11. ADVANCED LINES OF POSITION

Advanced Lines of Position are used when only a single landmark is available at a time, for instance when cruising along a desolate shore line. The advanced LOP can be taken after some time on the same landmark, or on a new one if the first one is no longer visible.

11.1 Principle behind the Advanced Lines of Position

The logic is simple: a first bearing is taken on the landmark, giving a first Line of Position "LOP 1" (Fig. 11.1). At some later time, depending on the speed of the boat and its distance from shore, a second bearing is taken of the same landmark or another one, yielding a second LOP, "LOP 2" (Fig. 11.6, p. 72). Ideally, the second bearing is taken at a time which results in a second Line of Position at approximately 90° from the first one: this provides the best precision.

The boat position is obviously not at the intersection of the first and second LOPs since the two sights are taken at different times: it is at the intersection of the second LOP and an **advanced** first LOP. Here, "advanced" means that the first LOP has been moved, parallel to itself, by the distance travelled by the boat. This is explained in the following example:

> A first bearing is taken at 10:00. We can then plot a first Line of Position, **LOP 1**. At 10:00, the boat is somewhere along LOP 1. (Fig. 11.1)
>
> Where is the boat at 11:45 when we take a second sight on the same landmark? If the boat had been at the point A at 10:00, it would be at A' at 11:45 (Fig. 11.2). The **Boat Vector** represents the distance travelled by the boat during the time interval between the two sights, given its speed and direction. i.e. 11:45 – 10:00 = 1:45 = 105 min.
>
> During that time, the boat has travelled a distance of (6 kn x 105 min) /60 = 10.5 NM in a direction of 160º T.

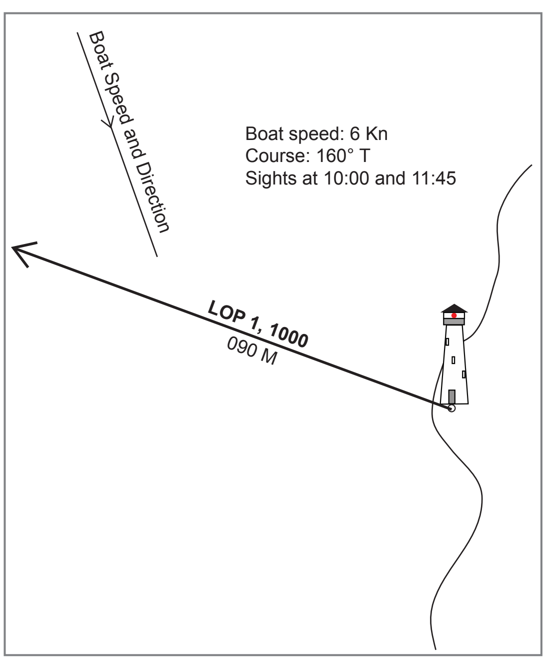

Fig. 11.1 Line of Position No. 1 (LOP 1) at 10:00.

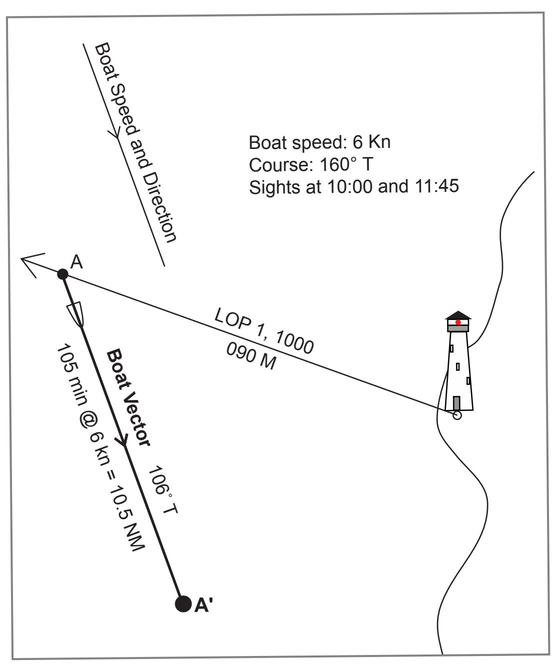

Fig. 11.2 Boat vector from a random point on LOP 1.

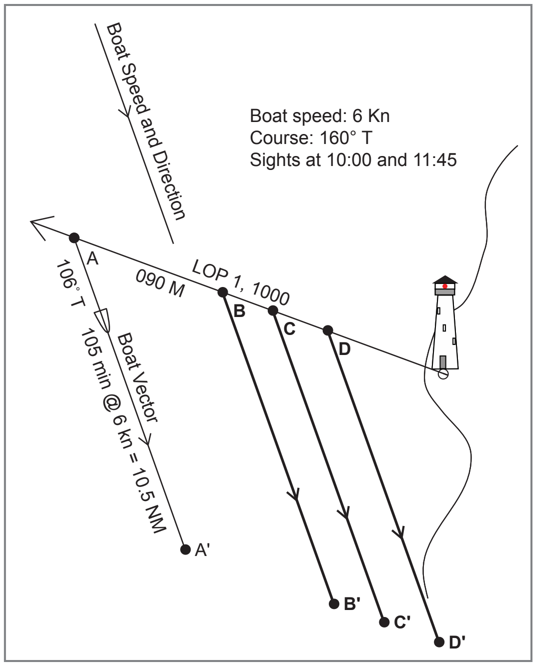

Fig. 11.3 Some possible positions of the boat at 11:45.

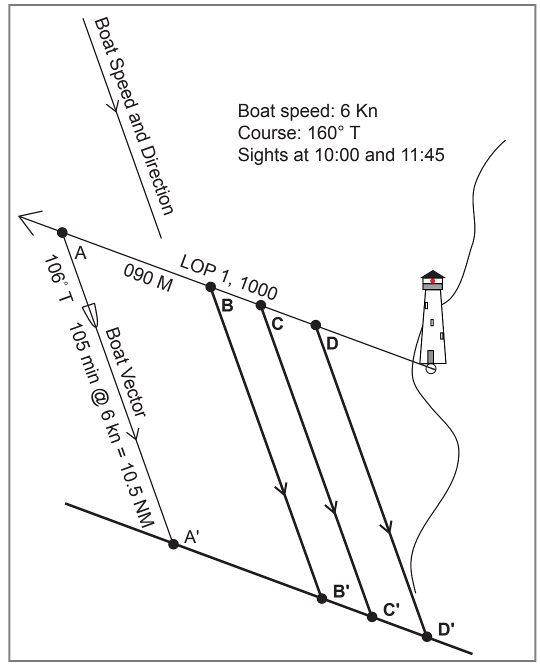

Fig. 11.4 All possible positions of the boat at 11:45.

If the boat had been at points B, C or D at 10:00, it would be at B', C', or D' at 11:45. (Fig. 11.3)

Therefore if at 10:00, the boat was somewhere on LOP 1, at 11:45 it has to be at the corresponding point on the parallel to LOP 1, advanced by the boat vector. (Fig. 11.4)

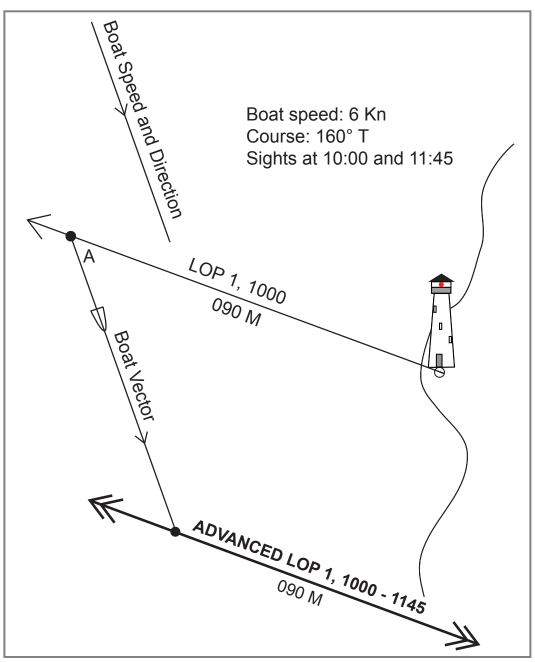

Fig. 11.5 Advanced LOP 1, 10:00 - 11:45.

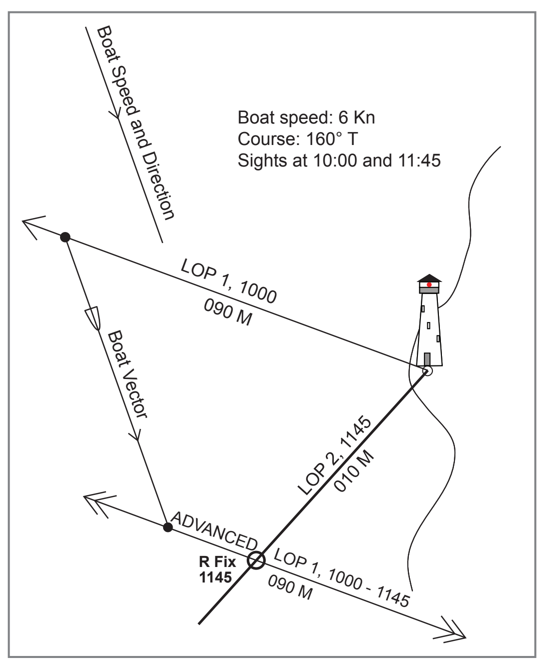

Fig. 11.6 LOP 2 at 11:45, and Running Fix at 11:45.

At 11:45, the boat is thus on the Advanced LOP 1. (Fig. 11.5)

At 11:45, the boat is also on the second LOP, LOP 2, which is determined by our second sight on the same landmark (Fig. 11.6). The intersection between the **Advanced LOP 1** and **LOP 2** determines the boat position at 11:45. It is a **Running Fix (R Fix)**.

11.2 Construction of an Advanced Line of Position

The construction is simple: (1): Plot the first LOP, **LOP 1,** corresponding to the first site. (2): Advance it by the boat vector and plot the **Advanced LOP 1**. (3): Plot the second LOP, **LOP 2,** corresponding to the second sight on the same landmark or another one. The boat is at the intersection of the **Advanced LOP 1** and **LOP 2**. This procedure is explained in the six steps below:

Step 1. Convert the bearings from Magnetic degrees to True for plotting on the chart.

Step 2. Plot the first LOP, **LOP 1,** at the time of the first sight, 10:00. (Fig. 11.7)

Step 3. Anywhere on LOP 1, choose a random boat position “A”, away from other graphic constructions. This random point can even be on land, i.e., in this picture, to the right of the lighthouse (Fig. 11.8).

Step 4. From the random point on LOP 1, draw the boat vector, i.e. the distance travelled by the boat during the time interval between the two sights, given its speed and direction. Here, in 1 h 45 min (105 min), the boat has travelled 10.5 NM along a course of 160º T. (Fig. 11.9)

Step 5. From the tip of the boat vector, draw an Advanced Line of Position, parallel to the first one, called **Advanced LOP 1** (Fig. 11.10).

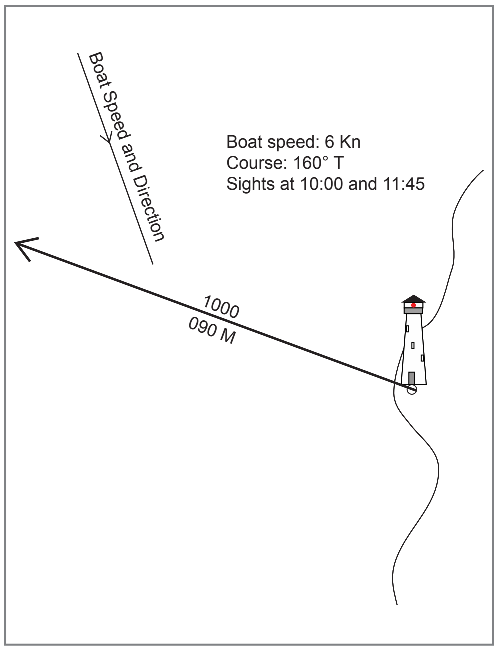

Fig. 11.7 **Step 1:** Plot LOP 1.

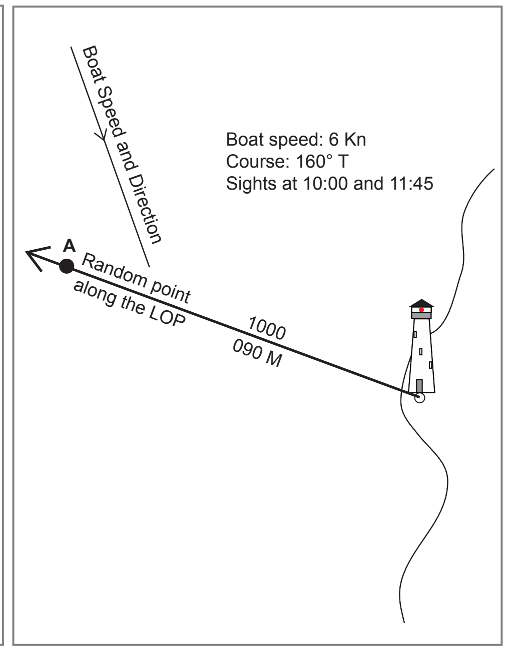

Fig. 11.8 **Step 2:** Randomly choose a point A on LOP 1.

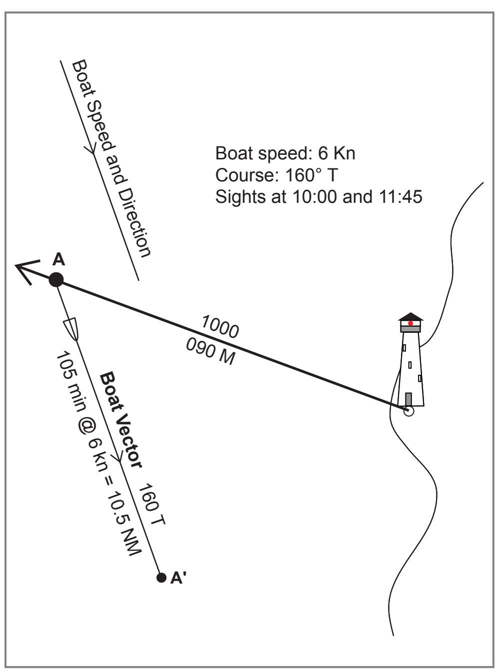

Fig. 11.9 **Step 3:** From A, plot the Boat Vector for the time interval between the first and the second sights.

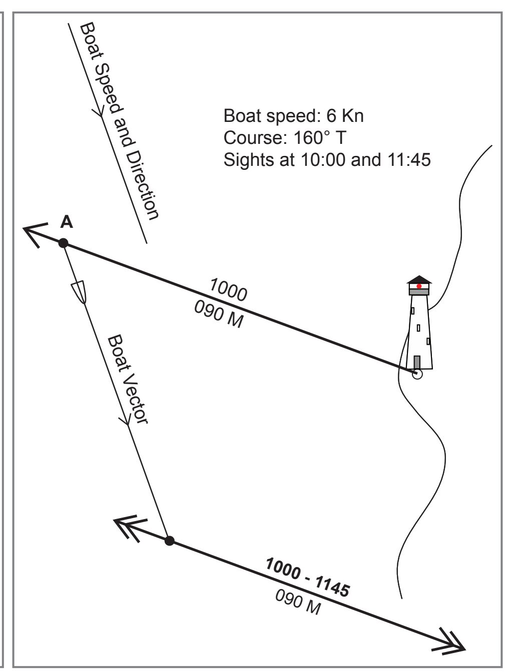

Fig. 11.10 **Step 4:** From the tip of the Boat Vector, draw a parallel to LOP 1.

Step 6. Draw the second Line of Position, **LOP 2,** at the time of the second sight, 11:45. This second LOP can be taken on the same landmark or another one. The boat position at 11:45 is at the intersection of the **Advanced LOP 1** (advanced to 11:45 by the boat vector) and **LOP 2**, drawn from the 11:45 sight. The location thus established with an Advanced LOP is a **Running Fix**, labelled **R Fix** (Fig. 11.11).

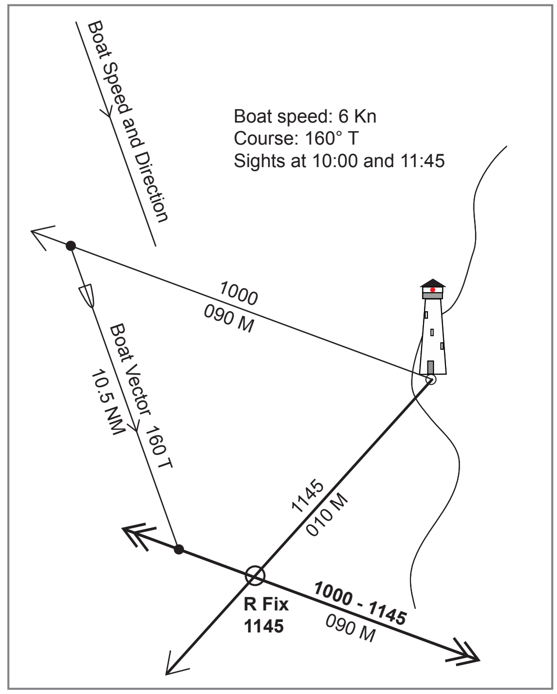

Fig. 11.11 **Step 5:** Plot LOP 2, and determine the boat position at the time of sight 2.

11.3 Example

A boat sails from Vancouver Harbour:

Course: 250˚ T
Magnetic variation V= 18ºE
Speed S = 6 kn.
Sight 1, Point Cowen light, 08:00, 295˚M
Sight 2, Point Cowen light, 08:40, 024˚M.
Position at 08:40?

Step 1: Convert the magnetic bearings to True directions for plotting on the charts:

T	V	M	D	C
313	18E	295		
042	18E	024		

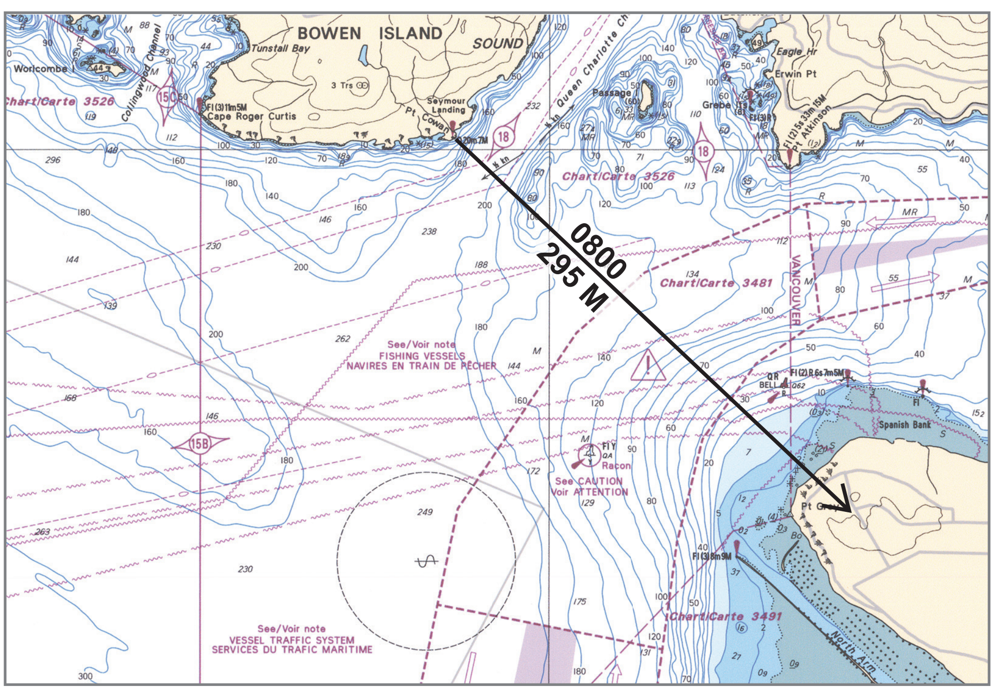

Fig. 11.12 **Step 2:** Plot LOP 1.

Step 2: Plot the first Line of Position for the sight taken at 08:00 (Fig. 11.12).

Step 3: On this LOP, randomly choose a starting point for the vector construction. Mark the point. (Red dot off Point Grey, Fig. 11.13).

Step 4: From this random point, draw the boat vector representing the distance travelled by the boat during the time interval between the two sights, i.e. in 40 min. at 6 kn (= 4 NM), in the given direction of the boat (= 250˚ T) (Fig. 11.14).

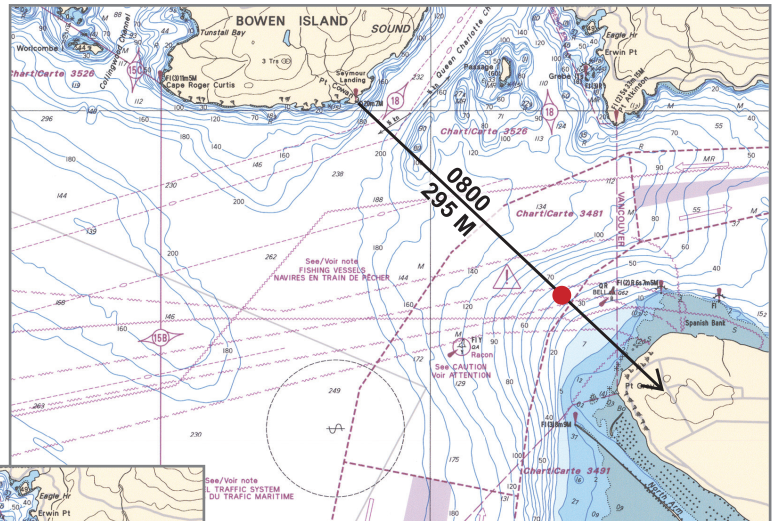

Fig. 11.13 **Step 3:** Choose a random point on the first LOP.

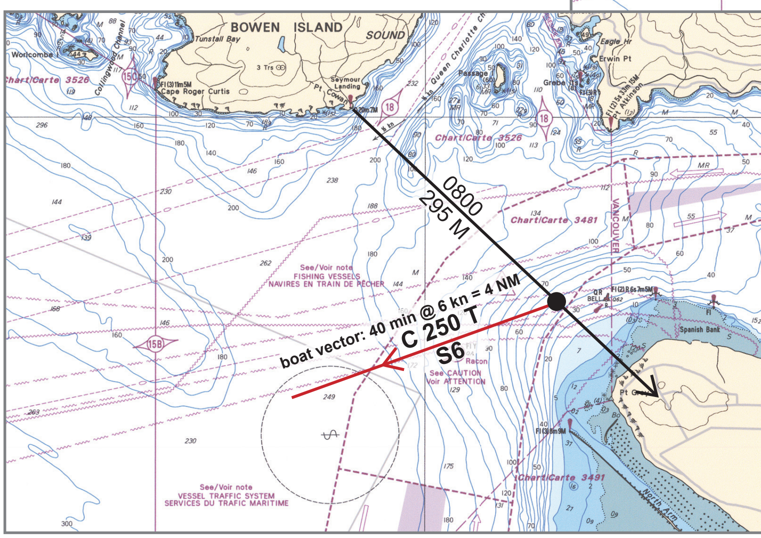

Fig. 11.14 **Step 4:** Draw the Boat Vector for 40 min (from 08:00 to 08:40).

Step 5: Through the tip of the boat vector, draw a parallel to the first LOP (Fig. 11.15). This parallel line is the **Advanced LOP,** advanced by the distance travelled by the boat between two sights. If the boat was somewhere along the first LOP at 08:00, it must be somewhere along the **Advanced LOP** at 08:40.

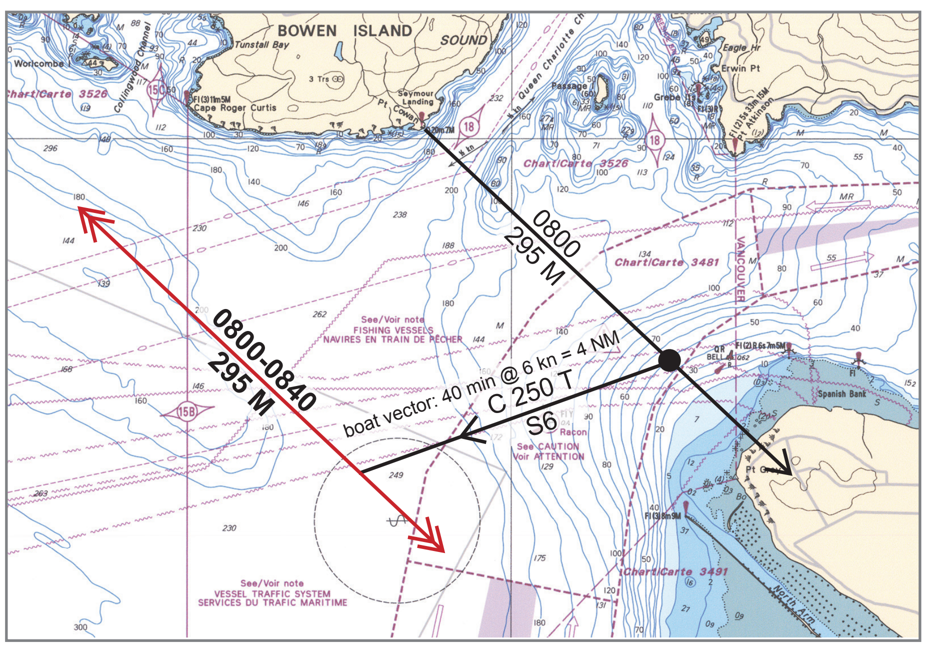

Fig. 11.15 **Step 5:** Advance the first LOP from 08:00 to 08:40.

Step 6: Draw the second LOP, for the second sight (08:40) on the Point Cowan light. At 08:40, the boat is at the intersection of the Advanced first LOP and the second LOP (Fig. 11.6). Mark the **R Fix** (running fix) and the time (08:40).

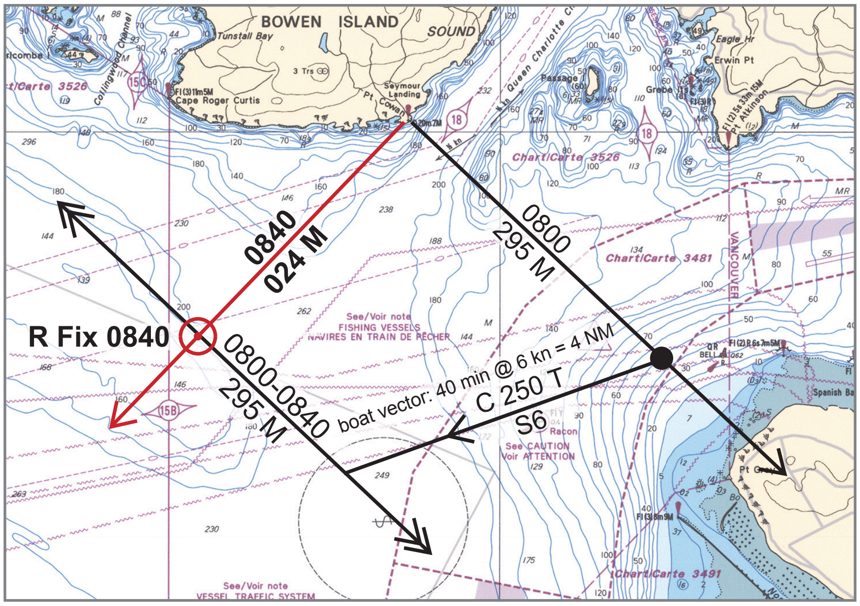

Fig. 11.16 **Step 6:** Draw LOP 2 at 08:40, and determine the fix at 08:40.

Measure the boat location on the chart at the 08:40 R Fix = 49° 17.6' N - 123 ° 25.4' W and record it in the boat's log.

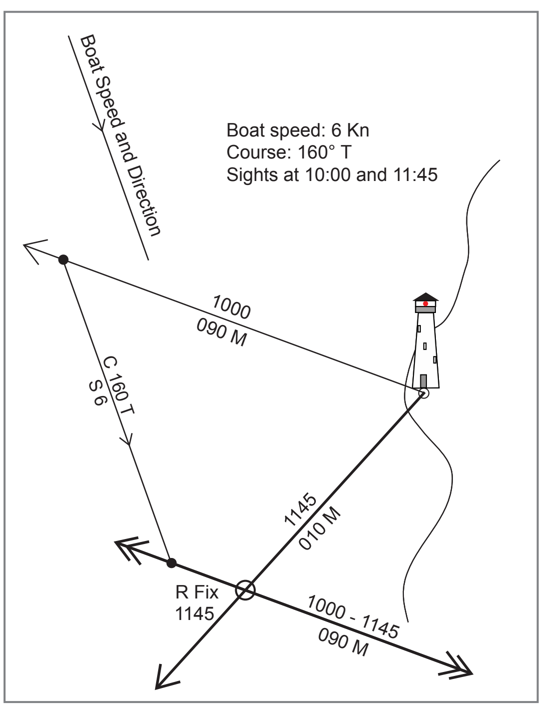

Fig. 11.17 Labeling of Advanced Lines of Position. On this graphic, boat direction (c) = 160° T; boat speed (s) = 6 kn.

11.4 Labeling

Advanced Lines of Position are identified with both the time of the original sight AND the time of the second sight, above the ALOP, and with a double arrow (chevron) at each end. The bearing of the first sight, as recorded with the hand bearing compass in magnetic degrees, is carried over to the Advanced LOP and noted below it. (Fig. 11.16 and Fig. 11.17)