Irish Geography
Vol. 57, No. 2 November 2024
DOI: 10.55650/igj.2024.1508

Geographical Society of Ireland
An Cumann Tíreolaíochta na hÉireann

Several million sheets: military maps of Ireland during World War 2

Arnold Horner
Glenageary, Co. Dublin, Ireland

First received: November 2024 *Accepted for publication: March 2025*

Abstract: Several million maps of, or relating to, Ireland – the greatest volume ever produced in a short period – were prepared during the early 1940s as authorities in Ireland, Britain and Germany struggled to anticipate the cartographic needs that might ensue were Ireland to become a theatre of conflict in the European sector of an expanding world war. This article explores some of the key features of this short but distinctive episode in Irish cartographic history. An introductory section includes a short review of some of the more significant requirements of military maps, most notably the need for convenience of use and the availability of a grid system that allows locations to be pinpointed accurately. The principal map series produced by or for the military authorities in Ireland, Britain and Germany are then described, with the main attention being given to the small- and medium-scale topographic maps available for land forces. Map scales ranging from 1:10,000 for Belfast to 1:1,000,000 are involved, with particularly large quantities being printed of the 1:63,360 GSGS 4136 map series. A classification of the coastline and of offshore geology is a feature of some German map series. A final section gives a brief consideration to the fate of the various map series.

Key words: *Military topographic mapping, Irish cartographic history, Grids for military maps, Ireland during World War 2*

Several million maps of, or relating to, Ireland – the greatest volume ever produced in a short period – were prepared during the early 1940s as authorities in Ireland, Britain and Germany struggled to anticipate the cartographic needs that might ensue were Ireland to become a theatre of conflict in the European sector of an expanding world war. The war, with a west European front that involved Britain, France and other countries in opposition to Germany, had begun in September 1939 and was marked by early German successes. By May/ June 1940, Germany was in control of most of the west European mainland. An invasion of Britain was a real possibility, with the further possibility that part of that invasion might be via, or in some other way involve, Ireland. The Irish state, controlling the 26-county area that had become Saorstát Eireann in 1922 (and which was widely identified as Éire during the 1940s), was formally neutral. Nonetheless, and particularly

*Arnold.horner@ucd.ie (Corresponding Author)

given the experience of some other countries, the possibility existed that Germany might use Ireland as a pathway to Britain. Indeed, as the documents supporting the proposed strategy for the invasion of Ireland, known as Operation Green, demonstrate, German strategists gave serious consideration to this option whilst, conversely, British strategists gave equally serious attention to the possible need for either a pre-emptive or a reactive invasion of the 26-county state from British-controlled Northern Ireland (Carroll, 1975; Fisk, 1983). Simultaneously, local Irish authorities had to prepare for the contingencies that any such invasion, from whatever direction, would precipitate. Those preparations included liaison with British military at the end of May 1940 to prepare a 'Plan W' whereby, should a German invasion of Ireland take place, the British army in Northern Ireland would move south to undertake joint operations with the Irish military (Fisk, 1983). In that eventuality, large numbers of topographic maps relating to any part of Ireland might be needed by British forces. Whether for the invaders or the defenders, the availability of usable maps was a key issue in the frenzied military preparations that were being made during 1940 and in the succeeding years while the threat of invasion remained.

The following review explores some of the key features associated with this short but distinctive episode in Irish cartographic history. After an identification of some of the more significant requirements of military maps, the main map series produced by or for the military authorities in Ireland, Britain and Germany are described, with the main attention being given to the topographic maps available for land forces. A final section gives a brief consideration to the fate of the various map series. The principal sources include *Map reading*, a 64-page training regulation booklet prepared for the Irish defence forces in 1942, the encyclopaedic reviews of medium- and intermediate-scale military and other British and Irish maps assembled by Hellyer and Oliver (2004, 2022), and the series of documents and maps comprising *Militärgeographische Angaben über Irland* [Military information-material about Ireland – hereafter usually referred to as MAI] which were prepared by the German authorities during 1940-42. Other sources have included *Sheetlines*, the journal of the Charles Close Society for the study of Ordnance Survey maps, a 1951 review of German map publications by the US Central Intelligence Agency (CIA) and the map images now generously made available at such web-sites as those of the National Library of Scotland (www.nls) and of the digitised collections of the University of California Berkeley (Powell and Mühr, 2021). As already stated, the aim in this article is to offer an overview. No attempt is made here to explore in detail the resources of individual archives such as Military Archives in Dublin, the Imperial War Museum in London, the Royal Engineers at Chatham, or the Abteilung Militärsarchiv of the Bundesarchiv at Freiburg.

In the interest of brevity, abbreviations are given to some of the most frequently-mentioned organisations. OS, OSI and OSNI respectively refer to the Ordnance Survey (Southampton), the Ordnance Survey of Ireland (Dublin) and the Ordnance Survey of Northern Ireland (Belfast). GSGS refers to the Geographical Section, General Staff of the UK, the War Office branch charged with organising and co-ordinating mapping requirements for land and air forces. GSGS appears here quite frequently as it is used in

conjunction with a four-figure number to identify various military map series, e.g. GSGS 4136 identifies the principal 1:63,360 ('one-inch') maps in use by the British during the 1940s. Finally, 'Mil-Geo' is used on occasion to describe the geographic service of the German army, roughly the equivalent of the GSGS. Established in 1935, it was initially a small unit of the German general staff: Gruppe IV, Abteilung für Kriegskarten und Vermessungswesen [Department for war maps and surveying, hereafter AKV] (CIA, 1951, p.6). Gruppe IV, AKV, in which various specialist German geographers served, was responsible for most of the German army documentation on Ireland. Its Irish work was just one element in a wide-ranging programme that involved 102 geographical handbooks on about 40 countries, 300 map series, over 500 city plans and more than 1300 through-way city plans (CIA, 1951, p.13-15). Other work included coastal handbooks of the entire European coastline from the eastern Mediterranean to northern Norway. Two handbooks with maps and photographs classify the coasts of Ireland: (a) the south and east coast (31 May 1941), and (b) west and north coasts (15 October 1941).

According to the CIA analysis (1951, pp.17-19), Mil-Geo made an intensive effort to collect country information (books, maps and photographs) as war approached. Its efficient organisation made it possible to produce regional studies and maps in a very short time

> *The basis for the maps were generally direct reprints of topographic maps for each country covered, on which strategic objectives or trafficability data were overprinted. A Mil-Geo title and legend were added.*
>
> *… Mil-Geo also performed a useful service by assembling photographs of various areas and by preparing and giving wide distribution to separate booklets of selected photographs that supplemented textual and map materials. Gazetteers and booklets of information on cities and towns also were published and widely circulated. [CIA, 1051, pp. 19-20].*

Mil-Geo material of, and other documents related to, Ireland appears with the 1940-41 Mil-Geo HQ of Berlin as the place of publication. However, the place of printing appears to have been at the Institut Cartographique Militaire in Brussels, where a Mil-Geo outpost (one of around twenty across Europe, CIA, 1951, p. 10) operated between 1940 and 1943 (Bracke, 2022). It was here that huge stocks of German military maps of Ireland were found by the anti-German allies during their advance in late 1944.

Military mapping requirements

The basic requirements for the Irish, British and German military authorities were broadly similar in that each needed maps that were broadly accurate and also maps compiled at the wide range of different scales that might be needed for different military tasks. Small-scale maps (e.g. at 1:1,000,000 or at 1:500,000) could show all or a large part of Ireland on one or perhaps two sheets and might be especially suitable for strategy planning, whereas medium-scale (e.g. 1:250,000, 1:100,000 or 1:50,000 or similar)

might provide greater detail on particular regions and so be of greater value for specific operations. Maps at larger scales (e.g. 1:25,000 or 1:10,000) might also be of yet more precise operational value, particularly in identifying specific sites or targets. However, larger scales also have the disadvantage of portraying only a limited area on a single sheet and of requiring large numbers of sheets to provide a blanket coverage of a large area – the British-produced 1:25,000 scale maps of Ireland required 665 sheets to cover the whole island. Larger-scale maps were therefore produced mostly for cities or for the areas around sites of high strategic interest. In an initial period of conflict, the main priority, however, may have been to ensure a good general coverage of Ireland that would provide a combatant with the maps needed wherever hostilities might develop.

Other branches of the British and German armed forces also had specific mapping requirements. Some of their preparations were less rushed, however. Coastal charts of Ireland had for long been part of the survey agenda of the British Admiralty. Similar charts, perhaps derived or modified from the British charts, were compiled by the Germans during the late 1930s, with coloured charts at scales of 1:150,000 and 1:500,000 being assembled into atlases co-ordinated by the German 'Seewarte' [naval observatory] on behalf of the Oberkommando der Kriegsmarine (the navy high command). By 1940, the navies of both Britain and Germany had access to detailed information on the underwater topography of the seas around Ireland. Those charts might prove to be essential for any landing of forces by sea. They might also provide critical information for the submarines used by both sides as naval warfare extended across the eastern Atlantic.

For the air forces, specific requirements included the availability of small-scale maps that would readily facilitate route plotting and navigation; prominent landmarks needed to be readily identifiable, and it had to be possible to relate compass bearings to the maps. 'Flight maps' were usually variants of the 1:500,000 and 1:250,000 topographic maps. The beautifully-presented German 'Fliegerkarten' at 1:500,000 covered Ireland in seven sheets. Produced by the civilian firm of Ravenstein's in Frankfurt, they were adapted by the German air ministry from the Irish sheets of the International Map of the World. The extensive range of aviation-related symbols included some for airships, a German speciality of the 1930s (Fig. 1).

Map sheet size and, as discussed below, the capability to determine precise location were yet further considerations for military users. A particular problem in Ireland was that, with a small number of exceptions, the 1:63,360 ('one-inch') mapping covered the country only in 205 small sheets. As a result, with each sheet displaying only a small tract of land (560 sq. km), the utility of the 1:63,360 map series was likely to be of limited value in any fast-moving campaign. Strategists therefore had to rely on the 25-sheet 1:126,720 series, which showed much larger areas on each sheet, or, perhaps alternatively, a re-cast of the one-inch maps as a larger sheet series. The latter option was followed by the Irish and British authorities, who separately produced 'large-sheet' versions of the one-inch maps, covering the whole country in 55 and 76 sheets respectively. By showing larger areas, these recast sheets afforded greater utility, the more so when they were also furnished with locational grids.

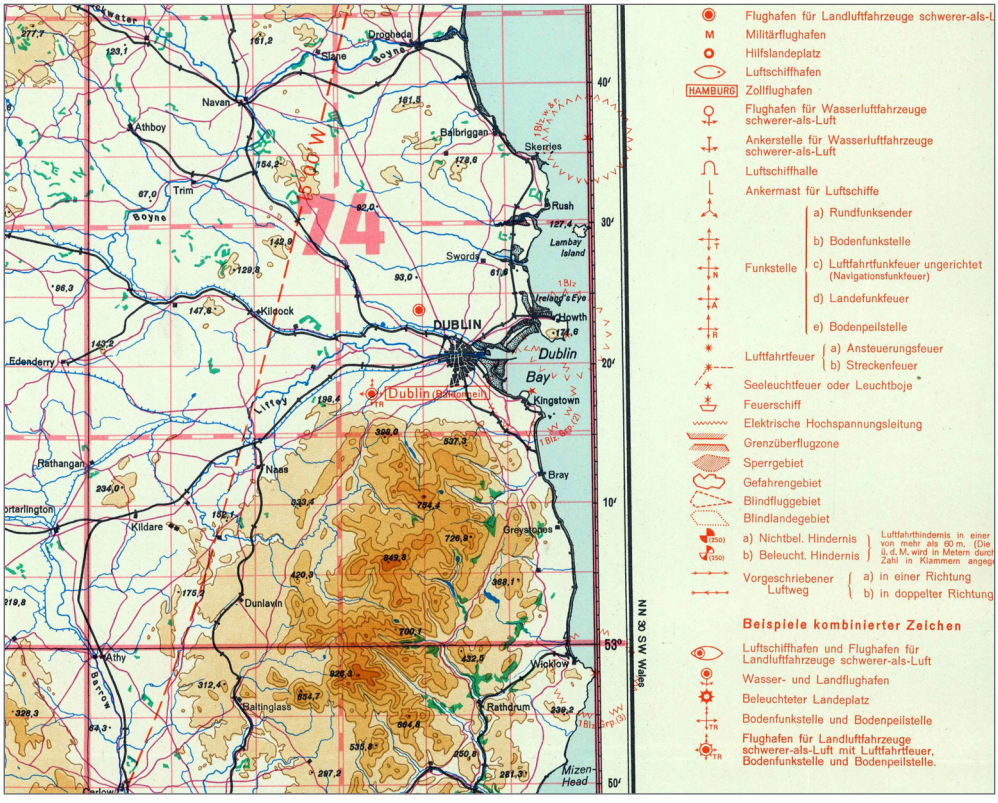


Fig. 1. Part of the 'Dublin' sheet, NN 29 SO, of the 1:500,000 Fliegekarte von Irland, as edited by the Reichsluftfahrtministerium, 1940. Showing airfields near Dublin at Baldonnel and near Finglas (unnamed, but actually Kildonan). The grid network in red is based on divisions of latitude and longitude. (Source: UC Berkeley, California, digitised public domain materials).

Sheet size was also an issue in relation to the 1:253,440 maps that were especially useful for plane navigators. In this instance, by 1940 the British authorities had created a six-sheet aeronautical map coverage of Ireland as part of a 1:250,000 (Air) series (GSGS 3982) that covered parts of Europe. This series gave prominence to relief (shown in mauve and purple shades), water surfaces (in solid blue) and roads, and also gave up-to-date information on magnetic variation. An accompanying key panel was further dedicated to identifying features such as air lights and radio beacons that might be relevant to aircraft and military operations. A collection of the six Irish sheets, drawn from the first and second editions and dating from 1942, is now in the National Archives of Ireland, Dublin (OS 111/66). In addition, this map scale was also served by the sixteen Ordnance Survey sheets that had covered Ireland at this scale since the early 1900s; these sheets were the basis for a British military edition of 1940 (GSGS 4142). However, in 1942, perhaps partly as a result of pressure from the newly-arrived US forces based in Northern Ireland, the six-sheet air chart series and the sixteen-sheet 'quarter-inch' maps were simplified, re-imagined and transformed into a 1:253.440 'large sheet series' consisting of seven sheets

(GSGS 4138) (Hellyer, 2003). Amongst other attractions, this update continued to allow navigators to plot courses across a large section of land on a single sheet.

Using grids to determine precise location

A further requirement, which was indeed possibly the most significant, was that maps being used by the military offered the capacity to determine precise location. Such a need had already been apparent during World War 1 (1914-18) as land-based long-range gunners sought to identify targets far beyond their immediate sight. Now came the further need for the accurate locational information required for long-range aerial reconnaissance and bombardment. On small-scale maps, where the choice of projection was also an issue, the minimum requirements were the clear representation of the graticule denoting latitude and longitude and a clear indication of how compass bearings should be taken. The German Fliegerkarten, which used a 'modified polyconic' projection, highlighted the graticule by a hierarchy of lines: solid red for each degree line, dashed red for every 15' of latitude and every 30' of longitude, and thin solid red lines for every 5' of latitude and every 10' of longitude (Fig. 1, above). A detailed grid was thereby produced that allowed specialist plane navigators to plot their course and to calculate location.

The need for a reliable grid referencing system was if anything even greater on medium-scale maps. New systems of grid referencing had to be developed that went well beyond the alphanumeric grids used during the early twentieth century for individual

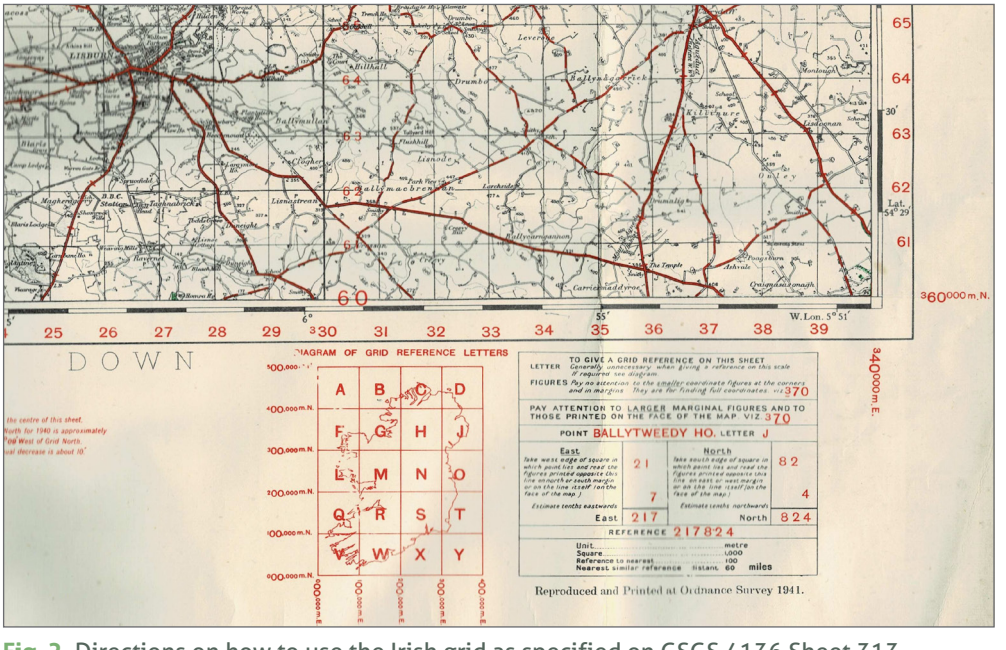


Fig. 2. Directions on how to use the Irish grid as specified on GSGS 4136 Sheet 313, Second Edition, 1941, covering Belfast and the area west to Lough Neagh. (Source: author's collection).

map sheets. These requirements ultimately led to the development of various types of national grid systems which allowed locations to be pin-pointed by 6-, 8-or 10-figure x, y co-ordinates (Fig.2). Those systems were eventually to be incorporated using the metric system and, usually featuring one-kilometre grid squares, came to be featured on most civilian topographic maps produced by national survey organisations. At least in countries such as Britain and Germany, however, they sometimes came earlier and were displayed more prominently on military map versions that were co-ordinated by the mapping sections of the military General Staff bodies. In Germany, for example, the Gauss-Krüger coordinate system, with meridians six degrees apart for the zones (Lang 2008; Powell and Múhr, 2021), became formalised into the Deutsches Heeresgitter [= German Army Grid], also sometimes identified as the Europäisches Einheitsgitter [= European standard grid], during the early 1940s. The special German editions of 1940 of the Irish medium-scale 1:100,000 and 1:50,000 topographic maps incorporated the Gauss-Krüger grid, whilst the German 1:200,000 Great Britain and Ireland series of 1942 is identified as being part of the Deutsches Heeresgitter.

In relation to Britain, *Military maps* by Hellyer and Oliver (2004) draws attention to a significant sub-group of topographic maps which were developed from the 1920s as a result of a need to add information of military relevance to the standard Ordnance Survey one-inch-to-one-mile (1:63,360) map base. The book tells a story of a hesitant, unsteady and financially-constrained adoption of new map elements, including new projections and new grids, during the 1920s and 1930s, and then how these maps were further and rapidly adapted and produced during the early 1940s as the prospect loomed that the maps might see an unanticipated and urgent application during World War 2 (1939-45). The volume is breath-taking in its detail, yet its focus is firmly fixed on the one-inch map. Attention to the larger-scale maps that provided detail on quite small areas is reserved for a more general study of *Ordnance Survey intermediate scale maps* (2022) – a category which in the military context of World War 2 is perhaps epitomised by the creation, for both Britain (1902 map sheets) and Ireland (665 map sheets), of the aforementioned 1:25,000 maps (GSGS Series 3906 emergency edition, 1940), a map series that was based on a photo-reduced version of the six-inches-to-one mile (1:10,560) map. The latter project created maps which offer an amazing overview on the variable sizes and shapes of field enclosures. Yet it is highly doubtful if the dense mass of reduced-scale detail could ever have been readily interpreted in a conflict situation.

Maps generated within Ireland: the 1:20,000 scale

A reflective paper by Major Niall MacNeill (1929) can be recognised as an early and significant attempt to recognise the future mapping needs of the 26-county Irish state. One of his principal proposals was the creation of a map series at the scale of 1:20,000. Such a scale had been used for trench maps during the 1914–18 war and continued to be developed in some other European countries. It had both civilian and (particularly) military value, offering a level of detail well beyond that of the one-inch map but nonetheless avoiding the problem that the six-inch scale posed in showing only a very

limited area on a single map sheet. Whereas MacNeill explored the possible content of the map in some detail, attention as to how it might be organised across the island of Ireland came a year later in a technical memorandum by Captain James Flynn and Lieut. Hugh O'Neill (1930). They set out in some detail how the six-inch sheets laid out on a Cassini projection might be fed into a Transverse Mercator Projection which would allow Ireland to be covered in 513 map sheets. In their discussion, they refer to two experimental sheets, of Athlone and Drogheda; these sheets do not appear to have survived.

During the 1930s, eight map sheets were formally published at the 1:20,000 scale. These covered Dublin city and suburbs in several versions (issued in 1931,1933 and 1934 (the last named being designated Sheet 265B), the area around the Curragh Camp (Sheet 296) and part of east Cork/ west Waterford (Sheets 432-3, 450-453) in the area around Kilworth army camp, near Fermoy. Four of the latter group, relating to areas in Co. Cork, appeared in 1934-5 and were reprinted in 1939; the other two in this group relating to the Lismore and Dungarvan areas of west Waterford, were issued only in 1939. Intriguingly, the 1934-5 issue was metricated with a grid at one-kilometre intervals, a contour interval of five metres and spot and trigonometrical heights in metres (Fig. 3). In contrast, in the 1939 version, the height data were in feet, whilst another change was the portrayal of trees and other vegetation in green.

The five-colour 1:20,000 map series was regarded as clearly designed and innovative, both at the time and by a small number of later commentators. Noticed briefly by Andrews (1975, p.298) in his 'postscript' to *A paper landscape*, he considers the map as being 'of considerable interest for its disregard of almost every cartographic tradition inherited

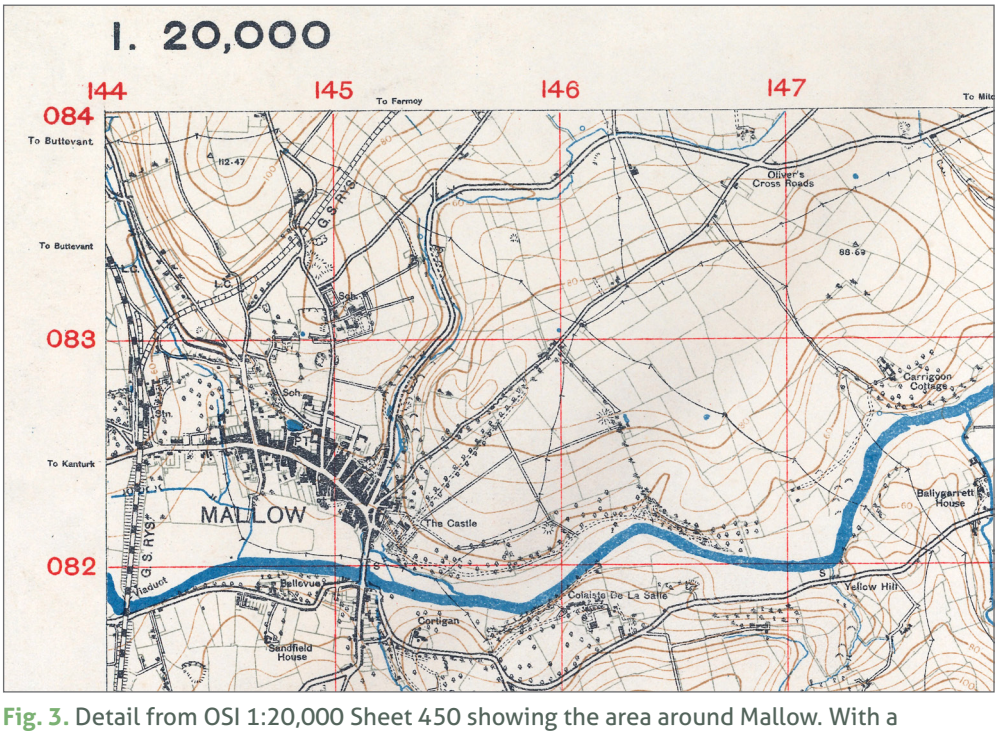


Fig. 3. Detail from OSI 1:20,000 Sheet 450 showing the area around Mallow. With a 1000-metre (1km) grid. 1935 edition. (Courtesy: Map Library, Trinity College, Dublin).

from 1922'. Much more recently the map has had a much-more detailed assessment and contextualisation from Hellyer and Oliver (2022, pp. 151-3, 204-5, 414-5). In their view (p.153), the series 'certainly owed something to the British and French 1:20,000s, although it was more radical than either'. They add that 'this was an uncompromisingly contemporary-looking map, one that could be taken as emblematic of Ireland's wish to be a modern, forward-looking European nation'. Yet the map series, for all its potential, was overtaken by events. The outbreak of war across much of Europe in September 1939 (the 'Emergency' in 26-county Ireland) curtailed further publication but did produce two special printings of the Dublin city sheet: in 1939 with war evacuation plans, and in 1941 as a special military edition (copies of both sheets in Military Archives, Dublin, see Hellyer and Oliver, 2022, pp. 153, 205). The ongoing conflict forced Irish attention to focus on a range of cartographic needs that were seen to be more urgently needed.

Table 1. Maps generated within 26-county Ireland during the early 1940s

Scale	No. of sheets	Elements of printing history	Type of grid	Notes
1:633,360	1	Various printings between 1905 and 1948, including 1940, 1944 (Hellyer, 1992, pp. 81-92).	Latitude and longitude, no other grid	'Reduced from the Four Mile Map'. A 'ten-mile' [to one inch] map covering the whole island in 'coloured' and 'outline' editions. 'Coloured' version shows water in blue, roads in brownish orange and higher hills in brown.
1:253,440	16	Produced in the early 1900s	Latitude and longitude, no other grid	'Coloured' and 'outline' versions
1:126,720	25	'Black outline', 'Hill-shaded' and 'layered' editions based on OSI half-inch of 1912-18. 'Modified and gridded (for military use only' edition produced 1940-1942	With 5000-yard grid printed in red	'...the ordinary ½-inch specially modified for rapid production by the omission of certain colours but retaining all features essential for military use' (Dept of Defence, 1942, p.5). The 1942 version categorises roads under 4 headings.
1:63,360	205	Coloured (with hill-shading) and black outline editions (with contours)	Alpha-numeric	Originally produced from 1855. Mostly revised in early 1900s
1:63,360	55	'Outline and gridded (for military use only)'	With 5000-yard grid printed in red	
1:20,000	7-8	Published in 1934-5 and (some in) 1939, covering Dublin, Curragh and parts of east Cork, west Waterford	With a one-kilometre grid	Sheets published were intended to be part of a never-completed 513 sheet coverage of Ireland. Dublin sheet reprinted 1939, with war evacuation plans, 1941, for military use only (Hellyer & Oliver, 2022, pp. 153, 205).
1:10,560	c. 1900	First published 1829-46. Revised versions 1887-1913.	No grid	'The scale is... too large for ordinary military use and will only be encountered in connection with special and localised tasks.' (Dept of Defence, 1942, p. 7)

Various map series modified for military use were rushed out during 1940-42. Each of these series featured a grid and had by 1942 also given some priority to road classifications. A Department of Defence manual on map reading (1942, pp.5-7) described how the ordinary half-inch map was

> *'… specially modified for rapid production by the omission of certain colours but retaining all features essential to military use. It is furnished with a 5000-yard Grid printed in red. …. {further detail, omitted here, followed on such issues as how overlaps between sheets are omitted, and how the letter 'A' is used to indicate where the older sheet frame is modified). … '[The conventional signs] shown for the modified edition apply to the edition of 1942; on this, roads are classified under four headings and represent their condition in December 1941.'*

The half-inch map, 1:126,720, was the scale which the Department of Defence intended to be the general operations map used by all units (Fig. 4). A military version of Sheet 16 (which takes in both Dublin city and the district around the Curragh military camp) had been printed as early as 1932. This map featured in red a 5000 yard grid, but failed to update the magnetic variation information which had appeared on the civilian printing of 1917. Watercourses were highlighted in blue, woods in green, and contours by thin orange lines; omitted were the green and orange layer shadings which helped identify relief on the contoured civilian version. A still more austere outline version, but with the magnetic variation data updated to 1940, was one of several 'half-inch' military map editions to appear during the early 1940s. According to Roger Hellyer (1996, p.30),

> *Three specific editions of the half-inch military map were issued. Almost all sheets were headed "Modified Edition". The first to appear was an outline edition with water and contours coloured, in 1940. In 1942 a coloured edition with hill-shading was issued, and in 1943 a document dated 28 February made reference to a change from hill-shading to layers. Some later issues lack the layer colours, and I [Hellyer] have a copy of Sheet 16 dated 1951 in this style. Mapping on all the sheets seen covering Northern Ireland is redrawn. Secret editions were prepared using this map as a base.*

Complementary to this were some special printings, of particular areas, for example of the one-inch district map covering the Cork harbour area, and of a limited-issue one-inch map series covering the country in 55 large sheets, each of which had been created by grouping together blocks of four sheets from the 205-sheet 'black outline' edition of the one-inch maps, issued about 1900. This large-sheet edition appears to have been under active preparation in early 1941. Hellyer (1995) quotes from an undated memorandum attached to a file [identified as File G2/X/0351 in Military Archives, Dublin] of 13 March 1941 that only limited quantities of the edition would be issued to the various groupings into which the enlarged army was divided: a total of 160 sets being given out to the commands, divisions and brigades. Around 100 sets would be given to the artillery corps, who might be expected to use a 1:20,000 map (where available) for gunnery but who

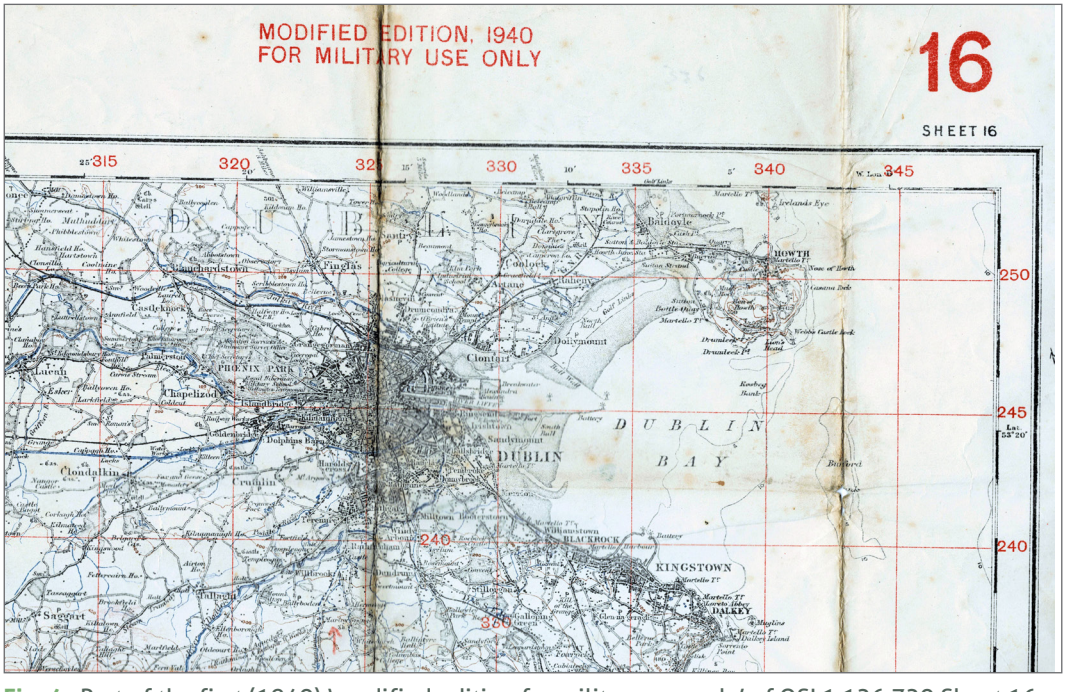


Fig. 4 . Part of the first (1940) 'modified edition for military use only' of OSI 1:126,720 Sheet 16. A 5000-yard grid has been added to the black outline OSI half-inch map. (Author's copy).

would use the 1" to 1 mile map for liaison purposes with the infantry and formation staffs. Sets would also be issued to the Military College, based at the Curragh, as required, whilst the Ordnance Survey was expected to maintain a reserve stock of about 300 sets and a supply to meet current replacements. These numbers may suggest that a total of around 1000 sets of the one-inch large sheet edition might have been regarded as sufficient to meet anticipated needs.

Paradoxically, each of these map series developed during 1940-42 featured a 5000-yard grid and so contrasted with the 5000-metre grid that had featured on the early 1:20,000 scale maps of the mid-1930s. The preference of the 5000-yard grid size on the 1940s maps is puzzling, the more so as the British authorities were simultaneously adopting a metric grid, this being one of the key recommendations of the 1938 UK Davidson committee on mapping requirements. As Hellyer and Oliver (2004, p.53) observe. 'had British and Irish troops embarked on joint operations, it would presumably have been necessary to resolve this difference'.

Northern Ireland

Table 2. Medium-scale topographic maps produced by the Ordnance Survey of Northern Ireland during the late 1930s.

Scale	No. of sheets	Elements of printing history	Type of grid	Notes
1:253,440	1	Published 1939, revised 1936-8, '38/8, price 3s'; '100/45. Ch', price 2s 6d; '3224, price 1s 6d'' Replaced by 1957 by the 'Quarter-inch Map '(Provisional Edition) with the Irish Grid and layer colouring	Latitude, longitude, no other grid	Shows 'garages and petrol supply stations' by orange 'G' symbol
1:63,360	12 proposed	Revised, with new larger sheets as 'new popular edition', from1935. Sheet 7 (Belfast, 1936): '3045/ Ch'. Six sheets 1935-40, remaining six 1948-50.	Alpha-numeric	No military edition ever prepared (Oliver, p.50).
1:7920	1	(Town Plan of Belfast City Centre). Based on 1901 survey, revised in 1938. Published 1939. Price 1s. 1100/40; 600/41; 500/42; 500/44. Ch; 2000/45. Ch; 2150/47; 3200/47	Alpha-numeric	'Produced by direct enlargement from the Six-inch Map and printed on cheap paper. Not reliable for engineering or survey purposes'.

Table 2 above records the principal locally-generated medium-scale map resources produced within Northern Ireland immediately before and during WW2. As indicated in Table 3, various other map series that included Northern Ireland were also produced by the British authorities. According to Hellyer and Oliver (2004, p. 50), no military edition of the recently-produced OSNI one-inch 'Popular Edition' was created. Perhaps the OSNI map most relevant for military use was the 'Quarter-Inch' road map of Northern Ireland, printed in August 1938 (revised 1936-8, published 1939). As well as a three-level classification of the road system in 'in orange', this map used the letter G, printed in orange, to identify 'garages and petrol supply stations'. It would be interesting to know if the inclusion of these potentially-strategic facilities was inspired by (or perhaps discouraged by) security considerations.

Table 3. British-produced topographic maps of Ireland

Scale	GSGS Series Number	No. of Sheets to cover Ireland	Elements (selected) of printing history	Type of grid, other features
1,000,000 Map of the World	2758	1	Compiled by OS and published by War Office, 1919; 2nd edition, 1934. 3000, 1940	Sheet N29, with parts of M29 and N30. Layer-coloured version, with heights in metres
1:500,000	4072	2	Compiled 1940 3rd edition 1943, 25,000 Jan 1944, 50,000 August 1944	Part of 1:500K Europe (Air); with Irish Military Grid
1:253,440	4338	7	1942, 'First Edition Ground/Air' (Sheet 7, Cork and Kerry)	Large sheet series, with Irish grid and 4-catefory road classification. 'Based on GSGS 4142'. Photolithographed by O.S. See Hellyer (2003).
1:250,000	3982	6	5,000 1940, with reprints in 1942, 2nd edition, with print runs up to 17,500 1942	Part of 1:250K Europe (Air) 'with air information as supplied by the Air Ministry'. 1942 printings carry the phrase 'Engineer reproduction plant, U.S. Army, Wash., D.C. 20554-1942'.
1:253,440	4142	16	1940, (Sheet 4, Sligo area: W.O. 10,000/40; 10,000/40/R).	With Irish grid. Replaced in 1942 by GSGS 4338. Discussed at length by Hellyer (2003).
1:126,720	4127	25	15,000, 1940	With metre scale added and with grid net in blue added
1:63,360	4136	76	1940 First and Second editions.	See H & O (2004), pp. 46-54, 62-4, 84 (sheet index), 89, 175-195.
	4136	76	1942,3rd edition. With repeated large print runs. Some sheets reprinted 1952-62	Large sheet series, outline and coloured versions. Also sheets overprinted with bogs, woods, training areas.
1:25,000	3906	665	Provisional edition, Aug-Sept 1940. Reprinted for Northern Ireland and some border areas, 1943, 1955	Reduced from six-inch sheets. A series that also covered Great Britain in 1902 sheets. See H & O (2022), pp. 56, 62 (sheet indexes), 150-7, 204, 319-336.

As can be seen from Table 3, the British military authorities had available a suite of map types that covered all except the largest map scales. The 1 to 1,000,000 Map of the World, together with the 1 to 500,000 and 1 to 250,000 scales, provided material for flight crews and for tactical planning. Larger scales were primarily derived from OSI base maps but were, like the maps prepared for the Irish army, fitted with grids and on occasions displayed roads classifications. The discussion here focusses on the one-

inch map, which was produced in vast quantities, and which would have been a critical element for strategy and operational planning had hostilities commenced.

In *Military maps*, Hellyer and Oliver offer an extended, and usually meticulously thorough, exploration of the often confusing range of British medium-scale map initiatives relating to Ireland. The discussion is accompanied by index sheets for the principal Irish map series, amongst which were two dating to the inter-war period (1920s and 1930s). GSGS 3917 mainly covered Northern Ireland but also took in the Lough Swilly 'treaty port' where, up to 1938, a British naval presence was permitted by the Anglo-Irish treaty of 1921. This series, which used the [British] War Office Irish grid, is illustrated in *Military maps* by extracts covering parts of Monaghan (1931) and Belfast Lough (1932). A second series, GSGS 3943, comprised just two map sheets, covering the other two 'treaty ports' at Bantry Bay and Cork Harbour. In the early stages of WW2 (before May 1940), it appears that the British GSGS aimed to develop GSGS 3943 and the small-sheet series 3917 to act as an expanded map coverage of Ireland (Hellyer and Oliver, 2004, pp. 49-50). However, a major change in policy in May 1940 resulted in the abandonment of these series in favour of a new 'large sheet series', GSGS 4136, that would be replete with an Irish grid in 76 sheets.

First printed in mid-1940, GSGS 4136 was for the UK the principal medium-scale map series relating to Ireland that was in use during World War 2. The three editions of the series produced during 1940-43 deserve notice as they exhibit significant contrasts. All 76 sheets of the first edition, with black outline and an overprint in red of military information, were printed over a five-week period during July and August 1940. A second edition, with green woodland added and main road infill added, began to be issued about December 1940; some further amendments were made over the following year, most notably to the road classification and by the addition to some sheets of layering to (curiously) denote areas lying between the lowlands below 200 feet and the main uplands. This edition was superseded by the production in early 1942 of a third edition which was very extensively printed and which effectively represents the GSGS 4136 in its maturity. The third edition exists in several versions which include a 'standard' five colour sheet without layers, a sheet with layers as on the second edition, a sheet with the distribution of bogs overprinted in purple, and, for Northern Ireland, in 1943 sheets identifying the training areas used by British and the recently-arrived US troops. Of these, the bogs overprints have the particular interest that they were based partly on the information shown on Geological Survey of Ireland maps which had apparently been 'loaned' to authorities in Northern Ireland (perhaps via the British military mission in Dublin) (Hellyer and Oliver, 2004, pp. 52, 177). (Fig. 5).

The base map from which GSGS 4136 was developed was presumably the black outline small sheet OSI edition of the one-inch map. However, as Hellyer and Oliver (2004, p.52) indicate, various additions and amendments were made to particular sheets. For example, on Sheets 345, 350, printings from 1941 onward record the Poulaphuca Dam, near Blessington, Co. Wicklow, as under construction. Further north, the three editions of Sheet 314, covering the Belfast area, demonstrate how this sheet evolved to

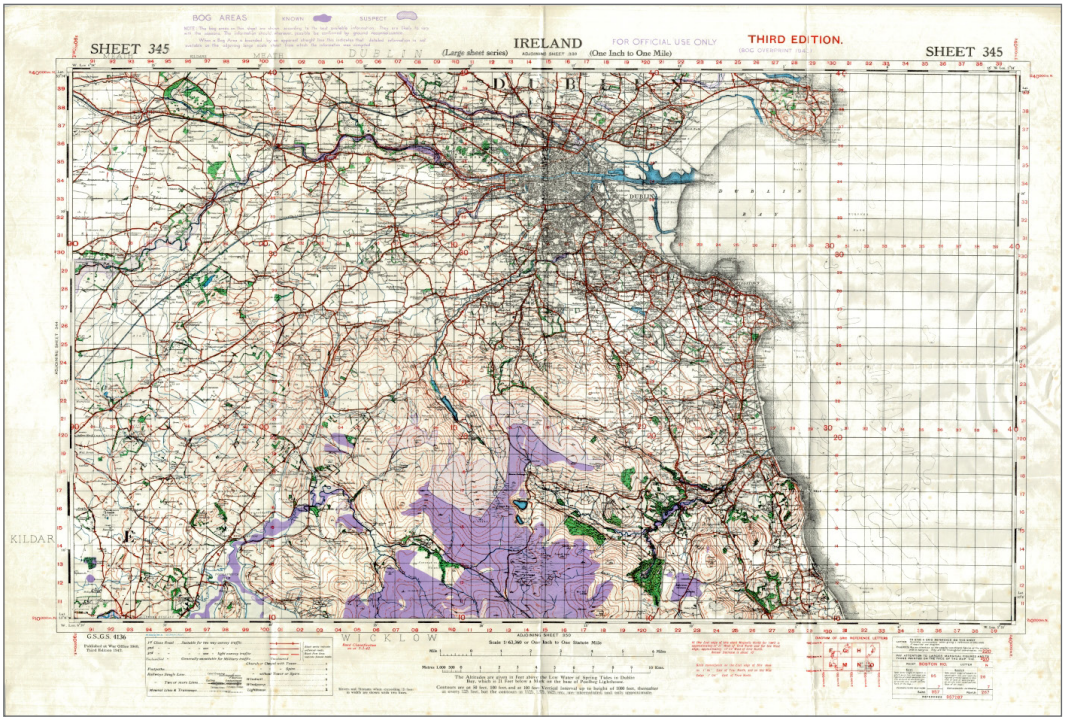


Fig. 5. Sheet 345 from GSGS 4136, Third edition, 1943, with bog-land areas overprinted in purple. On this map, grid-lines are prominent. (Author's copy).

take in recently built areas and to depict in colour a four-class road classification. Later editions show the new Belfast Harbour airport (which had been indicated on the 1939 OSNI Popular edition, and, as Hellyer and Oliver (2004, pp. 62-3) show, on the first, and at least one version of the second, GSGS 4136 edition as 'Proposed site of aerodrome'). These maps give a good overall impression of the city around 1940 (see Fig. 11 below), the more so as some 'patching' was undertaken to show new development south of Belfast (Hellyer and Oliver, 2004, p.51-2). However, their scale was almost certainly too small for them to have been a useful input in any analysis that followed the devastating bombings of April and May 1941. For that input, the 1:7920 (eight inches to one mile) town plan of Belfast, first issued in 1938, was presumably much more relevant. The planning, and, more especially, the impact of the Belfast bombings has recently been the focus of a GIS-based appraisal by Graham and Montgomery (2021).

The 'print runs' specifying various detail including the numbers printed in a particular batch, are recorded on many, but not all, of the maps belonging to GSGS 4136. From the vast amount of detail that is known (Hellyer and Oliver, 2004, pp. 175-195), however, it seems clear that well over six million map sheets related to GSGS 4136 were produced in a series of printings during World War 2. At least 50,000 copies were printed of each of the 76 sheets covering Ireland, with at least 100,000 copies being printed for sheets relating to Northern Ireland, the greatest known total being 159,000 for Sheet 313, Belfast area.

Exactly why so much paper was generated is not fully clear. One possibility may be that periodic new printings ensured the magnetic variation remained accurate. Stocks from earlier printings were presumably then sent for salvage. But the sheer volume of maps created does presumably indicate the seriousness with which the UK authorities had to take the possibility that Ireland might become a theatre of conflict.

GSGS 4136 sheets relating to Northern Ireland continued to be ordered by the military up to 1965, after which the series was superseded by the nine-sheet M723, which employed new OSNI one-inch mapping related to a recently developed Irish Transverse Mercator projection and an Irish national grid. Series M723 continued in use until the mid-1980s when it was in turn superseded by M728 based on the new 1:50,000 civil map jointly developed by OSNI and OSI.

German topographic material relating to Ireland

That Ireland might be a zone of conflict was also taken seriously by the military in Germany. According to the analysis by the CIA (1951), several separate agencies served the intelligence needs of the army, navy, air force and department of Defence; specifically in relation to England, but with relevance also to Ireland, Wheeler (2003) provides a further useful perspective on the diverse operations and publications of these different agencies. As noticed in the introduction, the concerns of the army were under the control of the Abteilung für Kriegskarten und Vermessungswesen, a unit in Group IV of the German General Staff known s 'Mil-Geo' which was responsible for the production of a suite of literature and maps relating to each of around 40 countries, including Ireland and Great Britain. In the case of Ireland, a series of publications, labelled only for official use, were produced during 1940 and 1941. These included an overview volume, described further below, of text, maps and photographs, '*Militärgeographische Angaben über Irland*' [MAI], which had been completed by 30 September 1940. Accompanying this main work were various ancillary volumes, of which the most substantial, also 1940, was a 'Bildheft' of photographs showing Irish landscapes and towns. A small booklet, completed earlier at the beginning of August, provided a 30-page alphabetical listing of the locations of the railway stations of Great Britain and Ireland and acted as a cross-reference to a very large 1:1,000,000 scale railway map of the two islands. Another booklet, completed by end-September, contained maps of the 'stadtdurchfahrtpläne' (transit routes) through 25 of the main towns across Ireland. The maps for Dublin and Cork identify the AA (Automobile Association) offices – perhaps an indication that many, perhaps all, of the maps were sourced from an AA handbook. As critiqued at some length by Fisk (1985, esp. pp.220-232) and others (Cox, 1975), these volumes were thorough and detailed although they also included sections that in places contained information that can be regarded as flawed or banal to the point of ridicule. Yet collectively they also represented a very significant assemblage of geographical information.

During 1941, two more substantial volumes appeared, focusing (a) on the south and east coast (31 May 1941), and (b) west and north coasts (15 October 1941). The latter

focused on the western and northern coasts of Ireland, from Mizen Head in the south to Malin Head in the north, and comprised a 54-page text which was followed by 152 pages of photographs and sketches, and a final map section containing (a) 1:500,000 map of the geology of western Ireland, (b) three 1:250,000 maps which acted both to identify locations and to depict and classify different sections of the western coastline, (c) (at least in the volume seen by the present author) a further 1:250,000 map depicting and classifying the east coast from Carnsore Point to Carlingford Lough. The geological map has the particular interest that it is a 'wehrgeologische übersichtkarte' (overview map of the 'military geology') of western Ireland from Malin Head to Mizen Head. The coverage extends east to take in much of Connacht and runs along the south coast as far east as Youghal Harbour. The map itself portrays essentially a very interesting and simplified geological classification which attempts an interpretation of the terrain and the underlying geology in relation to the ease or difficulty with which military vehicles might move in particular areas.

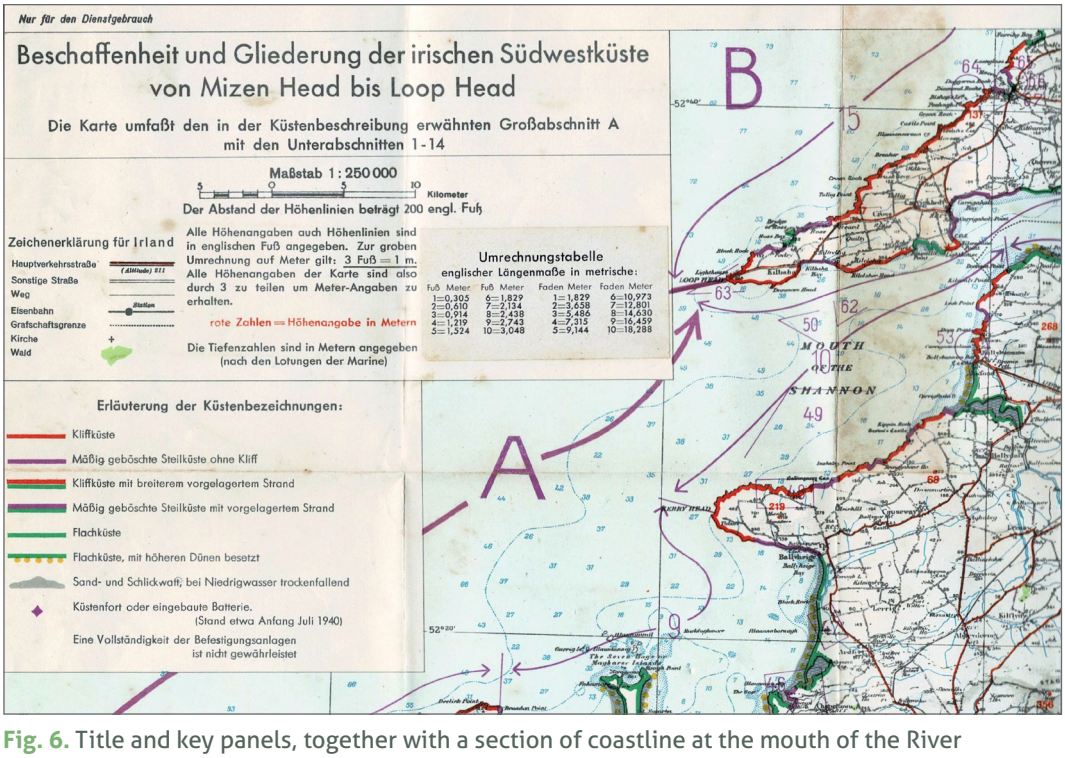


Fig. 6. Title and key panels, together with a section of coastline at the mouth of the River Shannon, from the German Mil-Geo 1:250,000 map of the Irish south-west coast from Mizen Head to Loop Head, 1941. (Courtesy: Andrew Kingston).

The 1:250,000 maps used the 16-sheet 1:253,440 'quarter-inch' map that had been produced by the Ordnance Survey of Ireland in the early 1900s. For the purposes of classifying the coasts these maps were collapsed into six larger map sheets and then overprinted with further data showing how the coastline was divided in to 23 sections for descriptive purposes and also classifying sections of the coastline into seven major categories: ranging from cliffs to sandy beaches (Figs. 6, 7). The location of gun batteries, as they were known in July 1940, is also shown – an identification that appears to have had little relevance across most of Ireland.

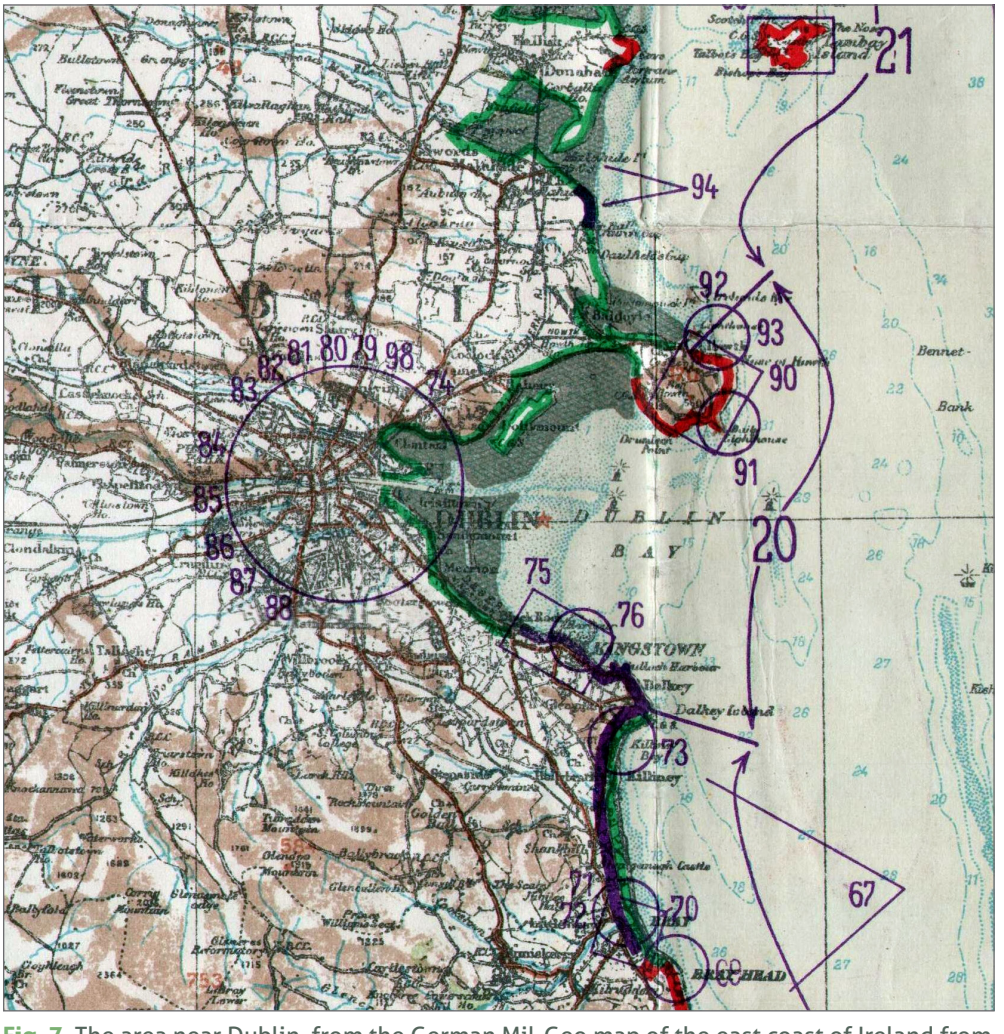


Fig. 7. The area near Dublin, from the German Mil-Geo map of the east coast of Ireland from Carnsore Point to Carlingford Lough, 1941. The numbers in purple may indicate places of strategic priority, including a cordon around Dublin. (Courtesy: Andrew Kingston).

Many of the sketches profile sections of the coastline as it might be seen from some distance out to sea, perhaps as it might be viewed from a U-boat for example. Other sketches depict plans of particular harbours, including one showing how Galway harbour was modified between 1937 and 1940. The photographs are very varied and appear to be intended to give an impression of what to expect in areas in or near the coastline (some areas as far inland as Killarney are also included). Reference is made on p. 15 to details and overview maps in 'Handbuch der Westküste Irlands' (Handbuch, 1934-44); otherwise, the sources of the photographs do not appear to be acknowledged, but it does seem evident that the coverage goes well beyond what might be considered tourist images. Air photos are included of some places, for example north-west Clare.

This coastal volume is of interest not only on account of its content but also as an indication that German information on Ireland was still being expanded several months after the eastern front had re-opened in June 1941. As already noted, the Irish material was, however, just one component in a wider publication agenda that covered Britain and parts of mainland Europe. Coastal volumes were also prepared for the south and east coasts of England, whilst Mil-Geo information booklets, photograph albums and maps were produced for an England divided into eleven regions. At least in relation to England, further information appears to have been under assembly into 1942. Thereafter, however, at least to judge by some of the volumes being published, attention may have been absorbed more by eastern and south-east Europe.

Even though some were derived from British or Irish maps using imperial measure and with scales related to the number of inches in a mile, all except one of the map scales used by the German authorities were 'rounded' to more simple fractions (Table 4). The one exception was the two-sheet route map in the Mil-Geo MAI volume which was left at its original 1:316,800 (one inch to five miles). Four other small-scale maps were included in that volume: a coloured 'übersichtkarte' [overview physical and general map] which had been developed from the 1934 British version of Sheet N29 of the 1:1,000,000 Map of the World, and three single-sheet black outline thematic maps showing respectively the railway and telecommunications networks (both maps at 1:1,000,000 scale) and, for the 26-county state only, the electricity network at 1:750,000. In addition, Mil-Geo prepared at least two city maps, showing central Dublin and much of Belfast at the scale of 1:10,000 (Fig. 8). These maps were overprinted to identify public buildings and industrial sites, and appear to be adapted from the street plans then being published by the London firms of Bacon & Co., and of Geographia, respectively. The Belfast map included a side panel giving short descriptions on over thirty sites, most of them industrial, that might be of target or strategic significance.

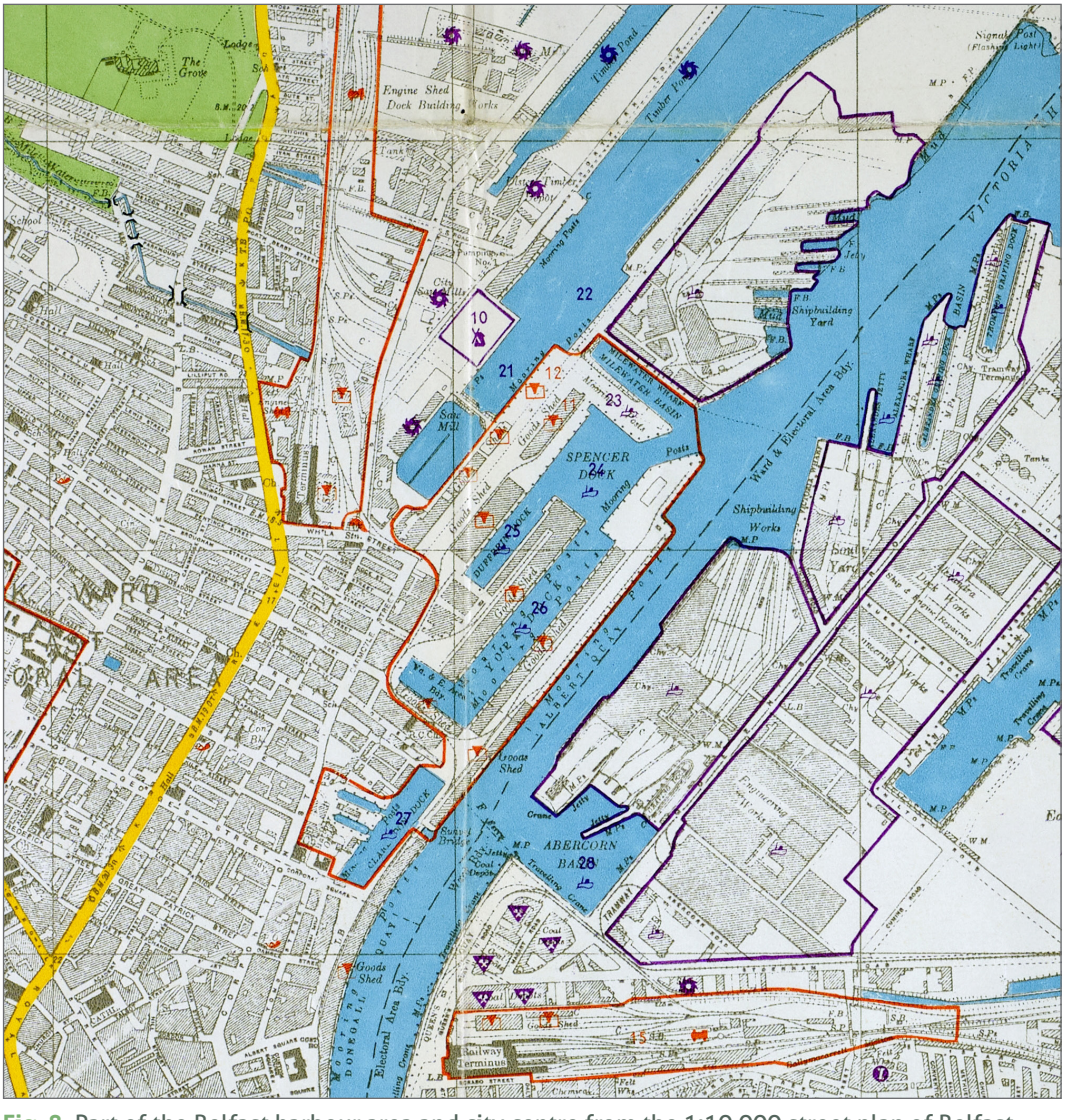


Fig. 8. Part of the Belfast harbour area and city centre from the 1:10,000 street plan of Belfast accompanying *Militärgeographische Angaben über Irland* (September, 1940). The map appears to be adapted from the street plan of the London firm, Geographia, but has additional annotation in purple and red, identifying industrial, railway and port sites and areas as potential targets. [Courtesy: National Library of Ireland, 16.L.34 (8)].

Table 4. Principal German-produced topographic and city maps of Ireland

Scale	No. of sheets	Topic	Year	Notes
1:1,000,000	1	Based on 2nd edition, 1934, of International Map of the World, Ireland N 29	1940	With additional annotations by Mil-Geo to indicate, e.g., city size, areas that might be difficult for motorised troops
1:1,000,000	1	Thematic maps of the railway and telecommunications networks	1940	In Mil-Geo MAI
1:750,000	1	Thematic map of the electricity transmission network	1940	Relates only to Eire. In Mil-Geo MAI
1:500,000	7	Fliegerkarte von Irland	Published by the German Air Ministry 1940	With grid related to latitude, longitude
1:316,800	2	Route and settlement map	1940	Latitude, longitude. No other grid. In Mil-Geo MAI.
1:250,000	16	Vorläufige Sonderausgabe	1940	Latitude, longitude.
1:200,000		Fliegerausgabe, GB & Ireland	1943	See University of Reading website
1:200,000	14 for Ireland	With the heading 'Deutsche Heereskarte', Great Britain and Ireland 1:200,000 series	1942	With Deutsche Heeresglitter (grid). Derived from OSI c.1900
1:100,000	25	Sonderausgabe (special edition) Irland	1940-41	Derived from OSI 1:126,720. A map that gives particular prominence to the roads system. Some summit heights highlighted in red. with GK grid.
1:50,000	205	Sonderausgabe (special edition) Irland	Printings in July 1940 and April 1941	Derived from OSI 1:63,360. With GK grid.
1:10,000	1	Dublin city		Perhaps derived from a Bacon & Co., London, street plan of Dublin made about 1930. With additional annotation. In Mil-Geo MAI.
1:10,000	1	Belfast	1940	Perhaps derived from the Geographia (London) street plan of Belfast but with additional annotation of industrial targets shown in purple and red. Extensive marginal notes on industrial sites. In Mil-Geo MAI.
1:1200 to 1:32,000	25	'Stadtdurchfahrtpläne' covering 25 cities and towns	1940	Perhaps mainly derived from AA (Automobile Association) town plans. Mostly showing in yellow the preferred through routes.

Notes: GK = Gauss-Kruger grid

Complementing the Mil-Geo MAI and other descriptive volumes was a major focus on the production of large quantities of medium-scale maps to give countrywide coverage, in this instance 25 sheets at the 1:100,000 scale in 1940-1, 205 sheets at the 1:50,000 scale as a 'Sonderausgabe' [Special Edition] in 1940-1 (in at least some cases, an initial printing in July 1940 being followed by a further printing in April 1941), and 14 sheets at 1:200,000 in 1942. The last-named scale replaced an earlier 1940 1:250,000 series derived from the 16-sheet OS 'quarter-inch' map. Powell and Muhr (2020) draw on the wartime experience of Willy Eggers (1974) to to describe the scope and limitations of a typical Sonderausgabe, such as those map series issued for Ireland

> *Most Sonderausgabe sets were reprints with minor revisions. These minor revisions included resizing maps, making scale adjustments, and partially changing the color scheme. Other revisions were done to make it easier for the German-speaking troops to use the maps: adding German-language information to the map margin, inserting a bilingual legend (and sometimes a glossary), and translating into German any references to the landscape and names of important objects. Cartographic data updates, if they happened at all, were limited to border sheets.*

The addition of grids also had its limitations, and sometimes took place only slowly and unevenly (Cruickshank, 2004; Powell and Mühr, 2021). Significantly, however, the 1 to 100,000 and 1to 50,000 Irish Sonderausgaben of 1940 did have a grid-system added, as did the 1 to 200,000 series which was part of the new Deutsche Heereskarte [German Army Map] series of 1942.

Vast stocks of these German maps were discovered at a Brussels map printers as the allied US/British troops advanced in December 1944 (Bracke, 2022; CIA, 1951; Powell and Muhr, 2020). Although he makes no attempt to explore further the German military maps of Ireland, Oliver (in Hellyer and Oliver, 2004, p.53) gives appropriate prominence to the comments of Joseph T. Carroil (1975), who observed that

> *The huge stocks of German military maps of Ireland found by the allies in Brussels in 1944 and the manuals on how to treat the natives (their 'lack of hygiene' was noted) were paralleled by the lorry loads of maps which the British army in Northern Ireland had ready for the day it might be called on to cross the border either to help the Irish resist a German invasion or to take the ports by force… [Ireland in the war years (1975, pp.173-4)].*

The fate of the World War 2 map sheets relating to Ireland

It was fortunate that, unlike in many other parts of the continent, most of the several million Irish map sheets generated during the early 1940s remained in storage for a contingency that never developed. Much of the stock once held by the German, British and Irish military authorities was probably sent for some form of salvage. But at least

some had a different destiny. Some ninety tons of captured German maps, including some relating to Ireland, were shipped to the US by the US Army Map Service, where some were sorted into collections for university and other libraries. Earlier, to save paper during the scarcity year of 1945, yet other German sheets, including some relating to Ireland, were marked as cancelled, then the blank reverse sides were re-used for printing maps showing German localities. It is thus possible to find (as this writer has) a map sheet with, on one side, a 1:50,000 cancelled German map made in 1940 from OSI one-inch sheet 199 depicting Roaringwater Bay, Co. Cork, and, on the reverse side, a US/British January 1945 version of German Topographische Karte 1:25,000 sheet 4912 dated 1936 (Fig. 9). These German versions of the OSI one-inch series were re-used over much of 1945. Another example, which shows on one side the German 1:50,000 version of OSI Sheet 83 (headed 'Jnishbofin' [*sic*] on the German map) from the second 'Sonderausgabe' of April 1941, had its reverse side re-used in July 1945 to depict a British War Office 1:50,000 Sheet 335 of the area around the city of Braunschweig (Brunswick) (Fig. 10 a,b).

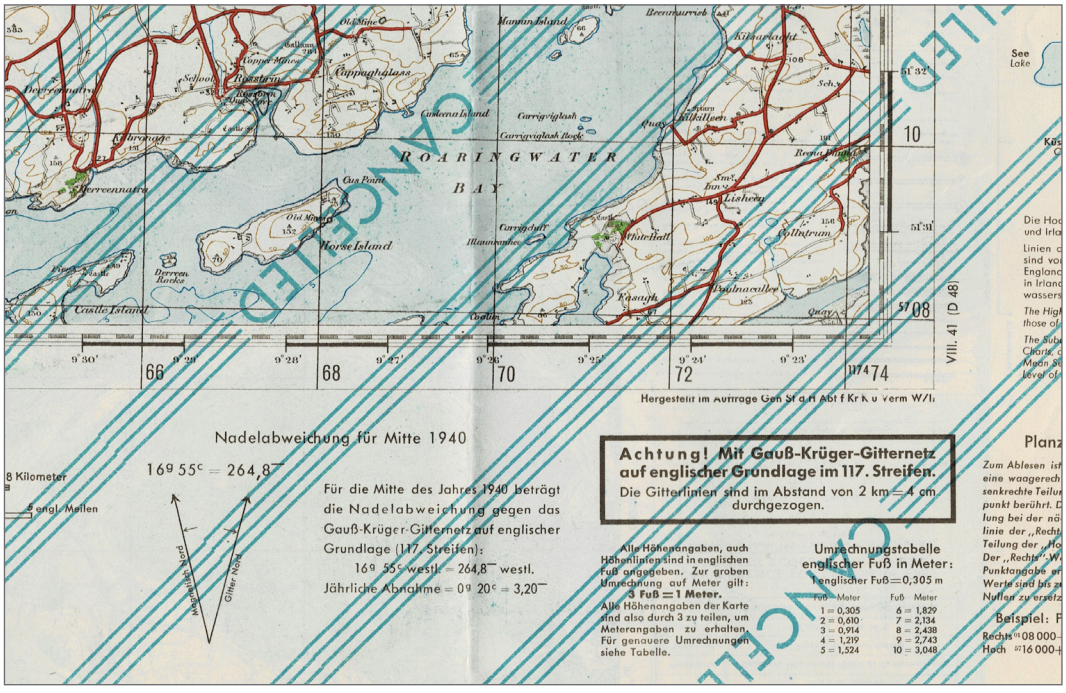
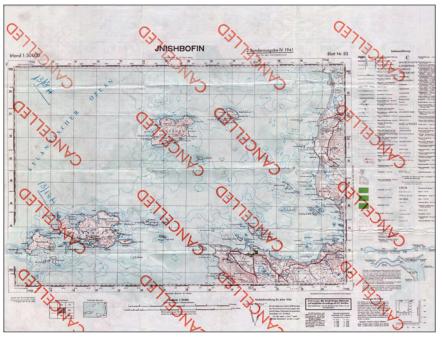


Fig. 9. Part of the 1940 German version of OSI one-inch Sheet 199 showing part of the south Cork coast near Roaringwater Bay. This particular map sheet is from stock captured by the anti-German forces in 1944-5, which was marked cancelled with the blank reverse side being re-used in January 1945. (Author's copy).

Much of the British and Irish stocks of maps relating to Ireland were no doubt also sent for salvage. Some stocks were nonetheless retained, presumably for contingency purposes, and only finally withdrawn during the mid-1960s (Hellyer and Oliver, 2004, p.178). Indeed, possibly in response to the IRA campaign of 1954-62, some sheets of the 1 to 25,000 GSGS 3906 and the 1 to 63,360 GSGS 4136 series relating to Northern Ireland were reprinted during the mid-1950s and as late as 1962 in the case of GSGS 4136. Other sheets of GSGS 3906 relating to the Republic of Ireland were apparently transferred to the Irish army authorities (Hellyer and Oliver, 2022, p. 154). By the 1960s, however, these dated series were increasingly unfit for purpose and new map series had to be generated for military use when a new, prolonged, phase of 'Troubles' developed in Northern Ireland from the late 1960s (Hellyer and Oliver, 2022, p. 154; Horner, 2021).



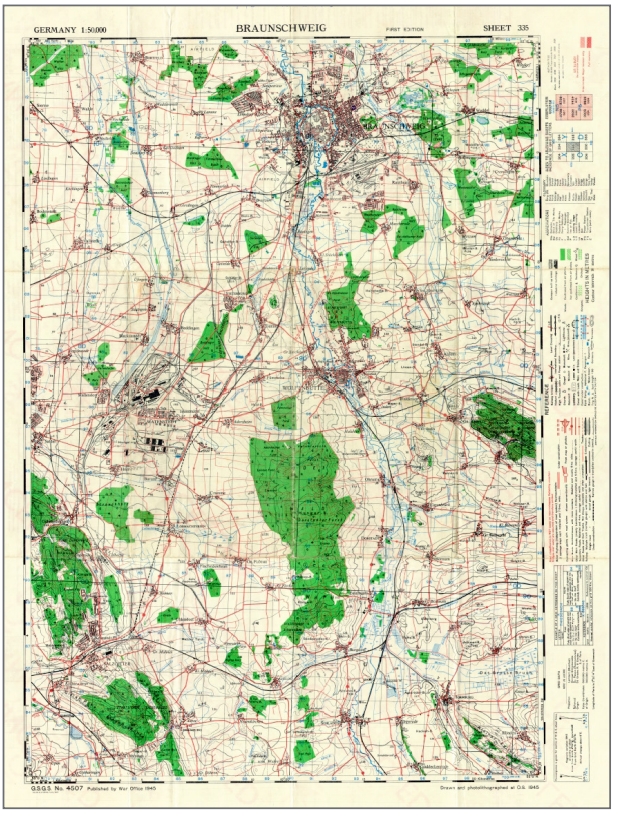
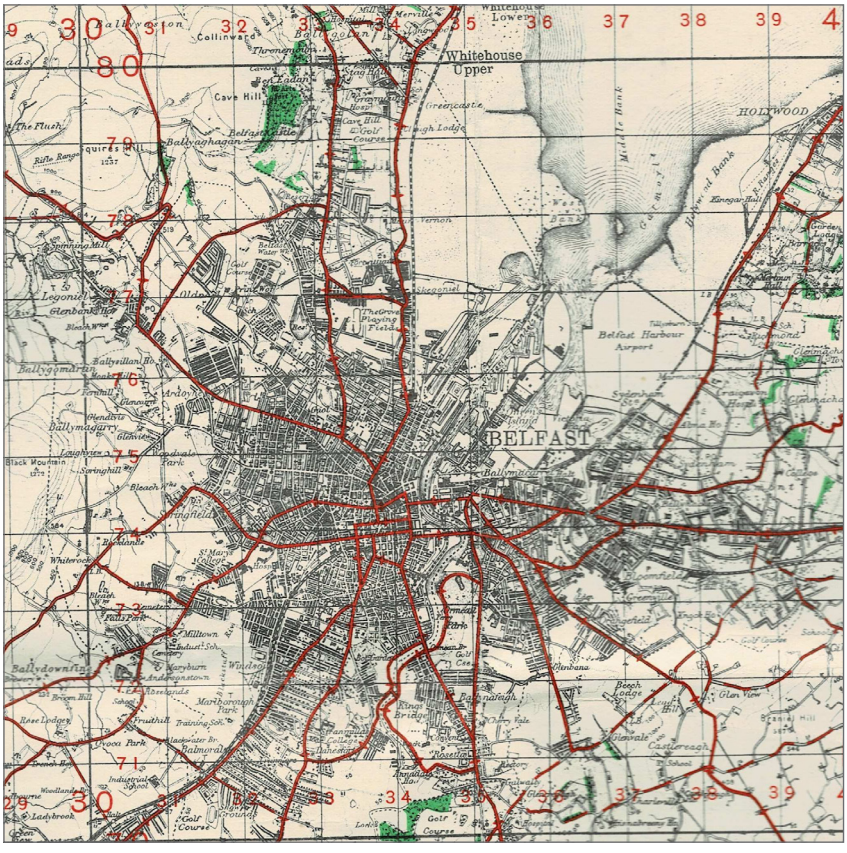


Fig. 10. *(top)* The German 1:50,000 version of OSI 'one-inch' Sheet 83, printed in Brussels in 1941 and cancelled by allied forces in 1944-5, and *(right)* the (British) War Department version of Germany 1:50,000 Sheet 335 as printed on the reverse in July 1945. (Author's copy).

Conclusion

The explosion of paper maps of all scales that was associated with World War 2 represents a unique episode in the history of Irish and European cartography that, in the digital era that now dominates, is never likely to be repeated. Although vast numbers of map sheets were involved, the impact on the longer course of European cartography has yet to be widely explored. Some of the reviews that have been made give little or no attention to



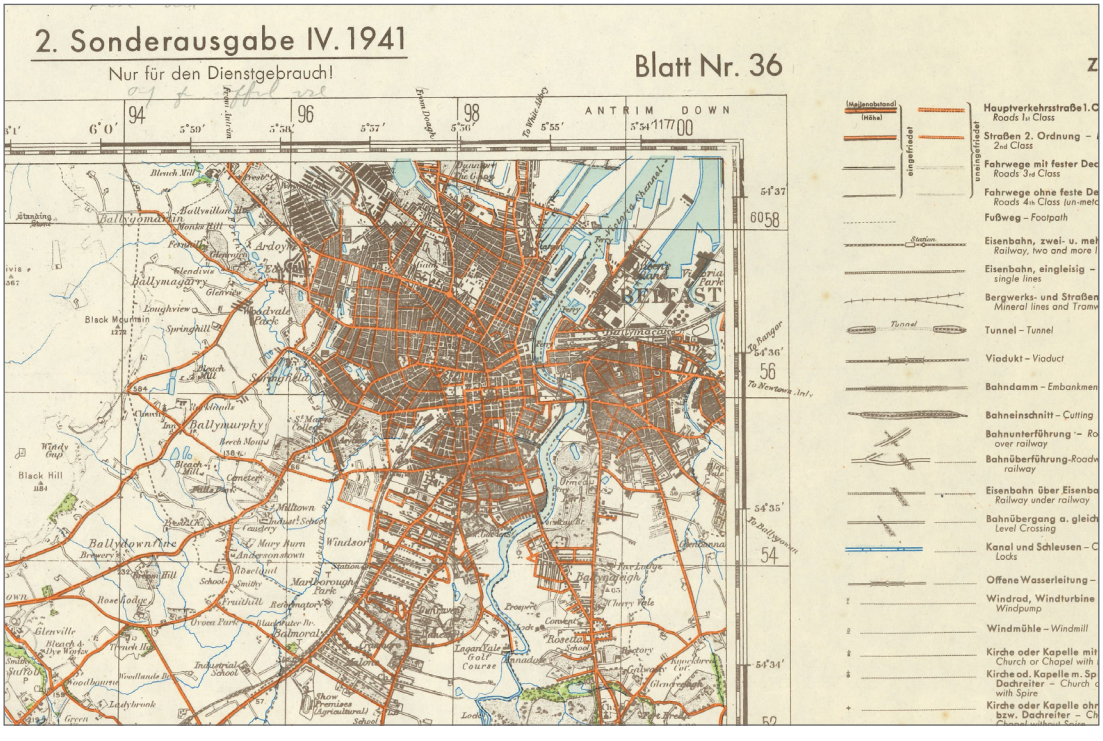


Fig. 11. British (GSGS 4136, second edition) and German (Sheet 36, 2nd edition) one-inch 1:63,360 maps depicting the area near Belfast, both published in 1941. Differences in the depiction of the roads network are noticeable. (Sources: Author's copy and Map Library, Trinity College Dublin).

Ireland (see the contributions on military mapping by major powers and of geographic areas in Monmonier, 2015, pp. 884-977, for example Neumann (2015) on German military mapping). Perhaps the most general consequence was a renewed appreciation of the value of maps that were accurate, in terms of up-to-date content and in terms of their locational precision. In an Irish context, the military appreciation of the value of being able to pinpoint location across large tracts of territory reinforced the case for the introduction of a national grid and paved the way for the development by OSI and OSNI of a jointly-supported Irish Grid. Based on the Transverse Mercator Projection, which had been adopted by the US and NATO countries during the late 1940s and early 1950s (Nolan, 2013), the new grid was linked also to a re-triangulation of the whole of Ireland that finished in 1964. Maps with the Irish grid as a feature appeared from the mid-1950s, their appearance no doubt having been accelerated by the experiences of World War 2.

The aim of this present article has been to give some sense of the diversity of map-related material depicting Ireland that was generated during WW2. Further studies will be needed to explore many issues in more detail, for example within Ireland a more systematic exploration is warranted of the WW2 maps at the Irish Military Archives, some of which may be embedded as unlisted attachments to longer files. Other topics deserving attention include the extent to which the U.S. Army Map Service was involved in generating Irish maps during the later stages of the war, more extended comparisons of the content shown on British and German maps (Fig. 11), the role of Luftwaffe and other aerial photography in the development of war-time mapping, and the exceptionally interesting documentation associated with the Kriegsmarine. At the very least, the German naval and army classifications of the Irish coast and its offshore geology deserve a place in any history of Irish geomorphology. But it is for a much wider range of scholars that, whatever their origins may be, WW2 maps related to Ireland are of interest, for they show how, for a few years in the early 1940s, Irish cartography was caught up in wider issues of geopolitical significance.

Acknowledgements

Special thanks are due to those who read drafts of this article and to Andrew Kingston who generously shared with the author some highly relevant German military documents relating to Ireland. Thanks are also due to the various public domain providers, without whom this article could not have been assembled.

References

Andrews, J.H., 1975. *A paper landscape: the Ordnance Survey in nineteenth-century Ireland*, Oxford.

Bracke, W., 2022. La production cartographique de l'Institut Cartographique Militaire en Belgique pendant la 2e Guerre Mondiale, pp. 179–202 in *Nuova Antologia Militare*, 3, Special issue on Military cartography edited by Mirela Altic.

Bordick, Charles, Gruen, German military plans and Ireland, 1940. *An Cosantóir*, March 1974

Carroll, Joseph, T., 1975. *Ireland in the War Years*, Newton Abbot.

Cox, Colm, 1975. Militärgeographische Angaben über Irland, *An Cosantóir*, March 1975,

Cruickshank, J.L., 2004. German military maps of UK & Ireland of World War II, *Sheetlines*, 69, pp. 15–19.

CIA, 1951. *Mil-Geo: The Geographic Service of the German army. M-12*. Washington, DC: Central Intelligence Agency.. Accessed March 29, 2021.

Department of Defence, 1942. *Map Reading, Training Regulation No. 19*, Defence Forces Regulations. Dublin: Stationery Office, especially pp. 5–7.

Eggers, W., 1974. Kriegskarten im Zweiten Weltkrieg: Planung und Herstellung. *Fachdienstliche Mitteilungen Des Obersten Fachvorgesetzten Des Militärgeographischen Dienstes* 10:19–34.

Fisk, Robert, 1983. *In time of War: Ireland, Ulster and the price of neutrality, 1939–45*, London. [Reprinted, Dublin, 1985].

Flynn, James and O'Neill, Hugh, 1928. 'Memorandum on the steps involved in the production of a 1:20,000 map of Ireland from existing large-scale Ordnance Survey plates'. TCD Library. [summarised in Hellyer and Oliver, 2022, pp. 414–15).

Graham, Conor, and Montgomery, Heather, Mapping the Belfast Blitz, presentation at the Royal Geographical Society, 3 June 2021. Accessed, 26.4.2024, on YouTube at https://www.youtube.com/watch?v=D3oFfISGFf4&t=204s.

Handbuch, 1934–44. *Handbuch der Westküste Irlands. dabei: Nachtrag 1939 herausgegeben vom Oberkommando der Kriegsmarine + Ergänzung 1944.* [Handbook of the West Coast of Ireland, 298pp with 74 text photos, plus addenda 1939, 1944]. Berlin.

Hellyer, Roger, 1992. *The 'Ten–Mile' maps of the Ordnance Surveys*, London: The Charles Close Society.

Hellyer, Roger, 1996. Some further notes on military mapping in Ireland, *Sheetlines*, 46, 29–32 [Reports on early 1940s maps at Military Archives, Dublin].

Hellyer, Roger, 2003. Some notes on the origins of GSGS 4338 (or the first layered OS quarter inch map of Ireland), *Sheetlines*, 68, pp. 13–22.

Hellyer, Roger and Oliver, Richard, 2004. *Military maps: the one-inch series of Great Britain and Ireland*, London: The Charles Close Society.

Hellyer, Roger and Oliver, Richard, 2022. *Ordnance Survey intermediate scale maps*, London: The Charles Close Society.

Horner, Arnold, 2021. A note on military mapping for engaging with the Northern Ireland Troubles, *Irish Geography*, 54 (2), pp. 41–54.

Lang, H., 2008. *Deutschlands Vermessungs- und Kartenwesen: Aspekte seiner Entwicklung seit der Reichsgründung 1871*. Dresden: Schütze, Engler, Weber Verlags GbR.

MacNeill, N., 1929. Our mapping requirements, *An t-Óglach*, 2, 63–71.

Militärgeographische Angaben über Irland. Abgeschlossen am 30. September 1940. Generalstab des Heeres. Abteilung fur Kriegskarten und Vermessungswesen (IV. Mil.-Geo.). Berlin, 1940.

Monmonier, Mark (ed.), 2015. *The History of Cartography, Volume Six: Cartography in the twentieth-century,* Chicago: University of Chicago Press.

Neumann, J., 2015. Military mapping by Germany. In *History of cartography*, ed. M. Monmonier, vol. 6, 909–21. Chicago: University of Chicago Press.

Nolan, Mike, 2013. The introduction of Universal Transverse Mercator (UTM) grid on military maps: a sixty-year retrospect, *Sheetlines*, 96, pp. 20–29.

Oliver, Richard, 1985. British-produced 1:63,360 mapping in Ireland, 1922–1985, *Sheetlines*, 13, 11–18.

Powell, Susan and Mühr, Heiko, 2020. Capturing the complex histories of German World War II captured maps, in 'That map belonged to somebody: the importance of provenance for librarians', vol 16 (2), 2020, pp. 166–193 of *Journal of Map and Geography Libraries, Advances in Geospatial Information, Collections and Archives.*

Wheeler, R.C., 2003. German maps of England of World War II and associated publications, *Sheetlines*, 68, pp. 26–32.