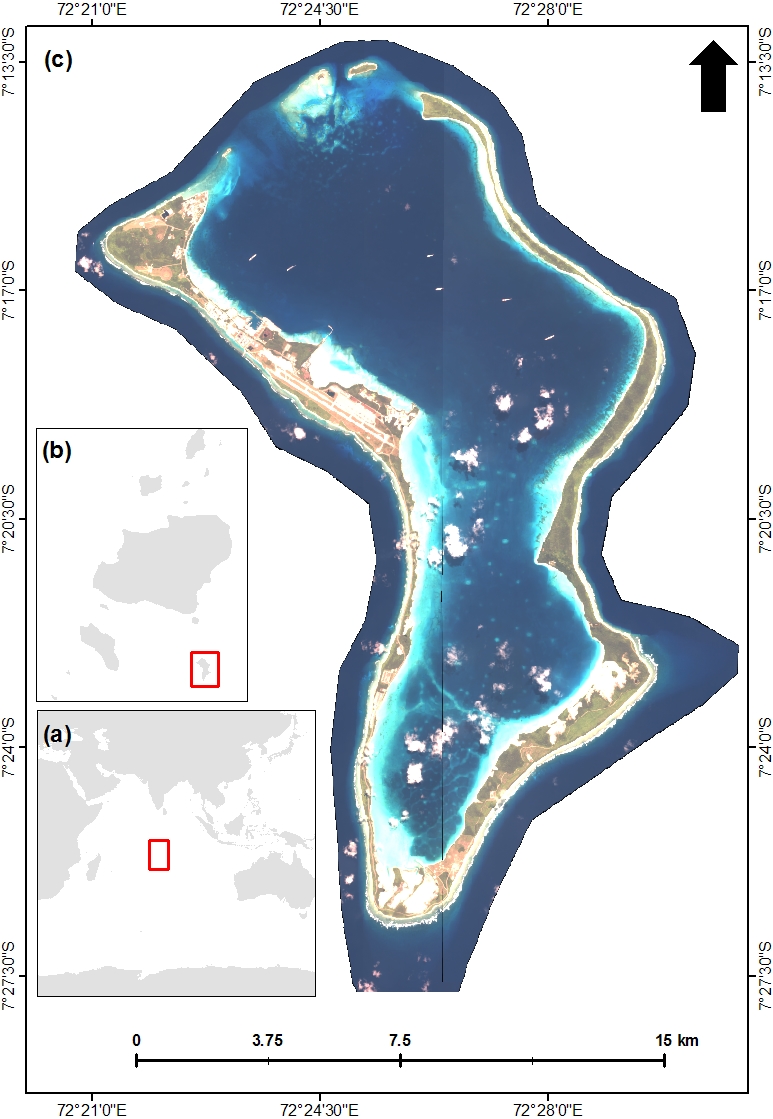
**Calculating the change in lagoon volume at Diego Garcia Atoll, Chagos Islands**

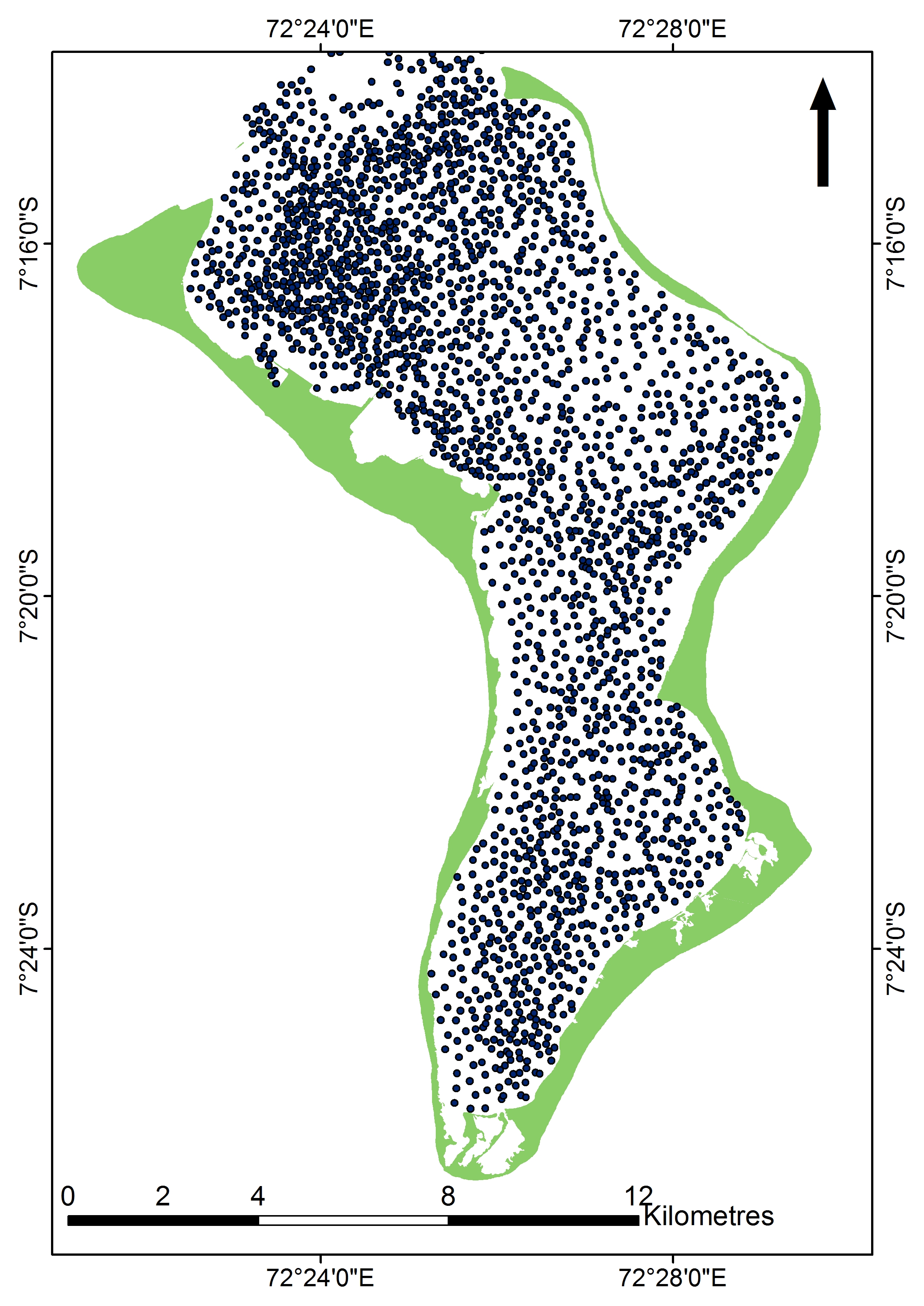
Diego Garcia is a horse-shoe shaped atoll (9 × 22 km2) that lies 55 km south of the Great Chagos Bank in the central Indian Ocean. Approximately 70% of the atoll area is comprised of the extensive lagoon (11 km2), which is enclosed by a mostly continuous land rim around the periphery, which has an open channel to the North. In the 1970s an American air base was built along the north western sector of Diego Garcia atoll rim, thus, recent anthropogenic influences associated with the construction of military infrastructure include dredging and dumping of sands within the lagoon.

**Figure 1.** (**a**) The location of the British Indian Ocean Territory in the central Indian Ocean, (**b**) the location of Diego Garcia at the southern end of the Chagos archipelago (BIOT), and (**c**) Diego Garcia atoll.



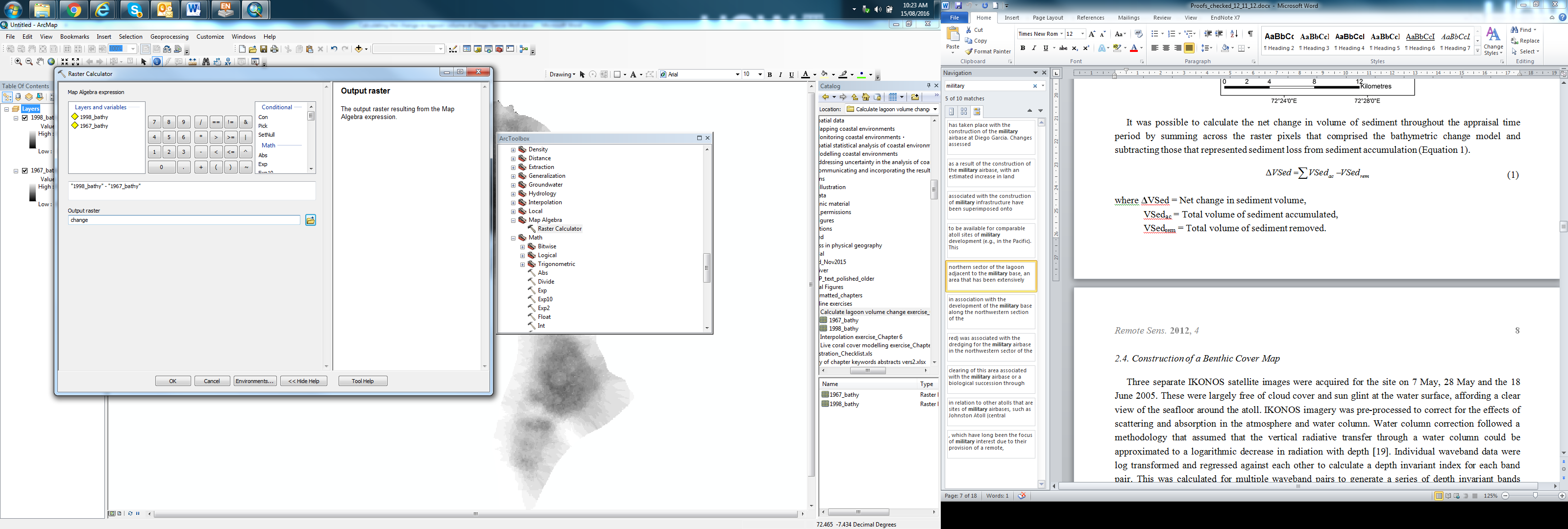
For this exercise, two raster layers are provided that depict bathymetric models of the lagoon at Diego Garcia Atoll, Chagos Islands. These have been produced by digitising 2590 numbered points into a georeferenced point file from hydrographic charts developed on the basis of two surveys of the atoll lagoon, undertaken in 1967 (H.M.S. Vidal) and 1998 (UK Hydrographic Office) (Figure 2). A kriging interpolation was applied to digitised sounding points to derive a continuous bathymetric model representing water depth across the entire lagoon floor. More detail on the collection of sounding points and production of the bathymetric model can be found in Hamylton and East (2012).

**Figure 3.** Point file displaying the 3,584 soundings from the 1998 UK Hydrographic Office bathymetric chart.



Overall change in lagoon volume can be estikmated via a two-step process that calculates a ‘change raster’ to estimate bathymetric change on a pixel by pixel basis (step one), then sums these to generate overall estimates of change for the entire lagoon (step two).

Note that conventionally, bathymetric maps are datasets that represent water depths as negative values because they are beneath the sea surface. A change raster can be calculated by subtracting the earlier survey (1967) from the later survey (1998). This can be achieved in the raster calculator (spatial analyst, map algebra). This will produce a new layer with positive values where the water depth has reduced (i.e. sediment has accumulated) and negative values where the water depth has increased (i.e. sediment has been removed).



The net change in volume of sediment between the two different survey times can be calculated by summing across the raster pixels that comprised the bathymetric change model and subtracting those that represented sediment loss from sediment accumulation (Equation 1).

|  |  |
| --- | --- |
|  | (1) |

where **Δ**VSed = Net change in sediment volume,

VSedac = Total volume of sediment accumulated,

VSedrem = Total volume of sediment removed.

The values of VSed and VSed ac can be calculated by summing up the total negative and total positive pixels values from the change raster derived in step one, then multiplying through by the volume of a single pixel. Pixels where the water depth has not changed (value = 0) are excluded from the analysis. Thus, estimated change (in Tonnes) for these datasets would be 116 - 3163 = -3047 Tonnes (see Table 1 for values)

Table 1. Per pixel change in volume of the Diego Garcia Lagoon.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sediment accumulated | | | Sediment removed | | |
| VALUE | COUNT | Total (value \* count\*pixel volume/m3) | VALUE | COUNT | Total (value \* count\*pixel volume/m3) |
| 1 | 3031 | 378875000 | -8 | 4 | -4000000 |
| 2 | 560 | 140000000 | -7 | 29 | -25375000 |
| 3 | 97 | 36375000 | -6 | 72 | -54000000 |
| 4 | 23 | 11500000 | -5 | 423 | -264375000 |
| 5 | 16 | 10000000 | -4 | 828 | -414000000 |
| 6 | 11 | 8250000 | -3 | 1603 | -601125000 |
| 7 | 11 | 9625000 | -2 | 3204 | -801000000 |
| 8 | 13 | 13000000 | -1 | 7990 | -998750000 |
| 9 | 15 | 16875000 | 0 | 10575 | 0 |
| 10 | 15 | 18750000 | Total/m3 | | -3162625000 |
| 11 | 9 | 12375000 | Total/ Tonnes | | -3163 |
| 12 | 10 | 15000000 |  | | |
| 13 | 6 | 9750000 |
| 14 | 5 | 8750000 |
| 15 | 4 | 7500000 |
| 16 | 9 | 18000000 |
| 17 | 3 | 6375000 |
| 18 | 3 | 6750000 |
| 19 | 8 | 19000000 |
| 20 | 8 | 20000000 |
| 21 | 9 | 23625000 |
| 22 | 5 | 13750000 |
| 23 | 5 | 14375000 |
| 24 | 4 | 12000000 |
| 26 | 2 | 6500000 |
| 27 | 1 | 3375000 |
| Total/m3 | | 116000000 |
| Total/ Tonnes | | 116 |