Aerodrome elevation is shown in the box to the bottom right of the main plan view (see Figure 4–72, page 115). The box also includes a diagram of the aerodrome and an arrow to indicate the approximate final path of the aircraft in relation to the runways.

4.139 The minimum sector altitude (MSA), which provides 1000 ft clearance above obstructions within 25 nm of the aid, is shown in a small diagram on the lower left corner of the plan view. The MSA is 5600 ft AMSL to the east (between MB 020° and MB 200° inbound to the station) and 8000 ft AMSL in the remaining sector, owing to higher terrain.

4.140 However, if the aircraft is tracking in bound on a published track (shown on an ERC), it is permissible to operate at a lower safe altitude (LSALT) below MSA; for example, tracking from East Sale to Cooma on W290, the aircraft may descend to the LSALT 7500 ft AMSL, whereas the MSA is 8000 ft.

4.141 Prior to using the NDB, you must verify that it is:

- selected;
- identified (COM – *dah-dit-dah-dit, dah-dah-dah, dah-dah*); and
- 'ADF'ing (sensing and pointing).

4.142 The ADF does not have a failure warning flag, so you must monitor the IDENT continuously during an NDB approach, although the volume may be reduced to minimise any distraction. The approach procedure commences at 5,700 ft AMSL overhead the COM NDB. If the aircraft arrives at the NDB at MSA 8,000 ft then the holding pattern should be entered (shown in the upper right corner of the plan view) to descend to 5,700 ft.

4.143 Even if the aircraft arrives overhead at 5,700 ft AMSL (eg, inbound from the east), it may not be permissible to proceed straight into the approach. This is only permitted if the inbound track is within 30° either side of the initial leg of the procedure. A holding pattern entry may therefore be required to position the aircraft for the approach. For example, if 157° is the initial approach leg, then a holding pattern entry will be required unless the inbound track lies within the sector 127° and 187°.

IFR/primary navigation certification specifications for GPS equipment include a requirement for multiple receiver channels and a navigation integrity monitoring system known as *receiver autonomous integrity monitoring* (RAIM).

RAIM

21.43 RAIM is a special receiver function which analyses the signal integrity and relative positions of all satellites which are in view, so as to select only the best four or more, isolating and discarding any anomalous satellites. At least five satellites must be in view to have RAIM find an anomalous situation, and six to actually isolate the unacceptable satellite. In controlled airspace ATC must be advised if RAIM is lost for more that 5 minutes. (*AIP ENR 1.1 para 4.8.1 (b) (1)).*

21.44 When operating, it ensures that the minimum acceptable level of navigation accuracy is provided for the particular phase of flight. In the process, it ensures that a potential error, known as the *position dilution of precision* (PDOP) or *geometric dilution of precision* (GDOP), is minimised. The PDOP depends on the position of the satellites relative to the fix. The value of the PDOP determines the extent of range and position errors.

21.45 When the satellites are close together, the tetrahedron formed covers a large area and results in a high PDOP value (see Figure 21–6).

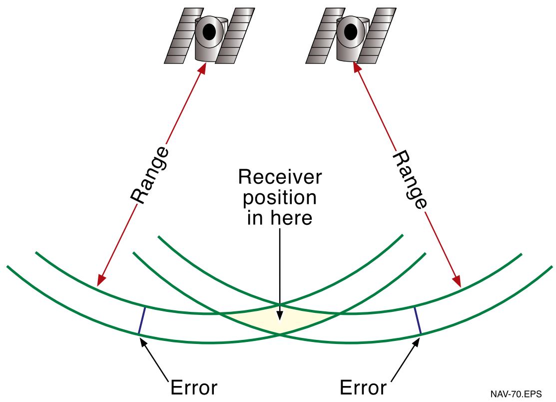

Figure 21-6 Poor satellite geometry resulting in high PDOP.

21.46 However, when the selected satellites are far apart, the area covered by the tetrahedron is much more compact, resulting in a lower PDOP value and therefore greater accuracy. A PDOP value of less than six is acceptable for en route operations. A value of less than three will be required for non-precision approaches.

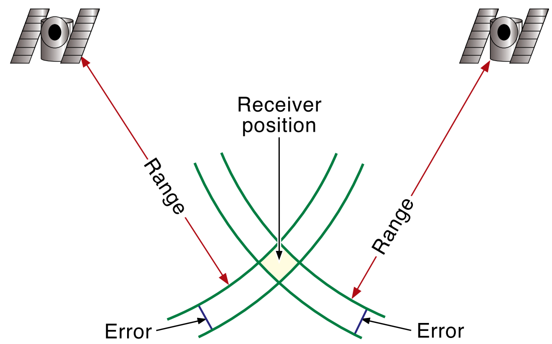

Figure 21-7 Good satellite geometry resulting in low PDOP.

Operations without RAIM

21.81 *AIP ENR 1.1 para 4.8.1.* If RAIM is lost, the accuracy of the system is considered unacceptable for both navigation and ATC separation purposes. Therefore, the following procedures apply:

- Aircraft tracking must be closely monitored against other on-board navigation systems.
- If in controlled airspace, ATC must be advised if:
  - RAIM has been unavailable for a period of greater than 5 minutes; or
  - RAIM is unavailable at the time ATC requests GNSS distance, or if an ATC clearance or restriction based on GNSS distance is imposed; or
  - the GNSS receiver is in Dead Reckoning (DR) mode for more than one minute; or
  - the GNSS receiver experiences loss of navigation functions fore more than one minute.

21.82 ATC may then adjust separation as follows:

- if valid position information is lost (2D and DR Mode), or non-RAIM operation exceeds ten minutes, the GNSS information is to be considered unreliable, and other navigation techniques should be used until RAIM is restored; and
- if RAIM is restored, the appropriate ATS unit should be notified prior to using the GNSS for primary navigation to allow ATC to reassess the appropriate separation standards.

Human Factor Considerations

21.83 We know that, in its fully operational mode, GPS (GNSS) has the capability of providing precise navigation information and guidance. However, like all forms of advanced computer technology, its capability, and therefore ultimately the safety of the flight, is governed largely by the manner in which the equipment is operated and monitored. This can be especially so when the equipment interfaces with an autopilot, flight director or advanced autoflight system. Regardless of equipment design and ergonomic factors, the pilot in command must ultimately shoulder the responsibility for the safe performance of any aviation system under his or her control.

21.84 Accident and incident history shows, however, that an alarming number of pilots tend to be too trusting when using advanced aviation technology, as with GPS operation. There are some who are quite happy to allow the equipment to 'drive the ship' without questioning its accuracy or applying basic airmanship principles, such as cross-checking the steering data it provides. Put simply, some pilots operating equipment like GPS can and often do lose situational awareness, i.e. they allow themselves to drop out of the loop.

21.85 Generally, the tendency develops as the result of complacency, since GPS seems to perform so admirably for most of the time. However, GPS is subject to a number of errors and limitations which pilots must understand. These have been discussed. However, there are also important human factor related errors and procedures applicable to GPS (and, for that matter, other RNAV systems) that need to be addressed. It is therefore necessary to appreciate what they are so that the errors can be avoided.