

# **HISTORICAL UXO RESEARCH**

## **Nedre Frednes in Porsgrunn (Norway)**



**ADEDE RESEARCH REPORT 740 – 2021**

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# 1 INTRODUCTION

The project area is situated at Frednes, which is a part of the Norwegian municipality Porsgrunn (see fig. 1-3). The client plans in the project area a combination of apartment buildings with underground parking, office areas, stores, a park etc. (see fig. 4).

Unexploded ordnance (UXO) from the Second World War may be present in the project area, since Herøya, a peninsula close to the project area, was bombed in 1943. A historical study of the war actions in the vicinity of the project area is necessary, in order to quantify the risk of finding unexploded aerial bombs and artillery within certain zones of the project area. The risk zones will be delimited as precisely as possible.

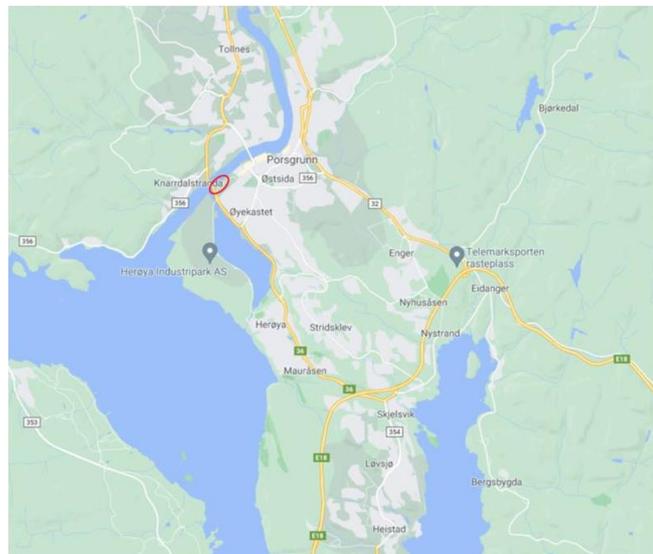


fig. 1: Location of the planned project within the municipality of Porsgrunn.

The project is located close to the peninsula of Herøya.



fig. 2: An overview of the current state of the project area.



## 2 SECOND WORLD WAR

### 2.1 The Bombardment of Herøya (24 July 1943)

During the last week of July 1943, which became known as “Blitz Week”, the Eighth Air Force of the United States Army performed a series of six bombardment missions against German targets. The first and longest mission went to Norway: on the 24<sup>th</sup> of July 1943, 166 B-17s and 1 YB-40 of the 303<sup>rd</sup> Bombardment Group, not escorted by fighters, carried out a daylight mission. The bombers – each carrying ten high explosive M43 bombs of 500 lbs – took off in England and flew over the North Sea to Norway (see fig. 5). From a height of 15 350 feet, they dropped a total of 1657 bombs. An estimate of between 1000 and 1500 bombs fell on land.<sup>1</sup>

The German-occupied area around Porsgrunn was defended by both fighter planes and anti-aircraft guns or *Flugabwehrkanone* (Flak). As for the fighter planes, only five to fifteen were observed: mostly Focke-Wulf Fw 190s, some Messerschmitt Me 109s, and two twin-engine planes. The anti-aircraft guns, on the other hand, were many. Flak batteries with 8,8 cm or 10,5 cm guns were located on Herøya (Roligheten quay – north of the industry park –, and the vicinity of Hydros Kasino), and in the hamlets of Tollnes (Pors Stadion), Solum (Flakvarp hill), and Herre (Rafnes farm) (see fig. 6). The anti-aircraft fire was intense and accurate: one bomber sustained major damage and nine received minor damage. There were no fatalities among the personnel of the bombers.<sup>2</sup>

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<sup>1</sup> The National Archives, Kew, AIR 40/424;

U.S. Explosive Ordnance, OP 1664, Navy Department. Bureau of Ordnance, Washington, 1947, p. 384, 390; TM 9-1980. Bombs for Aircraft, Departments of the Army and the Air Force, Washington, 1950;

“1943-07-24”, in: Eighth Air Force Operations History. Missions (online), 2012-2014. <http://www.8thafhs.com/missions.php>.

<sup>2</sup> “1943-07-24”, in: Eighth Air Force Operations History. Missions (online), 2012-2014. <http://www.8thafhs.com/missions.php>;

Birkenes J., Okkupasjonsårene i Porsgrunn. Dagliglivet i Porsgrunn under krigen, p. 96-113;

Lunde I., op. cit., p. 336-338.

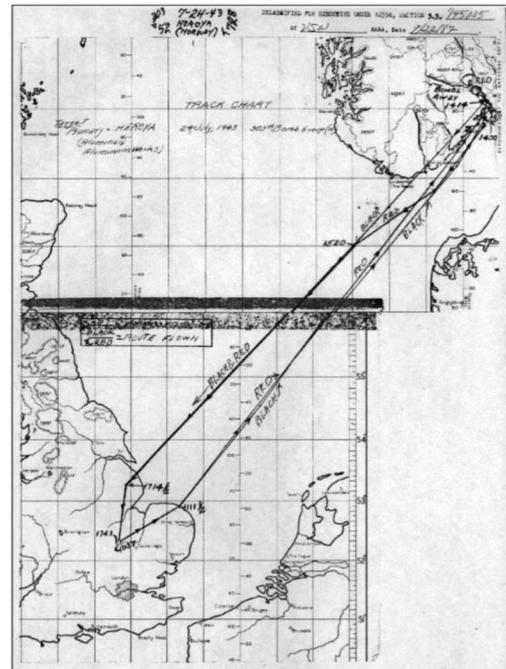
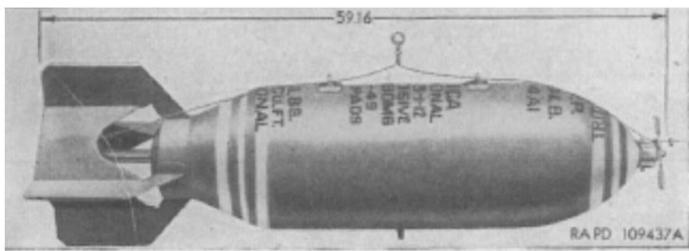
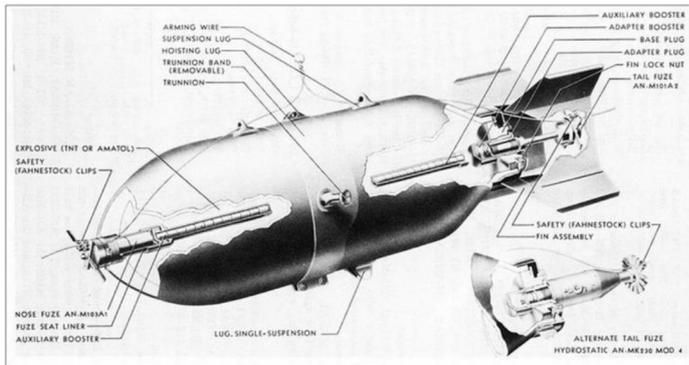


fig. 5: On the left: Each bomber carried ten high explosive M43 bombs of 500 lbs.<sup>3</sup>  
 On the right: Route map of the USAAF bombardment mission to Herøya, 24 July 1943.

<sup>3</sup> U.S. Explosive Ordnance, OP 1664, Navy Department. Bureau of Ordnance, Washington, 1947, p. 391.

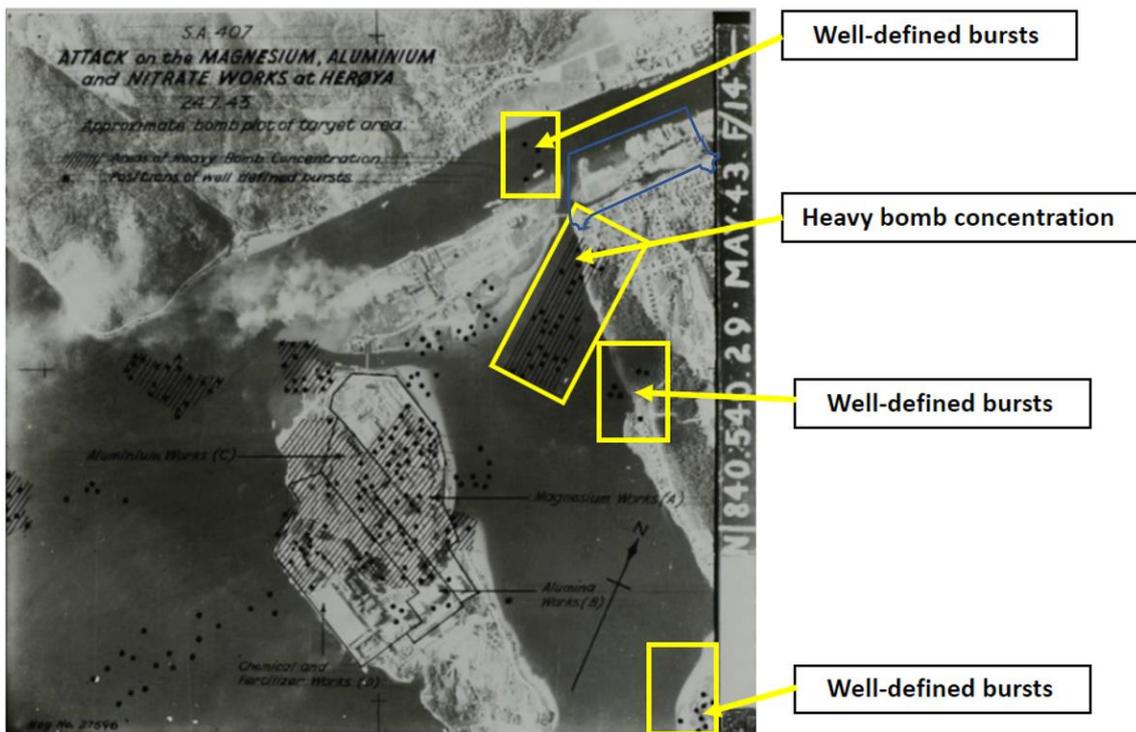


fig. 6: Approximate bomb plot at the northeast and southeast banks of Gunneklev Fjord.<sup>4</sup>

Despite the German air defence, several B-17s and 1 YB-40 managed to cross Gunneklev Fjord, from the northeast to the southwest. On Herøya, they bombed the magnesium, alumina, aluminium, and nitrate plants of A/S Nordisk Lettmetal, which were considered essential to the German war effort. The plants were just completed as the bombs began to drop.<sup>5</sup> Both Gunneklev Fjord and Herøya Peninsula were severely hit. On and near the northeast, the east and southeast banks of Gunneklev Fjord, which were wooded and sparsely settled, a concentration of respectively 39, 11 and about 40 bursts could be observed (see fig. 7 and 8).

<sup>4</sup> The National Archives, Kew, AIR 40/424, Interpretation Report SA 407, 26<sup>th</sup> of July 1943.

<sup>5</sup> The National Archives, Kew, AIR 40/424, Interpretation Report No. K. 1629, 27<sup>th</sup> of July 1943;

"1943-07-24", in: Eighth Air Force Operations History. Missions (online), 2012-2014. <http://www.8thafhs.com/missions.php>.

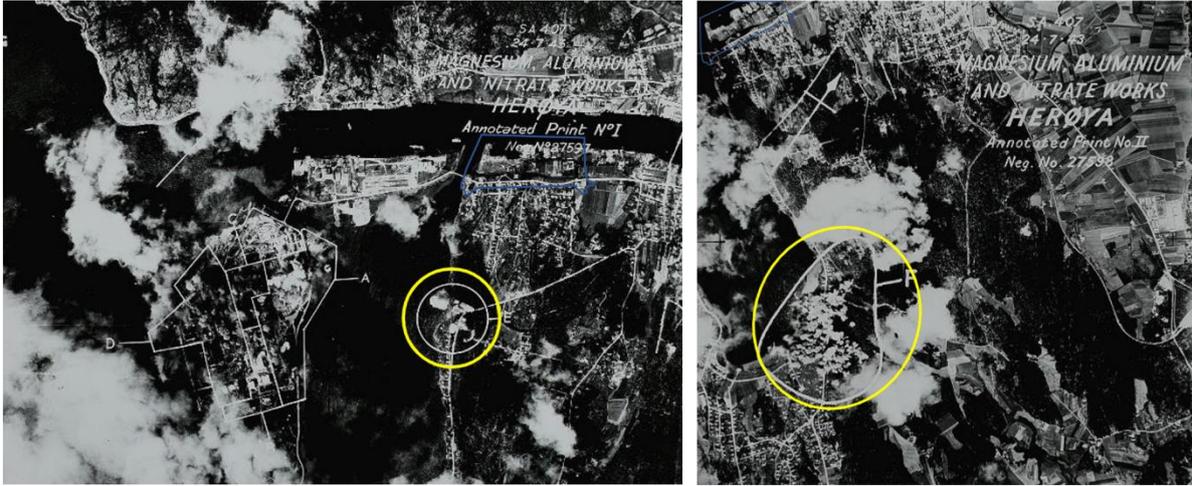


fig. 7: On the left: Bombing of the northeast bank of Gunneklev Fjord.<sup>6</sup>  
 On the right: Bombing of the east and southeast bank of Gunneklev Fjord.<sup>7</sup>

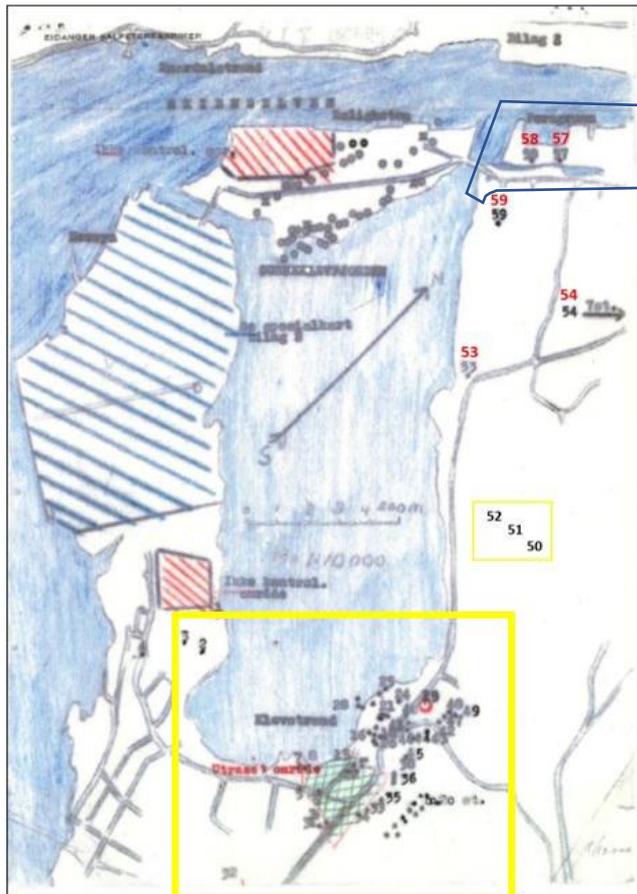


fig. 8: Approximate bomb plot at the east of Gunneklev Fjord.<sup>8</sup>

<sup>6</sup> The National Archives, Kew, AIR 40/424, Interpretation Report SA 407, Annotated print No I Neg No 27597 Herøya.

<sup>7</sup> The National Archives, Kew, AIR 40/424, Interpretation Report SA 407, Annotated print No II Neg No 27598 Herøya.

<sup>8</sup> Norsk Industrierbeidermuseum, Hydro Archives, Rapport fra Eidanger Salpeterfabriker. Luftangrep på bedriften 24-7-43, Bilag 8.

A very heavy concentration of bombs fell on the magnesium and aluminium plants at Herøya Peninsula. Several important installations were completely damaged and abandoned by the Germans. Many top-ranking German and Norwegian collaborators who were attending the dedication ceremony at A/S Nordisk Lettmetal, were killed. Of all the crew members of the allied bombers, three were wounded – two seriously and one slightly –, and ten missing; no one was killed. On land, however, there were many civil casualties.<sup>9</sup>

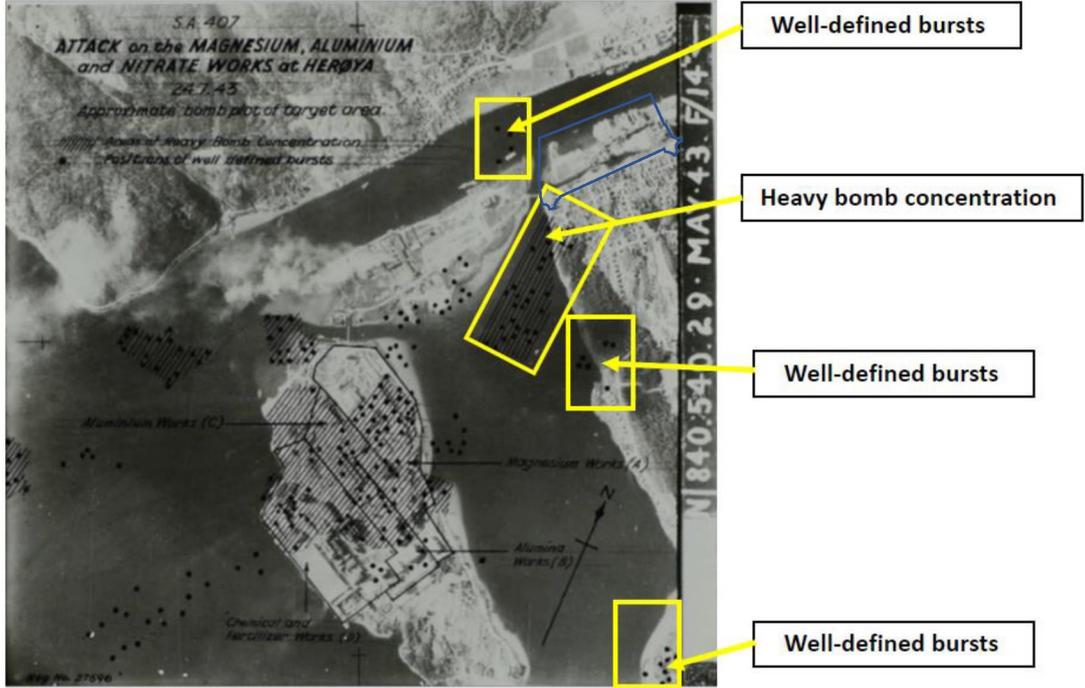


fig. 9: Approximate bomb plot at the northeast and southeast banks of Gunneklev Fjord.<sup>10</sup>

<sup>9</sup> The National Archives, Kew, AIR 40/424, Mission No. 75: Herøya, magnesium, aluminium and nitrate works, July-November 1943; "1943-07-24", in: Eighth Air Force Operations History. Missions (online), 2012-2014. <http://www.8thafhs.com/missions.php>.

<sup>10</sup> The National Archives, Kew, AIR 40/424, Interpretation Report SA 407, 26<sup>th</sup> of July 1943.



fig. 10: Bombing of the northeast bank of Gunneklev Fjord.<sup>11</sup>

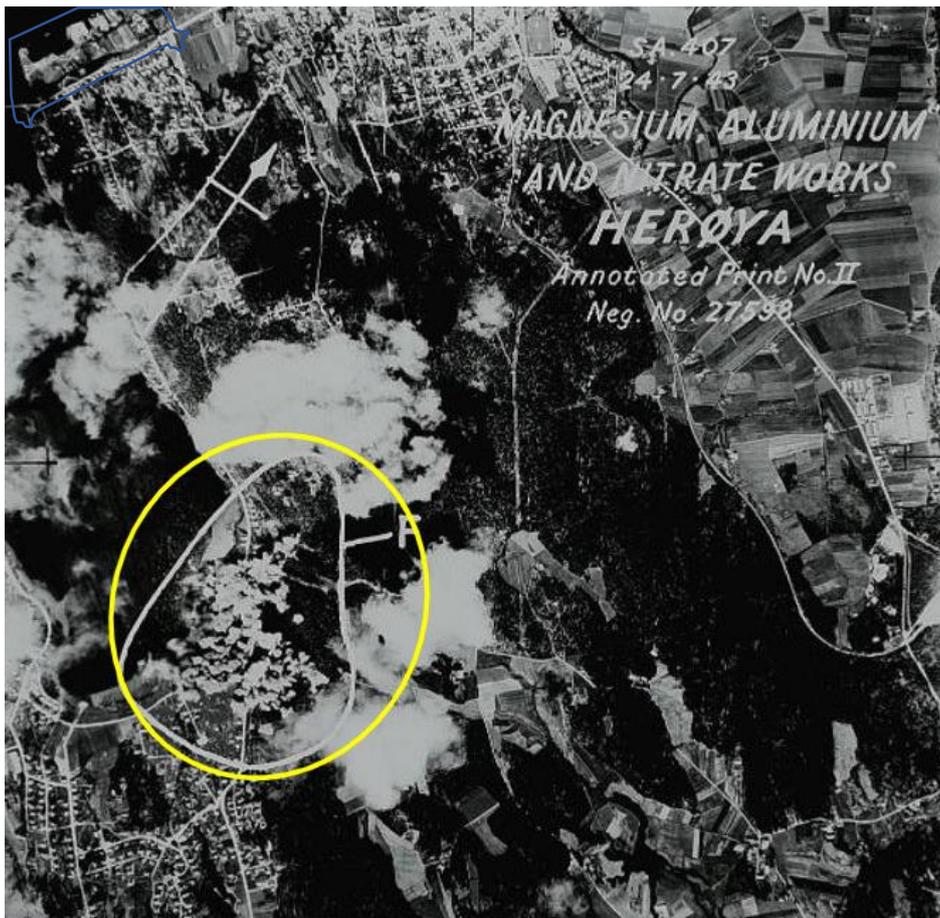


fig. 11: Bombing of the east and southeast bank of Gunneklev Fjord.<sup>12</sup>

<sup>11</sup> The National Archives, Kew, AIR 40/424, Interpretation Report SA 407, Annotated print No I Neg No 27597 Herøya.

<sup>12</sup> The National Archives, Kew, AIR 40/424, Interpretation Report SA 407, Annotated print No II Neg No 27598 Herøya.

## 2.2 The Gardening Operations in Porsgrunn (28-29 December 1944 & 24-25 February 1945)

The so-called Gardening Operations of the British Royal Air Force (RAF) Bomber Command implied the dropping of mines from bomber aircraft into the sea. The mines were “sown” near ports and harbours, inland waterways, estuaries, and busy shipping lanes. To this end, the coastline throughout Europe was divided into areas and subareas, which were given distinct code names, mostly after trees and plants. Area 3, which took in the south coast of Norway from Kristiansand eastwards to Oslo, contained several ports of varying capacity. Porsgrunn was part of area 3 and subarea “Polyanthus VI” (see fig. 12).



fig. 12: The subareas of area 3, in which the Gardening Operations of the RAF Bomber Command took place.<sup>13</sup>

Since the German attack on Norway in April 1940 and the subsequent occupation of that country, area 3 had been a scene of much enemy shipping of troops and supplies from the Baltic. By the autumn of 1944 almost the whole U-boat fleet was based in Norway. Traffic through the southern ports, devoted to carrying stores and supplies for their maintenance, increased considerably. At the same time and by the reverse route, the Germans were engaged in transferring army divisions from the northern front back to Germany. The whole area thus assumed a new importance.

<sup>13</sup> The National Archives, Kew, ADM 234/560, British mining operations 1939-1945, vol. 1, 1973, chapter 11.

Intended to interfere with these important movements, Porsgrunn was first mined during the night of 28 to 29 December 1944. Seven Halifax bombers of the 424 and 433 RAF squadrons flew to Porsgrunn. From a height of between 100 and 200 feet, they released 28 A Mk V and A Mk VII mines of 1000 lbs – four mines each. In the night of 24 to 25 February 1945, eight Lancasters of the 424 and 433 squadrons flew to Porsgrunn and Sandefjord. They released from a height of 100 feet 48 A Mk I-IV and A Mk VI mines of 2000 lbs – six mines each (see fig. 13). After parachuting, the chutes disengaged, and the mines sank to the water bottom. Although the port of Porsgrunn was not too deep and thus suitable for mining, the site was small in extent, so that even slight inaccuracies in laying from the air led to mines being deposited on land.<sup>14</sup>

The mines would set off either by a ship's magnetic interference (set to a specific signal to detonate under larger ships) or via the sound of a ship's propellers – acoustic microphones were sensitive enough to pick out different sizes of vessel. Some mines also included a delay mechanism which allowed the mine to prevent detonation until it had been triggered several times; for example, the mine could be set at seven passes and explode on the eighth.

In general, it can be said that the mining operations carried out in area 3 from September 1944 onwards, did succeed in causing serious disruption to important traffic. This result, however, stemmed largely from the enemy's inability to provide an adequate mine countermeasures defence force.

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<sup>14</sup> The National Archives, Kew, AIR 24/209, Administrative and Operations Branches, 1945; The National Archives, Kew, ADM 234/560, British mining operations 1939-1945, vol. 1, 1973, chapter 11.



fig. 13: Loading Lancasters with A Mk I-IV and A Mk VI mines of 2000 lbs.

## 2.3 The Bombardment of Porsgrunn (11 April 1945)

In 1945, as the Second World War drew to a close, Porsgrunn was the primary port for the evacuation of German troops from Norway to Germany.<sup>15</sup> On 11 April 1945, 35 de Havilland DH.98 Mosquito fighter-bombers Mk VI of the British 143, 235, 248 and 333 RAF squadrons, escorted by twelve P-51 Mustangs, flew from Banff Airport in Scotland over the North Sea to Porsgrunn (see fig. 14). They attacked the ships moored at the mechanical workshop on the quay. For this attack they may have used 3-inch Rocket Projectiles (RP-3) of 60 lbs, judging by the smoke plumes on the pictures (see fig. 15-16).

The aircraft formation in turn was attacked by ten to twelve German Messerschmitt fighters (Bf 109G-14s) from Rygge Airport and anti-aircraft guns on moored ships and a factory roof at the mechanical workshop. Two Mosquitoes were shot down: one by a fighter and one by anti-aircraft fire. Four merchantman vessels sank – three Norwegian and one German – and two were damaged – one Swedish and one German (see fig. 15 and 16). It was the last major offensive rocket attack by the British RAF in Norway.<sup>16</sup>

Two historical aerial photographs of 6 May 1945 show the traces of the British air raid (see fig. 17 and 18). The photographs are separate frames from the same sortie. Both were necessary for identifying the craters. This was done through QGis, by georeferencing and comparing them in detail.

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<sup>15</sup> "P/O Ray Harington", in: Robbie Reid. Banff Wing Strikes. Diaries (online), 2010. <http://www.robbyreid.co.uk/rhdiary.html>.

<sup>16</sup> Hafsten B., 1991, Flyalarm. Luftkrigen over Norge 1939-1945, Sem & Stenersen, Oslo, p. 265-266; Johannessen B., 2008, "63 år siden luftkamp i Porsgrunn", Telemarksavisa. Grenland, 11 April 2008; "Sorties Flown by RAF Banff Strike Wing 1943-1945", in: Scottish History Online (online), 4 April 2009. <https://www.scotshistoryonline.co.uk/sorties.html>.



fig. 14: Armours load four 500 lbs MC bombs into the bomb-bay of a de Havilland DH.98 Mosquito fighter-bomber (FB) Mk VI, 1944. This type of aircraft was armed with four .303 in Browning machine guns and four 20 mm cannons.<sup>17</sup>

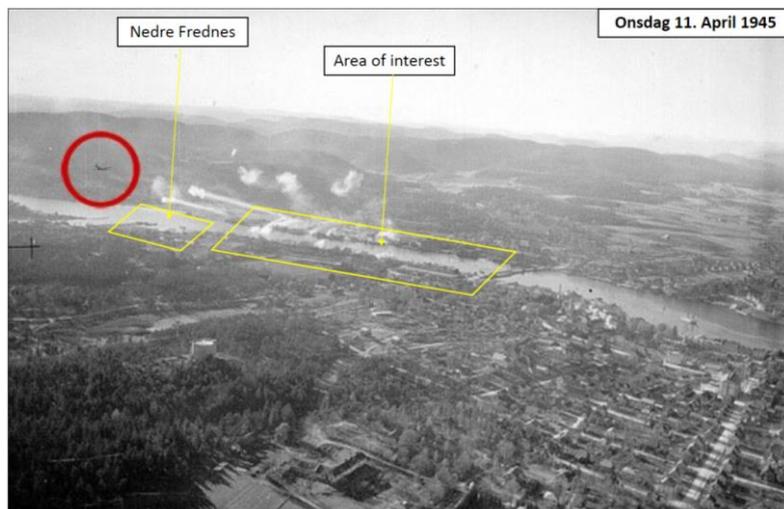


fig. 15: A de Havilland DH.98 Mosquito fighter-bomber (FB) Mk VI flies to the target area, 11 April 1945.<sup>18</sup>

The photograph shows in the centre the area of interest for the air raid.

<sup>17</sup> Imperial War Museums, photograph CH 12407.

<sup>18</sup> Johannessen B., 2008, "63 år siden luftkamp i Porsgrunn", Telemarksvisa. Grenland, 11 April 2008.



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fig. 16: Attack on the ships moored at the *Porsgrunn mekaniske verksted* in Porsgrunn.



fig. 17: Situation of the project area on a historical aerial photograph of 6 May 1945.<sup>19</sup>

<sup>19</sup> National Collection of Aerial Photography, Sortie 106G/L/0104, Frame 3284.



fig. 18: Situation of the project area on a historical aerial photograph of 6 May 1945.<sup>20</sup>

<sup>20</sup> National Collection of Aerial Photography, Sortie 106G/L/0104, Frame 3283.

## 3 POST-WAR

### 3.1 Systematic clearance of UXO

Historical research based on primary and secondary sources (see bibliography) shows that various acts of war took place in the vicinity of the project area. The area was hit by aerial bombs as well as by artillery (see chapter 2). Since usually 8 to 10 % of all ammunition does not detonate (because ammunition ends up on a muddy surface or because of a technical defect in the ignition mechanism), chances are that there is unexploded ammunition in the underground.

Immediately after July the 24<sup>th</sup> 1943, a crew from the German Bomb Disposal Command cleared unexploded ordnance within a diameter of 200 m around the impact sites near Porsgrunn. Some bombs were destroyed on site, some were destroyed elsewhere, and some stayed in place, when they had fallen into loose soil and when there was a suspicion that they had time-delay fuses. In that case, a safety period of two years was considered. After this two years period, the bombs were removed. That means that there are no longer bombs with time-delay fuses from the 1943 bombardment in the project area.<sup>21</sup> During the following years and after the war, probably no other systematic ammunition clearance has been done. In 1974, for example, officers found an aerial bomb in Porsgrunn (see fig. 19).<sup>22</sup>



fig. 19: Officers found an aerial bomb in Porsgrunn in 1974.<sup>23</sup>

<sup>21</sup> Norsk Industriarbeidermuseum, Hydro Archives, Rapport fra Eidanger Salpeterfabriker. Luftangrep på bedriften 24-7-43, p. 35.

<sup>22</sup> Telemark Museum, Bilde av befal med bombefunn i Porsgrunn, ca. 1974.

<sup>23</sup> Telemark Museum, Bilde av befal med bombefunn i Porsgrunn, ca. 1974.

### 3.2 Large-scale earthworks

In this section we investigate whether soil was removed or supplied in the project area after the Second World War. Removing soil could have reduced the chance of finding unexploded ammunition in the underground, depending on the depth at which the soil was excavated. Supplying soil, on the other hand, could have increased the chance of finding explosives, provided the soil came from areas with an unknown and/or high chance of finding UXO, for example the immediate vicinity of the project area.

Post-war aerial photographs show that important infrastructure works have taken place in the project area between 1947 and 2019 (see fig. 20). The docks were filled in, the land area was expanded in the southwest, and buildings and roads were constructed. Since the origin of the backfill soil is unknown, it is assumed that the soil may still contain artillery ammunition.



fig. 20: Situation of the project area on aerial photographs of 1947 and 2019.

## 4 CONCLUSION

Based on the historical research, it is possible to distinguish different zones in the project area with a very low to very high risk of encountering unexploded ordnance in the underground. In this section we suggest a demarcation for aerial bombs, artillery ammunition, mines, and rockets, in a horizontal sense. For a delineation of the risk zones in a vertical sense, we refer to the report of the risk analysis. In this report, the advised risk mitigation measures of ADEDE can also be found.

### **Aerial bombs**

There is a very high risk of encountering Allied M43 and MC bombs of 500 lbs in the entire project area, except along the banks where soil was brought in after the war. In these bank areas, there is only a high risk for the soil under the backfill packages (see fig. 21). The average penetration depth of aerial bombs is up to 7 m below the 1943 ground level.

### **Rockets**

3-inch rocket projectiles (RP-3) may be found in the entire project area (except in the post-war backfilled areas) (see fig. 21). The average penetration depth of rocket projectiles is up to 2 m below the 1943 ground level.

### **Artillery ammunition**

There is a high risk of encountering German grenades of 8,8 and 10,5 cm in the entire project area (see fig. 22). That's because the project area is situated within a 500 m buffer of several former anti-aircraft guns, both southwest and northwest of the area. (In July 1943, a German battery was set up on the Roligheten quay on Herøya. In April 1945, anti-aircraft guns were placed on moored ships and a workshop roof in Porsgrunn.) The average penetration depth of artillery ammunition is up to 4 m below the 1943 ground level, except in the post-war backfilled areas, where the entire volume of supplied soil may be contaminated with ammunition.

## **Mines**

British A Mk V and VII mines of 1000 lbs, and I-IV and VI mines of 2000 lbs may be found in the water features of the project area (see fig. 22). They are usually located on the seabed or in the soft silt layer. Due to silting, the mines can be 2 to 3 m deep below the 1943 ground level. Mines may also be found in the project subareas that were backfilled after the war.



fig. 21: Above: Risk map for aerial bombs in the project area (red: very high risk; purple: very high risk under the backfill package). Below: Risk map for rockets in the project area (red: very high risk).

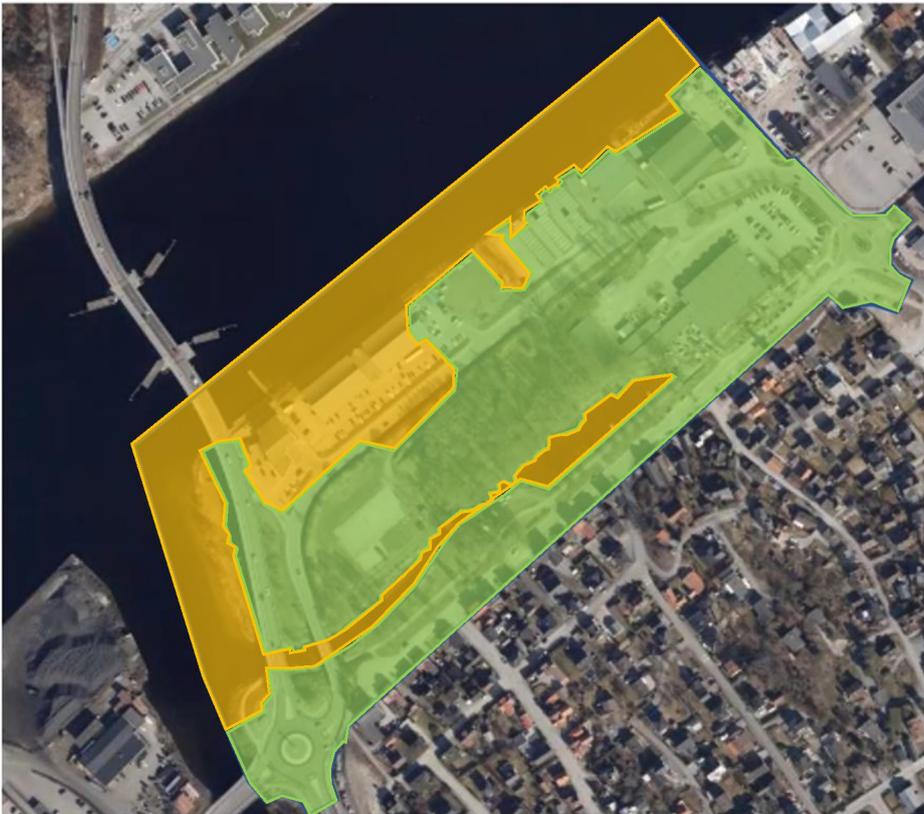


fig. 22: Above: Risk map for artillery ammunition (orange: high risk).  
Below: Risk map for mines in the project area (orange: high risk).

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