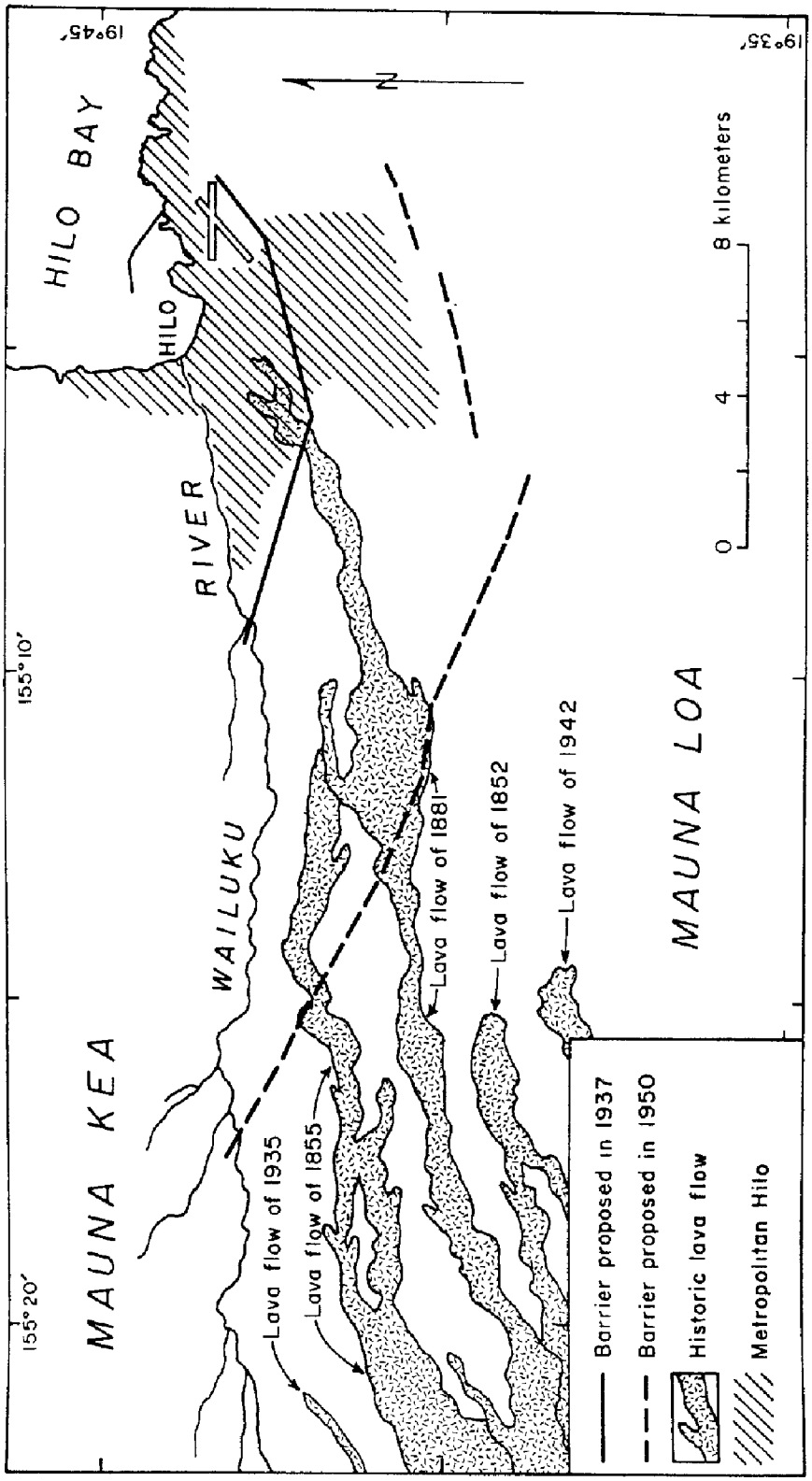

Figure 2. Map of the vicinity of Hilo, Hawaii, showing the position of barriers suggested to divert lava flows from the city and harbour.

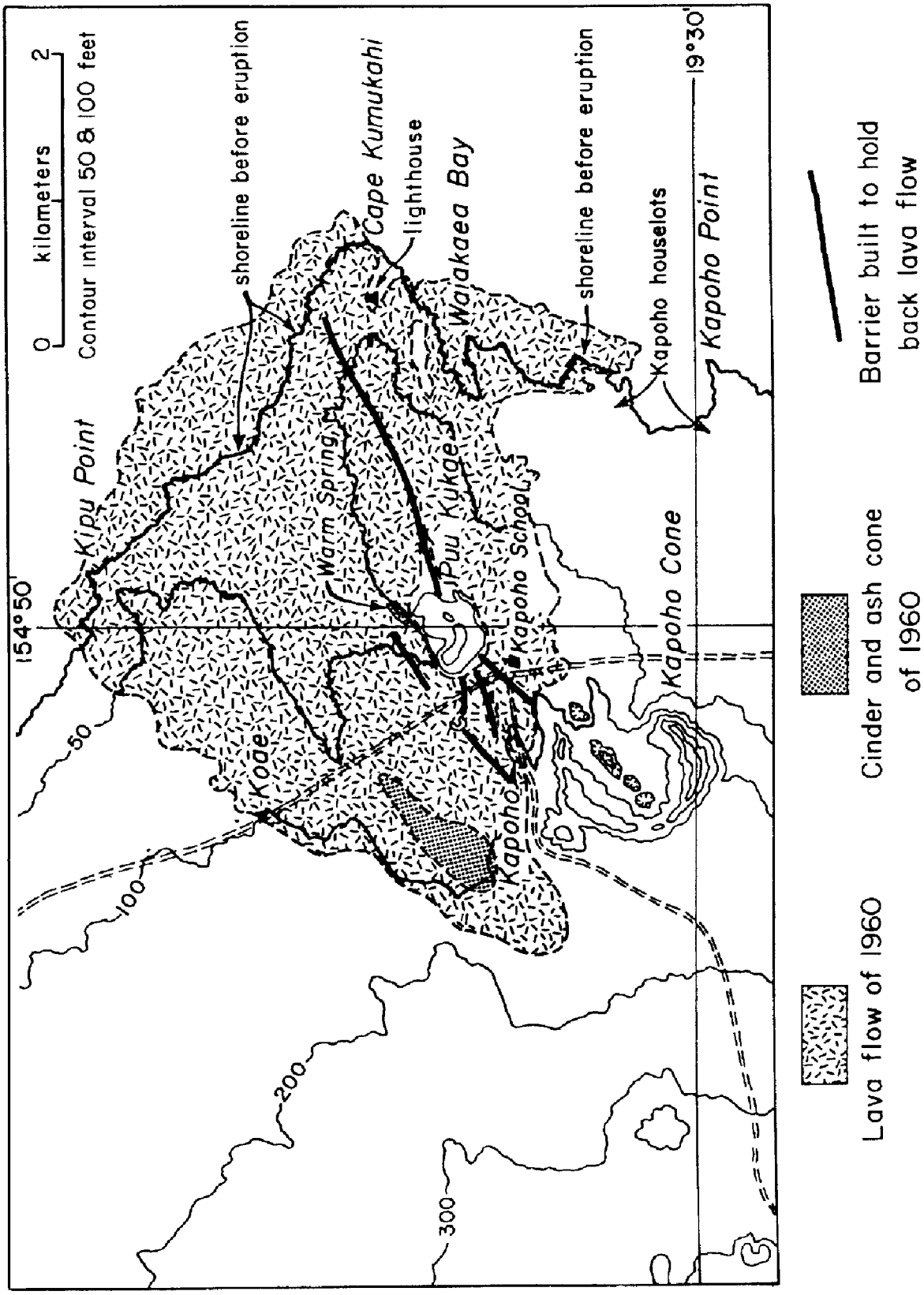

Figure 3. Map of the region around Kapoho, Hawaii, showing the barriers built in an attempt to prevent the southward spread of the lava flow of 1960. (From Macdonald and Abbott, 1974).

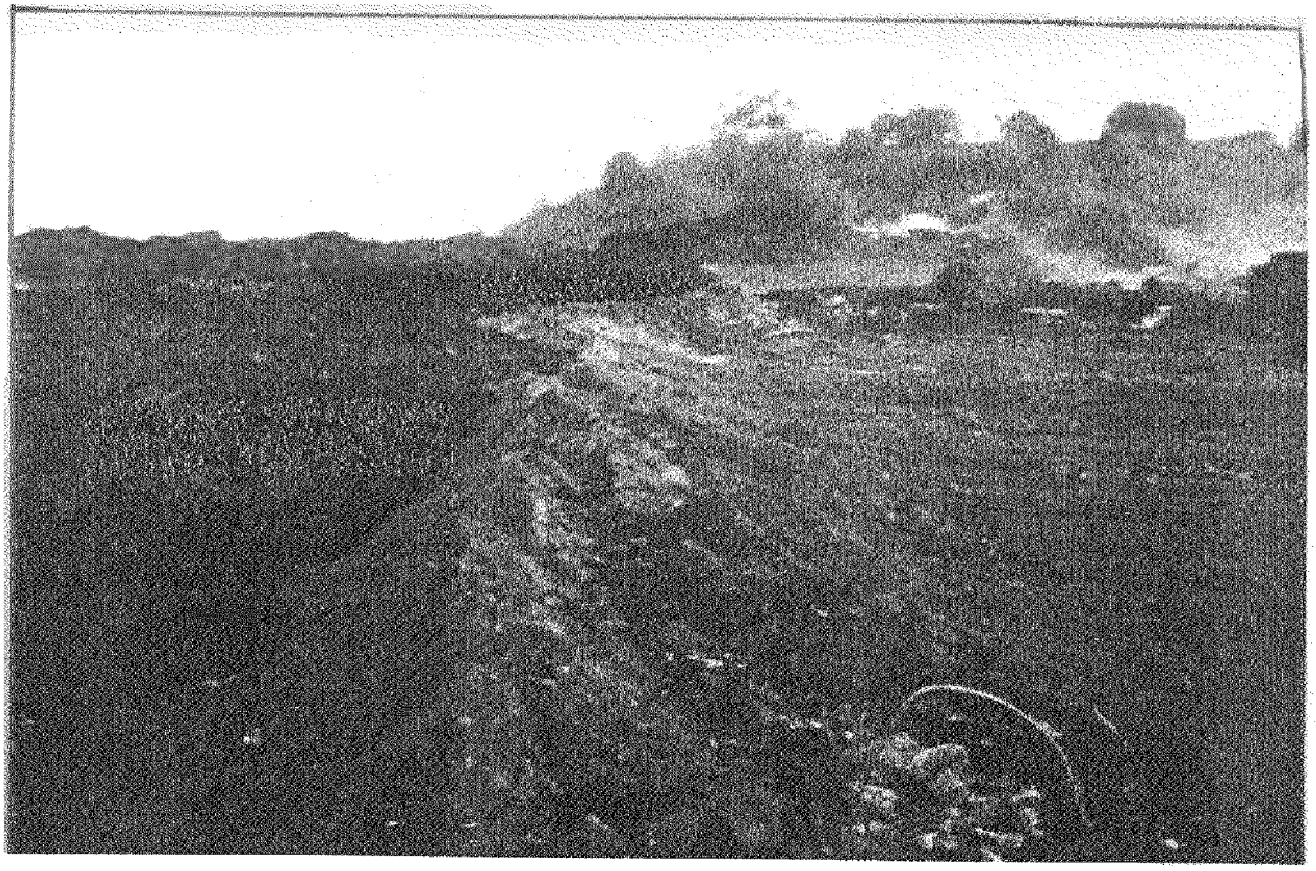

Plate 4. Barrier built to prevent the spreading of a lava flow at Kapoho, Hawaii, in January 1960. The wall is about 6 meters high. Lava is confined to the left of the wall. Eventually a new outbreak on the right of the wall flooded that area with lava also.

(Source: Hawaii Institute of Geophysics,
G.A. Macdonald).

against them, suggesting that properly built barriers under favourable conditions might well be successful. Experience indicated, however, that the material used to construct the wall must be heavy (cinder proved worthless), that the width of the base of the wall must be several times as great as the height, and that the slopes of the wall must be gentle (Macdonald, 1962).

As with bombing, topography places a limit on the possible success of diversion barriers. A flow probably cannot be diverted out of a valley that is much deeper than the flow is thick. Even where a flow is not confined in a valley, the height and breadth of a barrier necessary to divert a thick flow of block lava may be prohibitive. True, as pointed out above, the height may not need to be as great as the thickness of the flow, and though it probably would have to equal a considerable proportion of the thickness, just what proportion is not known. The breadth of the barrier necessary to resist the lateral component of the hydrostatic thrust of the lava also is not known. Where the opportunity presents itself, experiments in barrier construction should be carried out to gain more insight into these matters.

Still another method of restricting and diverting lava flows has been the subject of half-joking conjecture for several decades, and has finally been tried. The idea was simply to spray water from fire hoses onto the edge of an advancing lava flow to chill it and retard its progress. It was given some credibility by the behaviour of some lava flows on entering the ocean. For instance, when the 1911 flow of Matavanu, Samoa, entered the ocean it turned and advanced along shore, instead of continuing straight on into deep water. It seemed possible that the change of course was caused by chilling of the oceanward side of the flow, making it easier for the lava to spread laterally, but it was also possible that the change was at least partly the result of the lava following the broad depression between the shoreline and the low ridge at the outer edge of the coral reef. However, in 1960 at Kilauea the flow behaved in the same way, and there was no depression parallel to the shoreline to guide it. Later in the 1960 eruption, on several occasions the Hawaii Fire Department tried artificial spraying of the flow margin to determine its effects. One example may be given. For several days the edge of the flow had been creeping slowly toward a wooden house. When the lava was about 6 m from the house volunteer firemen, who were not then otherwise occupied, turned two streams of water from 75 mm hoses onto the side of the flow. Within a few minutes the lava stopped moving, and it remained stationary for several hours. In short, it was found that even with rather small amounts of water the spread of the flow could locally be checked for periods long enough to remove the contents of buildings, or even to move entire buildings to safety.

The scheme was employed on a very much larger scale during the 1973 eruption on Heimaey Island, south of Iceland (Williams and Moore, 1973). The lava was flowing northeastward into the ocean and northward into the mouth of the harbour of Westmannaeyjar, and was spreading northwestward into the town (fig. 4). Under the direction of Th. Sigurgeirsson, water was pumped from the harbour onto the flow margin. Using fireboats, ships' pumps, and big land-based pumps, approximately 900 liters/second of cold water was sprayed onto the flow margin, and the spreading of the lava into the town stopped. It is believed (Thorarinsson, personal communication) that the pumping played an important role in saving most of the town.

The use of the spraying method depends, of course, on the availability of large amounts of water, and of suitable pumps and other equipment. Its success depends on favourable topography, and on the volume and rate of flow of the lava.

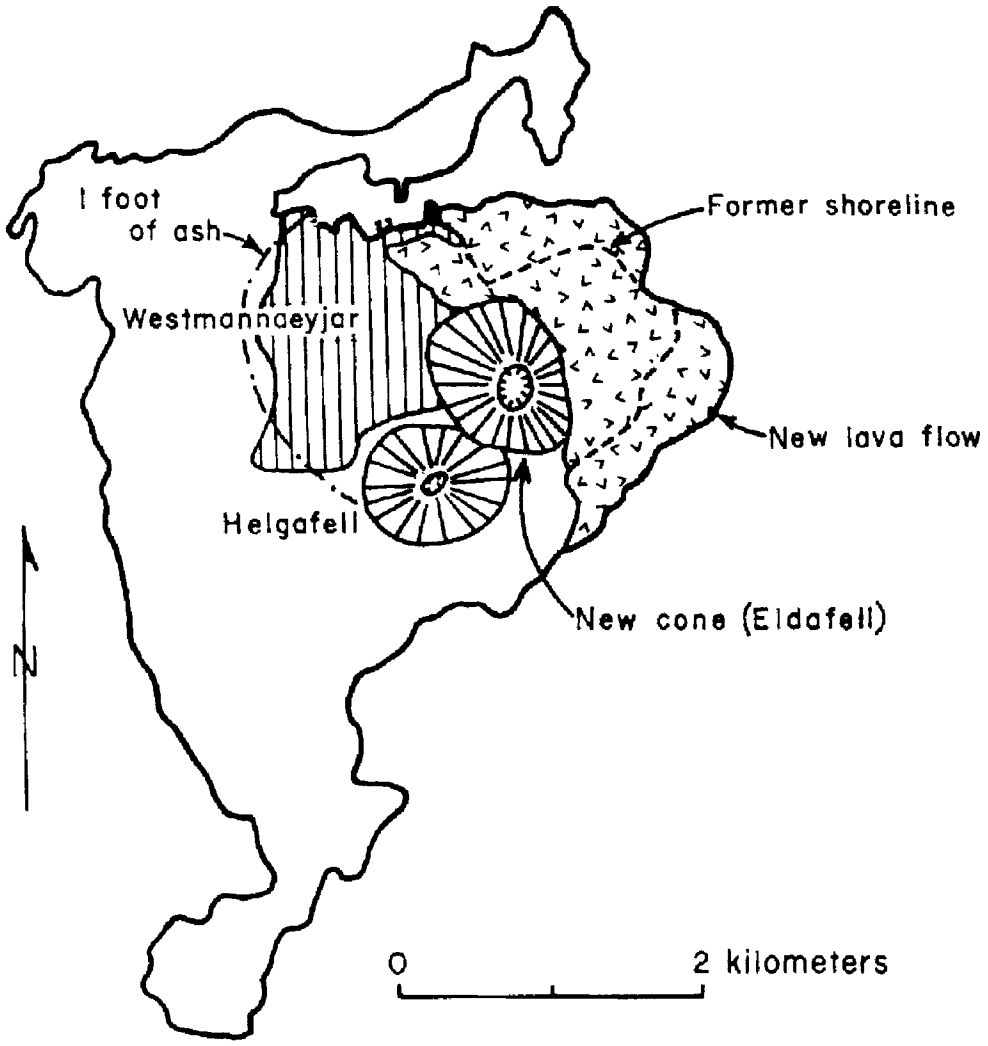

Figure 4. Map of the island of Heimaey, south of Iceland, showing the cone and lava flow of 1973 and the location of the city of Westmannaeyjar.

(After Williams and Moore, 1973).

The rapidity of natural revegetation of lava flows varies greatly with differences in climate. In the rainy subtropical climate of the lower northeast slope of Kilauea, the 1840 lava flow had a continuous cover of small forest trees in less than a century, but in a region of lower rainfall the 1750 lava flow remains largely barren after more than two centuries. A moderate amount of experimentation has now been done in Hawaii in treating the surfaces of recent lava flows to make them useable. The surfaces of aa flows are easily modified with bulldozers, and extensive tracts of house lots have been developed. Disregarding risk from future eruptions, they are wholly satisfactory as building sites, and some householders have established gardens and lawns. Crushing of the surface material by bulldozers or rollers creates enough fine material to hold moisture, and grass will then grow, though it is greatly aided by addition of a small amount of top soil. Within two years of the end of the eruption, several hundred acres of acerola trees had been started on the levelled surface of the 1955 aa flows, by planting them in a little soil placed in a small hole dug in the lava. They did well, and the cost of preparing the land was not appreciably greater than that of clearing new land of forest. Other crops that require only thin soil also can be grown successfully.

Fine-textured block lava flows probably could be treated much like the aa flows, but treating those with very large blocks and very irregular surfaces would be much more difficult, and might prove impractical. Pahoehoe furnishes adequate building sites, but is considerably more difficult than aa to make suitable for plantings.