figure 1

OBSTACLE LIMITATION SURFACES (SIDE VIEW)



## Figure 2

# OBSTACLE LIMITATION SURFACES



## Table 1

## AERODROME REFERENCE CODE

| Code Element 1 | | Code Element 2 | | |
|---|---|---|---|---|
| Code Number | Aeroplane Reference Field Length | Code Letter | Wing Span | Outer Main Gear Wheel Span |
| (1) | (2) | (3) | (4) | (5) |
| 1 | Less than 800 m | A | Up to but not including 15 m | Up to but not including 4.5 m |
| 2 | 800 m up to but not including 1200 m | B | 15 m up to but not including 24 m | 4.5 m up to but not including 6 m |
| 3 | 1200 m up to but not including 1800 m | C | 24 m up to but not including 36 m | 6 m up to but not including 9 m |
| 4 | 1800 m and over | D | 36 m up to but not including 52 m | 9 m up to but not including 14 m |
| | | E | 52 m up to but not including 60 m | 9 m up to but not including 14 m |

# PART II

# PROTECTION OF TELECOMMUNICATIONS AND ELECTRONICS SYSTEMS

## *(NAVIGATIONAL AIDS, RADAR AND COMMUNICATIONS)*

## 2.1 GENERAL

The information contained in this part represents the minimum standards normally required by the Technical Services Branch for the protection of navigational aids and other telecommunications systems. Structures conforming to these standards would normally be acceptable; however, confirmation must be obtained from the approving authority in the region, i.e., the Regional Director, Technical Services.

Planners should also be aware that specific applications which contravene the standards contained herein may sometimes be approved, provided analysis indicates that such approvals will be on a non-interfering basis.

Consultation with the Regional Director, Technical Services must take place at an early stage in the project in order to avoid costly redesign or undue pressure when seeking building and site approvals. It is recommended that consultation take place at the building concept stage, before site approval is sought.

It is the responsibility of the Regional Director, Technical Services to ensure that full co-ordination takes place with operational authorities where there is any operational impact anticipated. This is usually done through the Regional Land Use Committee.

NOTE:

The standards with respect to protection of telecommunications and electronics systems are published in the Technical Services Branch Standards and Procedures manuals (TESPs), which are the governing documents.

## 2.2 RADAR SYSTEM

The size and construction material of buildings and other structures must be controlled to ensure that the radar coverage volume is not reduced and that the number of false targets detected is not increased.

The radar coverage volume for all types of radar systems can be reduced by a structure blocking the transmit or receive signal path. The severity of this blockage is proportional to the size of the structure and varies according to its location with respect to critical airspace.

False targets are usually a problem only with the Secondary Surveillance Air Traffic Control Radar System. They are created by transmitted or received signals being reflected from structures. The magnitude of the reflection is proportional to the size of the structure and the electrical behaviour of the material used. Non-metallic materials can reduce the magnitude of the reflection.

### 2.2.1 Air Traffic Control Radars

(a) Primary Surveillance Radar (PSR)

(i) within 300 m of the radar site, no building or other structure should be allowed to exceed a height of 5 m below the geodetic height of the antenna platform. The preference is to have no structure at all or to have trees surrounding the site.

(ii) from 300 to 1 000 m from the radar site, the upper limit on the height of an allowable structure is increased at a rate of approximately 0.007 m per metre. Thus at a distance of 1000 m from the site, the structure can be as high as the geodetic height of the antenna tower platform.

(iii) beyond 1000 m from the radar site, no site protection requirement is specified; however, it is preferable not to have any large structure exceeding 0.25° above the radar horizon. Large structures are defined as having an azimuth of more than 0.43°. No structure that blocks critical airspace should be allowed. The consequences of building such a structure should be brought to the attention of those responsible for approving the proposal for construction.

(b) Secondary Surveillance Radar (SSR)

The provisions given above for a Primary Radar System apply as well for a Secondary Surveillance Air Traffic Control Radar System. In addition, it is essential that all buildings or other structures within 1000 m of the radar be constructed with non-metallic materials having a low reflectivity at frequencies from 1.0 to 1.1 GHz.

(c) Precision Approach Radar (PAR)

Within 900 m of the approach area to a runway served by a Precision Approach Radar System, no reflecting objects (trees, buildings or other structures) are allowable.

(d) Airport Surface Detection Equipment Radar (ASDE)

No structure should be built on the airport that blocks the line-of-sight from the ASDE radar antenna to any runway, taxiway, intersection, etc., unless it is approved by the Regional Director, Technical Services, in co-ordination with the Regional Director, Air Traffic Services. The blockage would have to be judged operationally insignificant.

### 2.2.2 Weather Radar

No structures exceeding the height of the radar antenna should be built within a radius of 300 m of weather radars. The Regional Director, Technical Services will co-ordinate the necessary approvals with Environment Canada, which is responsible for siting weather radars.

### 2.2.3 General Radar Siting Criteria

(a) Terrain

Terrain within 1000 m of the antenna is of prime importance to the performance of the radar system. The terrain should have either a rough surface (variations of 1 m or more) or be well covered with trees and shrubs, preferably of a coniferous variety. Terrain of this type will reduce the amount of ground reflection. Beyond 1000 m, rough or vegetated terrain, as described above, or low, small buildings (e.g., residential housing) are preferred.

(b) Coverage

The Primary and Secondary Surveillance Radar Systems should be located more than 500 m from the edges of areas where large, wide-bodied aircraft are known to remain for sustained periods of time. Structures or natural growth should not block the line-of-sight from the radar to the airspace on approach to runways or to other critical airspace as identified for a particular airport by the Regional Director, Air Traffic Services.

(c) Consultation

If large structures (e.g., warehouses, power lines, hangars, etc.) are to be constructed within 10 000 m of a radar, it is essential that the Technical Services Branch of the Department be consulted regarding the location, building material and orientation of the structures prior to authorization of the construction.

## 2.3 VHF/UHF RADIO COMMUNICATION SYSTEMS

VHF/UHF transmitters and receivers must be located in an environment as free as possible from sources of electrical noise. This noise can be caused by engine ignitions, electric motors, electrical switching gear, high tension line leakage, diathermic and industrial heating generators and many household appliances. Such electrical noise generators should be kept at least 1.6 km from the radio antennae; in no circumstance should they be closer than 500 m.

Intermodulation problems which can be caused by high powered AM, FM and TV stations can be avoided by locating such equipment at least 8km from the transmitters and receivers.

To prevent the screening of airspace, all structures shall not subtend a vertical angle of more than within 1.5 km of the radio antenna or extend more than 1.2° above the horizontal.

Metallic structures, which may cause reflection of communication signals, should not be constructed within 300 m of a transmitter/receiver installation without prior consultation with the Technical Services Branch of the Department.

## 2.4 NAVIGATIONAL AID 2.4S

### 2.4.1 Non-Directional Beacons (NDB) and Stand-Alone Distance Measuring Equipment DME)

No structures or obstacles shall be permitted within 150 m of the NDB or DME antenna. Beyond 150 m, the maximum angle of elevation subtended by any steel towers, power lines, metal buildings, etc., shall not exceed 3° measured from the base of the NDB tower or DME antenna support structure.

### 2.4.2 VHF Direction Finding Systems (VHF/DF)

Siting requirements for VHF/DF are of major importance. In particular, the equipment requires that:

| | | |
|---|---|---|
| (a) | within 45 m of the site: | Ground to be level ±1° and surface roughness ±30cm |
| (b) | within 90 m of the site: | Ground to be clear of trees, masts, metal fences and vehicles. |
| (c) | within 180 m of the site: | Ground to be clear of buildings, car parks and small metal structures. |
| (d) | within 365 m of the site: | Ground to be clear of built-up areas, hangars, railways and other metallic structures. |

In general, a clear line-of-sight through shall be maintained between the antenna system and local flying aircraft.

It is essential that the DF antennae be separated from any VHF air/ground communication (transmitting) antennae to the greatest extent practical, but by at least 2 km and be separated from any antennae transmitting a high power broadcast by at least 8 km.

### 2.4.3 Distance Measuring Equipment (DME)/VHF Omni-Directional Range (VOR)/TACAN

Transport Canada normally purchases an area approximately 125 m square in which to locate this equipment and then seeks restrictive easements covering two areas adjacent to the site.

These easements and the areas concerned are as follows:

*Area No. 1* – This is the area enclosed by a circle with a radius of 300 m centred on the geometric centre of the site. In this area there shall be no trees, fences, wire lines, structures, machinery or buildings, except with the prior written consent of the Regional Director, Technical Services, Transport Canada and only where calculations show that the proposed obstruction has no impact on the operation of the navigational aid.

*Area No. 2* – This is the area enclosed by a circle with a radius of 600 m centred on the geometric centre of the site but excluding the area included in Area 1. Within this area, the height, measured to the highest point of structures and buildings having large metal content, and wire lines and fences shall not subtend a vertical angle of more than 1.2° or extend more than above the horizontal plane as measured from the array centre. These limits may be increased by 50% for fences or lines which are essentially radial or which subtend an angle of not more than 10" measured in the horizontal plane. Wooden structures or buildings with negligible metallic content may subtend vertical angles up to 2.5°. No structures, buildings, wire lines or fences shall be permitted without written permission from the Regional Director, Technical Services, Transport Canada.

Beyond the 600 m normally covered by protective easements, large continuous metallic objects such as overhead power lines, masts, water towers or large metal-clad buildings which will penetrate beyond above the horizontal plane as measured from the array centre or which subtend an angle of greater than 1.2° are to be analyzed for potential interference prior to being approved.

NOTES:

(1) This standard does not take into account clearing easements which vary greatly with the topography of the site. Clearing requirements are determined from topographical site survey plans and easements are obtained by Property Management Services, Public Works Canada.

(2) It is permissible to use the method of a series of tangents and chords to define the easement limits in preference to the present circular definition. However, the distance from the VOR site to the boundary formed by any chord must not be reduced by more than 10% from the normal 600 m and 300 m radius easements.

(3) In the event that a Doppler type VOR is used, the designated areas No. 1 and No. 2 can be reduced by at least one half as long as the optical line-of-sight requirement of the NAVAID is retained. Advice and prior approval must be obtained from the Regional Director, Technical Services, Transport Canada on this type of installation.

## 2.5 INSTRUMENT LANDING SYSTEMS (ILS)

### 2.5.1 General

In all cases, it is desirable that land planners consult engineers of the Technical Services Branch of Transport Canada concerning details of Instrument Landing Systems (ILS) installed or planned at the airport in question. As an interim measure, ILS standards will be applied for all Microwave Landing System (MLS) installations.

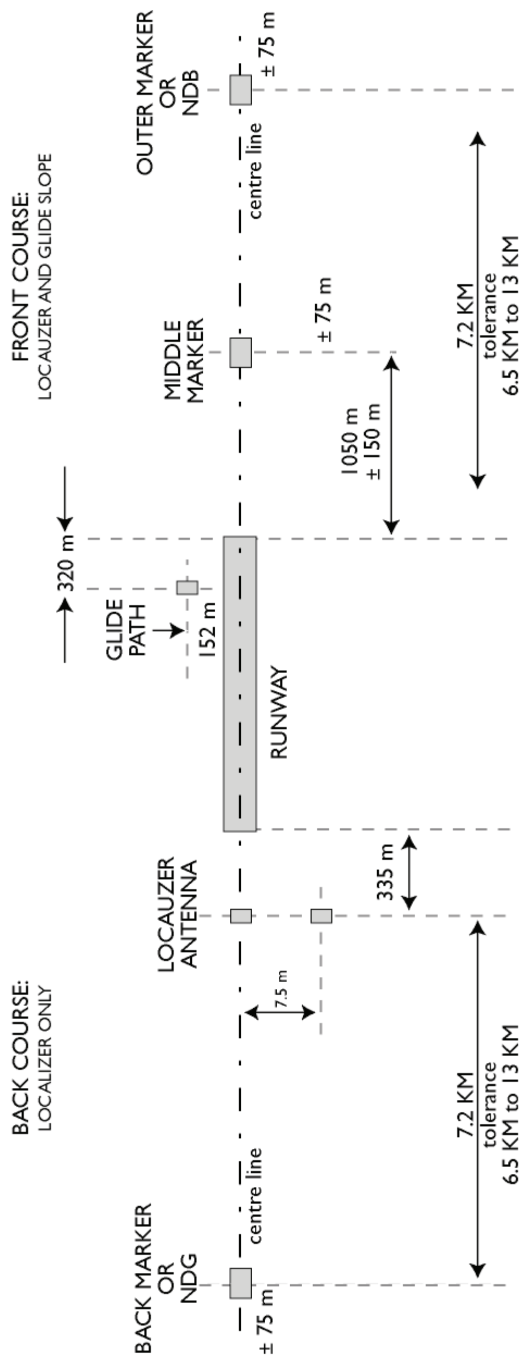
An ILS is made up of five major components: a localizer, a glide path and three markers. The location for these components varies according to the terrain; however, typical locations are as follows (see Figure 3):

| | | |
|---|---|---|
| (a) | Localizer | 335 m outward from the stop-end of the runway on the extended centre line. |
| (b) | Glide Path | 320 m (variable) in from the threshold for a 3.0° glide path. The antenna will typically be 122 m (Null Reference type) or 152 m (M-Array type) from the runway centre line, depending on the type of antenna, and may be located on either side of the runway (usually located on the opposite side of existing or planned taxiways). |
| (c) | Middle Marker | 1050 m ±150m outward from the threshold of the runway in the approach direction and within 75 m of the extended runway centre line. |
| (d) | Outer Marker | 7.2 km (nominal) outward from the threshold of the runway in the approach direction and within 75 m of the extended runway centre line. Limits 6.5 km to 13 km. |
| (e) | Back Marker | 7.2 km from the end of the runway in the departure direction and within 75 m of the extended runway centre line. Limits 6.5 km to 13 km. |

The most significant sources of interference for ILS facilities are metallic objects having appreciable horizontal dimensions such as structural steel towers, metal-clad buildings and power/telephone transmission lines. These objects reflect the ILS signals in unwanted directions, distorting the information provided to aircraft.

## Figure 3

## TYPICAL ILS SITE CONFIGURATION



High voltage power lines and substations radiate electromagnetic noise (EMN) due to corona, gap discharge, etc. This EMN may inhibit reliable reception of ILS signals. In addition, EMN radiated by industrial-scientific-medical (ISM) apparatus such as dielectric heaters and plastic welders can also interfere with the reliable reception of ILS signals.

For planning purposes, all runways should be considered to be equipped with an ILS at each end. Therefore the restrictions outlined below should be applied to both ends of the runway. The requirements listed below may affect land use outside the airport property boundary.

### 2.5.2 Protection Requirements - Electromametic Compatibility

It is important to ensure that EMN radiated by power lines, substations and ISM apparatus will not interfere with the proper reception of ILS guidance signals in the approach path. For this reason the following guidelines should be observed:

(a) power lines with voltages greater than 100kV should be no closer than 1.8 km from the runway centre line and no closer than 3.2 km from the ends of the runway;

(b) AC electrical substations for voltages greater than 100 kV should be no closer than 3.2 km from the centre line of the runway and no closer than 16 km from the ends of the runway;

(c) power lines and substations should be designed, constructed and maintained using state of the art techniques to minimize radiated EMN in the ILS frequency bands; and

(d) ISM apparatus should be restricted from operating within the rectangular area extending 1.5 km on either side of the centre line of the runway to the outer markers.

Special sites or sites not conforming to the above criteria should be discussed with the Technical Services Branch, Headquarters on an individual basis.

### 2.5.3 Protection Requirements - Interference from Structures

### ILS Localizer (Refer Figure 4)

*Area A* Circle 75m radius centred on the localizer array. No objects higher than 1.2 m.

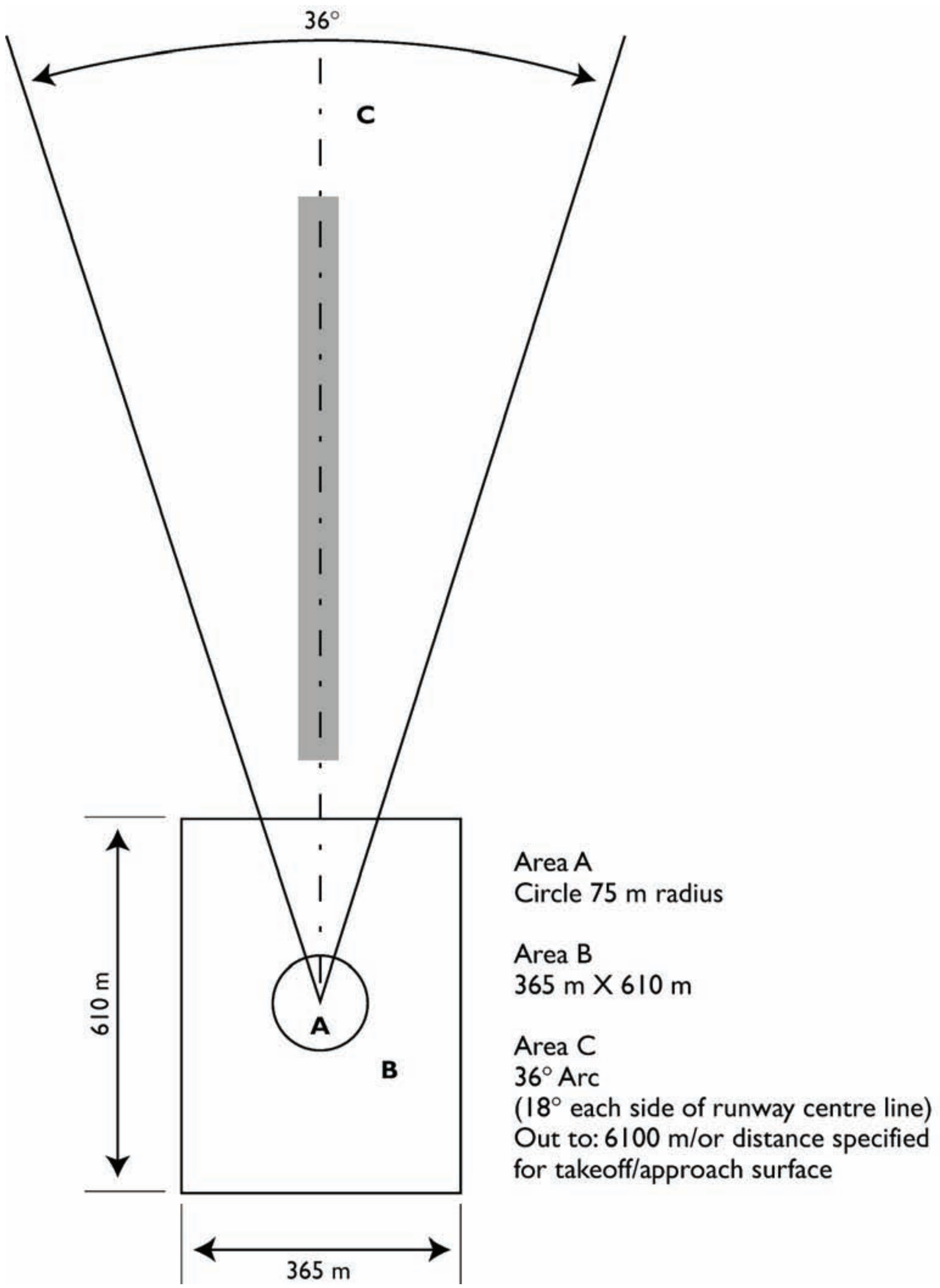
*Area B* Rectangle 365m x 610 m centred on the localizer array. No metallic objects higher than 1.2 m, no non-metallic objects higher than 2.5 m.

*Area C* The area originating at the centre of the localizer array covering an arc of 36° in the direction of the runway and terminating 6100 m from the localizer array; or to the distances specified for the takeoff approach surfaces, the transitional surfaces, and the horizontal surfaces; whichever is the lesser.

No metal-walled structure should subtend a total vemcal angle greater than 0.8º no structural steel work should subtend a total vertical angle greater than 1.6º and no non-metallic object should subtend a total vertical angle greater than 2.4°. Trees are included in this latter category. Note that these are "bottom-to-top" subtended angles measured from the antenna elements, with no reference to the horizon or the horizontal plane being meant (See Figure 5). Within the remaining 324º these restrictions can be relaxed by a factor of approximately 2. Restrictive easements are normally obtained by Transport Canada when necessary.

Figure 4

RESTRICTIONS FOR ILS LOCALIZER



In the vicinity of the runway no large surfaces are to be constructed parallel to the runway centre line. Large surfaces will be considered only if they are:

(a) perpendicular to the runway centre line;

(b) at an angle to the runway such that reflections will occur away from the ILS course;

(c) radial to the localizer antenna; or

(d) in the electromagnetic shadow of other structures.

Airport service roads must not intercept the front course or back course of the localizer within 180 m of the array. If a service road must cross the back course, it should be at least 180 m from the array and the antenna counterpoise should be a minimum of 2.5 m above the road elevation. "No Parking No Stopping" signs should be erected at both ends of that portion of the road subtending an angle of ± 25º from the extended runway centre line, measured from the antenna array.

NOTES:

(1) Generally, the orientation of large surfaces should be such as to cause minimum interference to any ILS on the airport. Surfaces radial to a transmitting antenna generally present minimum interference.

(2) In addition, all surfaces parallel to runway centre lines, or with an orientation which may cause interference, should contain as little metal as possible.

(3) Generally, the "mirror" concept may be used to determine where reflections will cause scalloping on the runway and/or extended centre line. Reflecting objects close to the runway centre line will cause scalloping of greater amplitude than objects farther from the centre line.

(4) Thin metallic and non-metallic vertical objects such as masts and poles (without guy wires) are excluded from the above restrictions.

(5) The effects of large parked aircraft must be considered. The orientation of such aircraft should be specified to ensure minimum interference to the ILS signals.

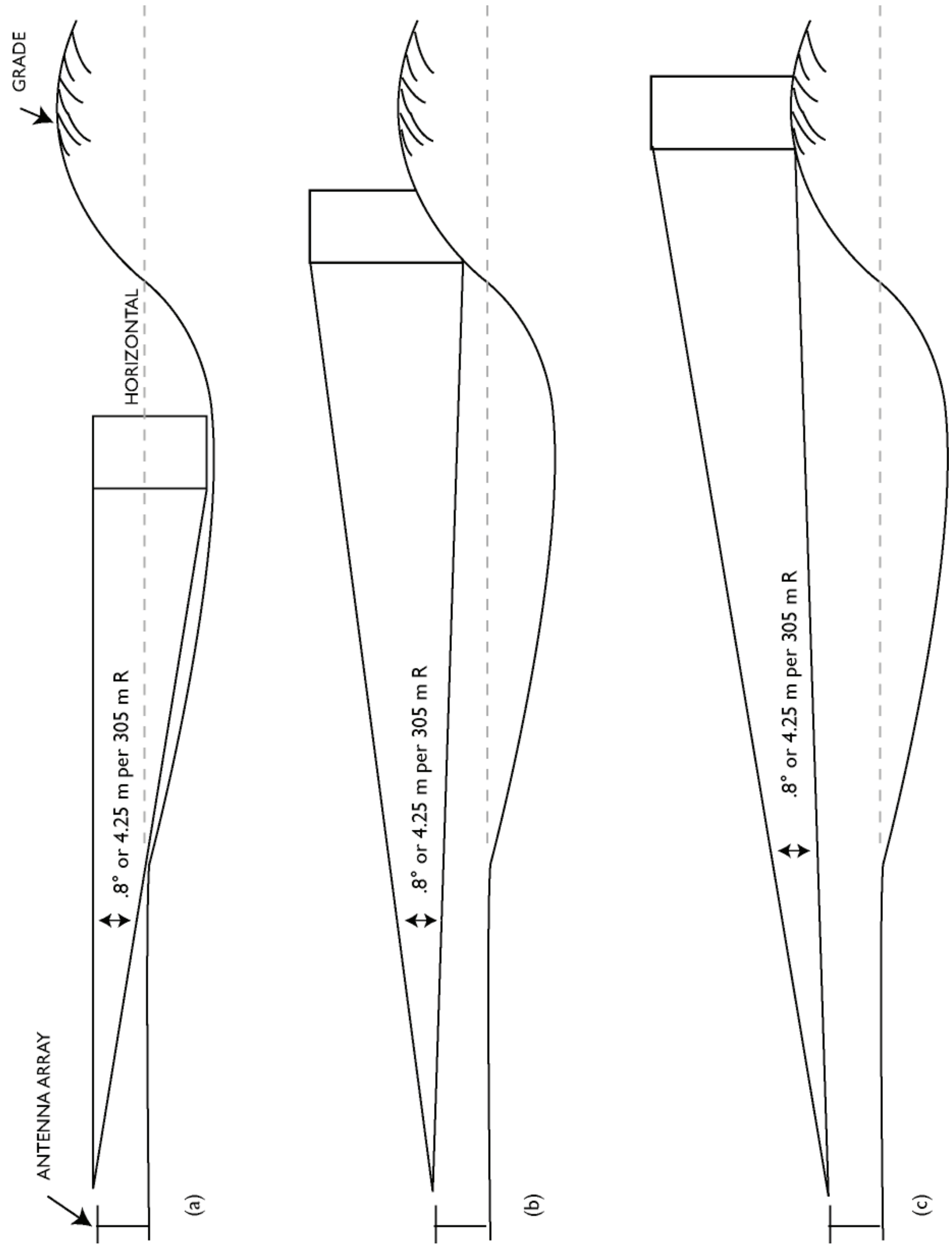
(6) If it is planned to utilize the localizer back course, it will be necessary to duplicate Area "C" in the back course approach direction.

(7) If any part of the restricted area depicted in Figure 4 is outside the airport boundary, restrictive easements should be obtained to avoid future encroachment on restrictions.

(8) Identical restrictive areas exist at the other end of the runway.

Figure 5

EXAMPLES SHOWING APPLICATION OF LOCALIZER RESTRICTIONS IN AREA C



### 2.5.4 Image Type Glide Path Restricted Areas

The restricted areas for image type glide paths are depicted in Figure 6. They are areas D, E and F.

*Area D* The area originating at the glide path antenna covering an arc of and extending 1500 m in the approach direction. No metallic fences, power lines, telephone lines, buildings, roads or railroads.

NOTE:

This is the "ideal" situation. In practice, compromise will be necessary at existing airports. Horizontal bars in approach lighting systems should be avoided within 600 m of the glide path antenna. At CAT II sites in particular, every effort should be made to ensure that existing encroachments on these restrictions are not aggravated. An obstruction-free area of 900 m minimum is highly desirable but this should be extended to 1500 m if circumstances permit, particularly in the case of a categorized facility.

*Area E* A triangle with a base 150 m wide extending from the glide path antenna in the direction away from the runway with the apex intersecting Area "D" at approximately 570 m in the approach direction. Same restrictions as Area "D".

*Area F* Triangular area between Area"D" and the runway.

Same restrictions as Area "D".

NOTES:

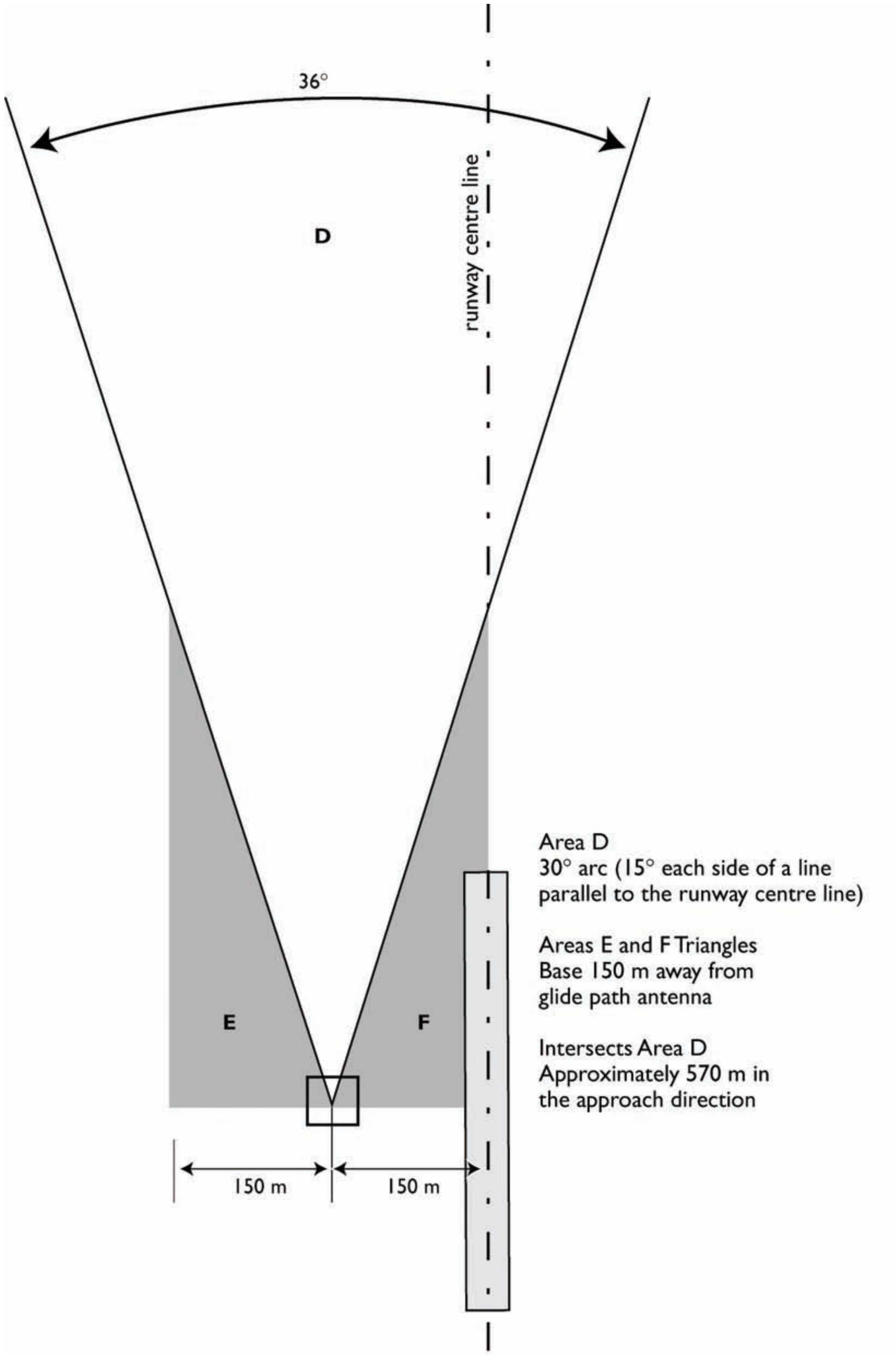
(1) The glide path may be located on either side of the runway, depending on local site conditions, taxiways, runways, etc.

(2) Identical restrictive areas exist at the other end of the runway.

(3) If any part of the restricted area depicted in Figure 4 is outside the airport boundary, restrictive easements should be obtained to avoid future encroachment on restrictions.

## Figure 6

## RESTRICTIONS FOR ILS IMAGE TYPE GLIDE PATH



### 2.5.5 VHF Markers

The markers must be installed at specific locations dictated by the extended runway centre line and the distance from the runway threshold. Normally, all markers are sited within 75 m on the extended centre line of the runway with the middle marker 1050 m from the threshold, the outer marker at 3.9 NM from the threshold, and the back marker 3.9 NM from the stop-end of the runway.

These distances imply that off-airport sites are usually required for installation of these facilities for each ILS system.

Land requirements for each facility are small (middle marker 15 m x 15 m, outer marker 60 m x 60 m); however, power and control lines are required. Marker facilities can be designed either to blend with surrounding buildings or to be hidden by foliage. They can also be installed in leased areas within existing buildings if there is a requirement to accommodate, insofar as is practicable, local zoning and building regulations.

NOTES:

(1) When an NDB is installed at a marker site, the siting requirements for the NDB must also be met.

(2) If the middle and outer marker sites must be off the centre line, it is desirable that they be off on the same side.

(3) Where an offset localizer is installed, the middle and outer markers shall be located on the extended runway centre line.

(4) If the provision of an outer marker is impractical due to cost and/or siting, the installation of a DME will provide a satisfactory alternative.

# PART III

# BIRD HAZARDS

## 3.1 GENERAL

Birds of all types can be hazardous to aircraft because they can cause structural damage or loss of engine power. The hazard created by birds is greatest at and in the vicinity of airports due to the concentration of aircraft activity close to the ground, where the majority of birds fly.

Airports are naturally attractive areas to many species of birds because the wide open, short grass areas provide the basic elements of security from predators and humans, a place to nest and loaf (just generally sit about) and access to food and water sources. Programs at Transport Canada operated airports effectively reduce this natural attraction of birds to airport lands, primarily through major habitat management and manipulation projects, as well as through day to day vigilance and the use of bird- scaring techniques. While these on-airport activities are effective, they can be neutralized by the presence of attractive land use or activities outside the airport boundary. Hazardous bird types will be persistent in their attempts to use the airport as a convenient stopover and resting place before or after feeding at a nearby location. It is therefore important that land uses in the general airport-surrounding area be regulated with the same goal as on-airport land use, to minimize the attraction to birds.

The following information provides guidelines on the acceptability of different land use practices for the vicinity of airports and should only be included upon the expert advice of a bird hazard specialist. General land use practices have been evaluated on their relative attractiveness to the traditionally hazardous bird species.

## 3.2 BIRD HAZARD SPECIALIST REQUIREMENTS

Aircraft zoning regulations are enacted to prohibit the use of land outside airport property boundaries where such land uses are hazardous to aircraft operations. Provisions must be made for prohibiting the location of garbage dumps, food waste landfill sites, coastal commercial fish processing plants, and/or the planting of crops, that may either attract birds or adversely affect flight visibility, within 8 KM of an aerodrome reference point. **Prohibitions for bird hazard considerations should only be included upon the expert advice of a bird hazard specialist.**

The above activities are extremely attractive to bird species that are:

(a) a hazard to aircraft because of their larger size, behavioral characteristics (flocking, soaring), and their preference for airport environments, and

(b) far-ranging in their daily food-searching activities.

## 3.3 COMMERCIAL ACTIVITIES

The following land use practices are NOT RECOMMENDED FOR AREAS 3.2 KM OR LESS, FROM THE AIRPORT REFERENCE POINT (At some airports, more than one reference point may be established for the purpose of defining the area) because they attract bird species that:

(i) because of their smaller size, behavioral characteristics, and not particularly far-ranging in their food-searching activities, and/or

(ii) are of concern as aircraft hazards chiefly during limited time spans only, i.e., migration, infrequent climatic conditions.

(a) Agricultural Practices

| | | Not Recommended | | Suggested Alternatives |
|---|---|---|---|---|
| (i) | Crops | | | |
| | Grains: | Barley | | Rye |
| | | Oats | | Buckwheat |
| | | Wheat (particularly Durum) | | Flax |
| | | | | Canola |
| | | Corn | | Timothy |
| | | Sunflower | | Alfalfa |
| | | Clover | | |
| | Fruits | Berries | | Vegetables (except potatoes) |
| | | Cherries | | |
| | | Grapes | | |
| | | Apples | | |
| | | | | |
| (ii) | Livestock | | | |
| | Feedlots | Beef Cattle | | Pasture-fed |
| | Piggeries | Livestock | | |

(b) Commercial Activities – Outdoor (Drive-In) Theatres

(c) Managed and/or Supplemented Natural Habitats (Refuges, Sanctuaries) Migratory Waterfowl Refuges/Feeding Stations/Crops [see (a)(i)].
Designated Game-Mammal Refuges

## 3.4 OTHER ACTIVITIES

Airport authorities should be aware of the basic attractants. The list below provides a guide to such attractants, the typical land use activities where they may be found, and suggested remedial actions. In these cases, remedial action (if attainable) is a viable alternative to the exclusion of a particular land use from an area around the airport.

| Attraction | Typical Activities | Suggested Remedial Action |
|---|---|---|
| Food Garbage | Restaurants (indoor/outdoor) | Improve maintenance/disposal |
| | Picnic areas | Covered garbage containers |
| Freshly Tilled/Plowed soil | Cropping activities | Plow/Till at night |
| | Sod fanning | |
| High Insect /Mouse Activity | Grass and hay cutting activities | Cut/Bale at night |
| | Baling of hay (before/after) | Remove bales as soon as possible |
| Livestock Manure Piles | Barnyards | |
| | Stables | |
| | Racetracks | |
| | Fairgrounds | |
| | Game Farms | |
| Lagoons | Sewage Lagoons | |
| | Storm water Retention | |
| | Ponds | |

# PART IV

# AIRCRAFT NOISE

## 4.1 GENERAL

An accurate assessment of the annoyance resulting from exposure to aircraft noise is essential to both aviation planners and those responsible for directing the nature of development of lands adjacent to airports. This Part will discuss noise measurement, annoyance prediction, the Noise Exposure Forecast and the Noise Exposure Projection. It also contains an assessment of various land uses in terms of their compatibility with aircraft noise.

### 4.1.1 Noise Measurement

The sound pressure level created by an aircraft (or any other noise source) can be measured by means of a sound level meter. The microphone of the sound level meter senses the pressure fluctuations over a short period of time. The sound pressure is the root mean square value of the difference between atmospheric pressure and the instantaneous pressure of the sound, the mean being read over several periodic cycles. For mathematical convenience, the logarithmic parameter called sound pressure level (SPL) is used. The unit of sound (noise) measurement is the decibel (dB).

A particular sound signal may comprise several different frequencies to which the human ear may respond in various ways. In order that noise measurements may relate more closely to loudness as judged by the average person, sound level meters are equipped with weighting networks which make use of information related to the frequency response characteristics of the human ear. Some sound level meters have the capability of reading on A, B, C, and D weighting scales, and decibel values are correspondingly indicated as dB(A), dB(B), dB(C) or dB(D), according to the weighting network used. However, the dB(A) is the most common. The dB(D) value was designed as the preferred measuring unit for aircraft noise, but dB(A) is widely used since it has been found to have good utility in determining annoyance reactions to a wide variety of noises occurring in communities.

The noise metric known as Perceived Noise Level (PNL), measured in the unit PNdB, provides a frequency weighting system which attempts to more closely approximate the subjective reaction of the human ear to an aircraft noise stimulus. Although weighting networks are available which provide a means of directly measuring approximate PNL values, i.e., dB(D), true PNL values are determined by the analysis and treatment of sound pressure levels in various 1/3 octave bands.

A more sophisticated noise metric, the Effective Perceived Noise Level (EPNL), expressed in the unit EPNdB, was developed specifically for use in the measurement of aircraft noise. This metric is basically similar to the PNL except that corrections have been applied to account for the effects of discrete tones and the duration of the noise event, i.e., factors which contribute to the annoyance of the listener.

### 4.1.2 Predicting Annoyance

In addition to the annoying characteristics of an individual noise signal, overall subjective reaction to noise is dependent on the number of times the disturbance occurs as well as the daily distribution of these events. These factors must be included in any noise forecasting system if it is to be applicable to the communities located in the vicinity of airports. The Noise Exposure Forecast (NEF) system used by Transport Canada takes into consideration all of these factors.

The NEF system provides for the summation of noise from all aircraft types operating at an airport based on actual or forecast aircraft movements by runways and the time of day or night the events occur. The large number of mathematical calculations necessary for the construction of NEF contours requires the use of computer techniques for the practical application of this system.

### 4.1.3 The Noise Exposure Forecast System (NEF)

Effective Perceived Noise Level is the basis for estimating noise annoyance in the Noise Exposure Forecast system.

The data required for determining NEF contours consist of EPNL (see 4.1.1 -last paragraph) vs distance information for various aircraft types, along with generalized aircraft performance data. In calculating NEF at a specific location, the EPNL contribution from each aircraft operating from each runway is assessed by considering the distance from the point in question to the aircraft, and then obtaining EPNL values from the appropriate EPNL vs distance curve. The noise contributions from all aircraft types operating on all runways are summed on an anti-logarithmic basis to obtain the total noise exposure at that one location. Thus, the determination of NEF contours is strictly a numerical calculation procedure. As stated previously, due to the large number of mathematical calculations involved, computer techniques provide the only practical means of constructing NEF contours.[1]

## 4.2 NOISE EXPOSURE CONTOURS

There are three types of noise exposure contours produced depending on the time element involved. These are Noise Exposure Forecasts (NEFs), Noise Exposure Projections (NEPs) and Planning Contours. Both NEFs and NEPs undergo a rigorous review and approval process within Transport Canada Aviation before public release.

### 4.2.1 Noise Exposure Forecast (NEF)

The Noise Exposure Forecast (NEF) is produced to encourage compatible land use planning in the vicinity of airports. NEFs are approved (official) contours and Transport Canada will support them to the level of accuracy of the input data. Accordingly, the input data must be as accurate as current technology permits. Traffic volume and aircraft type and mix used in calculating the noise contours are normally forecast for a period of between five and ten years into the future (See NOTE). Runway geometry must be the current layout, except that new and approved projects involving changes in the runways may be included, when the completion date of the project lies within the forecast period.

NEFs are made available to provincial and local governments for use in conjunction with Transport Canada's recommended Land Use Tables (Table 3) which will enable planners to define compatible land use in the vicinity of airports over the short term.

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1 Kingston, Beaton and Rohr, A Description of the CNR and NEF Systems for Estimating Aircraft Noise Annoyance (R-71-20), Department of Transport, 1971)

NOTE:

These forecasts are prepared and/or approved by Statistics and Forecasts Branch of Transport Canada, Policy and Co-ordination.

Transport Canada retains copies of NEFs and NEPs, both regionally and at headquarters, in order to:

(a) provide municipalities and local governments with a basis for zoning; and

(b) inform the public of noise sensitive areas in the vicinity of airports.

Transport Canada does not support or advocate incompatible land use (especially residential housing) in areas affected by aircraft noise. These areas may begin as low as NEF 25. At NEF 30, speech interference and annoyance caused by aircraft noise are, on average, established and growing. By NEF 35 these effects are very significant. New residential development is therefore not compatible with NEF 30 and above, and should not be undertaken.

## Local Variances From NEF Contours

The procedure for dealing with requests for local minor variances from the published NEF contours will be as follows:

(a) the proponent of the change (property owner, developer) determines from the municipalities that a variance from the present zoning, established on the basis of Transport Canada's applicable official NEF contour, would be considered if adequate justification is provided. Municipal authorities advise Transport Canada (TC) Aviation, Air Navigation System (ANS) of the request;

(b) the proponent undertakes to provide evidence that NEF contours, as they apply to his/her property, do not take into account factors that would affect aircraft noise attenuation or propagation. It is recommended that the proponent consult with TC Aviation, ANS to determine what evidence would be required to verify his/her contention;

(c) the proponent obtains and submits the evidence to municipal authorities;

(d) municipal authorities ask TC Aviation, ANS for its recommendations concerning the validity of evidence and claimed adjustment to noise impact relative to the official NEF contour;

(e) TC Aviation, ANS makes recommendations to the municipality, and provides any pertinent additional information or advice that could bear on the municipality's decision; and

(f) the municipality determines whether to allow variance from established zoning, taking into account TC Aviation, ANS's recommendations, and advises the proponent, provincial Ministries concerned and Transport Canada.

It is intended that this process will not affect the status of the applicable NEF map. The NEF map will not be changed to reflect the local variance, nor will future forecast show the local variance. The process just described is intended to accommodate small-scale characteristics of the property which can locally affect aircraft noise impact such as terrain features, ground condition, reflective or shielding surfaces, etc. The NEF model does not include such small scale characteristics, and it is not intended to incorporate a capability to do so in the future.

In summary, Transport Canada will not include local small-scale effects in the calculation of NEF contours, nor will official NEF contour sets be revised if and when it is demonstrated that localized small-scale effects modify predicted aircraft noise levels in specified areas. The municipality or province may request Transport Canada's technical advice and recommendations concerning such small-scale effects on aircraft noise levels, in order to consider the technical validity of claims to variances from official land zoning plans. The onus is on the proponent of such zoning variances to provide evidence of the noise impact adjustment; Transport Canada will not undertake any studies into the matter, and will only advise the municipality on the basis of evidence provided by the proponent.

### 4.2.2 Noise Exposure Projection (NEP)

It is recognized that much land use planning involves projections beyond five years into the future, when aircraft fleet mixes and runway configurations are most likely to be different from the known conditions of today. To provide provincial and municipal authorities with long range guidance in land use planning, Transport Canada introduced the Noise Exposure Projection (NEP). The NEP is based on a projection (not a forecast) of aircraft movements for more than ten years into the future, and includes aircraft types and runway configurations that may materialize within this period: NEPs are approved (official) contours and Transport Canada will support them to the level of accuracy of the input data. The information required to produce an NEP must, at least, be contained in an Aviation System or Airport Master Plan.

NEPs are available to interested parties in the same manner as NEFs.

### 4.2.3 Planning Contour

The third type of noise contour is the Planning Contour which is produced to investigate planning alternates and must be labelled as such. This may be released to the public by a regional TC Aviation office without Headquarters' (Ottawa) approval. Any agency may produce these contours as they do not have any official status.

## 4.3 PRODUCTION OF NOISE CONTOURS — AIRPORTS THAT ARE NEITHER OWNED NOR OPERATED BY TRANSPORT CANADA

The preparation and approval of noise contours for airports that are neither owned, nor operated by the Federal Government is not a responsibility of TC. However, TC will assist the owner or operator of such airports to produce noise contours for the airports, provided that:

(a) the owner or operator initiates this action;

(b) supplies or approves a projection of aircraft traffic, both as to type and numbers; and

(c) uses the noise impact prediction methods, procedures and recommended practices relating to aircraft operations as established by TC.

## 4.4 PRODUCTION OF NOISE CONTOURS: DND AERODROMES

Production of noise contours for airports, used solely by the Department of National Defence (DND), is the responsibility of DND as to data input and production. When requested by DND, these contours will be published subject to TC's approval of the technical accuracy of the contours.

Noise contours for joint use DND/TC airports will normally be produced by regions in the same manner as for TC airports with the exception that DND Headquarters in Ottawa will provide the official military traffic forecasts. Requests for military forecasts will be submitted to TC Headquarters who will liaise with DND Headquarters for their procurement.

## 4.5 NOISE CONTOUR MAPS

All contour maps will be prepared at a 1:50 000 scale.

It may be necessary for computer-produced contour lines to be mechanically smoothed to remove irregularities that arise in the plotting process. This will be done particularly in areas of sharp corners or tips.

NEF and NEP maps must depict the 40, 35 and 30 contours as a solid line. TC does not require any other contours to be depicted.

With respect to printing of maps with approved, superimposed NEF/NEP contours, TC Aviation Headquarters will produce a single master map with enough copies for internal TC Aviation use. Additional copies will be available from TC Aviation regional offices (see Appendix A) for a nominal fee. For new airports, see Section 4.6.1.

## 4.6 COMMUNITY RESPONSE TO NOISE

During developmental work on preliminary noise rating systems, it was established that community response to aircraft noise correlated well with the noise contours then in use. Case histories of noise complaints at twenty-one airports were analyzed as to severity, frequency of complaint, and distribution around the airports to establish a relationship with known noise values. The results of this work, which may be found in Table 2, have been used for relating land uses to NEF contours.

The analysis of the effect of aircraft noise on various working and living environments is a complex matter. For each case where there is a note in the Land Use Tables (Table 3), it is desirable that a noise climate analysis or a noise reduction requirement analysis be undertaken, since each note indicates a particular specialized problem. Many of the factors that would be considered in such analyses are subject to changing technology. Also, the attitudes of those exposed to the noise environment are subjective and varied. Since these factors are under constant review, authorities undertaking analyses of noise climates and noise reduction requirements in buildings should maintain liaison with agencies conducting these reviews. At the present time, such agencies include: the National Research Council and TC Aviation.

### 4.6.1 New Airports and Community Response to Noise (new section)

Where an airport is already surrounded by residential or other noise sensitive land uses, the intent of land use planning guidelines is to prevent any increases in incompatible land use. As urbanization increases, any new airport would, by necessity, be planned for and built in non-urban areas. Therefore, where a *new airport* is planned on land designated as an airport site, an opportunity exists to establish appropriate land use planning guidelines that recognize the unique noise environment of a non-urban area and preserve the balance between the integrity of the future airport and the quality of life of the community that it will serve.

For the purposes of this section, "*New Airport*" means any land designated by the Governor in Council an *"Airport Site"* under the Aeronautics Act after January 1, 2001.

The encroachment of incompatible, sensitive land uses is clearly a vital factor in planning and establishing appropriate protection criteria for new airports. The best and often only opportunity to establish a sufficient buffer zone to control noise sensitive development around a new airport is in the initial planning stage of that new airport. This opportunity diminishes quickly as the airport develops and community land use patterns become established.

In addition to the traditional approach of defining land use planning guidelines, pertinent factors considered in a study of land use guidelines for new airports included not only individual activity interference (speech & sleep) criteria, but also habituation to noise, the type of environment (non-urban versus urban environment), community attitudes toward the noise source, the extent of prior exposure to the noise source, and the type of flight operations causing the noise.

For new airports, Transport Canada recommends that no new noise sensitive land uses be permitted above 25 NEF/NEP. Noise sensitive land uses include residential, schools, day care centres, nursing homes and hospitals. This approach is the single most practical for reasons of ease of implementation and administration since below this threshold, all noise-sensitive land uses would be permitted without restrictions or limitations. The guidelines for all other land uses remain unchanged from Table 3. This buffer would also offer protection against the long term uncertainties inherent in planning for a new airport.

To implement this NEF 25 criterion, NEF and NEP maps for new airports must depict the 25 contour as a solid line in addition to the noise contour requirements set out in Section 4.5.

## 4.7 RECOMMENDED NOISE CONTROL ACTION

For a specific noise problem, Table 4 may be used to select different actions.

## 4.8 RECOMMENDED PRACTICES

NEF/NEP contours approved by TC Aviation are to be used in conjunction with these guidelines to encourage compatible land use in the vicinity of airports. Therefore, it is imperative that these official contours be distributed by Airport Operators to the authorities responsible for land use and zoning of the affected land. This would normally include both provincial and municipal planners, and zoning boards. It should be noted that distribution of these official contours is not restricted.

### Table 2

### COMMUNITY RESPONSE PREDICTION

| Response Area | Response Prediction* |
|---|---|
| 1 (over 40 NEF) | Repeated and vigorous individual complaints are likely. Concerted group and legal action might be expected. |
| 2 (35-40 NEF) | Individual complaints may be vigorous. Possible group action and appeals to authorities. |
| 3 (30-35 NEF) | Sporadic to repeated individual complaints. Group action is possible. |
| 4 (below 30 NEF) | Sporadic complaints may occur. Noise may interfere occasionally with certain activities of the resident. |
| * It should be noted that the above community response predictions are generalizations based upon experience resulting from the evolutionary development of various noise exposure units used by other countries. For specific locations, the above response areas may vary somewhat in accordance with existing ambient or background noise levels and prevailing social, economic and political conditions. | |

# Table 3

## LAND USE TABLES
## AIRCRAFT NOISE CONSIDERATIONS ONLY

This land use tabulation should not be considered as an exhaustive listing, but merely as examples of how various land uses would be assessed in the Noise Exposure Forecast Zones in terms of community response predictions.

| | |
|---|---|
| No | Indicates that new construction or development of this nature should not be undertaken. |
| No | Indicates that new construction or development of this nature should not be undertaken See Explanatory Note B. |
| (A) | This particular land use may be acceptable in accordance with the appropriate note and subject o the limitations indicated therein. |
| Yes | The indicated land use is not considered to be adversely affected by aircraft noise and no special noise insulation should be required for new construction or development of this nature. |

**(A)**

| Noise Exposure Forecast Values | >40 | 40-35 | 35-30 | <30 |
|---|---|---|---|---|
| Response Areas | 1 | 2 | 3 | 4 |
| **Residential** | | | | |
| Detached, Semi-Detached | No | No | (No) | (A) |
| Town Houses, Garden Homes | No | No | (No) | (A) |
| Apartments | No | No | (No) | (A) |

**(B)**

| Noise Exposure Forecast Values | >40 | 40-35 | 35-30 | <30 |
|---|---|---|---|---|
| Response Areas | 1 | 2 | 3 | 4 |
| **Recreational - Outdoor** | | | | |
| Athletic Fields | No | (J) | (K) | Yes |
| Stadiums | No | No | (K) | Yes |
| Theatres - Outdoor | No | No | No | (H) |
| Racetracks - Horses | No | (K) | (K) | Yes |
| Racetracks - Autos | Yes | Yes | Yes | Yes |
| Fairgrounds | (K) | (K) | Yes | Yes |
| Golf Courses | Yes | Yes | Yes | Yes |
| Beaches & Pools | Yes | Yes | Yes | Yes |
| Tennis Courts | No | (K) | Yes | Yes |
| Playgrounds | (K) | (K) | Yes | Yes |
| Marinas | Yes | Yes | Yes | Yes |
| Camping Grounds | No | No | No | (H) |
| Park & Picnic Areas | No | (K) | Yes | Yes |

**C**

| Noise Exposure Forecast Values | >40 | 40-35 | 35-30 | <30 |
|---|---|---|---|---|
| Response Areas | 1 | 2 | 3 | 4 |
| **Commercial** | | | | |
| Offices | F | E | D | Yes |
| Retail Sales | F | D | Yes | Yes |
| Restaurants | F | D | D | Yes |
| Indoor Theatres | No | G | D | Yes |
| Hotels & Motels | No | F | G | Yes |
| Parking Lots | Yes | Yes | Yes | Yes |
| Gasoline Stations | Yes | Yes | Yes | Yes |
| Warehouses | Yes | Yes | Yes | Yes |
| Outdoor Sales | E | K | Yes | Yes |

**D**

| Noise Exposure Forecast Values | >40 | 40-35 | 35-30 | <30 |
|---|---|---|---|---|
| Response Areas | 1 | 2 | 3 | 4 |
| **Public** | | | | |
| Schools | No | No | D | C |
| Churches | No | No | D | C |
| Hospitals | No | No | D | C |
| Nursing Homes | No | No | D | C |
| Auditoriums | No | No | D | C |
| Libraries | No | No | D | C |
| Community Centres | No | No | D | C |
| Cemeteries | N | N | N | N |

**E**

| Noise Exposure Forecast Values | >40 | 40-35 | 35-30 | <30 |
|---|---|---|---|---|
| Response Areas | 1 | 2 | 3 | 4 |
| **Municipal Utilities** | | | | |
| Electric Generating Plants | Yes | Yes | Yes | Yes |
| Gand & Oil Storage | Yes | Yes | Yes | Yes |
| Garbage Disposal | Yes | Yes | Yes | Yes |
| Sewage Treatment | Yes | Yes | Yes | Yes |
| Water Treatment | | | | |
| Water Storage | Yes | Yes | Yes | Yes |

**F**

| Noise Exposure Forecast Values | >40 | 40-35 | 35-30 | <30 |
|---|---|---|---|---|
| Response Areas | 1 | 2 | 3 | 4 |
| **Industrial** | | | | |
| Factories | I | I | Yes | Yes |
| Machine Shops | I | I | Yes | Yes |
| Rail Yards | Yes | Yes | Yes | Yes |
| Ship Yards | Yes | Yes | Yes | Yes |
| Cement Plants | I | I | Yes | Yes |
| Quarries | Yes | Yes | Yes | Yes |
| Refineries | I | I | Yes | Yes |
| Laboratories | No | D | Yes | Yes |
| Lumber Yards | Yes | Yes | Yes | Yes |
| Saw Mills | I | I | Yes | Yes |

G

| Noise Exposure Forecast Values | >40 | 40-35 | 35-30 | <30 |
|---|---|---|---|---|
| Response Areas | 1 | 2 | 3 | 4 |
| **Transportation** | | | | |
| Highways | Yes | Yes | Yes | Yes |
| Railroads | Yes | Yes | Yes | Yes |
| Shipping Terminals | Yes | Yes | Yes | Yes |
| Passenger Terminals | (D) | Yes | Yes | Yes |

H

| Noise Exposure Forecast Values | >40 | 40-35 | 35-30 | <30 |
|---|---|---|---|---|
| Response Areas | 1 | 2 | 3 | 4 |
| **Agricultural** | | | | |
| Crop Farms | Yes | Yes | Yes | Yes |
| Market Gardens | Yes | Yes | Yes | Yes |
| Plant Nurseries | Yes | Yes | Yes | Yes |
| Tree Farms | Yes | Yes | Yes | Yes |
| Livestock Pastures | (M) | Yes | Yes | Yes |
| Poultry Farms | (L) | (L) | Yes | Yes |
| Stockyards | (M) | Yes | Yes | Yes |
| Dairy Farms | (M) | Yes | Yes | Yes |
| Feed Lots | (M) | Yes | Yes | Yes |
| Fur Farms | (K) | (K) | (K) | (K) |

## EXPLANATORY NOTES FOR TABLE 3

The location of the lines between noise zones cannot be fixed exactly. It will therefore be necessary for the responsible public authority to make an appropriate interpretation of what regulations are to apply at a specific location.

In cases where reference is made to a detailed on-site noise analysis, or to peak noise levels, it will be appreciated that the notes are intended to apply specifically at existing airports, where a field assessment is possible. For planning with respect to new airports, such zones should be considered cautionary. Before reaching a final decision with respect to permitting the particular land-use in question, the authority may wish to consider local topographic effects and ambient noise levels, in conjunction with generalized peak noise level "footprints" for the predominant aircraft types to be using the new airport.

A. Annoyance caused by aircraft noise may begin as low as NEF 25. It is recommended that developers be made aware of this fact and that they undertake to so inform all prospective tenants or purchasers of residential units. In addition, it is suggested that development should not proceed until the responsible authority is satisfied that acoustic insulation features, if required, have been considered in the building design.[2]

B. This Note applies to NEF 30 to 35 only. New residential construction or development should not be undertaken. If the responsible authority chooses to proceed contrary to Transport Canada's recommendation, residential construction or development between NEF 30 and 35 should not be permitted to proceed until the responsible authority is satisfied that:

   (1) appropriate acoustic insulation features have been considered in the building[3] and

   (2) a noise impact assessment study has been completed and shows that this construction or development is not incompatible with aircraft noise.

Notwithstanding point 2, the developer should still be required to inform all prospective tenants or purchasers of residential units that speech interference and annoyance caused by aircraft noise are, on average, established and growing at NEF 30 and are very significant by NEF 35.

C. These facilities should not be located close to the 30-NEF contour unless the restrictions outlined in Note D are applied.

D. These uses should not be approved unless a detailed noise analysis is conducted and the required noise insulation features are considered by the architectural consultant responsible for the building design.

E. When associated with a permitted land use, an office may be located in this zone provided that all relevant actors are considered and a detailed noise analysis is conducted to establish the noise reduction features required to provide an indoor environment suited to the specific office function.

F. It is recommended that this specific land use should be permitted only if related directly to aviation-oriented activities or services. Conventional construction will generally be inadequate and special noise insulation features should be included in the building design.

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2 National Research Council, working in conjunction with Canada Mortgage and Housing Corporation (CMHC) and Transport Canada Aviation, has developed a technique for selecting residential building components based on NEF values. This information is published in CMHC's New Housing and Airport Noise Handbook, NHA 5185 81/05. Authorities are referred to this document for assistance in determining appropriate noise insulation features for a particular residential development.

3 *ibid*

G. Generally, these facilities should not be permitted in this zone. However, where it can be demonstrated that such a land use is highly desirable in a specific instance, construction may be permitted to proceed provided that a detailed noise analysis is conducted and the required noise insulation features are included in the building design.

H. Facilities of this nature should not be located close to the NEF 30 contour unless a detailed noise analysis has been conducted.

I. Many of these uses would be acceptable in all NEF zones. However, consideration should be given to internally generated noise levels, and acceptable noise levels in the working area.

J. Undesirable if there is spectator involvement.

K. It is recommended that serious consideration be given to an analysis of peak noise levels and the effects of these levels on the specific land use under consideration.

L. The construction of covered enclosures should be undertaken if this use is to be newly introduced to the noise environment. (See Note M).

M. Research has shown that animals condition themselves to high noise levels. However, it is recommended that peak noise levels be assessed before this use is allowed.

N. This appears to be a compatible land use in all NEF zones.

## Table 4

## RECOMMENDED MATRIX OF NOISE CONTROL ACTIONS

| CONSIDER THESE ACTIONS ↓ | | | IF YOU HAVE THIS PROBLEM → Noise from Taxiing | Departure | Approach | Landing Roll | Training Flights | Maintenance | Ground Equipment |
|---|---|---|---|---|---|---|---|---|---|
| AIRPORT PLAN | Changes in Runway Location, Length or Strength | 1 | ○ | ○ | ○ | ○ | ○ | | |
| | Displaced Thresholds | 2 | | | ■ | | ■ | | |
| | High-Speed Exit Taxiways | 3 | ○ | | | ○ | | | |
| | Relocated Terminals | 4 | ○ | | | | | ○ | ○ |
| | Isolating Maintenance Runups or Use of Test Stand Noise Suppressors and Barriers | 5 | ■ | | | | | ○ | ○ |
| AIRPORT AND AIRSPACE USE | Preferential or Rotational Runway Use * | 6 | ○ | ○ | ○ | ○ | ○ | | |
| | Preferential Flight Track Use or Modification to Approach and Departure Prodecures * | 7 | | ○ | ○ | | ○ | | |
| | Restrictions on Ground Movement of Aircraft * | 8 | ○ | | | | | | |
| | Restrictions on Engine Runups or Use of Ground Equipment | 9 | | | | | | ○ | ○ |
| | Limitations on Number or Types of Operation or Types of Aircraft | 10 | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| | US Restrictions, Rescheduling move flights to Another Airport | 11 | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| | Raise Glide Slope Angk or Intercept * | 12 | | | ○ | | ○ | | |
| AIRCRAFT OPERATION | Power and Flap Management * | 13 | | ● | ○ | | ○ | | |
| | Limited Use of Reverse Thrust * | 14 | | | | ○ | | | |
| LAND USE | Land or Easement Acquisition | 15 | ● | ● | ○ | ○ | ○ | ○ | ○ |
| | Joint Development of Airport Property | 16 | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| | Compatible Use Zoning | 17 | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| | Building Code Provisions and Sound Insulation of Buildings | 18 | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| | Real Property Noise Notices | 19 | | ● | ○ | ○ | ○ | ○ | ○ |
| | Purchase Assurance | 20 | | ○ | ○ | ○ | ○ | ○ | ○ |
| NOISE PROGRAM MANAGEMENT | Noise Related Landing Fees | 21 | ● | ● | ○ | ○ | ○ | | |
| | Noise Monitoring | 22 | | ● | ○ | | ○ | ○ | |
| | Establish Citizen Complaint Mechanism Establish Community Participation Program | 23 | ● | ● | ○ | ○ | ○ | ○ | ○ |

* These are examples of restrictions that involve TC Aviation's responsibility for safe implementation.

# PART V

# RESTRICTIONS TO VISIBILITY

## 5.1 GENERAL

Restrictions to visibility at an airport which can seriously limit aircraft operations may be caused by factors other than deteriorating weather conditions. These phenomena are briefly discussed in this Part.

Some industrial/manufacturing processes generate smoke, dust or steam in sufficient volume to constitute a restriction to visibility at nearby airports under certain wind conditions and temperature inversion. Examples of the types of industries which may be prominent in this regard are pulp mills, steel mills, quarries, municipal or other incinerators, cement plants, sawmills (slash and sawdust burners), and refineries.

An analysis of meteorological records at many airports has confirmed that generally fair weather is associated with westerly winds and poor weather with easterly winds. Although smoke, dust and steam can be obscuring factors regardless of the point of origin near the airport, there is little doubt that locations to the east of the airport are the most significant when poor weather conditions prevail.

During the planning stages for new industrial complexes, it is recommended that these factors be considered before approving such land uses near an airport. Prospective industrial sites near an airport should be assessed on an individual basis due to the many local factors involved. However, sufficient evidence is available from airports across the country to suggest that such industries generating visibility restrictions be located at least four to five statute miles away from the easterly boundary of an airport.

# PART VI

# SITE PROTECTION AND LINE OF SIGHT REQUIREMENTS

## 6.1 GENERAL

Air Traffic Control Towers and Flight Service Stations are sited to provide sufficient view of the manoeuvering surfaces to enable the controllers and flight service specialists to visually identify aircraft and other vehicles on the manoeuvring surfaces and to determine their movement relative to each other. The site must provide clear lines of sight unimpaired by structures, vegetation, parked vehicles, or by direct or indirect external light sources such as apron lights, parking area lights, street lights and light from reflective surfaces. It is important that clear lines of sight be maintained at all times.

The site is chosen such that consideration is given to local weather phenomena, which could restrict visibility due to fog. The site is protected from existing or future planned heating plants or other possible sources of visible contaminants and steam or heat distortion which may cause obstruction to the line of sight.

At controlled airports, visibility requirements for Flight Service Stations are only required for airside and weather watch duties.

# APPENDIX A

## REGIONAL OFFICES OF TRANSPORT CANADA AVIATION

Regional Director General (TA)
Transport Canada
800 Burrard Street
Suite 620
Vancouver, British Columbia
V6Z 2J8
[Telephone: (604) 666-5851]

Regional Director General (PA)
Transport Canada
4900 Yonge Street
Suite 300
Willowdale, Ontario
M2N 6A5
[Telephone: (416) 224-3472]

Regional Director General (SA)
Transport Canada
Canada Place
1100-9700 Jasper Avenue
Edmonton, Alberta
T5J 4E6
[Telephone: (403) 495-3879]

Regional Director General (NA)
Transport Canada
Regional Administration Building
700 Leigh Capreol Place
Dorval, Quebec
H4Y 1G7
[Telephone: (514) 633-3030]

Regional Director General (RA)
Transport Canada
333 Main Street
P.O. Box 8550
Winnipeg, Manitoba
R3C 0P6
[Telephone: (204) 983-7661]

Regional Director General (MA)
Transport Canada
P.O. Box 42
Moncton, New Brunswick
E1C 8K6
[Telephone: (506) 851-7253]