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Site Inspection Report

Naval Defensive Sea Area

Kodiak Island
Alaska

Department of the Navy
Naval Facilities Engineering Command Northwest
1101 Tautog Circle
Silverdale, WA 98315

FINAL
SITE INSPECTION REPORT FOR
NAVAL DEFENSIVE SEA AREA
KODIAK ISLAND, ALASKA

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EXECUTIVE SUMMARY

The U.S. Navy established a significant presence on Kodiak Island during the World War II era from approximately 1939 through 1945. Naval Air Station (NAS) Kodiak was established in 1941. The Navy and its contractors constructed harbor defense sites around the island. The first Army garrison troops arrived in April 1941. After World War II ended, the number of Navy and Army personnel at Kodiak rapidly began to decrease. By October 1, 1950, Naval Operating Base Kodiak was disestablished, and on July 1, 1952, Fort Greely was disestablished. NAS Kodiak continued to support aviation activities into the 1960s, as portions of the facility was transferred to the Air Force. On July 1, 1972, the Navy, with the approval of the Assistant Secretary of Defense, transferred government-owned land and improvements to the Bureau of Land Management for withdrawal for U.S. Coast Guard use.

The Naval Defensive Sea Area (NDSA) at Kodiak Island was established on March 22, 1941, by Executive Order 8717. The NDSA at Kodiak Island includes the territorial waters between the extreme high-water marks and the 3-mile marine boundaries.

Previous environmental and ordnance investigations conducted in similar water bodies have identified the potential for waters of NDSAs to be contaminated with munitions and explosives of concern (MEC). Activities that may have resulted in MEC contamination included the following:

- Practice firing of coastal defense artillery and anti-aircraft guns at fixed and towed targets
- Aerial gunnery firing practice at surface targets
- Aerial bombing practice at fixed targets
- Ordnance lost overboard during handling activities
- In-water ordnance disposal

Because there is a potential for MEC in the NDSA at Kodiak Island, the Navy is addressing the potential explosives safety, health, and environmental issues per the Navy's Munitions Response Program. The Navy conducted a preliminary assessment of this NDSA in 2013. The preliminary assessment report recommended that the Navy perform a site inspection (SI) within the in-water areas that have a greater potential to contain MEC based on historical activities, where the water depth is less than 20 fathoms (120 feet).

This report summarizes the SI field work performed at the NDSA at Kodiak Island in May 2015. A 69-foot vessel and a 15-foot vessel were used to perform geophysical surveys over a 14-day period. The survey team was able to survey on each of the 14 days without having to stand down because of poor weather conditions. In the SI work plan, 14 planned survey areas were identified. However, during the investigation some of the sites were counted separately to more easily record and report the survey data, resulting in a total of 17 areas described in this SI report. The first phase of surveying, or wide-area assessment (WAA) surveying, was performed across all or a major portion of 13 of the 17 planned survey areas. Sidescan sonar was used to survey large areas to identify targets for closer inspection during the second phase of surveying, or reacquisition and verification (RV) surveying. It was understood during the planning stage that the survey team would likely not be able to complete surveys in all areas within the allotted 14 days, but that the team would accomplish as much surveying as possible within that time frame.

No WAA survey was conducted at Happy Beach AATC Impact Area, Fort Abercrombie Gun Batteries Impact Area, Entrance Point AATC Dock, and Entrance Point AATC Impact Area. These were AATC areas that handled smaller rounds (i.e., 40-mm anti-aircraft rounds), or gun impact areas that used 8-inch rounds. The two smaller quality assurance/quality control (QA/QC) test shapes (the mock .50-caliber round and the 25-pound mortar shell) were not observed during QA/QC testing of the sidescan sonar and marine magnetometer. Therefore, WAA surveying would likely not have detected the probable projectiles in these four areas.

A total of 1,099 targets were identified during the WAA survey within the 13 areas surveyed. A total of 1,099 targets were identified during the WAA survey. Appendix C includes a list of each target identified during the WAA survey for each survey area, including related characteristics. Targets identified during using the sidescan sonar were initially classified as objects such as anchor, fish trap, piling, unknown, etc. during target characterization. Approximately 82 percent (898 of 1,099) of the targets were classified as “6-inch shell,” “mine-like object,” or “unknown”. Generally, if a target was initially classified as a likely inert item (anchor fish trap, piling, etc.) in the field, it was not selected as a target for RV surveying. Most targets selected for reacquisition in the field were initially classified as “mine-like object” or “unknown.”

The survey team performed RV surveying at 6 areas, and attempts were made to reacquire only 45 targets because of the 14-day time constraint. Table 4-4 lists the characteristics of each reacquired target. The geophysical subcontractor’s report is included as Appendix D in this SI report.

Table 4-5 summarizes the percent of targets initially classified as “unknown,” “mine-like object,” or “6-inch shells” that were reacquired as part of the RV survey. Of the 45 targets reacquired , 40 were initially classified as “unknown,” “mine-like object,” or “6-inch shells”” as summarized for each survey area in Table 4-5. Therefore, approximately 4% of the 898 targets

that were initially classified as "unknown," "mine-like object," or "6-inch shells" were reacquired, reducing the number of targets initially classified as "unknown," "mine-like object," or "6-inch shells" to 858. Of those 858 targets, 210 met the size criterion (smaller than 5 feet in all directions). The size criterion is based on the approximate maximum size of expected MEC items; many inert items, such as pilings and other debris exceeded the size criterion and were less likely to be MEC items. However, targets of interest that were slightly larger than this criterion were still reacquired.

An interactive map is included on a DVD (Appendix E) that shows planned survey areas, areas surveyed, sidescan sonar results, target locations with links to target characteristics, and reacquired target locations with links to videos taken with the remotely operated vehicle.

No target was positively identified as MEC. However, that does not mean that MEC are not present. A limited number of targets were reacquired as previously stated. Four targets appeared to be potential wooden crates that may contain ammunition in two of the explosive anchorage areas. Most of the targets were covered with moderate to heavy biological growth. The visibility at the seafloor was generally fair to very good.

It is unlikely that anti-ship mines, if they are present, have been buried in the sediment and should be detectable on the sea floor in the former anti-ship mine areas. This type of MEC is larger and less dense than smaller projectiles, such as 40-mm and 8-inch-diameter artillery rounds, that may become buried in the sediment over time. If present, anti-ship mines could be accessible to divers, or could be caught accidentally in fishing equipment. Therefore, the MEC in the former anti-ship mines areas appear to be of greater potential risk to human health than the areas that may have smaller projectiles, which may be buried in the sediment.

Based on the results of the 2015 SI surveys at the NDSA at Kodiak Island, no further action is recommended at the following two areas:

- Happy Beach AATC Impact Area
- Entrance Point AATC Impact Area

Additional action is recommended at 15 sites. Further RV surveying is recommended at the following 12 areas to reacquire and verify targets identified during the WAA survey phase:

- Explosive Anchorage No. 1
- Explosive Anchorage No. 3
- Navy Dock Locations in Womens Bay
- Army Dock Locations in Saint Paul Harbor

- Former Army Dock at Puffin Island
- Former Navy Dock at Woody Island
- Fort Greely Gun Batteries Impact Area
- Long Island Dock
- Former Anti-Ship Mines Area between Long and Woody Islands
- Former Anti-Ship Mines Area East of Long Island
- Humpback Rock Glide and Dive Bombing Target and adjacent Former Anti-Ship Mines Area
- Former Anti-Ship Mines Area

Further WAA surveying followed by RV surveying is recommended in the following three areas:

- Explosive Anchorage No. 2
- Former Abercrombie Gun Batteries Impact Area
- Entrance Point AATC Dock

After the additional RV surveying is completed, either no further action or remedial investigation can be recommended for the 15 sites. If the additional RV surveying can be completed in the 2016 season, the project work plans could be minimally amended, and the results could easily be included into the SI report.

The estimated cost to perform the additional recommended surveying at the nine survey areas is approximately $367,000.

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TABLES

ABBREVIATIONS AND ACRONYMS

AA	anti-aircraft
AATC	anti-aircraft training center
AMTB	antimotor-torpedo boat
CDA	coastal defense artillery
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHIRP	compressed high-intensity radar pulse
cm	centimeter
Coast Guard	U.S. Coast Guard
DMM	discarded military munitions
GIS	geographic information system
GPS	Global Positioning System
Gravity	Gravity Environmental Consulting, LLC
hp	horsepower
Hz	hertz
kg	kilogram
kHz	kilohertz
km	kilometer
kW	kilowatt
MC	munitions constituent
MEC	munitions and explosives of concern
MHz	megahertz
Mk	Mark
mm	millimeter
MRP	Munitions Response Program
N/A	not applicable
NARA	National Archives and Records Administration
NAS	Naval Air Station
NAVFAC	Naval Facilities Engineering Command
Navy	U.S. Navy
NDSA	Naval Defensive Sea Area
NOB	Naval Operating Base
nT	nanotesla
PA	preliminary assessment
QA	quality assurance
QC	quality control
RDX	cyclotrimethylene trinitramine
ROV	remotely operated vehicle

ABBREVIATIONS AND ACRONYMS (Continued)

R/V	research vessel
RV	reacquisition and verification
SI	site inspection
URS	URS Group, Inc.
UXO	unexploded ordnance
WAA	wide-area assessment
WGS84	World Geodetic System 1984

1.0 INTRODUCTION

The U.S. Navy (Navy) established a significant presence on Kodiak Island during the World War II era from approximately 1939 through 1945. Figure 1-1 shows the location of Kodiak Island in relation to Alaska and the Aleutian Island chain. Naval Air Station (NAS) Kodiak was established in 1941. Marines stationed at Chilkoot Barracks in Haines, Alaska, provided protection while the Navy and its contractors constructed harbor defense sites around the island. The first Army garrison troops arrived in April 1941. The Army expanded its garrison troops on Kodiak to more than 11,000 to support fixed defensive garrisons. By June 9, 1942, Naval Operating Base (NOB) Kodiak, consisting of the NAS, Submarine Base, and Section Base, was commissioned (U.S. Navy 2013).

The Naval Defensive Sea Area (NDSA) at Kodiak Island was established on March 22, 1941, by Executive Order 8717 (U.S. Navy 2013). An NDSA is a water area set aside by executive order of the President of the United States because of its strategic nature, or for purposes of defense. The NDSA at Kodiak Island includes the territorial waters between the extreme high-water marks and the 3-mile marine boundaries. The extent of the NDSA at Kodiak Island is shown on Figure 1-2.

Previous environmental and ordnance investigations conducted in similar water bodies have identified the potential for waters of NDSAs to be contaminated with munitions and explosives of concern (MEC). Activities that may have resulted in MEC contamination include the following:

- Practice firing of coastal defense artillery (CDA) and anti-aircraft (AA) guns at fixed and towed targets
- Aerial gunnery firing practice at surface targets
- Aerial bombing practice at fixed targets
- Ordnance lost overboard during handling activities
- In-water ordnance disposal

The Navy's Munitions Response Program (MRP) was established because the National Defense Authorization Act of 2000 required the U.S. Department of Defense to establish a program that addresses the potential explosives safety, health, and environmental issues caused by MEC and munitions constituents (MCs) used or released at sites during past operations and activities.

Because there is a potential for MEC in the NDSA at Kodiak Island, the Navy conducted a preliminary assessment (PA) of this NDSA (U.S. Navy 2013).

At the conclusion of the PA report, it was recommended that the Navy perform a site inspection (SI) within the in-water areas that have a greater potential to contain MEC, as defined in the PA, where the water depth is less than 20 fathoms (120 feet).

The Navy prepared a site-specific work plan (U.S. Navy 2014) for conducting the SI to locate MEC in specific in-water areas within the NDSA surrounding Kodiak. Details of the SI surveying, including methods, equipment, and data collection, were specified in the work plan.

URS Group, Inc. (URS) provided the Navy with the related services for this SI under Delivery Order 80 of contract N44255-09-D-4001. Gravity Environmental Consulting, LLC (Gravity) was subcontracted to provide a geophysical survey team and equipment and Northern Telecommunications Consultants, Inc., to provide the research vessel services.

1.1 PURPOSE

The purpose of the SI survey within the NDSA surrounding Kodiak Island was to conduct a detector-aided field investigation with visual verification of selected targets of specific in-water areas to obtain empirical evidence that MEC is present on the seafloor.

The purpose of this SI report is to document the findings of the SI surveys, present a refined conceptual site model, report the results of the initial munitions hazard screening process, and recommend further actions based on the SI results and evaluation.

1.2 PROJECT SCOPE AND OBJECTIVES

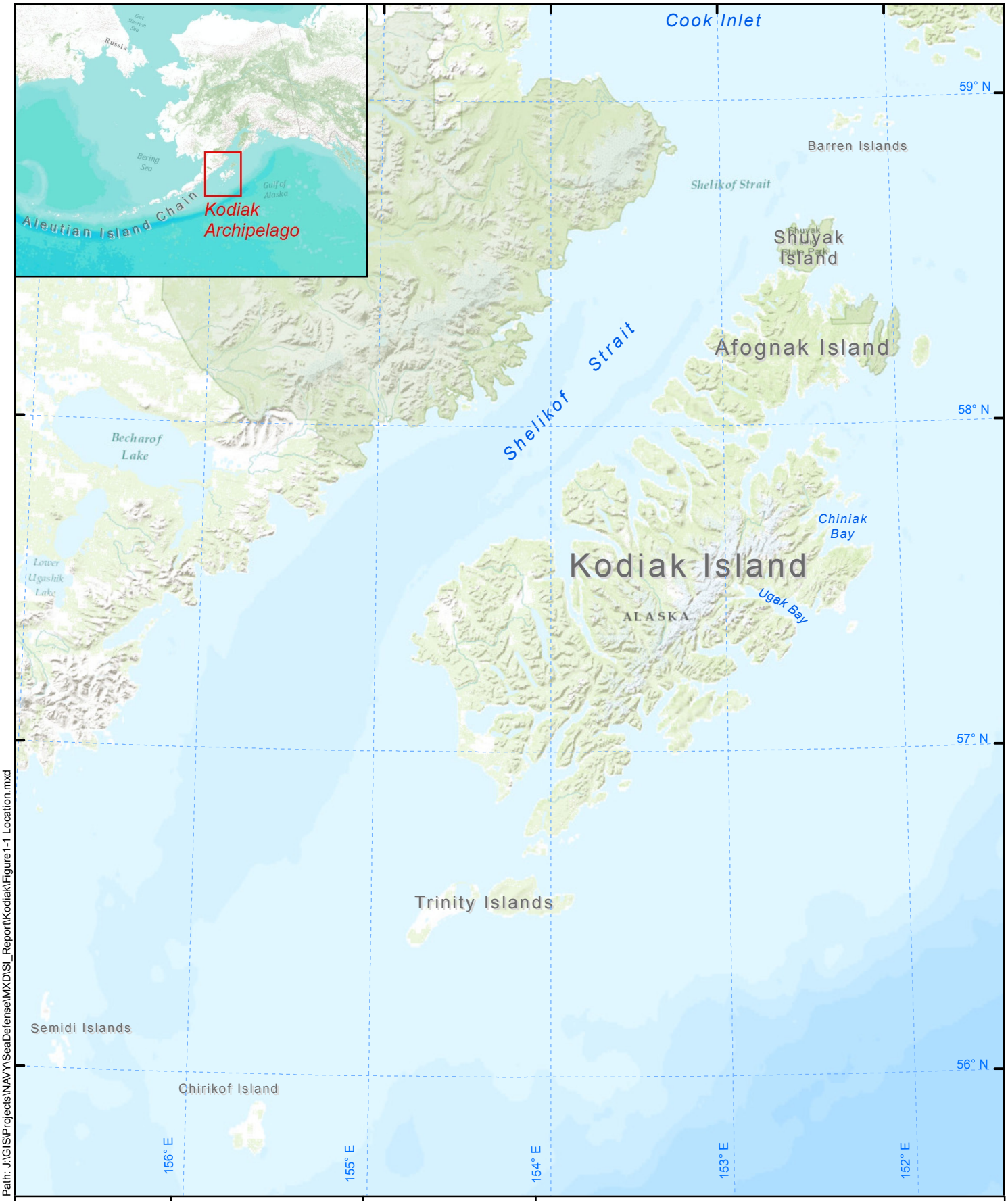
The scope of the SI was to investigate the presence of MEC on the seafloor at known in-water ranges and bombing targets, over-water ordnance handling sites, and in-water MEC disposal areas within the Kodiak NDSA. These areas having a greater potential to contain MEC, as defined in the PA, include the 17 investigation areas identified and described in Section 2.6.

This SI was not intended as a full-scale study of the nature and extent of explosives hazards. The National Oil and Hazardous Substances Contingency Plan identifies the SI as the on-site investigation to determine whether there is a release or potential release and the nature of the associated threats.

The objective of the SI is to provide conclusions and recommendations for further action or no additional action by providing supporting rationale based on the PA and SI findings.

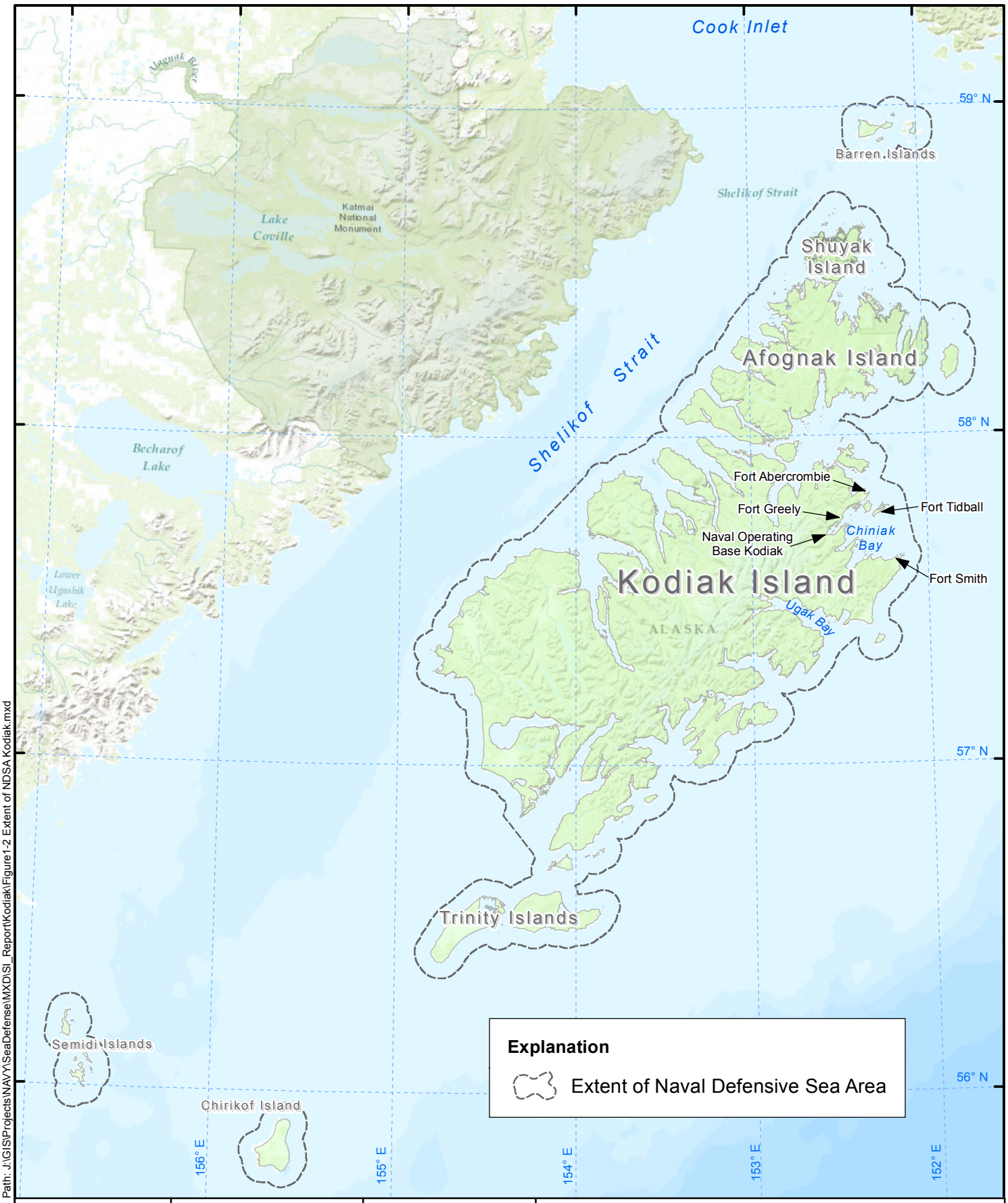
This SI report presents the following information in the subsequent sections:

- Section 2, Review of Existing Information: To familiarize the reader about the site background information, this section summarizes previously reported information presented in the related PA report and SI work plan.
- Section 3, Site Inspection Survey Design and Methods: This section describes how the surveys were conducted with specific equipment, including data acquisition and processing.
- Section 4, Results of Site Inspection Survey: This section presents the areas that were surveyed and detailed information for each target identified and reacquired during the wide-area assessment (WAA) and reacquisition/verification phases of the surveys.
- Section 5, Conceptual Site Model: An updated conceptual site model, including exposure and migration pathways, and potential or existing MEC risks and hazards are presented.
- Section 6, Conclusion and Recommendations: This section contains a brief conclusion of the SI findings and recommendations for further actions, if applicable.
- Section 7, References



Path: J:\GIS\Projects\NAVY\SeaDefense\MXD\SI_Report\Kodiak\Figure1-1 Location.mxd

U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska	0 10 20 Scale In Miles	**Figure 1-1** **Location of Kodiak Island Alaska**



Path: J:\GIS\Projects\NAVY\SeaDefense\MXD\SI_Report\Kodiak\Figure1-2 Extent of NDSA Kodiak.mxd

U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska	0 9 18 Scale In Miles	**Figure 1-2** **Extent of the Naval Defensive Sea Area Surrounding Kodiak Island**

2.0 REVIEW OF EXISTING INFORMATION

Information regarding Kodiak Island and the military presence and operations on the island was researched during the PA phase of this project. Material presented in this section summarizes information presented in *Preliminary Assessment Report for Naval Defensive Sea Area Kodiak Island, Alaska* (U.S. Navy 2013) and *Site Inspection Work Plan for Naval Defensive Sea Area Kodiak Island, Alaska* (U.S. Navy 2014).

2.1 SITE LOCATION AND SETTING

Kodiak Island is a large island situated in the Gulf of Alaska 25 miles (i.e., 40 km) southeast of the Alaska Peninsula near the entrance to Cook Inlet. It is separated from the Alaska mainland by the Shelikof Strait. Kodiak Island is the largest of the 25 islands in the Kodiak Archipelago and the second largest island in the United States. The Kodiak Archipelago consists of all islands extending from the Barren Islands on the north to Chirikof Island and the Semidi Islands group to the south. Kodiak Island is approximately 100 miles (i.e., 160 km) long and varies in width from 10 to 60 miles (i.e., 16 to 96 km). It is located at 57° 28′ north latitude and 153° 26′ west longitude. Figure 1-1 shows the location of Kodiak Island and the relative position of the remaining islands of the Kodiak Archipelago.

Kodiak Island is situated at a convergent boundary between two tectonic plates that make up the Earth's crust. The more southern or Pacific Plate is being subducted under the more northern North American Plate. This results in an area that is spotted with active and/or dormant volcanos and very earthquake prone. Earthquakes with magnitudes greater than 6 on the Richter scale are common. The island is mountainous and heavily forested in the northeast portion of the island, but fairly treeless in the southwest. It has many deep, ice-free bays that provide sheltered anchorages for boats. One of the larger of these bays (Chiniak Bay) is located at the northeast end of the island.

2.2 MILITARY PRESENCE AND OPERATIONS

A chart study conducted by the Plans Division of the Bureau of Aeronautics in the spring of 1927 indicated the need for the Navy to develop one main base and several subsidiary bases in the southern Alaskan sector, and the general vicinity of Kodiak appeared the best strategic location for the main base. In 1937, the Womens Bay area of Chiniak Bay was selected as the site of a future seaplane base and the Buskin River Flats area as a landing field (McDade 1945).

The eastern portion of Kodiak Island was withdrawn from the public domain for naval purposes in November 1939 (McDade 1945). Construction of military facilities began in September of 1939. On August 1, 1940, the Navy Department established the Alaskan Sector as a military command within the Thirteenth Naval District. This sector included the territorial limits of Alaska and its adjacent waters. By 1941, naval expansion plans scheduled for Kodiak included a seaplane base, section base, submarine base, and ultimately a naval operating base. On March 22, 1941, Executive Order 8717 established the Kodiak Island NDSA.

Naval Air Station (NAS) Kodiak was established in February 1941 and commissioned on June 15, 1941, even though construction was not complete. Marines stationed at Chilkoot Barracks in Haines, Alaska provided protection while the Navy and its contractors constructed Fort Greely and other harbor defense sites around the island. The Army eventually assigned one regiment of infantry minus one battalion, three batteries of 155-mm guns, two AA battalions, one mine planter, and one detachment of searchlights for harbor defense (USACE 2002). The first Army garrison troops arrived in April 1941. The Army had expanded its garrison troops on Kodiak to more than 11,000. Fixed defensive garrisons included Fort Abercrombie at Miller Point, Fort Tidball on Long Island, and Fort J.H. Smith at Cape Chiniak (Alaska Geographic Society 1995) as shown on Figure 1-2.

The first Army Air Corps units, the 18th Fighter Squadron and 36th Bombardment Squadron, arrived in February 1942. Later the same year, the 111th Canadian Fighter Squadron also arrived (USACE 2002). Naval units stationed at Kodiak include Patrol Wing Four, as well as numerous visiting ships and submarines.

By June 9, 1942, NOB Kodiak (consisting of the NAS, Submarine Base, and Section Base) was commissioned (McDade 1945). On July 1 of the same year Submarine Base Kodiak was commissioned, though it was never used to its full potential. Submarine Base Kodiak was decommissioned in May 1945. After 1942 the naval aerial mission decreased and airplane repair grew in importance, as did submarine repair activities. The Kodiak Island base never expanded beyond original plans since other bases were constructed farther west, to be closer to the action (USACE 2002).

On August 28, 1944, NAS Kodiak was assigned to the Naval Air Bases Command, Seventeenth Naval District. At the same time NAS Kodiak became headquarters of the Seventeenth Naval District with its commanding officer commander of the entire district (McDade 1945).

After World War II ended, the number of Navy and Army personnel at Kodiak rapidly began to decrease. The mission of NAS Kodiak was to maintain and operate facilities, provide services and materials to support operations of aviation activities and units of the Navy Operating Forces, and support other activities and units as designated by the Chief of Naval Operations. During the

1960s, the mission remained the same, but portions of the reservation and improvements were transferred to the Air Force. By October 1, 1950, NOB Kodiak was disestablished, and on July 1, 1952, Fort Greely was disestablished (USACE 2002).

On July 1, 1972, the Navy, with the approval of the Assistant Secretary of Defense, transferred government-owned land and improvements to the Bureau of Land Management for withdrawal for U.S. Coast Guard (Coast Guard) use. Currently, the Integrated Support Command Kodiak remains on the former Navy property (USACE 2002). Coast Guard Air Station Kodiak is the largest Coast Guard station in the United States. Modern Coast Guard units stationed at Kodiak conduct patrols and search and rescue missions and provide fisheries enforcement (USACE 2002).

2.3 HISTORICAL WASTE MANAGEMENT PRACTICES

The primary waste of concern for this SI is MEC within the marine environment of the NDSA surrounding Kodiak and the surrounding islands. MEC includes unexploded ordnance (UXO), discarded military munitions (DMM), and MCs in high enough concentrations as to present an explosive hazard. The use and handling of ordnance at Kodiak resulted in waste entering the marine NDSA by the following mechanisms:

- Ordnance fired over water from CDA guns and AA batteries during target training and gun function testing that did not detonate as intended
- Ordnance dropped or fired at in-water targets, fixed or moving, from U.S. aircraft during target training and gun function testing that did not detonate as intended
- Ordnance lost into the water during transfer from transport ships to the shore, either at a fixed dock or at an explosive anchorage situated in the harbor away from shore installations
- Anti-ship mines that were sunk, not detonated, during harbor mine-sweeping activities
- Excess ordnance deliberately disposed of (referred to as DMM) into the marine environment at the conclusion of hostilities

Ordnance that was fired or dropped and did not detonate as intended is known as UXO. An unknown quantity of MEC was lost, discarded, deliberately dropped, or fired into the marine environment of the NDSA surrounding Kodiak and neighboring islands during World War II.

As much as 30 percent of the explosive ordnance that was dropped or fired during World War II did not detonate as intended (Francis and Alama 2011).

USACE evaluated Kodiak Island under the Formerly Used Defense Sites program and presented the findings in a coordinated comprehensive cleanup plan (USACE 2005). The evaluation applied to the on-land hazards of potential ordnance explosive and chemical warfare material. Prior to 2012, the in-water ranges and targets in the NDSA were not evaluated.

2.4 REGULATORY COMPLIANCE

The National Defense Authorization Act of 2000 required the Department of Defense to establish a program addressing military munitions as part of the Defense Environmental Restoration Program. The Navy's MRP complies with this requirement. The purpose of the MRP is to address the potential explosives safety, health, and environmental issues caused by MEC and MCs used or released on sites from past operations and activities. Based on Navy MRP policy (U.S. Navy 2007), the following criteria are used for inclusion of water sites in the MRP:

> Shallow water areas where munitions releases are known or suspected to have occurred prior to September 30, 2002, where Navy actions were responsible for the release, and where the site is not:
>
> - Covered by water deeper than 20 fathoms (120 feet)
> - Part of, or associated with, a designated operational range
> - A designated water disposal site
> - A Formerly Used Defense Site
> - A result of combat operations
> - A maritime wreck
> - An artificial reef

2.5 SOURCE CHARACTERIZATION

The sources of MEC released into the marine environment at NOB Kodiak and the surrounding facilities by U.S. forces consist of CDA and AA gun batteries, AA training centers (AATCs), supply transfer points, air combat units of the Eleventh Army Air Corps, and air units and ships attached to the Seventeenth Naval District.

Detailed records of training exercises, which are part of the operational records, were not required to be retained for the historical archives (Knechtmann 2012). Therefore, details of training exercises typically do not exist in the archived records. In rare instances, training exercise records may exist in the archive record if they were provided by a private individual (Knechtmann 2012). During the archived records search conducted in the summer of 2012, "plans of the day" for Kodiak were located in the Anchorage National Archives and Records Administration (NARA). These plans of the day typically included firing notices that specified the type and location of guns to be fired that day and the ranging information.

2.5.1 Source Descriptions

Information reviewed during the PA identified the following U.S. CDA and AA gun batteries in the vicinity of Kodiak Island (NARA II, NARA Anchorage, and NARA Seattle 2012):

- Battery No. 1 located at Saint Peters Head, Fort J.H. Smith, Cape Chiniak:
  - Two-gun 8-inch CDA battery (403)
  - Two-gun 40-mm AA battery
  - Two .50-caliber machine guns
  - Two .30-caliber machine guns
- Battery No. 2 located at Chiniak Point, Fort J.H. Smith, Cape Chiniak:
  - Four-gun 155-mm CDA battery (F 42-5)
  - Two .50-caliber machine guns
- Battery No. 3 located on Buskin Hill, Fort Greely, Kodiak Island:
  - Four-gun 155-mm CDA battery (F 42-6) of the 250th Coastal Artillery Battalion
  - Two .50-caliber machine guns
- Battery No. 4 located at Deer Point, Fort Tidball, Long Island:
  - Four-gun 155-mm CDA battery (F 42-4) of the 250th Coastal Artillery Battalion
  - Two .50-caliber machine guns
- Battery No. 5 located at Castle Bluff, Fort Tidball, Long Island:
  - Two-gun 6-inch CDA battery (296)
  - Two-gun 40-mm AA battery

  - Two .50-caliber machine guns
  - Two .30-caliber machine guns

- Battery No. 6 located at Fort Abercrombie, Miller Point:
  - Two-gun 8-inch CDA battery (404)
  - Two-gun 40-mm AA battery
  - Two .50-caliber machine guns
  - Two .30-caliber machine guns

- Battery No. 7 located on Puffin Island:
  - Four-gun 90-mm antimotor-torpedo boat (AMTB)
  - Two-gun 40-mm AA battery
  - Four .50-caliber machine guns

- Battery No. 8 located at Spruce Cape:
  - Four-gun 90-mm AMTB
  - Two-gun 40-mm AA battery
  - Two .50-caliber machine guns

- A 6-inch naval artillery battery located on Artillery Hill

- Twelve AA batteries identified in the vicinity of the seaplane base at Womens Bay that consisted of approximately four 40-mm and thirty-five 20-mm guns

- Fifty-two .30-caliber machine guns located at 26 coastal searchlight installations (two at each light)

Known locations of the U.S. gun batteries and practice firing ranges are shown on Figure 2-1. Information obtained during the document review indicated that during 1943 active firing occurred from three established practice firing ranges at NOB Kodiak: Anton Larson Bay, Buskin Beach and Bell's Flats. Practice firing of .30- and .50-caliber machine guns occurred at Anton Larson Bay. These guns fired on stations and balloon targets on or over Anton Larson Bay. Available documents indicate that 3-inch, 37-mm, and 90-mm guns, as well as 81-mm mortars, were fired from the Buskin Beach practice firing area toward targets in Chiniak Bay. A single record of 3-inch guns firing from Bell's Flat at targets in Womens Bay was also discovered during document review.

NOB Kodiak contained two AATCs where active firing occurred, one located at Entrance Point at the western entrance to Narrow Strait and a second at Happy Beach located between Womens Bay and Middle Bay. Firing at the Entrance Point AATC was directed from locations on a local topographic high with a stated danger area extending 6,000 yards into Marmot Bay between 315 and 000 degrees (Plan of the Day NOB Kodiak, September 30, 1943). Firing at the Happy Beach AATC was directed from the near beach area into Chiniak Bay, with a presumed danger area also extending 6,000 yards seaward between Spruce Cape and Humpback Rock. The locations of these AATCs are shown on Figure 2-1.

Information obtained during document review indicated that during 1942, approximately 575 anti-ship mines were placed in Chiniak Bay in three distinct mine fields located as follows:

- Between Humpback Rock and Midway Point on Chiniak Peninsula
- Between the northeast point of Long Island and Humpback Rock
- Between Woody Island and Long Island

The former locations of these mine fields are shown on Figure 2-2. During subsequent mine sweeping operations conducted in 1943 and 1944, their mooring chains were cut and the mines floated to the surface. Once on the surface, the mines were shot with machine guns until they either exploded or sank (Ostlund 2012). A total of 262 of the original 575 mines were accounted for once mine clearing operations ended. Fifty-five percent of the mines originally placed in Chiniak Bay were not accounted for during this operation (USACE 2001).

Three positions at NOB Kodiak are designated as explosive anchorage areas on a chart map of the area (NOAA 2004). Area number 1 is located between Zaimka Island and Puffin Island, area number 2 is located approximately 1/3 mile southwest of Blodgett Island, and area number 3 is located approximately ¼ mile north of Mary Island in Womens Bay. Figure 2-2 shows the locations of these three designated explosive anchorages. These areas were used by U.S. forces during the war period to off-load ammunition and high explosives from transport ships. They were established to protect shore-based facilities from damage caused by accidental detonation of explosives during off-loading activities. Ordnance was off-loaded onto barges for transfer to shore. Once on shore, ordnance was distributed to gun batteries.

The Army maintained a main dock in Saint Paul Harbor and barge docks at Long Island (Fort Tidball), Chiniak (Fort J.H. Smith), Entrance Point, Baranof Cove, and Puffin Island. The Navy docks were clustered in Womens Bay. The locations of known docks are also shown on Figure 2-2. Location information for the Chiniak and Baranof Cove Docks was not discovered during the PA. Occasionally, DMM were lost into the harbor during ordnance-handling activities. Available information suggests that materials lost into the marine waters that did not present a danger or obstruction to shipping were not recovered. No record was found

documenting the loss or recovery of MEC from the marine environment at these locations during the PA.

Records indicate that during the 1940s, the Seventeenth Naval District established three air gunnery areas, three AA gunnery areas, and nine glide and dive bombing targets within the marine environment surrounding Kodiak Island (USACE 2001). These firing areas and bombing targets were used for training by air groups in the Kodiak Sector. The locations of the fixed gunnery areas, free gunnery areas, and bombing targets are shown on Figure 2-3.

The air gunnery areas were located approximately 7 to 25 miles southeast from Cape Chiniak (Area No. 1), approximately 15 to 35 miles east-northeast from Miller Point (Area No. 2), and in Shelikof Strait between Afognak Island and the Alaska Peninsula (Area No. 3). These air gunnery areas were used for aircraft bombing and strafing practice against towed targets. Two AA gunnery areas (No. 1 and No. 2) were located east-northeast from Miller Point and Long Island. A much larger AA gunnery area (No. 3) was located off Cape Chiniak. These three AA gunnery areas were used for shipboard AA training against towed targets. The glide and dive bombing targets were located as follows (Perry 1942 and McDade 1944):

• Long Island, Ugak Bay	57.4225943382 N	152.497916400 W
• Humpback Rock, Chiniak Bay	57.7075399573 N	152.250665014 W
• Stripe Rock, Marmot Bay	58.0432280860 N	152.594868281 W
• Sealion Rocks off Tonki Cape	58.3421585361 N	151.813364204 W
• Latax Rocks off Shuyak Island	58.6749760259 N	152.494529595 W
• Cape Ugat, Kodiak Island	57.8733640030 N	153.849342755 W
• Cape Ilktugitak, Alaska Peninsula	58.0237771390 N	154.600389523 W
• Dry Rock off Tugidak Island	56.4893779392 N	154.427848366 W
• Outer Seal Rock, Kodiak Island	57.3024355555 N	154.840656003 W

Historical records related to NOB Kodiak were reviewed to evaluate the magnitude of gun training exercises that occurred during war-time activities. This review discovered a partial set of Plan of the Day orders for NOB Kodiak. These orders identified nearly daily gunnery training exercises on or surrounding Kodiak Island. The PA evaluated available daily firing orders from discovered Plans of the Day for NOB Kodiak during 1943 where firing occurred over waters of the marine environment. Figure 2-4 shows the projected impact areas for these 1943 gunnery training activities based upon the discovered information as described in the respective Plans of the Day.

Ammunition data sheets for ordnance reportedly used at the Unalaska NDSA are included in Appendix B. Ordnance includes the ammunition listed above and the sea mines that were potentially used at the former anti-ship mines areas.

2.5.2 Estimated Quantity of Munitions and Explosives of Concern

No reasonable estimate of the quantity of MEC in the marine waters of the NDSA surrounding Kodiak Island can be determined from the information reviewed during the PA.

Very little information regarding the quantity of ordnance used during a typical training exercise was discovered during the review of archive records. No record was found indicating the number of coastal artillery rounds (90 mm and larger) fired during training activities at NOB Kodiak. However, quarterly reports of AA firing were discovered for three consecutive quarters.

For the quarter ending December 31, 1943, the AATC at NOB Kodiak reported consuming the following quantity of ordnance:

- 40 mm: 284 rounds (776 for the calendar year)
- 20 mm: 910 rounds (3,640 for the calendar year)

For the quarter ending March 31, 1944, the AATC at NOB Kodiak reported consuming the following quantity of ordnance:

- 40 mm: 507 rounds
- 20 mm: 19,316 rounds
- .50 caliber: 1,000 rounds

For the quarter ending June 30, 1944, the AATC at NOB Kodiak reported consuming the following quantity of ordnance:

- 40 mm: 2,274 rounds (2,781 for the calendar year)
- 20 mm: 35,198 rounds (54,514 for the calendar year)
- .50 caliber: 5,000 rounds (6,000 for the calendar year)

Given the extensive coastal artillery and AA gun training conducted at NOB Kodiak, the presence of bombing targets within the Kodiak Island NDSA, the reported fact that 55 percent of the anti-ship mines originally placed in Chiniak Bay were not accounted for during removal operations, the significant quantity of on-water ordnance handling that occurred in Chiniak Bay, the assumption that up to 30 percent of ordnance may not have detonated as intended, and the snagging of a 650-pound depth bomb in a fishing net in 1974, there is a good possibility that MEC exists in the marine waters of the NDSA surrounding the islands of the Kodiak Archipelago.

2.6 PLANNED SURVEY AREAS

The sources of MEC released into the marine environment of the Kodiak Island NDSA by U.S. forces consist of CDA and AA gun batteries, two AATCs, on-water ordnance transfer operations, harbor mine removal operations, and air combat training by units of the Eleventh Army Air Corps and the Seventeenth Naval District. The areas potentially affected by MEC releases encompass a broad reach of the NDSA surrounding the eastern portion of Kodiak Island. The Navy decided to focus available funding to survey areas within the NDSA that have a higher likelihood of human exposure to MEC on the seafloor based on the following:

- Reported discovery
- Proximity to human activity
- Known frequency of MEC release

The SI work plan (U.S. Navy 2014) qualitatively prioritized the known MEC release sites based on information presented in the associated PA (U.S. Navy 2013). The survey areas were grouped into the following four investigation areas:

- Northwestern Chiniak Bay, Saint Paul Harbor, and Womens Bay
- Northeastern Chiniak Bay
- Southeastern Chiniak Bay
- Entrance Point AATC area

The known release sites were prioritized because there was a 2-week period established in which to perform the field work at the site. The prioritization of the known release sites helped determine the order of field investigation. It was understood that it was likely that the known release sites with a lower priority would not be surveyed because of the time constraints.

Table 2-1 lists each area to be surveyed, its survey priority and the estimated size of each area in acres. In the SI work plan, 14 planned survey areas were identified. However, during the investigation some of the areas were counted separately to more easily record and report the survey data, resulting in a total of 17 areas identified in the SI report. Specifically, “Three Explosive Anchorages in Womens Bay” identified in the PA was divided into three separate areas for the SI report: Explosive Anchorage No. 1, Explosive Anchorage No. 2, and Explosive Anchorage No. 3; and “Former Area Anti-Ship Mines (2)” in northeastern Chiniak Bay was divided into two separate areas in the SI report: Former Anti-Ship Mines Area between Long and Woody Islands and Former Anti-Ship Mines Areas East of Long Island. The investigation results, conceptual site model, and recommendations discussed throughout this report are based on these 17 individual survey areas.

2.6.1 Northwestern Chiniak Bay, Saint Paul Harbor, and Womens Bay Area

Information presented in the PA report identified three areas within Womens Bay and Saint Paul Harbor designated as explosive anchorages. These areas were used by U.S. forces to off-load ammunition and high explosives from transport ships. Ordnance was off-loaded onto barges for transfer to shore docks. Occasionally MEC were lost into the marine environment during ordnance-handling operations. These explosive anchorage and shore dock locations were designated as first priority areas for site survey activities and are shown on Figure 2-5.

One of the two AATCs operated on Kodiak Island during World War II was located at Happy Beach where 40- and 20-mm guns fired northeast over Chiniak Bay. Daily records from NOB Kodiak that were reviewed for the PA identified impact areas for gun training exercises conducted from these and other locations during 1943 (U.S. Navy 2013). The presumed danger area (i.e., range fan) for this AATC, where water is less than 120 feet deep, was designated as a second priority area for site survey activities and is shown on Figure 2-5.

The PA conducted for this project identified CDA and AA gun batteries at Fort Greely on Kodiak Island consisting of:

- Four 155-mm CDA guns
- Four 90-mm AMTB guns
- Two 40-mm AA guns
- Six .50-caliber machine guns associated with the gun batteries

Ordnance fired over water from these batteries would consist of gun-function testing and accuracy practice firing at fixed and towed targets. Daily records from NOB Kodiak reviewed for the PA identified impact areas for gun training exercises conducted from these and other locations during 1943 (U.S. Navy 2013). The impact areas identified from available daily gun training exercises for the Fort Greely gun batteries, where water is less than 120 feet deep, were designated as third priority areas for site survey activities and are shown on Figure 2-5.

2.6.2 Northeastern Chiniak Bay Area

Information presented in the PA report identified the Long Island Barge Dock as an ordnance off-loading point (U.S. Navy 2013). This explosive off-loading dock location was designated as a first priority area for survey activities and is shown on Figure 2-6.

During World War II the Navy placed 575 anti-ship mines in Chiniak Bay. During mine-clearing activities, 262 of the original 575 mines (55 percent) were not accounted for during this operation (USACE 2001). Mines were placed in two areas of Northeast Chiniak Bay, one area

between Woody Island and Long Island and an area southeast of Long Island. Mine-clearing activities consisted of cutting the mooring chains and machine gunning the mines once they floated to the surface. The mines either exploded or sank (U.S. Navy 2013). Those that sank may still remain on the seafloor in water less than 120 feet deep. These areas of the former mine fields were designated as second priority areas for survey activities and are shown on Figure 2-6.

The PA conducted for this project identified CDA and AA gun batteries at Fort Abercrombie on Miller Point and Fort Tidball on Long Island consisting of the following:

- Two, 8-inch CDA guns
- Two, 6-inch CDA guns
- Four, 155-mm CDA guns
- Four 90-mm AMTB guns
- Six 40-mm AA guns
- Eight .50-caliber and four .30-caliber machine guns associated with the gun batteries

Ordnance fired over water from these batteries would consist of gun-function testing and accuracy practice firing at fixed and towed targets. Daily records from NOB Kodiak reviewed for the PA identified impact areas for gun training exercises conducted from these and other locations during 1943 (U.S. Navy 2013). The impact areas identified from available daily gun training exercises for the Fort Tidball gun batteries indicate impacts where water is greater than 120 feet deep. The impact areas identified from available daily gun training exercises for the Fort Abercrombie 40-mm AA gun batteries indicate impacts where water is less than 120 feet deep. These shallow water impact areas were designated as a third priority area for survey activities and are shown on Figure 2-6.

2.6.3 Southeastern Chiniak Bay Area

Information presented in the PA report identified one glide and dive bombing target at Humpback Rock located in the southeast portion of Chiniak Bay (U.S. Navy 2013). Because as much as 30 percent of the ordnance that was dropped or fired during World War II did not detonate as intended, UXO or MEC could be present in shallow water surrounding Humpback Rock. This area was designated as a first priority area for site survey activities in this part of Chiniak Bay and is shown on Figure 2-7. It should be noted that the PA report identified eight additional glide and dive bombing targets within the Kodiak Island NDSA. These additional targets were not identified for further investigation by the SI because of the remoteness of their locations.

Mines were placed in two areas of southeast Chiniak Bay, one area between Long Island and Humpback Rock and an area between Humpback Rock and Cape Chiniak. Mine-clearing activities consisted of cutting the mooring chains and machine gunning the mines once they floated to the surface. The mines either exploded or sank (U.S. Navy 2013). Those that sank may still remain on the seafloor in water less than 120 feet deep. These areas of the former mine fields were designated as second priority areas for survey activities and are shown on Figure 2-7.

The PA conducted for this project identified CDA and AA gun batteries at Fort Smith on Cape Chiniak consisting of the following:

- Two 8-inch CDA guns
- Four 155-mm CDA guns
- Two 40-mm AA guns
- Four .50-caliber and two .30-caliber machine guns associated with the gun batteries

Daily records from NOB Kodiak reviewed for the PA identified impact areas for gun training exercises conducted from these and other locations during 1943 (U.S. Navy 2013). Little information was found relating to daily gun training exercises for the Fort Smith gun batteries. MEC that may be present at depths greater than 120 feet deep are not part of this investigation.

2.6.4 Entrance Point AATC Area

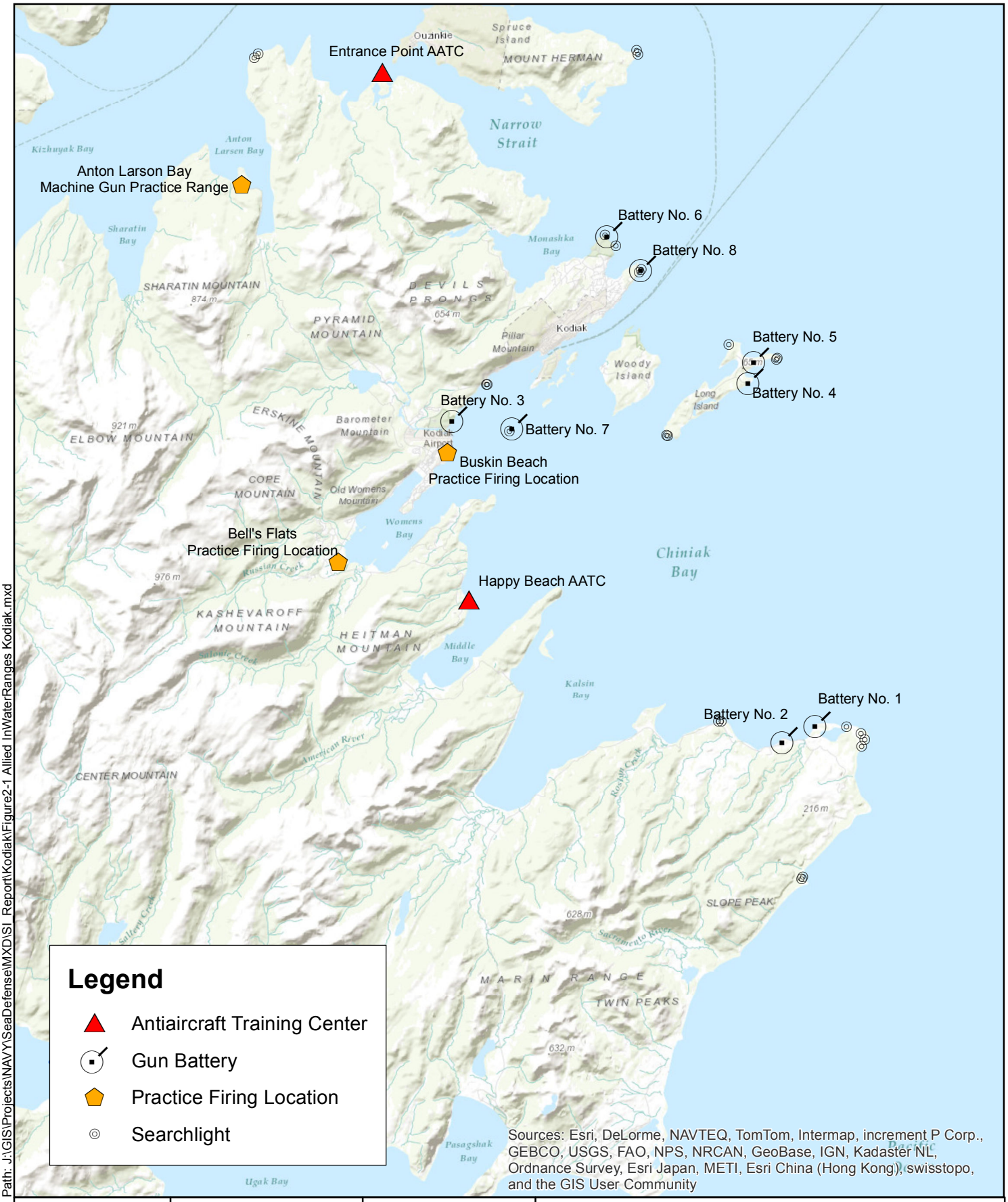
Information presented in the PA report identified the Entrance Point AATC Dock as an ordnance off-loading point (U.S. Navy 2013). This explosive off-loading dock location was designated as a first priority area for survey activities and is shown on Figure 2-8.

The second of two AATCs operated on Kodiak Island during World War II was located at Entrance Point where guns of unconfirmed size (probably 40 and 20 mm) fired north over Marmot Bay. Daily records from NOB Kodiak reviewed for the PA identified impact areas for gun training exercises conducted from this and other locations during 1943. The presumed danger area (range fan) for this AATC, where water is less than 120 feet deep, was designated as a second priority for survey activities and is shown on Figure 2-8.

2.6.5 Reprioritization of Survey Areas Based on Weather Conditions

After the SI work plan was completed, the project team decided during the first field kickoff meeting that some of the survey areas should be reprioritized if there were periods of poor weather conditions that prevented the survey crew from conducting surveys during the planned

14-day survey window. If there were periods of poor weather conditions during the survey period, the plan was to conduct surveys based on the reprioritization of the survey areas (Figure 2-9) when surveying could be conducted during good weather conditions. This figure was presented as Addendum 2 to the SI work plan. Fortunately, weather conditions were favorable such that surveying could be performed each day during the 14-day window, and the reprioritization of the survey areas was not implemented.



Path: J:\GIS\Projects\NAVY\SeaDefenseMXD\SI_Report\Kodiak\Figure2-1 Allied InWaterRanges Kodiak.mxd

U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska		**Figure 2-1** **Known Locations of U.S. Gun Batteries and Antiaircraft Training Centers, Kodiak Island**

Legend

- Anti-Ship Mine Location
- Explosive Anchorage Area
- Known Military Docks

Army Facilities

- A1 Army Dock
- A2 Army Pier Harbor Craft Float
- A3 Long Island Barge Dock
- A6 Puffin Island Barge Dock
- A7 Entrance Pt AATC Dock

Navy Facilities

- N1 Woody Island Barge Dock
- N2 Marginal Pier
- N3 Permanent Pier
- N4 Navy Harbor Craft Float
- N6 Boat House Floats and Walks
- N7 Barge Dock
- N8 Yale Mooring
- N9 Algonquin Mooring
- N10 Temporary Pier
- N11 Small Boat Landing
- N12 Tatoosh Mooring
- N13 Ships Water Service Station
- N14 Honey Barge Dock

A7 A1 A2 N1 A3 A6 N8 N9 N7 N10 N6 N11 N13 N12 N4 N14 N3 N2

Explosive Anchorage No. 1

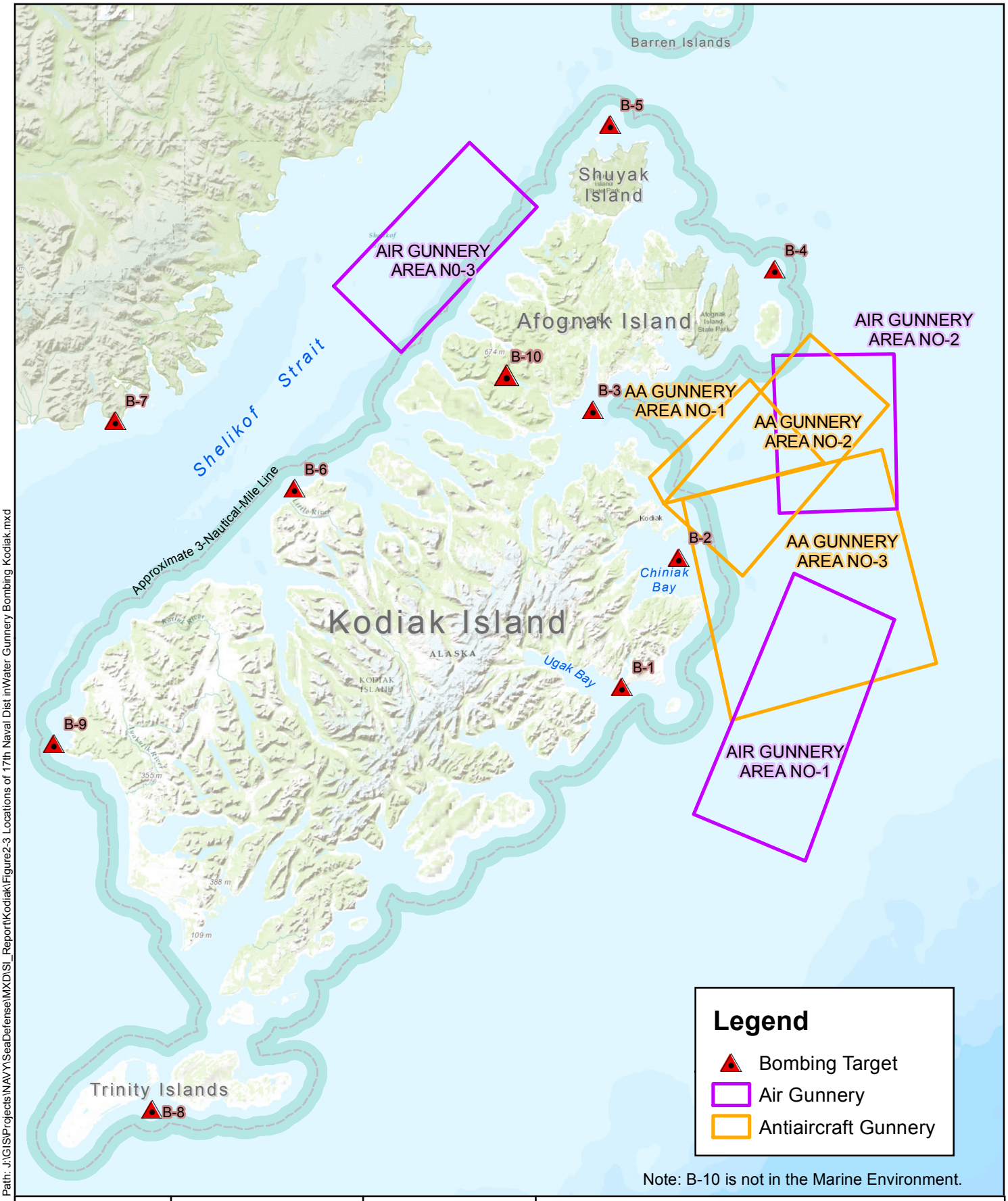
Explosive Anchorage No. 2

Explosive Anchorage No. 3

Chiniak Bay

Path: J:\GIS\Projects\NAVY\SeaDefense\MXD\SI_Report\Kodiak\Figure2-2 Mines Explosive Anchorage Docks Chiniak Bay Kodiak.mxd

U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska	0 0.75 1.5 Scale In Miles	**Figure 2-2** **Location of Anti-Ship Mines, Explosive Anchorage Areas, and Known Military Docks Located in Chiniak Bay, Kodiak Island**



Path: J:\GIS\Projects\NAVY\SeaDefense\MXD\SI_Report\Kodiak\Figure2-3 Locations of 17th Naval Dist inWater Gunnery Bombing Kodiak.mxd

U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska	0 10 20 Scale In Miles	**Figure 2-3** **Location of Seventeenth Naval District in-Water Gunnery Areas and Bombing Targets in the Vicinity of Kodiak Island**

Entrance Point AATC

Anton Larson Bay
Machine Gun
Practice Range

Battery No. 6

Fort Abercrombie

Battery No. 8

Extent of Naval Defensive Sea Area

Battery No. 5

Long Island

Woody Island

Battery No. 4

Fort Greely

Battery No. 3

Battery No. 7

Buskin Beach
Practice Firing
Location

Bell's Flats
Practice Firing
Location

Happy Beach
AATC

Battery No. 1

Battery No. 2

Fort Smith

Path: J:\GIS\Projects\NAVYSeaDefense\MXD\SI_Report\Kodiak\Figure2-4 Projected Impact Areas for 1943 Gunnery Training Activities NOB Kodiak.mxd

Legend

- Practice Air Raid Danger Area
- Practice Firing Area
- Practice Firing Area/Towed Target
- Practice Impact Area
- Antiaircraft Training Center
- Gun Battery
- Practice Firing Location
- Searchlight

U.S. NAVY

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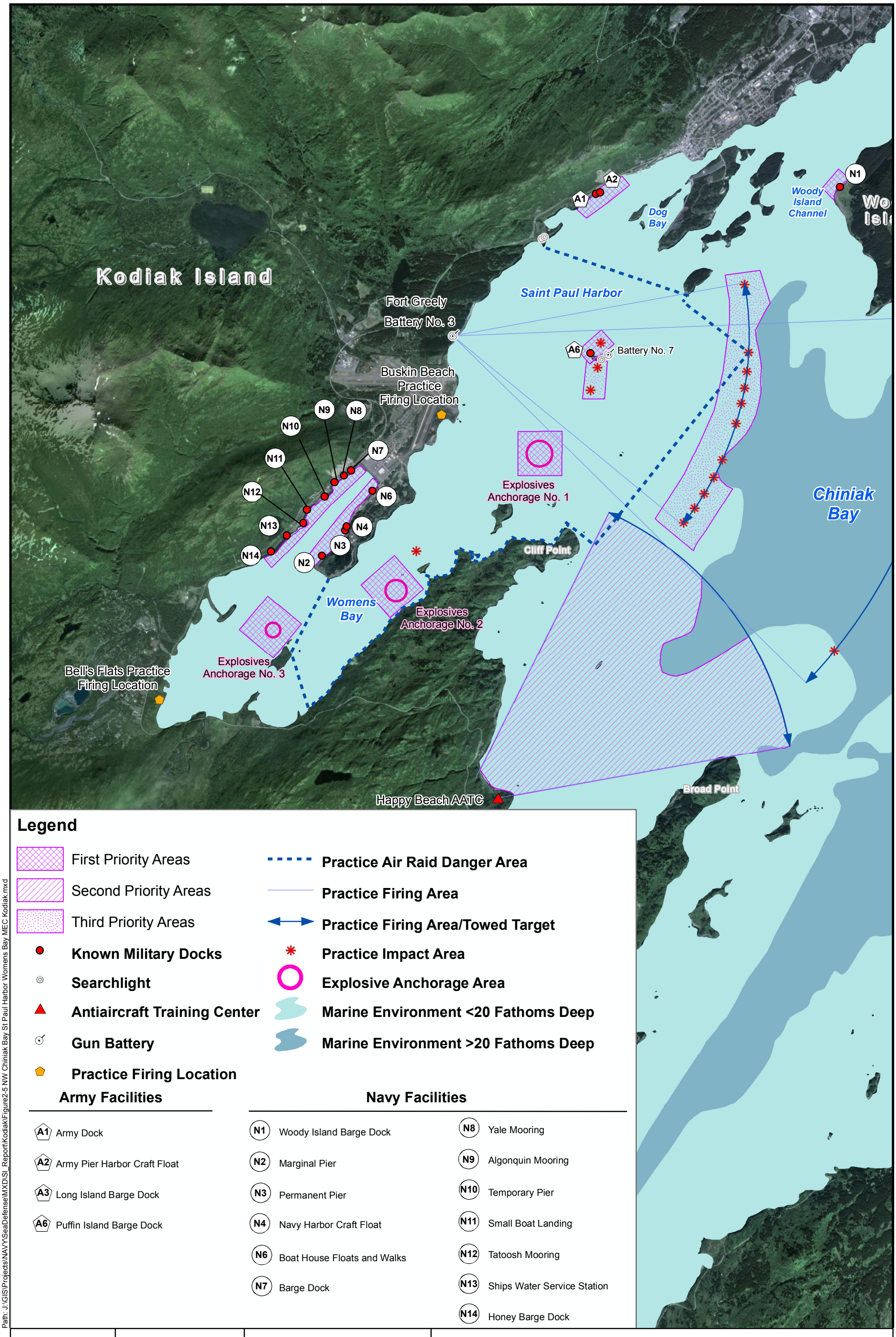
SI Report
Naval Defensive
Sea Area
Kodiak Island, Alaska

0 1.25 2.5
Scale In Miles

Figure 2-4
Projected Impact Areas for 1943 Gunnery Training Activities, NOB Kodiak



Legend

- First Priority Areas
- Second Priority Areas
- Third Priority Areas
- **Known Military Docks**
- **Searchlight**
- **Antiaircraft Training Center**
- **Gun Battery**
- **Practice Firing Location**
- **Practice Air Raid Danger Area**
- **Practice Firing Area**
- **Practice Firing Area/Towed Target**
- **Practice Impact Area**
- **Explosive Anchorage Area**
- **Marine Environment <20 Fathoms Deep**
- **Marine Environment >20 Fathoms Deep**

Army Facilities

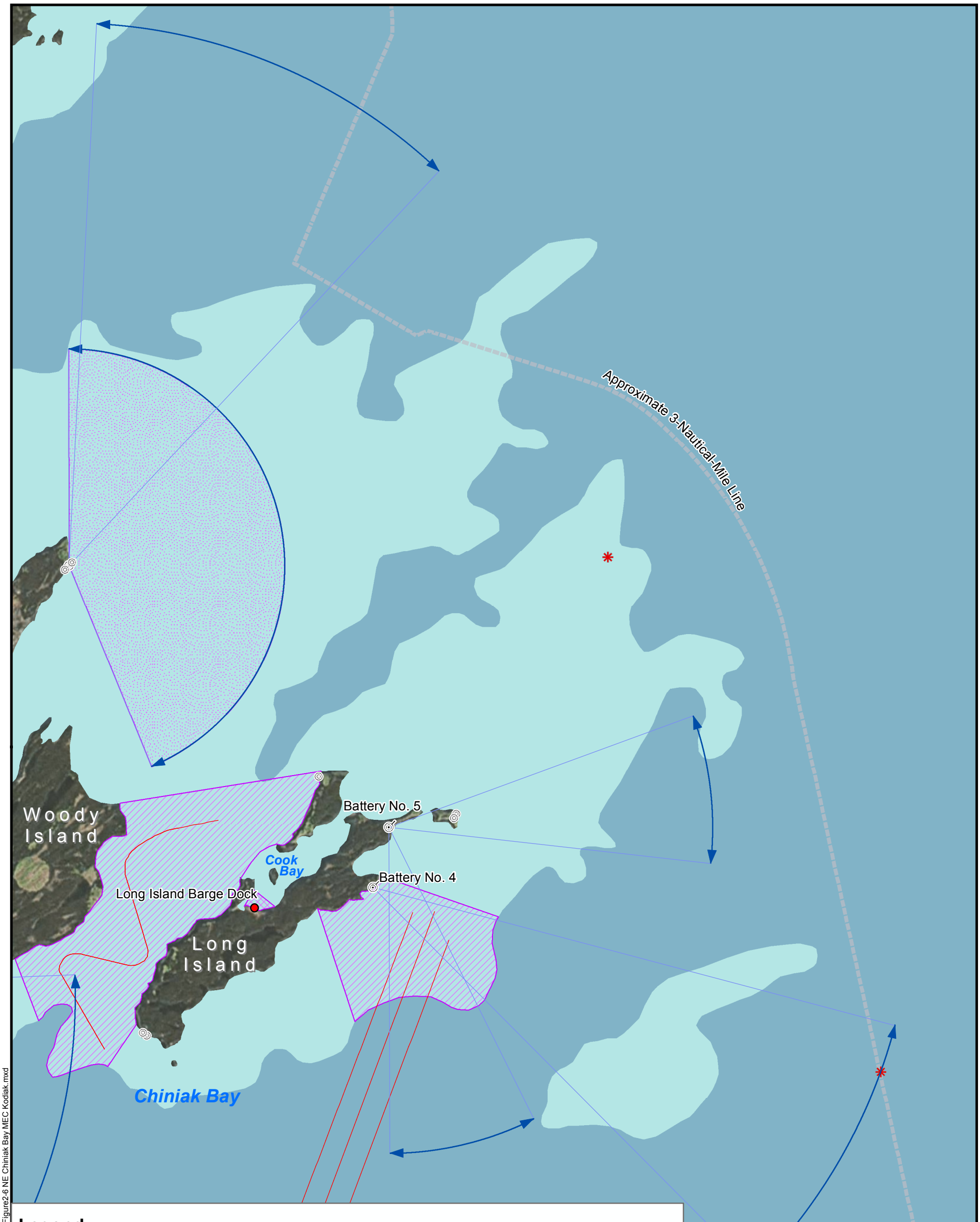
- A1 Army Dock
- A2 Army Pier Harbor Craft Float
- A3 Long Island Barge Dock
- A6 Puffin Island Barge Dock

Navy Facilities

- N1 Woody Island Barge Dock
- N2 Marginal Pier
- N3 Permanent Pier
- N4 Navy Harbor Craft Float
- N6 Boat House Floats and Walks
- N7 Barge Dock
- N8 Yale Mooring
- N9 Algonquin Mooring
- N10 Temporary Pier
- N11 Small Boat Landing
- N12 Tatoosh Mooring
- N13 Ships Water Service Station
- N14 Honey Barge Dock

Path: J:\GIS\Projects\NAVY\SeaDefense\MXD\SI_Report\Kodiak\Figure2-5 NW Chiniak Bay St Paul Harbor Womens Bay MEC Kodiak.mxd

U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska	N 0 0.5 1 Scale In Miles	**Figure 2-5** **Planned Survey Areas in Northwestern Chiniak Bay, Saint Paul Harbor and Womens Bay, Kodiak Island**



Path: J:\GIS\Projects\NAVY\SeaDefense\MXD\SI_Report\Kodiak\Figure2-6 NE Chiniak Bay MEC Kodiak.mxd

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Naval Defensive
Sea Area
Kodiak Island, Alaska

0 0.5 1
Scale In Miles

Figure 2-6
Planned Survey Areas in Northeastern Chiniak Bay, Kodiak Island

Long Island

Chiniak Bay

B-2

Approximate3-Nautical-Mile Line

Battery No. 1

Battery No. 2

Fort Smith

Legend

- First Priority Areas
- Second Priority Areas
- Third Priority Areas
- Searchlight
- Gun Battery
- Glide/Dive Bombing Target
- Practice Firing Area
- Practice Firing Area/Towed Target
- Anti-Ship Mine Location
- Practice Impact Area
- Marine Environment <20 Fathoms Deep
- Marine Environment >20 Fathoms Deep

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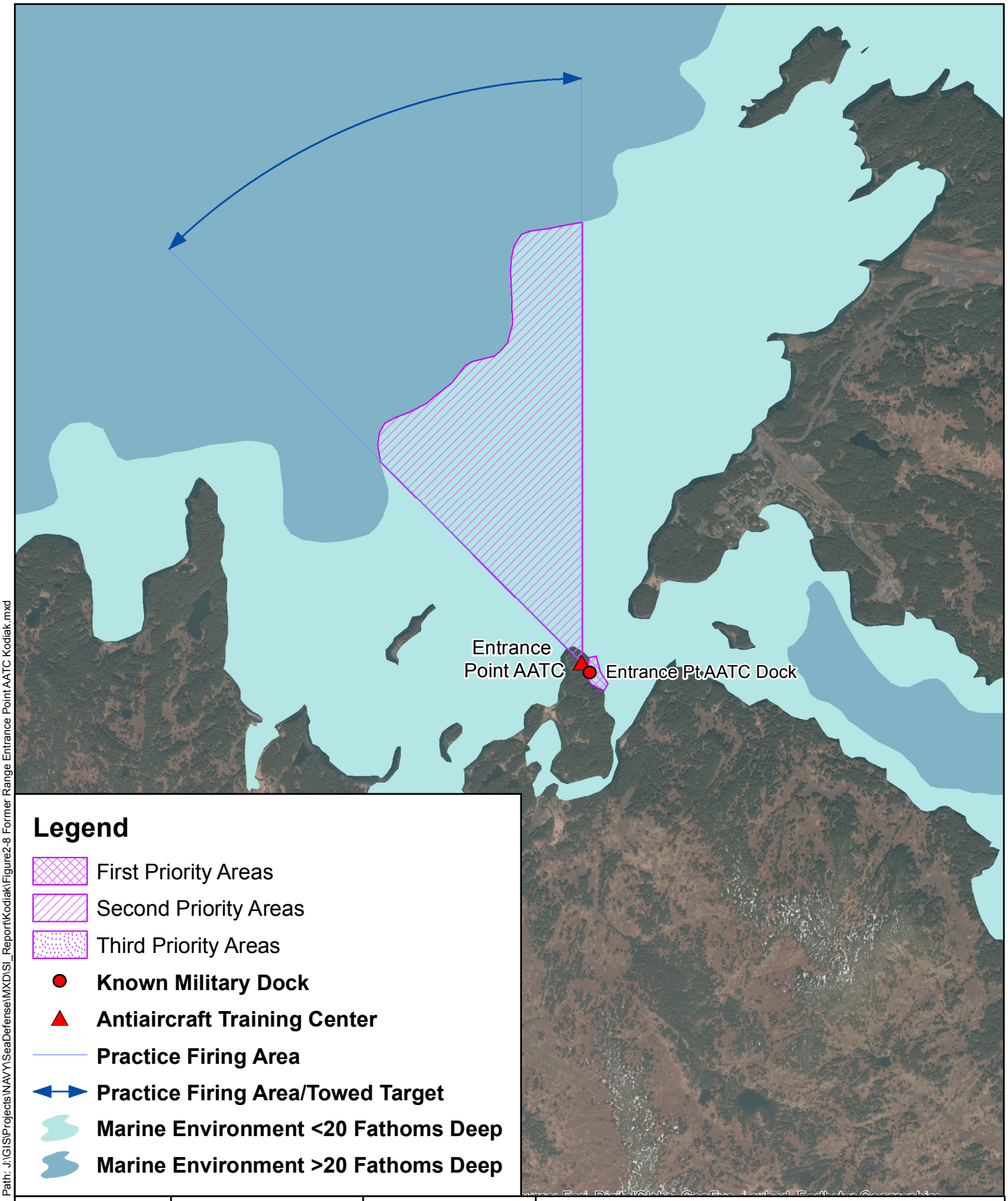
Naval Defensive
Sea Area
Kodiak Island, Alaska

0 0.5 1
Scale In Miles

Figure 2-7
Planned Survey Areas in Southeastern Chiniak Bay
Kodiak Island



Path: J:\GIS\Projects\NAVY\SeaDefense\MXD\SI_Report\Kodiak\Figure2-8 Former Range Entrance Point AATC Kodiak.mxd

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Naval Defensive
Sea Area
Kodiak Island, Alaska

0 2,000 4,000
Scale In Feet

Figure 2-8
Planned Survey Areas
Off the Entrance Point AATC,
Kodiak Island

Marmot Bay
Spruce Island
Entrance Point
Narrow Strait
Anton Larson Bay
Monashka Bay
Fort Abercrombie
Kodiak Island
Woody Island Channel
Woody Island
Long Island
Saint Paul Harbor
Fort Greely
Chiniak Bay
Womens Bay
Happy Beach
Humpback Rock
Fort Smith
3 Nautical Mile Boundary
Gulf of Alaska
1
2

Legend

- Known Military Docks
- Practice Impact Area
- Glide/Dive Bombing Target
- Antiaircraft Training Center
- Gun Battery
- Practice Firing Location
- Anti-Ship Mine Location
- 3 Nautical Mile (Boundary of Naval Defensive Sea Area)
- Practice Firing Area
- Practice Firing Area/Towed Target
- Explosive Anchorage Area
- First Priority Areas
- Second Priority Areas
- Third Priority Areas
- Marine Environment <20 Fathoms Deep
- Marine Environment >20 Fathoms Deep

Document Path: J:\GIS\Projects\NAVY\SeaDefense\MXD\SI_Report\Kodiak\Figure2-9 Planned Survey Areas Based on Weather Reprioritization.mxd

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Naval Defensive Sea Area
Kodiak Island, Alaska

0 1.25 2.5
Scale In Miles

Figure 2-9
Reprioritization of a Planned Survey Areas Based on Weather Conditions, Kodiak Island

Table 2-1
Planned Survey Areas in the Vicinity of Kodiak Island

Survey Area	Priority	Surface Area (Acres)
Northwestern Chiniak Bay, Saint Paul Harbor and Womens Bay		
Explosive Anchorage No. 1	1st	166
Explosive Anchorage No. 2	1st	166
Explosive Anchorage No. 3	1st	165
Navy Dock Locations in Womens Bay[a]	1st	211
Army Dock Locations in Saint Paul Harbor	1st	67
Former Army Dock at Puffin Island	1st	49
Former Navy Dock at Woody Island	1st	29
Happy Beach AATC Impact Area	2nd	3,930
Fort Greely Gun Batteries Impact Area (two areas)[b]	3rd	981
Total Area		**5,764**
Northeastern Chiniak Bay		
Long Island Dock	1st	21
Former Anti-Ship Mines Area between Long and Woody Islands	2nd	2,586
Former Anti-Ship Mines Area East of Long Island	2nd	1,225
Fort Abercrombie Gun Batteries Impact Area	3rd	4,569
Total Area		**8,401**
Southeastern Chiniak Bay		
Humpback Rock Glide and Dive Bombing Target	1st	213
Former Anti-Ship Mines Area (two areas)[c]	2nd	1,736
Total Area		**1,949**
Entrance Point		
Entrance Point AATC Dock	1st	9
Entrance Point AATC Impact Area	2nd	1,031
Total Area		**1,040**
Total Surface Area of All Planned Survey Areas		**17,154**

[a]The geophysical subcontractor (Gravity/SeaVision) recorded "Navy Dock Locations in Womens Bay" as two separate areas: "Navy Dock 1" on the northwest shoreline of Womens Bay and "Navy Dock 2" on the southeast shoreline).
[b]Includes Fort Greely area and an area referred to as Puffin Island South in Gravity's report and data.
[c]This area is referred to as Midway Point in Gravity's report and data.

3.0 SITE INSPECTION SURVEY DESIGN AND METHODS

The SI survey was performed with the use of two vessels and consisted of two phases. The first phase was a WAA survey and the second a reacquisition and verification (RV) phase. This section describes the vessels, equipment, and methods used to acquire data.

3.1 VESSEL DESCRIPTION

The research vessel (R/V) *Thunder*, owned by Northern Telecommunications Consultants, Inc., provided vessel services (Figure 3-1). R/V *Thunder* is a heavy weather, welded aluminum, high-speed, low-draft catamaran that measures 69 feet in length with a 20-foot beam, weighing approximately 34 tons. R/V *Thunder* had an adequate working space in the salon area for operating the computers and open rear deck to store and set up the equipment used for the SI survey. The vessel also had total berthing capacity for 19 persons, though the scientific crew planned to come ashore each evening.

The vessel was equipped with two 20-kW generators to provide abundant power, cable raceways and large workstations for a variety of electronic workstations, and 6-foot by 19-inch computer rack that provides space for rack mounted electronics. Deck equipment included a substantial 110-kg Bruce anchor for storm conditions, full Coast Guard safety equipment, a 4,500-pound deck crane, and an A-frame for towing operations.

The helm was equipped with Furuno electronics, marine PC, Max-Sea professional software, Wide Area Augmentation and Differential Global Positioning Systems, autopilot, and three Stidd helm chairs. Propulsion was provided by twin Caterpillar C-18 1,001-hp diesels, ZF gearboxes, and Hamilton 461 jets with commercial Hamilton redundant controls and low-speed maneuvering system.

R/V *Thunder* provided a five-person crew to support the surveying effort. The duties of the crew included a master, chief engineer, deck boss, mechanic, and cook for the crew.

A second smaller manned vessel (referred to as *Blackfoot*) was used for surveying rather than an autonomous underwater vehicle, as originally planned (Figure 3-2). Gravity recommended this change on March 4, 2015, prior to departure to the field, as documented in Addendum 1 to the SI work plan. *Blackfoot* is a 15-foot-long plastic inflatable skiff with a covered cabin. Using the manned vessel was recommended for shallow nearshore areas, which would work better than the autonomous underwater vehicle because of strong subsea currents, uneven bathymetry, and curved shorelines. R/V *Thunder* transported Gravity's skiff from Juneau, Alaska prior to starting the surveying at Kodiak.

3.2 WIDE-AREA ASSESSMENT SURVEYING

During the WAA, the survey team used interferometric and sidescan sonar. Gravity provided and operated the equipment for the survey. At the onset of field work, Gravity provided a five-person survey team. The Gravity team was reduced to four after the sixth day of surveying. The former Navy Remedial Project Manager, Grady May, joined the team on R/V *Thunder* to observe the survey operations on the first day of surveying.

3.2.1 Equipment Descriptions

The survey team brought different types of geophysical equipment on board. However, to survey the maximum amount of seafloor within the 14-day window planned to survey areas, sidescan and interferometric sonar were used during the WAA phase of the SI field work. The sidescan sonar was used on R/V *Thunder* while the interferometric sonar was used on *Blackfoot*.

Sidescan Sonar

The survey team towed an EdgeTech 4125 dual frequency 400-kHz/900-kHz compressed high-intensity radar pulse (CHIRP) sidescan sonar (Figure 3-3) that was designed as a towfish attached to a cable behind a vessel. A depressor wing was attached to the top of the sidescan sonar soon after its initial deployment so that it could be towed closer to the seafloor to provide better data. The survey team paired the EdgeTech sidescan sonar with a submeter accurate Hemisphere GPS R320 GNSS receiver. The Hemisphere GPS R320 supplied World Geodetic System 1984 (WGS84) latitude and longitude positioning at a rate of 20 Hz, with the positioning data distributed simultaneously to the EdgeTech 4125 acquisition system and a hydrographic survey software package for monitoring real-time navigation relative to preplanned survey lines during all survey operations.

The sidescan sonar surveys yielded plan-view imagery of large areas of the seafloor and served as an efficient means of identifying items that are present above the level of the seafloor, identifying the texture and type of seabed, and detecting debris and other navigational obstructions.

Sidescan sonar uses a special transducer that aims conical/fan-shaped acoustic pulses toward the seafloor across a wide angle perpendicular to the sensor's path. The acoustic pulses are directed downward toward the port (left) and starboard (right) sides. The sidescan sonar does not emit an acoustic pulse directly below the equipment, which causes a black line called a nadir gap that results from the lack of acoustic reflections. The intensity of this fan-shaped acoustic beam's reflections off the seafloor is recorded as a series of cross-track slices. Figure 3-4 shows two example screenshots of the real-time output of the sidescan data on a monitor during a survey. The nadir gap is shown as the black line in the center of the display. The seafloor is

approximately 50 to 75 feet below the sidescan sonar, as indicated by the nadir gap in the screenshots. Rock formations and sand waves are visible in the first screenshot. An anomaly is easily visible on the seafloor on the starboard side below the sidescan sonar as shown in the second screenshot.

Interferometric Sonar

The survey team mobilized a Ping DSP 3DSS 460 interferometric sonar and SBG Systems Ekinox-D Inertial Navigation System on the survey skiff *Blackfoot* to survey smaller survey areas generally close to shore. These survey areas had geometries that required tighter turning radii or shallower water, generally less than a 5-meter depth. The Ping DSP sonar is a high-resolution sidescan sonar operating at 460 kHz that collects simultaneous sidescan sonar imagery and bathymetry data. The SBG Inertial Navigation System couples a dual-antenna Trimble Global Positioning System (GPS) receiver with a tactical-grade inertial measurement unit to generate decimeter-level accurate positioning at a rate of 50 Hz. The Ping DSP sonar, rigidly mounted to a pole on the port beam of the survey skiff, integrates all of the positioning and orientation data in real time to generate high-resolution sidescan sonar imagery, 3D rendered sonar imagery, and high-resolution bathymetry.

3.2.2 Survey Geometry

Survey transects lines were established prior to the survey at each location. Transect lines were either parallel to the shoreline for nearshore areas, or were oriented in the same direction as the length of the area. Transects were spaced so that the coverage of the seafloor overlapped. Transects were conducted in water that is less than 20 fathoms (120 feet) to comply with the Navy MRP policy (U.S. Navy 2007) described in Section 2.4.

Survey operations with both the EdgeTech 4125 sidescan sonar and the Ping DSP interferometric sonar required similar survey geometries, with some variations according to water depth and overall survey area shape. The survey team used the following guidelines for planned survey transects:

- Survey lines should cover the entire survey area.
- Turns should be gently sweeping maneuvers.
- Lines that follow the shoreline should be used in nearshore survey areas.
- Line spacing for the survey lines should be set at the range setting for the sonar.
- Sonar range for the EdgeTech should be set at 50 to 70 meters. Sonar range for the Ping DSP should not exceed 50 meters.

Setting the line spacing equivalent to the sonar range (the range of a single channel) may appear on the surface to be somewhat inefficient, because both the EdgeTech and the Ping DSP sonars generate a swath width that is double the set range. However, the advantage to setting the line spacing equal to (or slightly less than) the sonar range is that coverage gap below the sonars, called the nadir gap, is minimized if not rendered completely inconsequential. Also, individual targets are likely illuminated in successive passes of the sonar, thus providing additional opportunities to identify, measure, and characterize targets.

3.2.3 Data Acquisition

Survey data acquisition with the EdgeTech 4125 sidescan sonar required deployment of the sonar from the A-frame at the stern of the R/V *Thunder* (Figure 3-5) with a preset cable pay-out. During all survey operations, the survey team manually recorded the amount of sonar towfish tow cable paid out to the A-frame turning block so that postprocessing can accurately correct the location of the towfish for cable payout, layback geometry, and distance between the turning block and the Hemisphere GPS R320 antenna. The sidescan sonar was generally towed at a speed of approximately 3 to 5 knots.

During survey operations, the survey team and vessel operator simultaneously monitored the track line positioning, towfish positioning, and survey vessel positioning in Hypack 2015 (a hydrographic survey software package) using cloned computer displays in the pilothouse and vessel salon. An example of the planned survey lines as observed on a monitor during a survey is shown on Figure 3-6. This allowed both the survey team and the vessel operator to monitor survey progress relative to planned survey lines. All data with the EdgeTech 4125 were collected with the EdgeTech Discover software and recorded to the proprietary JSF file format that records sonar data with geographic positioning information from the Hemisphere GPS R320 receiver.

Output from the sidescan sonar was observed in real time during the survey on a monitor on the vessel. An example of recorded survey lines as observed in real time on a monitor in the vessel is shown on Figure 3-7.

The Ping DSP sonar was attached to a metal pole that was lowered about 2 to 3 feet below the port side of *Blackfoot* (Figure 3-8). The survey crew used the Hypack 2015 hydrographic survey software to integrate and record the Ping DSP data with the SBG Ekinox-D inertial navigation data, monitor vessel positioning and track line positioning, and monitor completed survey coverage. Device offsets between the Ping DSP and the SBG inertial navigation system required only one measurement and entry into survey configuration files prior to all survey operations. For all survey operations, Hypack generated the HSX file format for each discrete survey line that integrated sidescan sonar, bathymetry, positioning, and orientation information.

3.2.4 Data Processing

The survey team completed all data processing (both in the field and in the office after field work) using Chesapeake Technologies' SonarWiz 6. SonarWiz is an industry-leading sidescan sonar processing software that allows review and post processing of a variety of data from commercially available sidescan sonars. The survey team organized all data according to survey area and treated each survey area separately for purposes of processing.

The survey team used the following general workflow for processing data from each survey area:

1. Import JSF or HSX data with proper geodesy and initial signal gain settings.

2. Enter and confirm device and vessel geometry to account for GPS location, turning block location, and cable layout so as to properly calculate towfish layback for all sidescan sonar imagery.

3. Review all data and track bottom in all survey lines. Slant-range correct all survey data once bottom tracking is complete.

4. Review data and impose automatic gain control and/or time-varied gain signal processing techniques to improve image quality and maximize image detail.

5. Review all files individually to select targets.

6. Reconcile targets that have been selected multiple times in multiple survey files.

7. Measure and characterize targets.

8. Manipulate files to generate sidescan sonar image mosaics of entire survey area.

9. Generate deliverable files for each survey area, relative to the project horizontal datum, which is North American Datum of 1983, Alaska (Zone 10) State Plane in feet.

The survey team rapidly executed steps 1 through 7 above when reviewing data in the field in order to select targets for the RV phase in each survey area. Rapid targeting identified several unique targets in each survey area that could be investigated later in the RV phase during field work, while comprehensive office-based postprocessing after the field period yielded dramatically increased numbers of targets in each survey area, some of which were clearly not MEC targets.

Steps 8 and 9 were performed in the office after completing the field work. Properly performed sidescan sonar surveys produced accurate geographically referenced data, postprocessed and converted to nearly seamless mosaics of plan-view sonar imagery in step 8. These mosaics of the seafloor of the entire survey area were produced by stitching together numerous adjacent sidescan sonar tracks, as shown for each surveyed area presented in Section 4. In addition to highlighting bottom conditions, the mosaics can be fed into a variety of computer-aided design (CAD) and geographic information system (GIS) software packages, including visualization software such as Google Earth. After processing was complete, all data files were delivered to URS in September 2015 on a hard drive to complete step 9.

3.3 REACQUISITION AND VERIFICATION SURVEYING

The RV phase included a closer inspection of selected targets identified during the WAA phase of the survey. A remotely operated vehicle (ROV) was the primary tool used in the RV phase to reacquire and visually inspect selected targets based on recorded GPS coordinates. The ROV provided ground-truth video and high-resolution sonar imagery of specific targets of interest identified by the survey team. The expectation was that if the water near the seafloor was relatively clear, the currents were not strong, and biological growth on the target was not excessive, the survey team would be able to visually find and identify the target.

To identify potential MEC targets of concern for the RV phase after completing WAA sidescan and interferometric sonar surveys in the various project survey areas, the survey team performed a rapid review, processing, and interpretation of the data. Field determination of potential targets for reacquisition and verification was based on several characteristic features in sidescan sonar imagery, including the following:

- Size: less than 5 by 5 feet: Some large targets may be of interest.
- Shape: cylindrical (for bombs/artillery shells) or rectangular (for crates)
- Strength of acoustic signal return

3.3.1 Equipment Description

An ROV is a tethered, unmanned, highly maneuverable vehicle that is operated from the shore or aboard a vessel. ROVs are typically linked to a topside interface by either a neutrally buoyant tether or a load-carrying umbilical cable. The tether/umbilical cable contains electrical conductors and fiber optics to simultaneously carry power, vehicle control, video, and data signals between the vehicle and the operator. Most ROVs are equipped with a video camera and lights, but may be customized to increase the vehicle's capabilities.

The ROV system deployed for the RV surveys in the Kodiak NDSA is shown on Figure 3-9 and consisted of the following inventory of equipment:

- VideoRay Pro4 Mini-ROV
  - Electrically-powered Mini-ROV with three DC-brushless thrusters for horizontal and vertical vehicle control
  - 570-line resolution video camera
  - Auto-depth and auto-heading capability
  - External LED lighting
  - TriTech Gemini forward-looking multibeam imaging sonar
- Over 500 feet of control umbilical cable
- Topside control unit with integrated control box featuring:
  - Windows-based graphic user interface
  - Head-up display of ROV heading, depth, and water temperature
  - Real-time video display
  - Real-time digital video recording to Windows Media Video (WMV) or AVI formats
  - Real-time digital video still-capture capability
  - Multifunction hand controller

The VideoRay Pro4 model used for the RV survey was custom modified to include additional lighting, self-contained camera equipment, and additional sensors. While video was assumed to be the primary RV survey tool, the ROV was also outfitted with a Tritech Gemini high-resolution forward-looking imaging sonar that provided longer range (greater than 100 feet) plan-view imagery in real time to aid the operator with understanding the underwater surroundings beyond what may be readily visible with the ROV onboard camera. The ROV provided real-time video, heading, and depth information, as well as time and date stamps and user-definable text title fields that provided the operator with the ability to maintain situational awareness during underwater survey operations and a proper video record of all survey activities.

The survey team used an ROV on R/V *Thunder* while *Blackfoot* continued to conduct the WAA using the interferometric survey. Two redundant ROVs were available on board.

3.3.2 Acquisition and Survey

After identifying and prioritizing potential targets for RV surveys, the survey team directed the vessel to anchor in the vicinity of each target. The vessel operator had to consider the current

and wind direction when determining the anchoring location for the best placement of the vessel closest to the targets.

Upon anchoring at each target location, the survey team marked the location of the survey vessel relative to the target and determined the bearing and range from the ROV launch location to each intended target. The ROV was hand launched from the stern of the survey vessel and operated so as to descend directly down from the stern of the vessel. The operator used the onboard ROV compass to bring the ROV to bear on the intended target while using the forward-looking Tritech Gemini sonar to reacquire the target on sonar, as shown on the example screenshot of the sonar output during reacquisition on Figure 3-10. The operator then flew the ROV to the target until the target could be detected visually with the video camera on the ROV. The live video was monitored on the vessel, as shown in an example screenshot (Figure 3-11) of a target on a video monitor. At most locations where the survey vessel anchored to reacquire targets, multiple targets were inspected that were within reach of the available length of the ROV umbilical cable.

The ROV collected video, still image, and sonar imagery of each target. The survey team classified the targets based on observations. Onboard scaling lasers, spaced at 3.25 inches apart, provided scale in the imagery to aid with characterizing target size. In some cases, the ROV was redeployed to collect higher quality video and still photographic imagery of specific targets of interest, using a high-resolution still camera and high-definition video camera. All data were organized and named in accordance with the conventions established in the SI work plan (U.S. Navy 2014). All data files, including videos and still photographs of reacquired targets, were delivered to URS on a hard drive in September 2015.

3.4 REACQUISITION AND VERIFICATION SURVEYING – MARINE MAGNETOMETER

The marine magnetometer was used during the RV phase in two areas after sidescan sonar was used in those areas during the WAA phase. The magnetometer measures variations in the earth's magnetic field as a result of subsurface geology, objects, or features by measuring the magnetic field with a portable sensor. Anomalies are likely to cause local variations in the ambient magnetic field (or in the magnetic gradient measured across the sensors). Ferrous objects or field-deflecting features such as pipelines, cables, UXO, and fish traps may be detected using magnetometers. The magnetometer helped to determine if targets identified during the WAA survey phase displayed a change in the ambient magnetic field, suggesting that the target or targets may be composed of a ferrous material.

The magnetometer output is basically a single observation: field strength. The sensor of the marine magnetometer has no directional component while having two variables (mass and distance). The anomaly created by an object is inversely proportional to the cube of the distance

between the target object and the sensor. Surveying using the magnetometer took two to three times longer to survey compared to surveying the same areas using sidescan sonar, primarily because the best results using the magnetometer require two sets of survey lines that are perpendicular. For these reasons, marine magnetometer surveying was not used during the WAA phase and was only used sparingly during the RV phase.

3.4.1 Equipment Description

The survey team used a Marine Magnetics SeaSpy magnetometer (Figure 3-12) that was designed as a towfish. It was paired with a submeter-accurate Hemisphere GPS R320 GNSS receiver that delivered WGS84 latitude and longitude positioning to the Hypack 2015 hydrographic survey software package. This software was configured for monitoring real-time navigation relative to preplanned survey lines, magnetometer layback and position, and magnetometer observations during all survey operations.

3.4.2 Survey Geometry

Survey operations with the Marine Magnetics SeaSpy required preplanned survey lines in two directions (perpendicular to each other). All lines were spaced 30 meters apart.

3.4.3 Data Acquisition

The survey crew deployed the marine magnetometer from the A-frame at the stern of the R/V *Thunder* to acquire data. Device offsets between the A-frame turning block and the GPS antenna, and attention to cable payout, were recorded into survey configuration files prior to all survey operations. The magnetometer was generally towed at a speed of approximately 3 to 5 knots.

Hypack 2015 hydrographic survey software was used to integrate and record the magnetometer data with the Hemisphere GPS R320 positioning data, monitor vessel positioning and track line positioning, and calculate magnetometer towfish layback relative to the survey vessel. The Hypack software generated the raw file format for each discrete survey line that integrated magnetometer data with time, positioning, and layback information.

Output from the magnetometer was observed in real time during the survey on a monitor on the vessel. Resulting output from each trackline was a graph that measures the total magnetic field strength in nanoteslas (nT). An example of real-time magnetometer output as observed on a monitor of a single completed track line is shown in the bottom right of Figure 3-6.

3.4.4 Data Processing

The survey team completed in-field processing of the magnetometer survey data by using the Hypack 2015 hydrographic survey software to generate a text XYZ file of each survey area where X represents easting values and Y northing values relative to the project horizontal datum of the North American Datum of 1983, Alaska (Zone 10) State Plane feet. The Z values represent the total magnetic field strength collected by the magnetometer in nT.

After generating XYZ files, the field survey team generated color-shaded relief imagery after triangulated irregular network surface generations to interpolate between points in the survey area and thus display anomalies against the background magnetic field for this area. The color-shaded relief imagery, in turn, produced GeoTiff geographically referenced TIFF images for use as basemaps to compare with sidescan sonar target shapefiles. This comparison provided the survey team with rough indications as to the presence of ferrous/metallic objects among the interpreted targets that sidescan sonar surveys produced.

Further processing of the magnetometer data uses the time stamp of the magnetometer data and a time-domain processing technique where the change in the magnetic field observation ("delta") is calculated between subsequent observations and a data matrix that records the X, Y, and delta values. This is a slightly different approach to processing and rendering than the field approach, because it focuses on the differential anomaly that any ferrous object may create in the local magnetic field. This processing approach also helped to suppress noise or abnormal behavior in the magnetometer.

3.5 QUALITY ASSURANCE/QUALITY CONTROL TESTING

Quality assurance/quality control (QA/QC) procedures related to the geophysical equipment were employed to verify how the geophysical equipment responded to test shapes that represented MEC on the seafloor. The survey crew deployed a mock .50-caliber round, inert 25-pound mortar, and inert 100-pound bomb as known targets in Explosive Anchorage No. 1 for testing of the EdgeTech 4125 sidescan sonar and the Marine Magnetics SeaSpy magnetometer (Figure 3-13). The mock .50-caliber round shell was an approximately 12-inch-long, 1.25-inch-diameter, thick-walled steel pipe. The 25-pound dummy mortar shell was approximately 24 inches long with a thick steel shell and fins and weighed about 25 pounds. The 100-pound dummy bomb was a hollow metal shell weighing approximately 15 pounds. It was filled with gravel to more closely resemble the density of the MEC item it represented and better reflect sound waves.

After deploying each inert test shape at a preplanned location and recording the position, a series of survey passes with the instruments were performed on May 8 and 10, 2015 to test detection and position accuracy. The position accuracy has been demonstrated throughout this project by virtue of the successful identification of targets in the WAA sidescan sonar surveys and RV of targets with the ROV.

3.5.1 Sidescan Sonar Survey QA/QC Test Results

The results of the sidescan sonar tests using the three test shapes showed that only the largest test shape was positively detected. In the case of the .50-caliber round and 25-pound mortar shells, neither the 400-kHz nor the 900-kHz frequencies indicated a positive detection of the test shape. However, both frequencies appeared to indicate the ability to detect the 100-pound test shape. It is important to note, however, that the 100-pound bomb test shape does not necessarily look like a bomb. Rather, it could easily be mistaken for a rock or a fuel tank or other storage tank. A sample sidescan sonar survey pass at 900 kHz over the 25-pound mortar and the 100-pound bomb test shapes is shown on Figures 3-14. An enlarged view of the 100-pound bomb and processed information is shown on Figure 3-15.

The approximate distance between the dropped location and the detected location of the test shape is roughly 30 feet. The error can be attributed to several sources of error during the deployment of the test shapes and sources of error inherent in the survey technique. As stated above, however, effective positioning has been demonstrated in practice via successful detection and reacquisition of targets.

As expected, though both the 400 and 900-kHz frequencies detected the 100-pound bomb target, the 900-kHz frequency appeared to provide better resolution and detail. Measurements of the target with 400- and the 900-kHz frequency on multiple passes indicated an object approximately 2 feet in length, 1 foot in diameter, and approximately 7 to 8 inches above the seafloor (comparable to the test shape).

3.5.2 Marine Magnetometer Survey QA/QC Results

The results of the marine magnetometer tests using the three test shapes showed that only the largest test shape was detected. Figure 3-16 illustrates the results from the magnetometer survey in Explosive Anchorage No. 1. Locations of the three test shapes and targets from the sidescan survey that correlate to the magnetometer data are shown on the figure. The results of the testing indicate that the magnetometer as deployed is likely to have detected the 100-pound bomb test shape, but detection of the 25-pound mortar shell and the .50-caliber round was inconclusive. The detected strength of an anomaly by the sensor becomes significantly weakened by the distance between the object and sensor as explained in Section 3.4. Placing the magnetometer at a fixed altitude near to the seafloor is necessary for effective detection of small ferrous objects

and very difficult to do with towed survey instruments. The poor detection of the 25-pound mortar shell and .50-caliber round is likely because of the magnetic permeability of the targets coupled with the tow altitude of the magnetometer during the survey of Explosive Anchorage No. 1.

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U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska	**Figure 3-1** **Research Vessel *Thunder***

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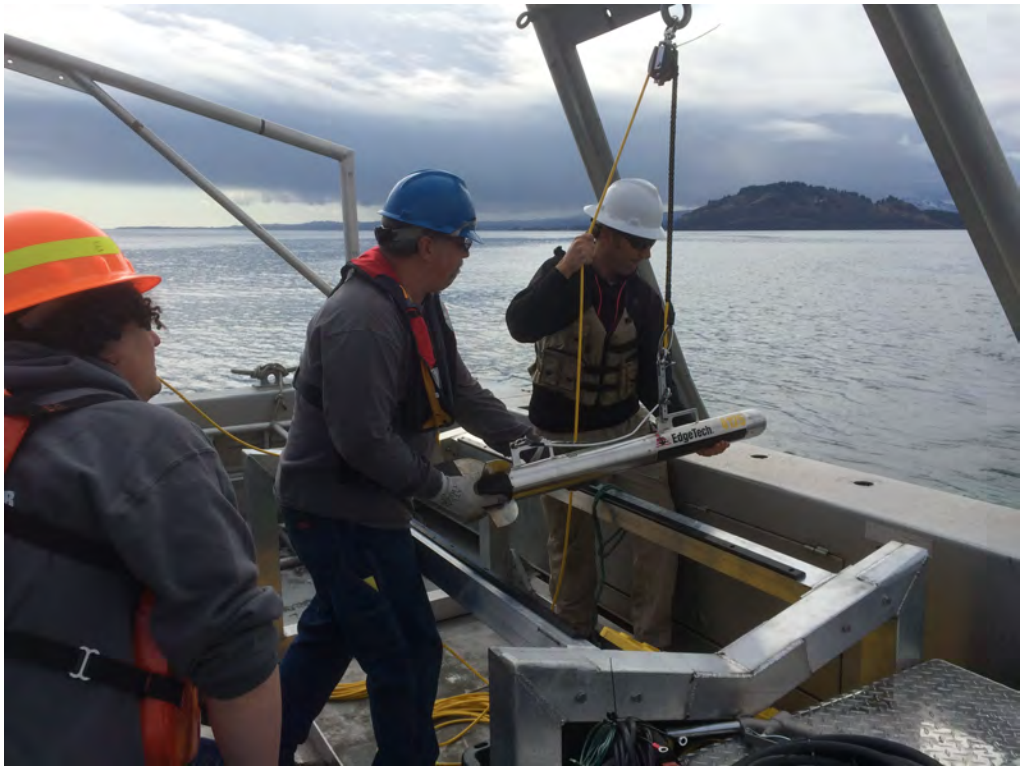
U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska	**Figure 3-2** ***Blackfoot***

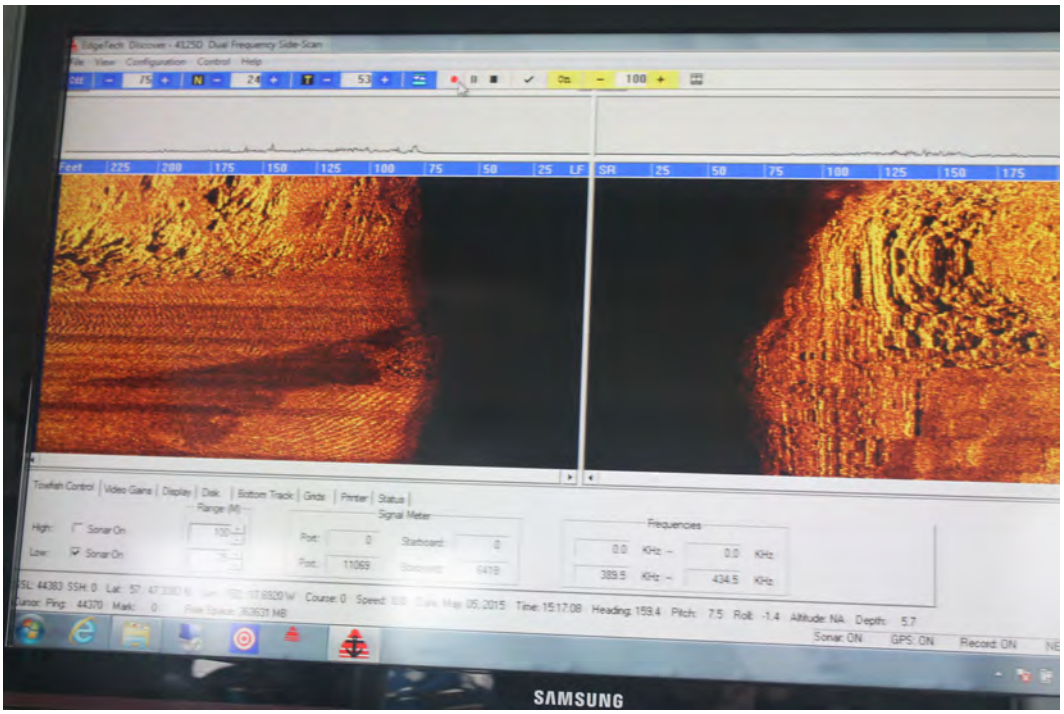
60413578_03.ai



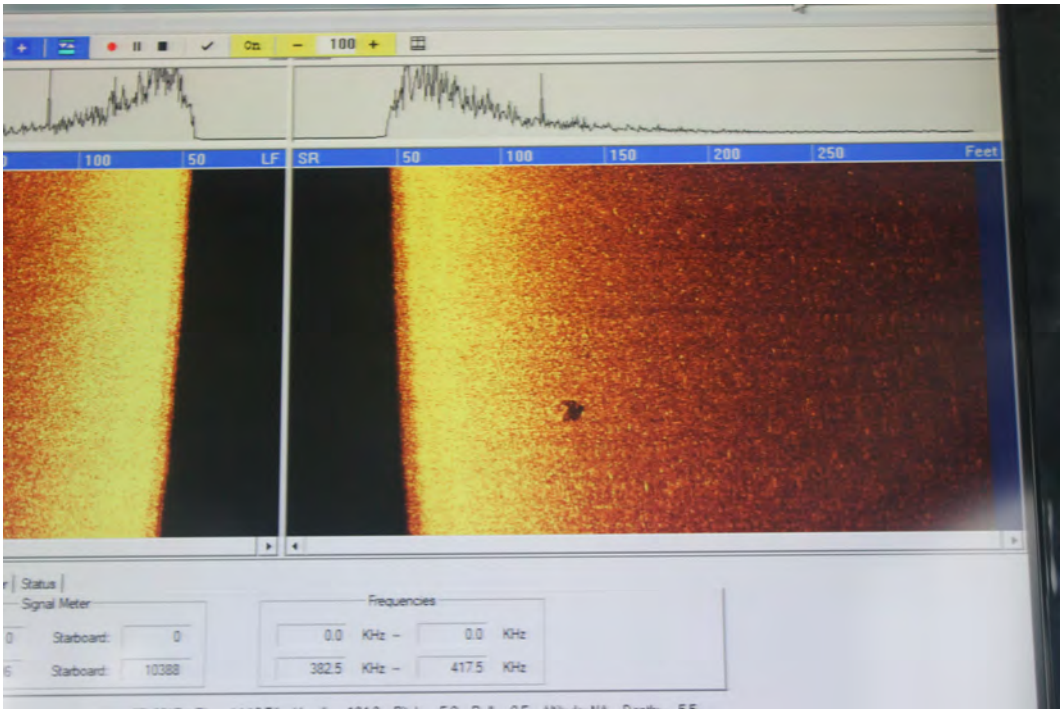
Sidescan sonar

Depressor on sidescan sonar

U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska	**Figure 3-3** **Sidescan Sonar with and without Depressor Wing**



Sidescan sonar display



Sidescan sonar display

U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska	**Figure 3-4** **Screenshots of the Real-Time Output of the Sidescan Sonar**

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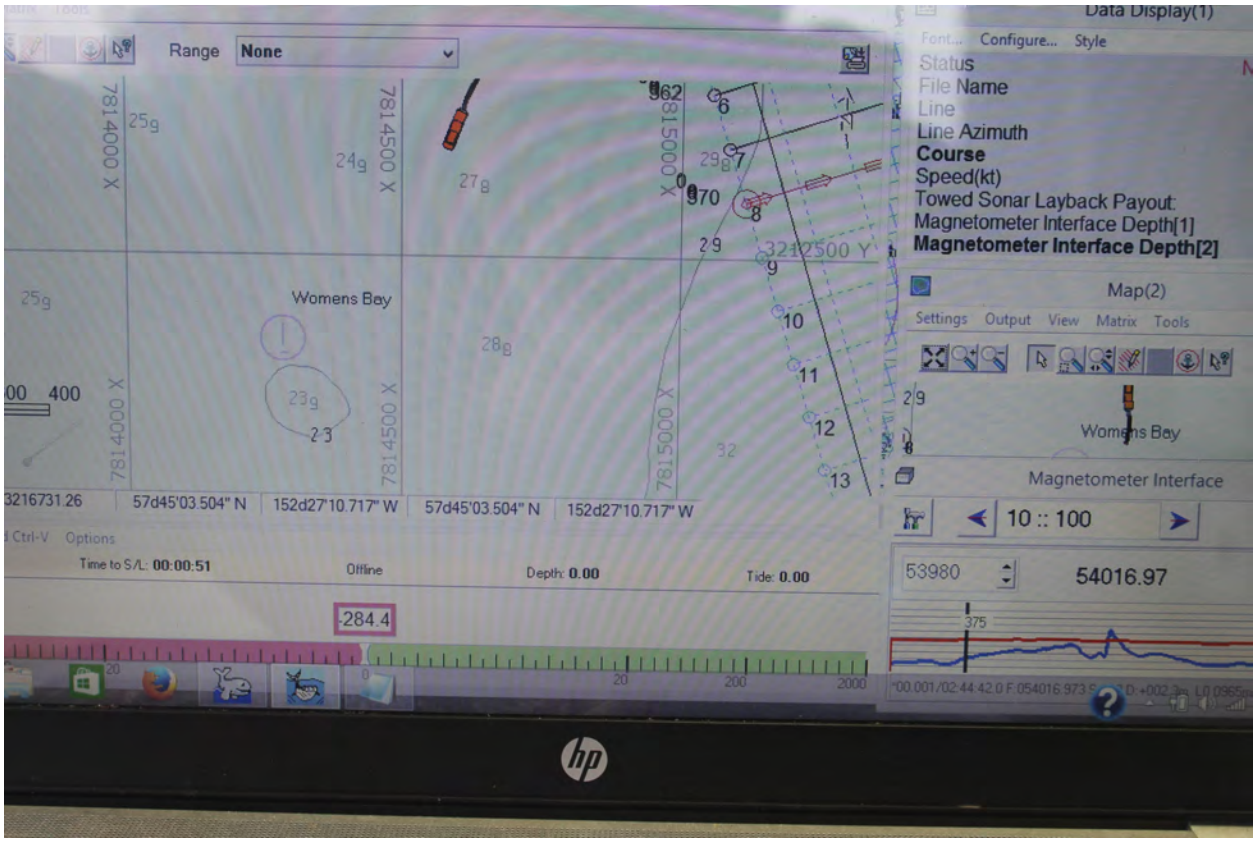
U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska	**Figure 3-5** **Towing Sidescan Sonar off A-Frame at Rear of R/V *Thunder***

60413578_06.ai



U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska	**Figure 3-6** **Example of Planned Survey Lines**

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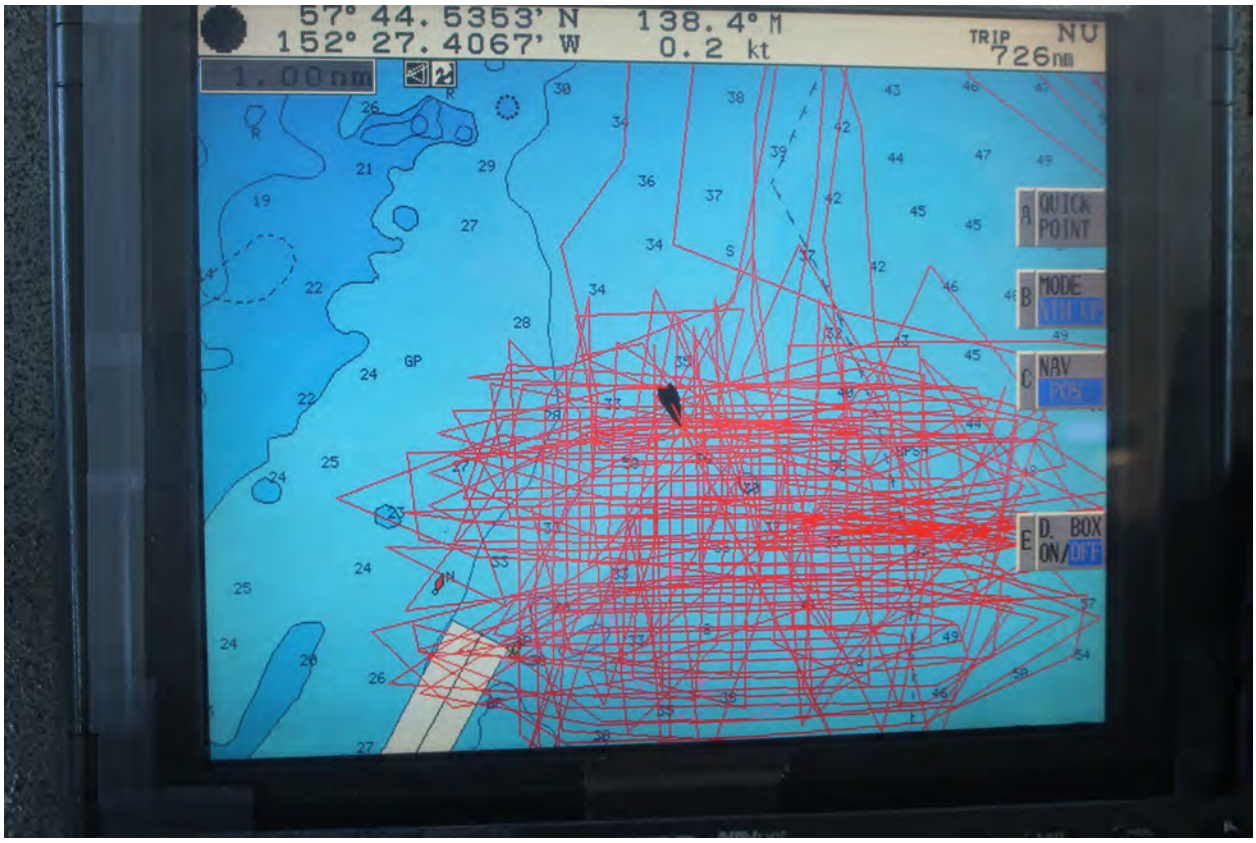

U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska	**Figure 3-7** **Example of Completed Survey Lines**

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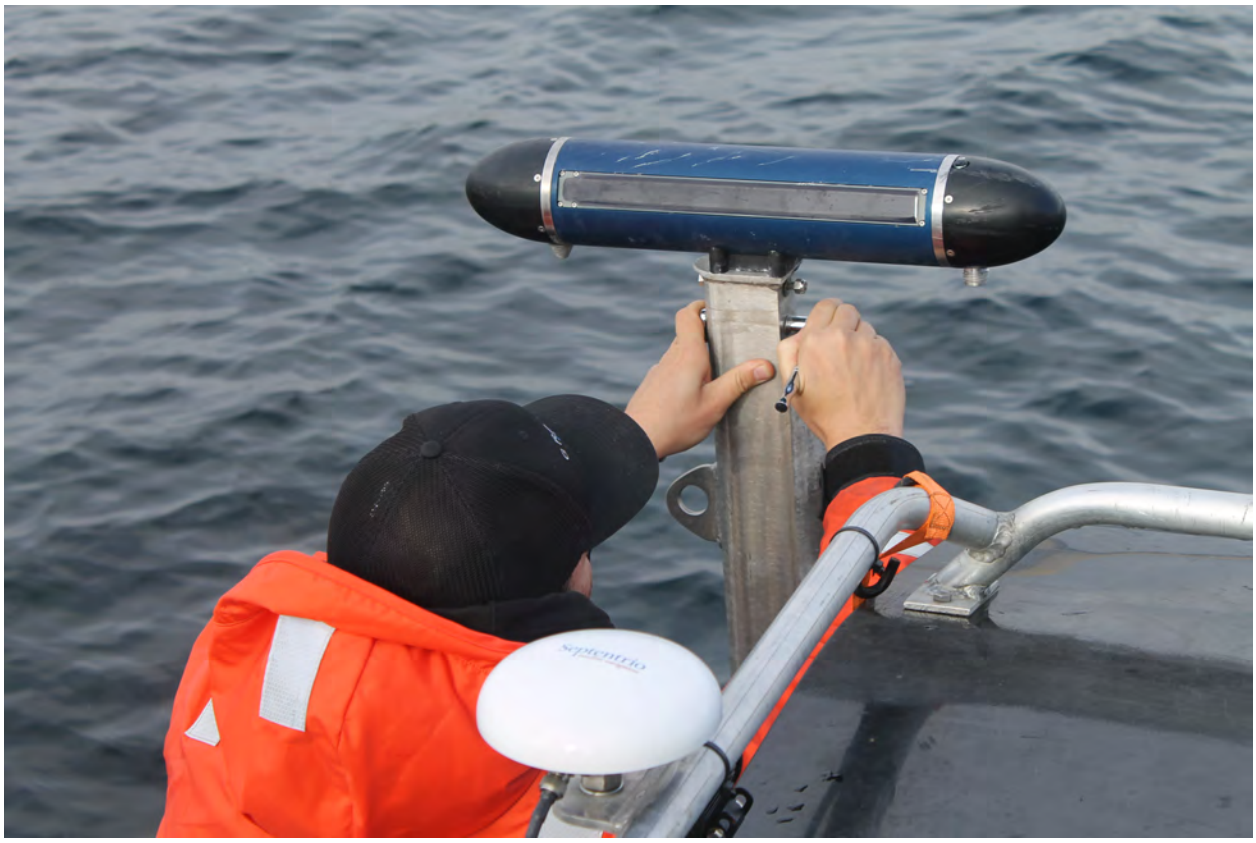

U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska	**Figure 3-8** **Ping DSP Sonar**

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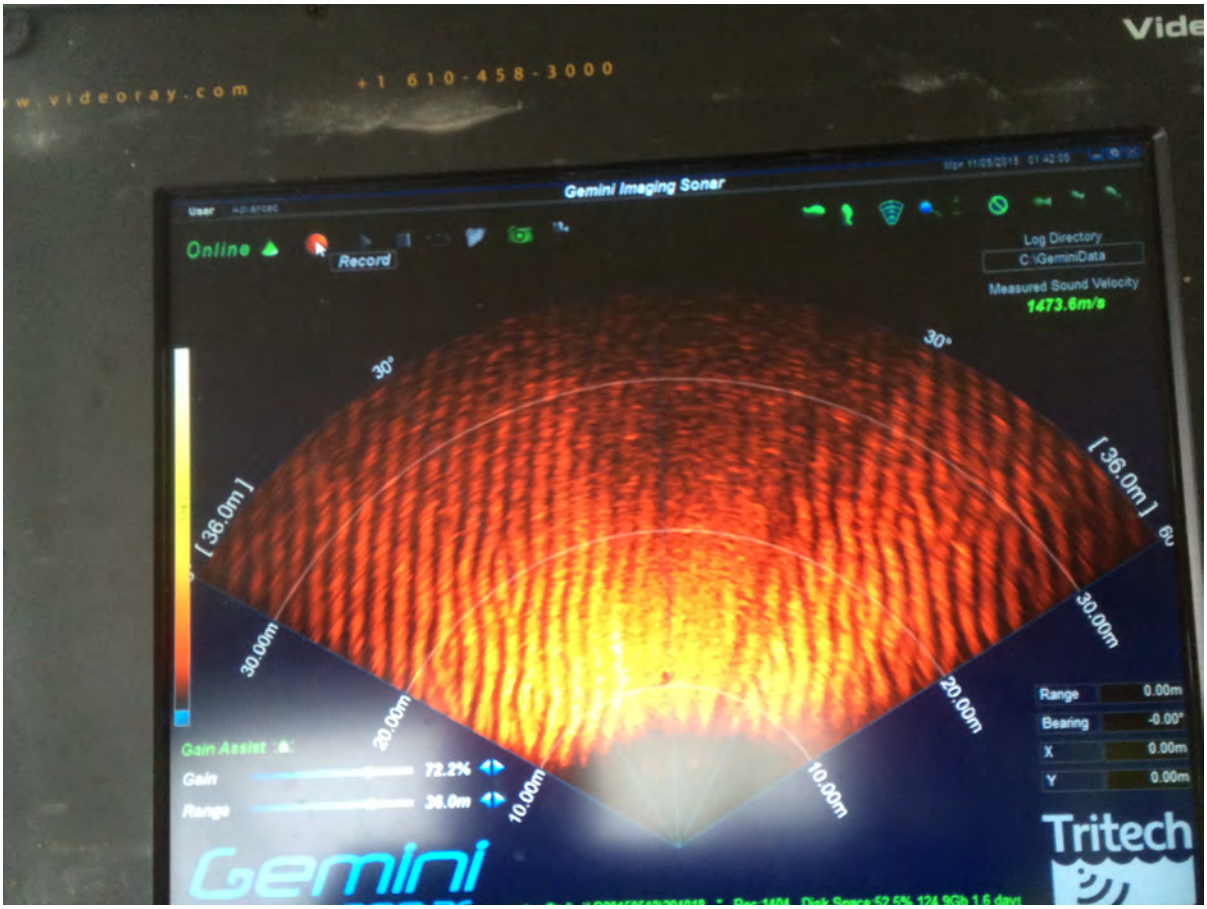
U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska	**Figure 3-9** **Remotely Operated Vehicle** **Used for Surveying**



U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska	**Figure 3-10** **Screenshot of Real-Time Output of Sonar on ROV**

U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska	**Figure 3-11** **Acquiring a Target Using the Remotely Operated Vehicle**

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U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska	**Figure 3-12** **Marine Magnetometer**

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Figure 3-13a
Test Shape – Mock 40-mm Shell

Figure 3-13b
Test Shape – Inert 25-Pound Mortar Shell

Figure 3-13c
Test Shape – Inert 100-Pound Bomb

U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska	**Figure 3-13** **Test Shapes**

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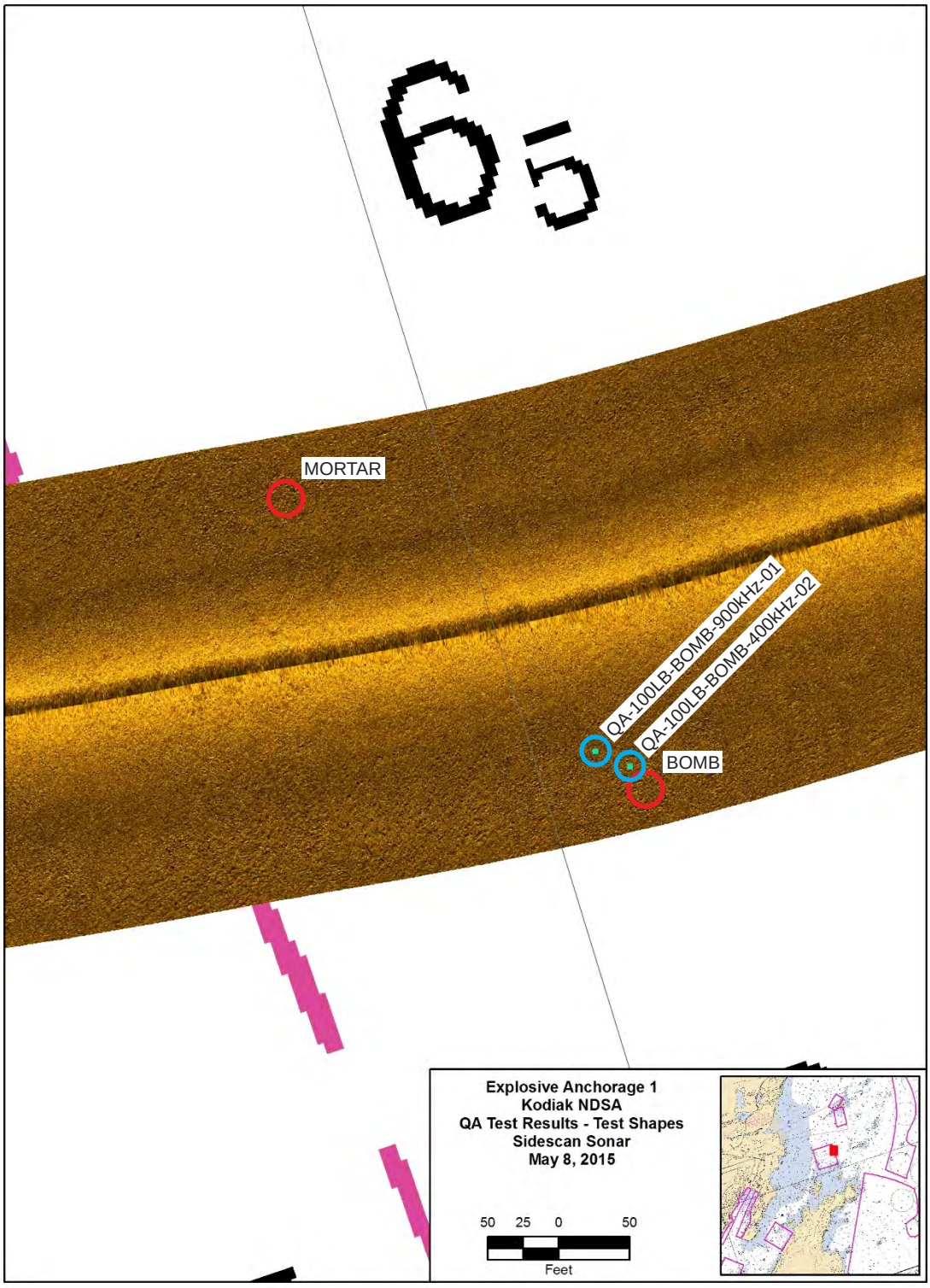

Note:
The dropped locations of the test shapes are indicated with red circles, while the interpreted locations of the 100-pound bomb (from multiple passes) are indicated with cyan circles.

U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska	**Figure 3-14** **Sample QA/QC Sidescan Sonar Survey Pass**

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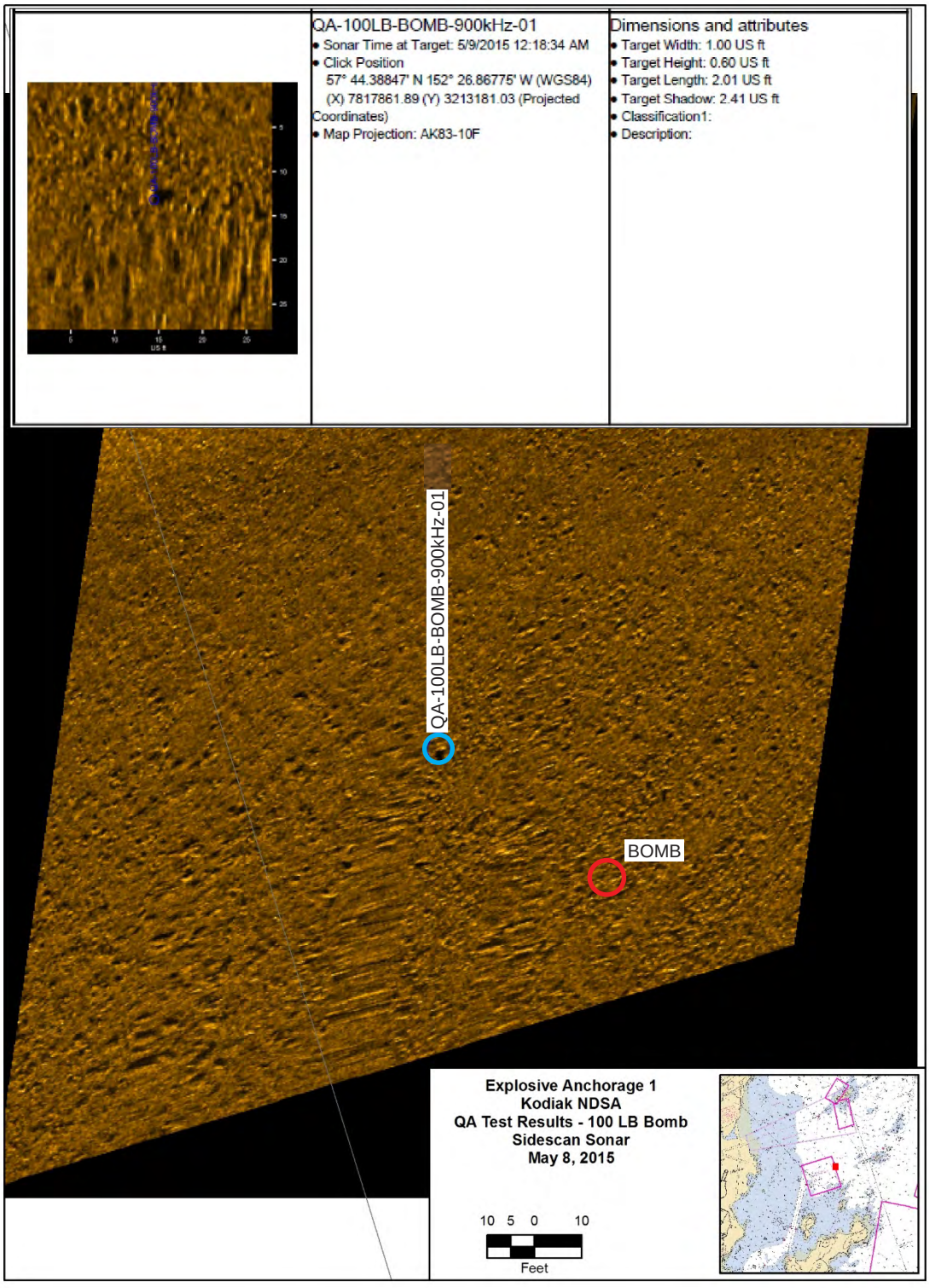

Note:
The dropped locations of the test shapes are indicated with red circles, while the interpreted locations of the 100-pound bomb (from multiple passes) are indicated with cyan circles.

U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska	**Figure 3-15** **Detected Target Characteristics, 100-Pound QA/QC Test Shape**

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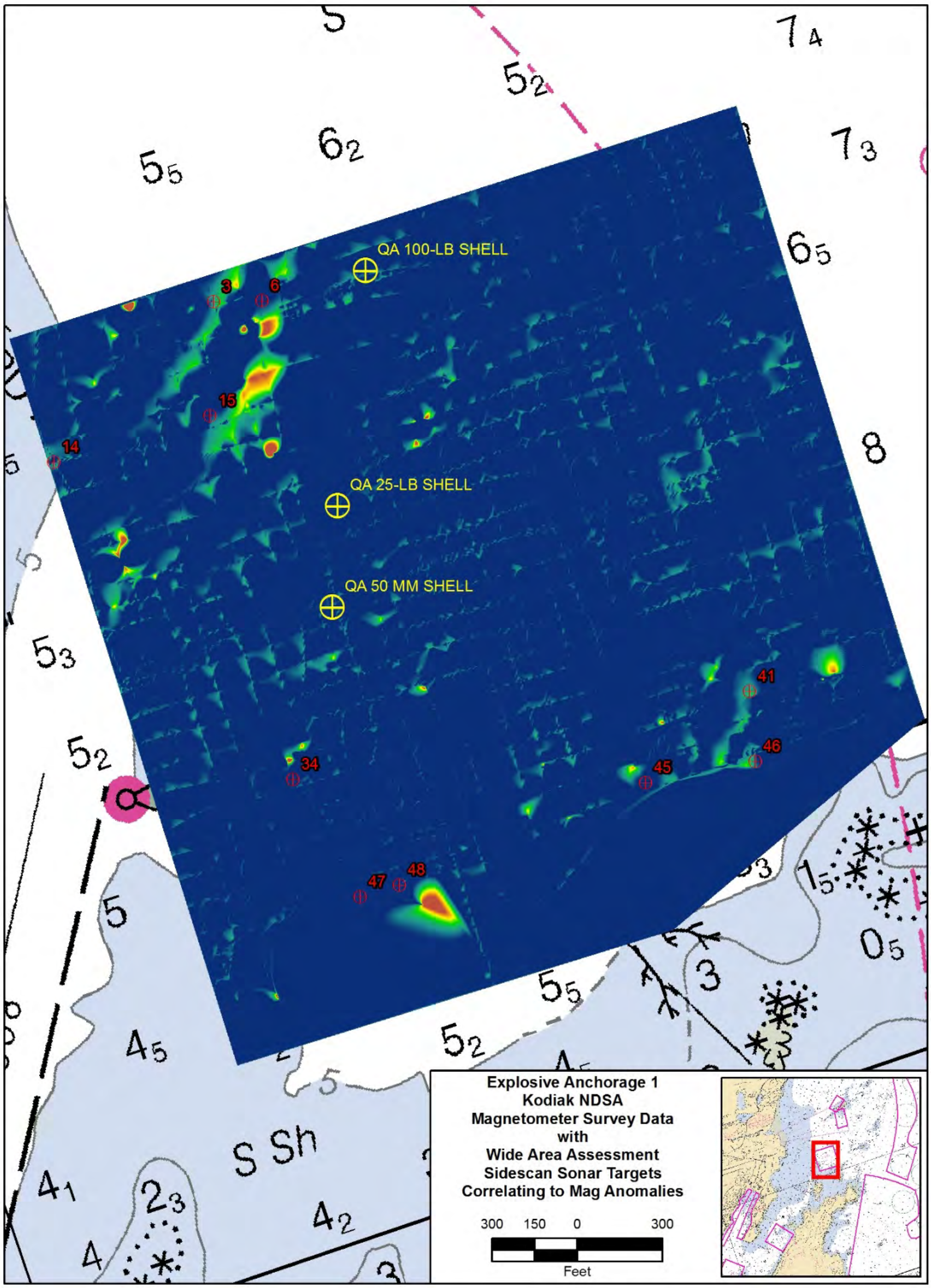


U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska	**Figure 3-16** **Magnetometer Survey Data with QA/QC Test Shape Locations and Selected Sidescan Sonar Targets**

Table 3-1
Survey Vessels and Associated Equipment

Survey Vessel	Equipment	Goal
Thunder	Marine Magnetics SeaSpy magnetometer	Detection of ferrous objects or field-deflecting features
	EdgeTech 4125 400/900-kHz digital CHIRP sidescan sonar	High-resolution imagery to detect very small targets
	Remotely operated vehicle with high-definition video camera and forward-looking sonar	Provide high-resolution videos and photographs of targets
Blackfoot	Ping DSP 3DSS 460-kHz interferometric sonar with SBG inertial navigation system	High-resolution sidescan sonar imagery and high-resolution bathymetry

Note: kHz - kilohertz

4.0 RESULTS OF SITE INSPECTION SURVEY

4.1 OVERVIEW OF RESULTS

The NDSA at Kodiak was surveyed from May 1 through May 14, 2015. The SI field work was conducted in early spring when the visibility of the seafloor was expected to be good and weather conditions acceptable. During the PA research conducted prior to the SI work plan, divers in the area stated that when the water warms during the summer, algal blooms hamper visibility near the seafloor.

The survey team on the R/V *Thunder* had no stand-down days resulting from poor weather and was able to survey on all 14 days. *Blackfoot* was not able to conduct surveying on one day because of windy conditions that were not safe for a smaller vessel. Additionally, the interferometric sonar was apparently not working correctly aboard *Blackfoot* the first few days of surveying until May 5, 2015. The dates on which the specific areas were surveyed and the type of equipment used to survey are listed on Table 4-1. A daily record of field events are documented in the field notes provided in Appendix A.

Of the 17 planned survey areas listed on Table 4-1, WAA surveying was performed at all or a majority of 13 of these areas. It was understood during the planning stage that the survey team would likely not be able to complete surveys in all areas within the allotted 14 days, but that the team would accomplish as much surveying as possible within that time frame.

No WAA survey was conducted at these four areas: Happy Beach AATC Impact Area, Fort Abercrombie Gun Batteries Impact Area, Entrance Point AATC Dock, and Entrance Point AATC Impact Area. The total area of these survey areas is 9,549 acres, which is approximately 56 percent of the 17,154 total areas planned for SI surveying as listed on Table 2-1. Two of these areas that were not surveyed were AATC areas that fired smaller rounds (i.e., 40-mm anti-aircraft rounds). The two smaller test shapes, the mock .50-caliber round and 25-pound mortar shell, were not observed during QA/QC testing of the sidescan sonar and marine magnetometer, as described in Section 3.5. Therefore, WAA surveying would not have been helpful in the AATC areas because of the expected size of munitions used.

For each survey area, Table 4-2 lists the WAA survey date and targets identified during the survey and RV survey date and targets reacquired, if applicable. A total of 1,099 targets were identified during the WAA survey. Appendix C includes a list of each target identified during the WAA survey, including related characteristics, for each survey area.

Targets identified using the sidescan sonar were initially classified as objects such as anchor, fish trap, piling, unknown, etc. during target characterization. Table 4-3 is a summary of how the targets were initially classified. Approximately 82 percent (898 of 1,099) of the targets were classified as "6-inch shell", "mine-like object," or "unknown". Generally, if a target was initially classified as a likely inert item (anchor, fish trap, piling, etc.) in the field, it was not selected as a target for RV surveying. Most targets selected for reacquisition in the field were initially classified as "unknown" or "mine like object."

The survey team performed RV surveying at 6 areas, and attempted to reacquire 45 targets. Table 4-4 lists the characteristics of each reacquired target, and the following sections provide more detail on the results of surveying within each individual survey area. The geophysical subcontractor's report is included as Appendix D in this SI report.

Table 4-5 summarizes the percent of targets initially classified as "6-inch shell", "mine-like object," or "unknown" that were reacquired as part of the RV survey. Of the 45 targets reacquired, 40 were initially classified as "6-inch shell", "mine-like object," or "unknown" as summarized for each survey area in Table 4-5. Therefore, approximately 4% of the 898 targets that were initially classified as "6-inch shell", "mine-like object," or "unknown" were reacquired, reducing the number of targets initially classified as "6-inch shell," "mine-like object," or "unknown" to 858 . Of those 858 targets, 210 met the size criterion (smaller than 5 feet in all directions) specified in Section 3.3. However, targets of interest that were slightly larger than this criterion were still reacquired.

4.2 INTERACTIVE GIS MAP OF SURVEYED AREAS

Prior to describing the results for each individual area, it may be of interest to the reader to become familiar with using the interactive GIS map, which is provided in Appendix E. The data are presented on four DVDs because the video files are too large to fit on fewer DVDs. The interactive GIS map is in a published map file format (.pmf file extension) and is opened only with ArcReader. ArcReader, which was developed by ESRI, can be downloaded for free at ESRI's website at http://www.esri.com/software/arcgis/arcreader/download. Appendix E includes basic instructions for opening and using the interactive GIS map.

Figure 4-1 shows an overview of all surveyed areas for this project at Kodiak. The interactive GIS map shows all surveyed areas, sidescan survey results of the seafloor, the 1,099 target locations identified during the WAA survey with linked target information, and videos of reacquired targets.

When viewing the coverage areas on the GIS map, one can zoom in to any surveyed area, see all target points identified during the WAA survey, and turn on various layers (e.g., sidescan sonar results of the seafloor, planned survey areas and priority, etc.). By clicking on the targets target points, the target information (target identification, coordinates, and dimensions) appears. Red points signify those targets reacquired using the ROV and have a linked video of the target. Yellow targets do not have a linked video. Note that the reacquired targets will be linked to videos only on one of the DVDs, as described above.

Each of the four DVDs includes coverage of all surveyed areas. As mentioned previously, no surveys were completed at Happy Beach AATC Impact Area, Fort Abercrombie Gun Batteries Impact Area, Entrance Point AATC Dock, and Entrance Point AATC Impact Area. The differences in the content of the DVDs include sidescan sonar content of specific areas and video content associated with the reacquired targets in specific areas.

DVD1 includes sidescan sonar results and links to videos of reacquired targets in:

- Explosive Anchorage No. 1
- Fort Greely Gun Batteries Impact Area (larger of two areas)
- Former Anti-Ship Mines Area between Long and Woody Islands

DVD2 includes sidescan sonar results and links to videos of reacquired targets in:

- Explosive Anchorage No. 2
- Explosive Anchorage No. 3
- Navy Dock Locations in Womens Bay (southeastern portion)

DVD3 includes sidescan sonar results for other areas in Womens Bay, St. Paul Harbor, and northwestern and northeastern Chiniak Bay including:

- Navy Dock Locations in Womens Bay (northwestern portion)
- Army Dock Locations in Saint Paul Harbor
- Former Army Dock at Puffin Island
- Former Navy Dock at Woody Island
- Fort Greely Gun Batteries Impact Area (smaller of two areas, referred to as Puffin Island south in database)
- Long Island Dock
- Former Anti-Ship Mines Areas East of Long Island

DVD4 includes sidescan sonar results for areas in southeastern Chiniak Bay including:

- Humpback Rock Glide and Dive Bombing Target
- Former Anti-Ship Mines Area (two areas)

4.3 INDIVIDUAL SURVEY AREAS

Results of the survey areas that were surveyed are summarized in the following sections. There is no subsection for Happy Beach AATC Impact Area, Fort Abercrombie Gun Batteries Impact Area, Entrance Point AATC Dock, and Entrance Point AATC Impact Area because no surveying was conducted, as explained in Section 4.1.

4.3.1 Explosive Anchorage No. 1

The survey team on R/V *Thunder* conducted the WAA survey of Explosive Anchorage No. 1 on May 8, 2015, and detected 54 targets. The locations of the targets identified during the WAA survey using the sidescan sonar are shown in Figure 4-2. Better viewing of the sidescan sonar results may be seen in this area on the interactive GIS map (Appendix E).

On May 10 through 12, 2015, the survey team on R/V *Thunder* used a combination of the marine magnetometer ROV for the RV survey. Magnetometer surveys highlight anomalies whose size and resolution are directly related to the track line spacing of the survey and do not yield discrete targets. Therefore, single magnetic anomalies may be related to one or more sidescan sonar targets depending on their magnetic characteristics, the distance between targets, and how a group of targets may combine to yield magnetic anomalies.

Figure 4-3 shows the results of the magnetic survey with locations of WAA sidescan sonar targets. The targets are numbered using the last two digits of the target identification (ID). Although most of the targets do not correspond to magnetic anomalies, there are a few that appear to correspond with magnetic anomalies.

Twelve targets were reacquired with the ROV during the RV survey and are shown as the red-colored targets on Figure 4-2. Videos recorded while reacquiring these targets are linked to the red targets on the interactive map (Appendix E on DVD). Table 4-4 lists the characteristics of each reacquired target, including coordinates, approximate dimensions, and classification. Twelve of the 52 targets (23%) that were initially classified as “6-inch shell,” “mine-like object,” or “unknown” were reacquired (Table 4-5). No MEC was positively identified. The reacquired targets were classified as one concrete anchor block, two crab pots, one timber crate or timber debris, one concrete plank, one possible ammunition crate, four rocks, and two unknown items. Further sorting of the characteristics of the targets in Appendix C shows that of the remaining

targets that were not reacquired in this survey area, there are 23 targets that were initially classified as "6-inch shell," "mine-like object," or "unknown" and meet the size criterion (less than 5 feet in all directions per Section 3.3) (Table 4-5).

Four of the targets reacquired with the ROV were also identified as magnetic anomalies, including the following:

- RI_ROV_ExplosiveAnchorage1_Target_0003 (concrete anchor block)
- RI_ROV_ExplosiveAnchorage1_Target_0006 (crab trap)
- RI_ROV_ExplosiveAnchorage1_Target_0014 (timber crate or timber debris)
- RI_ROV_ExplosiveAnchorage1_Target_0015 (unknown target)

The visibility at the seafloor was very good, which was sandy and covered with shell material. There was biological growth on several targets, as seen in the videos.

4.3.2 Explosive Anchorage No. 2

The survey team on *Blackfoot* conducted the WAA survey of Explosive Anchorage No. 2 on May 5 and 6, 2015, and detected 29 targets. The locations of the targets identified during the WAA survey using the sidescan sonar are shown on Figure 4-4. Better viewing of the sidescan sonar results may be seen in this area on the interactive GIS map (Appendix E). Figure 4-4 does not show that the entire anchorage area was surveyed. According to the subcontractor (Gravity), the data file for the southeast portion of the Explosive Anchorage No. 2 area was corrupted, and no data is available.

As part of the RV survey of Explosive Anchorage No. 2, the survey team on R/V *Thunder* used marine magnetometer on May 12, 2015, and the ROV on May 12 through 14, 2015. Figure 4-5 shows the results of the magnetic survey with locations of WAA sidescan sonar targets. The targets are numbered using the last two digits of the target ID. Many targets appear to correspond with magnetic anomalies.

Fourteen targets were reacquired with the ROV during the RV survey and are shown as the red-colored targets on Figure 4-4. Videos recorded while reacquiring these targets are linked to the red targets on the interactive map (Appendix E on DVD). Table 4-4 lists the characteristics of each reacquired target, including coordinates, approximate dimensions, and classification. Thirteen of the 26 targets (50%) that were initially classified as "6-inch shell," "mine-like object," or "unknown" were reacquired (Table 4-5). No MEC was positively identified. The reacquired targets were classified as timber pilings, one conical fish trap, one rock, three possible ammunition crates, one empty drum or expended shell, three crab pots, and three unknown items. Further sorting of the characteristics of the targets in Appendix C shows that of the remaining

targets that were not reacquired in this survey area, there are 3 targets that were initially classified as "6-inch shell," "mine-like object," or "unknown" and meet the size criterion (less than 5 feet in all directions per Section 3.3) (Table 4-5).

Ten of those targets reacquired with the ROV were also identified as magnetic anomalies, including the following:

- RI_ROV_ExplosiveAnchorage2_Target_0009 (possible ammunition crate)
- RI_ROV_ExplosiveAnchorage2_Target_0010 (unknown block)
- RI_ROV_ExplosiveAnchorage2_Target_0011 (unknown block)
- RI_ROV_ExplosiveAnchorage2_Target_0013 (possible ammunition crate)
- RI_ROV_ExplosiveAnchorage2_Target_0014 (possible ammunition crate)
- RI_ROV_ExplosiveAnchorage2_Target_0015 (empty drum or expended shell casing)
- RI_ROV_ExplosiveAnchorage2_Target_0016 (unknown debris)
- RI_ROV_ExplosiveAnchorage2_Target_0023 (crab pot)
- RI_ROV_ExplosiveAnchorage2_Target_0024 (crab pot)
- RI_ROV_ExplosiveAnchorage2_Target_0025 (crab pot)

The visibility at the seafloor was fair. It was murkier than the seafloor in Explosive Anchorage No. 1. The seafloor was covered with shell material in many places, and there was abundant biological growth on many targets.

4.3.3 Explosive Anchorage No. 3

The survey team on *Blackfoot* conducted the WAA survey of Explosive Anchorage No. 3 on May 6 and 8, 2015, and detected 23 targets. The locations of the targets identified during the WAA survey using the sidescan sonar are shown on Figure 4-6. Better viewing of the sidescan sonar results may be seen in this area on the interactive GIS map (Appendix E).

As part of the RV survey of Explosive Anchorage No. 3, the survey team on R/V *Thunder* used the ROV on May 13, 2015. Seven targets were reacquired with the ROV and are shown as the red-colored targets on Figure 4-6. Videos recorded while reacquiring these targets are linked to the red targets on the interactive map (Appendix E on DVD). Table 4-4 lists the characteristics of each reacquired target, including coordinates, approximate dimensions, and classification. Seven of the 20 targets (35%) that were initially classified as "6-inch shell," "mine-like object,"

or "unknown" were reacquired (Table 4-5). No MEC was positively identified. The reacquired targets were classified as four fish traps, one corroded drum, one Navy anchor, and one deteriorated timber frame. Further sorting of the characteristics of the targets in Appendix C shows that of the remaining targets that were not reacquired in this survey area, there are 2 targets that were initially classified as "6-inch shell," "mine-like object," or "unknown" and meet the size criterion (less than 5 feet in all directions per Section 3.3) (Table 4-5).

The visibility at the seafloor was fair. It was murkier than the seafloor in Explosive Anchorage No. 1. The seafloor was covered with shell material in many places, and there was abundant biological growth on the targets.

4.3.4 Navy Dock Locations in Womens Bay

The survey team on *Blackfoot* conducted the WAA survey of former Navy Dock Locations in Womens Bay on May 7 through 9, 2015, and detected 128 targets along the northwestern side of Womens Bay and 149 targets on the southwestern side of Womens Bay. The locations of the targets identified during the WAA survey using the sidescan sonar are shown in Figure 4-7. Better viewing of the sidescan sonar results may be seen in this area on the interactive GIS map (Appendix E).

As part of the RV survey of Explosive Anchorage No. 3, the survey team on R/V *Thunder* used the ROV on May 14, 2015. Six targets were reacquired with the ROV and are shown as the red-colored targets on Figure 4-7. Videos recorded while reacquiring these targets are linked to the red targets on the interactive map (Appendix E on DVD). Table 4-4 lists the characteristics of each reacquired target, including coordinates, approximate dimensions, and classification. Three of the 206 targets (1%) that were initially classified as "6-inch shell," "mine-like object," or "unknown" were reacquired (Table 4-5). No MEC was positively identified. The reacquired targets were classified as one large capacity battery, one ladder, one gangway from a ship, one 5-gallon bucket, one fish trap, and one tire and metal debris. Further sorting of the characteristics of the targets in Appendix C shows that of the remaining targets that were not reacquired in this survey area, there are 74 targets that were initially classified as "6-inch shell," "mine-like object," or "unknown" and meet the size criterion (less than 5 feet in all directions per Section 3.3) (Table 4-5).

4.3.5 Army Dock Locations in Saint Paul Harbor

The survey team on R/V *Thunder* conducted the WAA survey of former Army Dock Locations in Saint Paul Harbor on May 9, 2015, and detected 74 targets (Table 4-3). The locations of the targets identified during the WAA survey using the sidescan sonar are shown on Figure 4-8. Forty-five of the 74 targets were initially classified as "6-inch shell," "mine-like object," or

"unknown" (Table 4-5). Better viewing of the sidescan sonar results may be seen in this area on the interactive GIS map (Appendix E). Because of the allotted time for conducting surveys, no RV survey was conducted of the former Army Dock Locations in Saint Paul Harbor. Further sorting of the characteristics of the targets in Appendix C shows that there are 5 targets that were initially classified as "6-inch shell," "mine-like object," or "unknown" and meet the size criterion (less than 5 feet in all directions per Section 3.3) (Table 4-5).

4.3.6 Former Army Dock at Puffin Island

The survey team on *Blackfoot* conducted the first WAA survey of former Army Dock at Puffin Island on May 3, 2015, and then resurveyed on May 12, 2015. The crew detected 76 targets (Table 4-3). The locations of the targets identified during the WAA survey using the sidescan sonar are shown on Figure 4-9. Sixty-one of the 76 targets were initially classified as "6-inch shell," "mine-like object," or "unknown" (Table 4-5). Better viewing of the sidescan sonar results may be seen in this area on the interactive GIS map (Appendix E). Due to the allotted time for conducting surveys, no RV survey of the former Army Dock at Puffin Island was conducted. Further sorting of the characteristics of the targets in Appendix C shows that there are 11 targets that were initially classified as "6-inch shell," "mine-like object," or "unknown" and meet the size criterion (less than 5 feet in all directions per Section 3.3) (Table 4-5).

4.3.7 Fort Greely Gun Batteries Impact Areas

The survey team on *Blackfoot* conducted the WAA survey of the smaller portion of Fort Greely Gun Batteries Impact Areas on May 12, 2015, and detected 35 targets, while the crew on R/V *Thunder* conducted the WAA survey of the larger portion of Fort Greely Gun Batteries Impact Areas on May 1 and 3, 2015, and detected 100 targets. The locations of the targets identified during the WAA survey using the sidescan sonar are shown on Figure 4-9. Better viewing of the sidescan sonar results may be seen in this area on the interactive GIS map (Appendix E).

As part of the RV survey of Fort Greely Gun Batteries Impact Areas, the survey team on R/V *Thunder* used the ROV on May 9, 2015. Three targets were reacquired with the ROV and are shown as the red-colored targets on Figure 4-9. Videos recorded while reacquiring these targets are linked to the red targets on the interactive map (Appendix E on DVD). Table 4-3 lists the characteristics of each reacquired target, including coordinates, approximate dimensions, and classification. Two of the 99 targets (2%) that were initially classified as "6-inch shell," "mine-like object," or "unknown" were reacquired (Table 4-5). No MEC was positively identified. The reacquired targets were classified as one tire, one fishing net, and one unknown object. Further sorting of the characteristics of the targets in Appendix C shows that of the remaining targets that were not reacquired in this survey area, there are 35 targets that were initially

classified as "6-inch shell," "mine-like object," or "unknown" and meet the size criterion (less than 5 feet in all directions per Section 3.3) (Table 4-5).

The visibility at the seafloor was very good, which was sandy with some shell material. There was biological growth on one target, as seen in the associated videos.

4.3.8 Former Navy Dock at Woody Island

The survey team on *Blackfoot* conducted the WAA survey of former Navy Dock at Woody Island on May 12, 2015, and detected 52 targets (Table 4-3). The locations of the targets identified during the WAA survey using the sidescan sonar are shown on Figure 4-10. Fifty of the 52 targets were initially classified as "6-inch shell," "mine-like object," or "unknown" (Table 4-5). Better viewing of the sidescan sonar results may be seen in this area on the interactive GIS map (Appendix E). Because of the allotted time for conducting surveys, no RV survey was conducted of the former Navy Dock at Woody Island. Further sorting of the characteristics of the targets in Appendix C shows that there are 24 targets that were initially classified as "6-inch shell," "mine-like object," or "unknown" and meet the size criterion (less than 5 feet in all directions per Section 3.3) (Table 4-5).

4.3.9 Long Island Dock

The survey team on *Blackfoot* conducted the WAA survey of Long Island Dock Island on May 13, 2015, and detected 23 targets (Table 4-3). The locations of the targets identified during the WAA survey using the sidescan sonar are shown on Figure 4-11. Nineteen of the 23 targets were initially classified as "6-inch shell," "mine-like object," or "unknown" (Table 4-5). Better viewing of the sidescan sonar results may be seen in this area on the interactive GIS map (Appendix E). Because of the allotted time for conducting surveys, no RV survey was conducted of the Long Island Dock. Further sorting of the characteristics of the targets in Appendix C shows that there are eight targets that were initially classified as "6-inch shell," "mine-like object," or "unknown" and meet the size criterion (less than 5 feet in all directions per Section 3.3) (Table 4-5).

4.3.10 Former Anti-Ship Mines Area Between Long and Woody Islands

The survey team on R/V I conducted the WAA survey of former Anti-Ship Mines Area between Long and Woody Islands on May 5 and 6, 2015, and detected 92 targets. The locations of the targets identified during the WAA survey using the sidescan sonar are shown on Figure 4-11. Better viewing of the sidescan sonar results may be seen in this area on the interactive GIS map (Appendix E).

As part of the RV survey of former Anti-Ship Mines Area between Long and Woody Islands, the survey team on R/V *Thunder* used the ROV on May 10, 2015. The team attempted to reacquire three targets. It was too difficult to maneuver the ROV because the currents were too strong. Two of those targets are shown as the red-colored targets on Figure 4-11. Videos recorded while reacquiring or attempting to reacquire these targets are linked to the red targets on the interactive map (Appendix E on DVD). Table 4-4 lists the characteristics of each reacquired target, including coordinates, approximate dimensions, and classification. Three of the 78 targets (4%) that were initially classified as "6-inch shell," "mine-like object," or "unknown" were reacquired (Table 4-5). No MEC was positively identified. The reacquired target was classified as cable and fish trap, and the two other targets that were not reacquired were classified as unknown objects. Further sorting of the characteristics of the targets in Appendix C shows that of the remaining targets that were not reacquired in this survey area, there are 10 targets that were initially classified as "6-inch shell," "mine-like object," or "unknown" and meet the size criterion (less than 5 feet in all directions per Section 3.3) (Table 4-5).

The visibility of the seafloor was good, which was covered with shells and gravel. There was significant biological growth on the acquired target.

4.3.11 Former Anti-Ship Mines Area East of Long Island

The survey team on R/V *Thunder* conducted the WAA survey of the former Anti-Ship Mines Area (east of Long Island) on May 2, 2015, and detected 105 targets (Table 4-3). The locations of the targets identified during the WAA survey using the sidescan sonar are shown on Figure 4-12. Ninety-one of the 105 targets were initially classified as "6-inch shell," "mine-like object," or "unknown" (Table 4-5). Better viewing of the sidescan sonar results may be seen in this area on the interactive GIS map (Appendix E). Because of the allotted time for conducting surveys, no RV survey was conducted of the former Anti-Ship Mines Area (east of Long Island). Further sorting of the characteristics of the targets in Appendix C shows that there are two targets that were initially classified as "6-inch shell," "mine-like object," or "unknown" and meet the size criterion (less than 5 feet in all directions per Section 3.3) (Table 4-5).

4.3.12 Humpback Rock Glide and Dive Bombing Target and Adjacent Former Anti-Ship Mines Area

The survey team on R/V *Thunder* conducted the WAA survey of Humpback Rock Glide and Dive Bombing Target and the adjacent former Anti-Ship Mines Area on May 4, 2015, and detected 92 targets (Table 4-3). These two areas are reported together because the survey lines are continuous across the two areas. The locations of the targets identified during the WAA survey using the sidescan sonar are shown on Figure 4-13. Eighty-eight of the 92 targets were initially classified as "6-inch shell," "mine-like object," or "unknown" (Table 4-5). Better

viewing of the sidescan sonar results may be seen in this area on the interactive GIS map (Appendix E). Because of the allotted time for conducting surveys, no RV survey was conducted of Humpback Rock Glide and Dive Bombing Target and adjacent former Anti-Ship Mines Area. Further sorting of the characteristics of the targets in Appendix C shows that there are 11 targets that were initially classified as "6-inch shell," "mine-like object," or "unknown" and meet the size criterion (less than 5 feet in all directions per Section 3.3) (Table 4-5).

4.3.13 Former Anti-Ship Mines Area in Southeastern Chiniak Bay

The survey team on R/V *Thunder* conducted the WAA survey of the former Anti-Ship Mines Area in Southeastern Chiniak Bay on May 7, 2015, and detected 67 targets (Table 4-3). The locations of the targets identified during the WAA survey using the sidescan sonar are shown on Figure 4-13. Sixty-three of the 67 targets were initially classified as "6-inch shell," "mine-like object," or "unknown" (Table 4-5). Better viewing of the sidescan sonar results may be seen in this area on the interactive GIS map (Appendix E). Because of the allotted time for conducting surveys, no RV survey was conducted of the former Anti-Ship Mines Area in Southeastern Chiniak Bay. Further sorting of the characteristics of the targets in Appendix C shows that there are two targets that were initially classified as "6-inch shell," "mine-like object," or "unknown" and meet the size criterion (less than 5 feet in all directions per Section 3.3) (Table 4-5).

Narrow Strait
3 Nautical Mile Boundary
Monashka Bay
Fort Abercrombie
Kodiak Island
Woody Island Channel
Woody Island
Saint Paul Harbor
Long Island
Fort Greely
Chiniak Bay
Womens Bay
Humpback Rock
Happy Beach
Fort Smith

Legend

- Target Reaquired/Has Video Link
- Target Identified During Initial Survey
- Initial Survey Coverage; Some Targets Reacquired
- Initial Survey Coverage; No Targets Reacquired
- Planned Survey Area; But not Surveyed
- 3 Nautical Mile (Boundary of Naval Defensive Sea Area)
- Explosive Anchorage Area
- First Priority Areas
- Second Priority Areas
- Third Priority Areas
- Marine Environment <20 Fathoms Deep
- Marine Environment >20 Fathoms Deep

Note: No Survey done near Entrance Point area to the north (not shown on map)

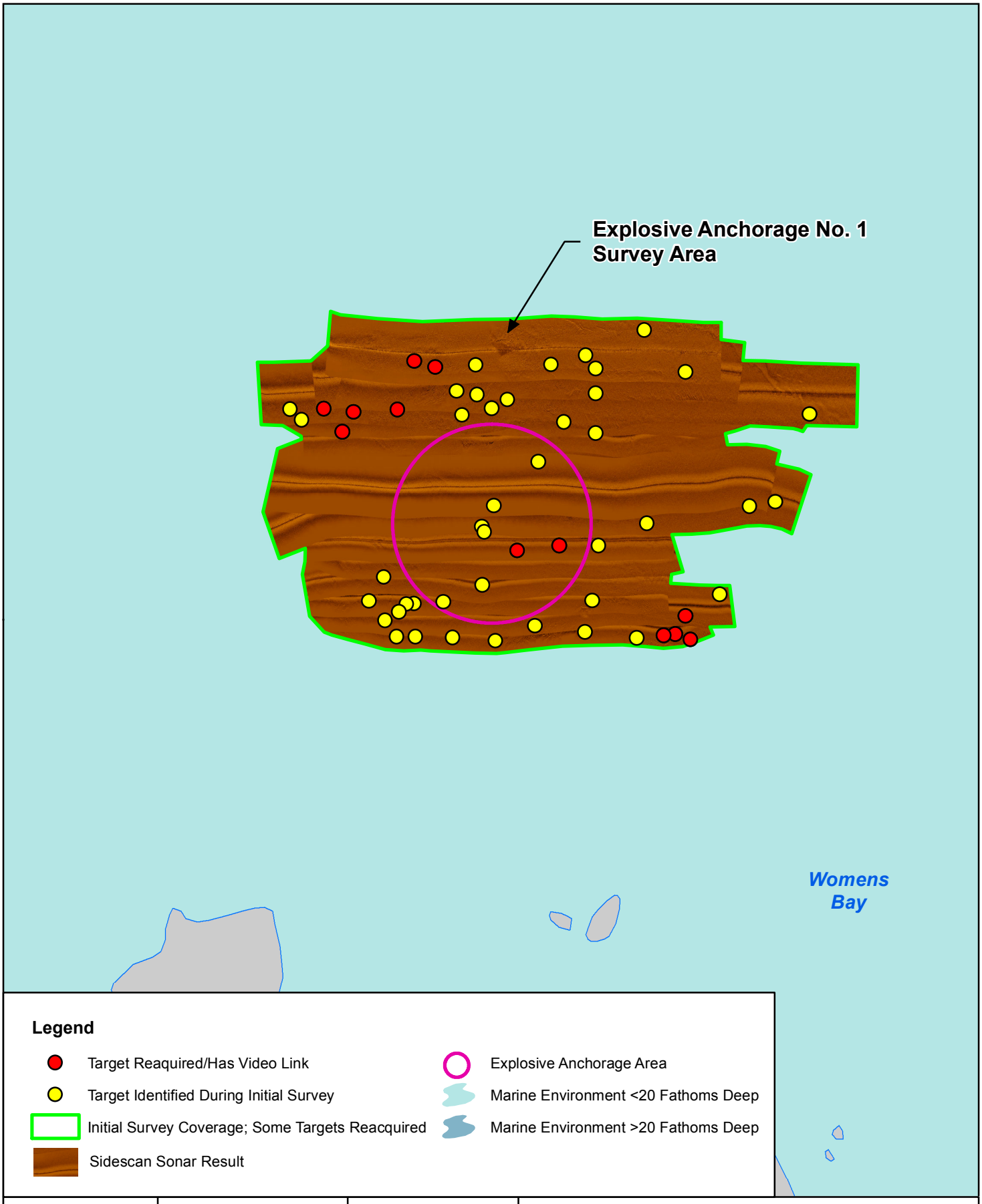
Document Path: J:\GIS\Projects\NAVY\SeaDefense\MXD\SI_Report\Kodiak\Figure4-1 Kodiak SHP SSS Targets and Surveyed Areas.mxd

U.S. NAVY

Delivery Order 0080
SI Report
Naval Defensive Sea Area
Kodiak Island, Alaska

0 0.75 1.5
Scale In Miles

Figure 4-1
Surveyed Areas Showing Target Locations



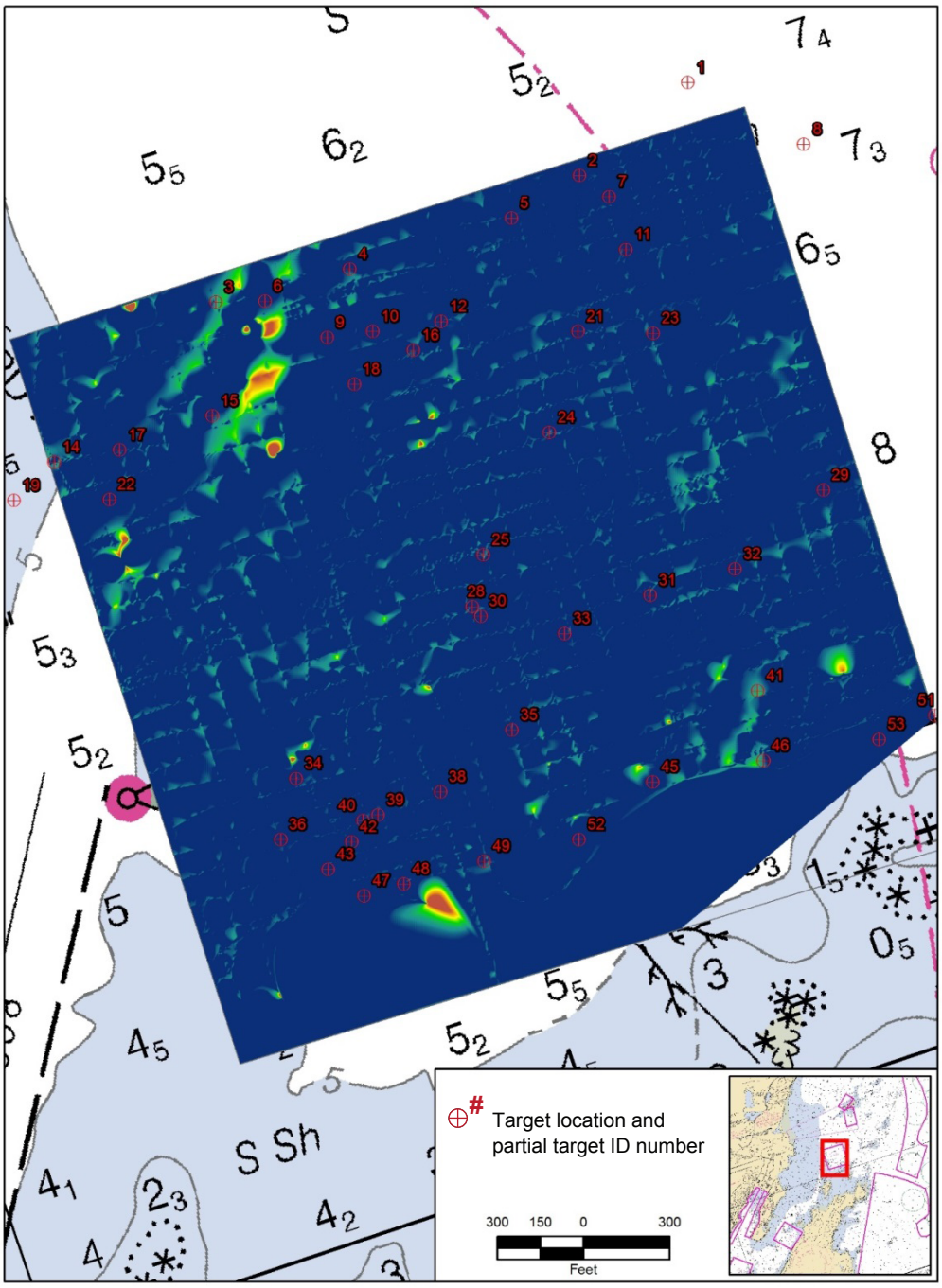
Document Path: J:\GIS\Projects\NAVY\SeaDefense\MXD\SI_Report\Kodiak\Figure4-2 Explosive Anchorage 1.mxd

U.S. NAVY

Delivery Order 0080
SI Report
Naval Defensive
Sea Area
Kodiak Island, Alaska

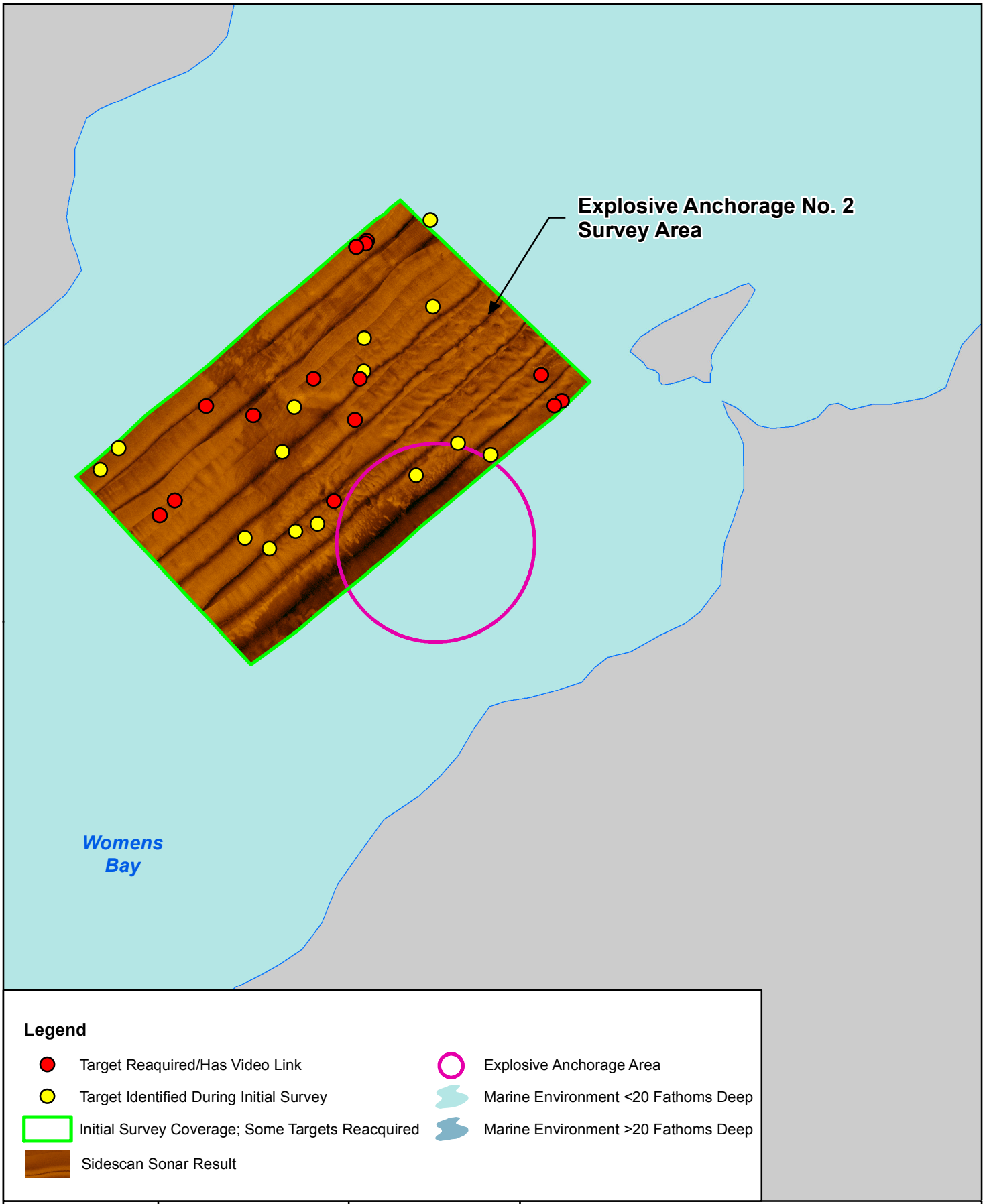
Figure 4-2
Explosive Anchorage No. 1, Sidescan Sonar Results and Target Locations

60413578_17.ai



Source: Gravity Consulting LLC and SeaVision Underwater Solutions Inc., 2015

U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska	**Figure 4-3** **Explosive Anchorage No.1, Magnetometer Survey Data Overlain with Sidescan Target Locations**



Document Path: J:\GIS\Projects\NAVY\SeaDefense\MXD\SI_Report\Kodiak\Figure4-4 Explosive Anchorage 2.mxd

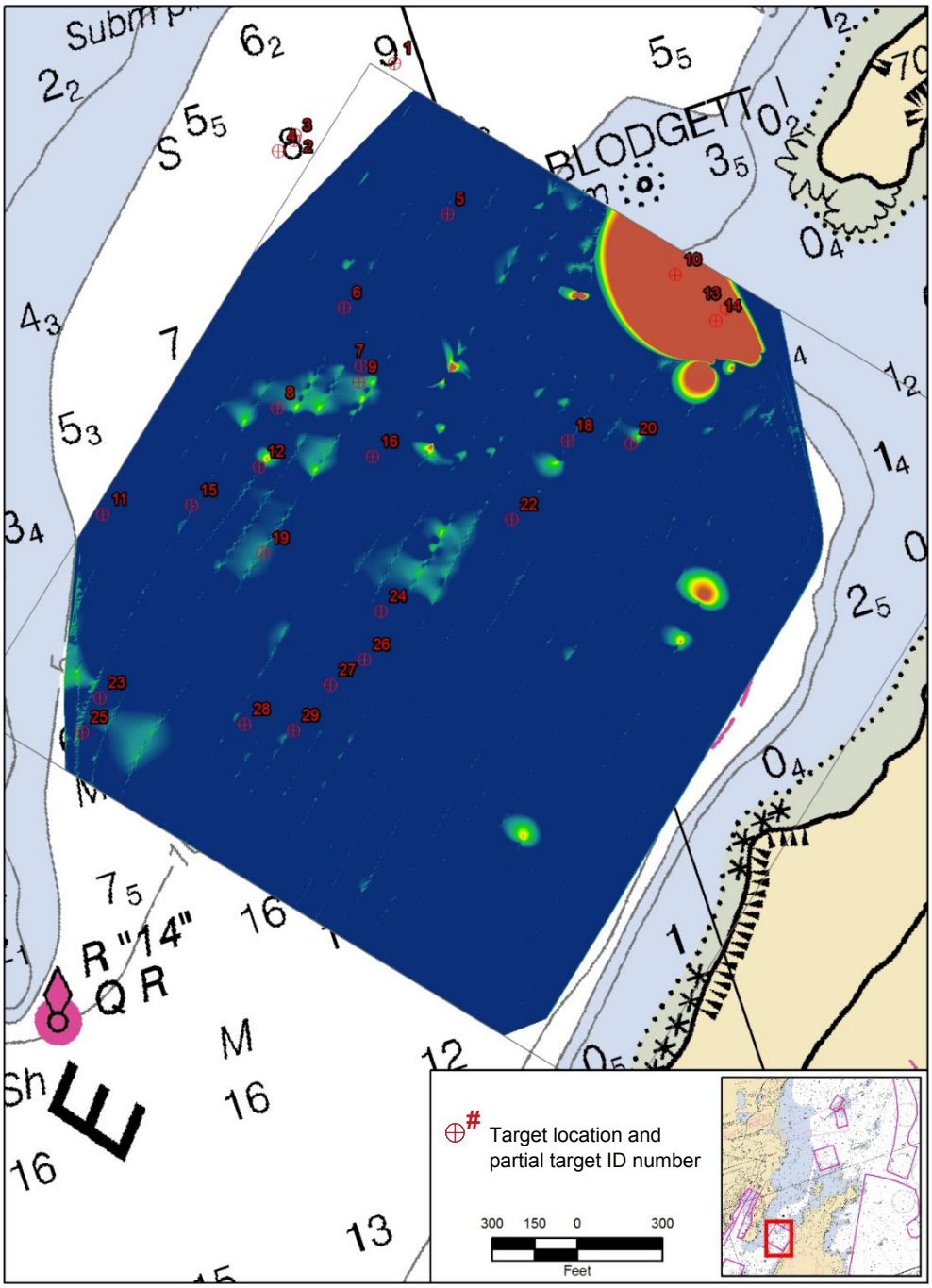
U.S. NAVY

Delivery Order 0080
SI Report
Naval Defensive
Sea Area
Kodiak Island, Alaska

0 450 900
Scale In Feet

Figure 4-4
Explosive Anchorage No. 2, Sidescan Sonar Results and Target Locations

60413578_18.ai



Source: Gravity Consulting LLC and SeaVision Underwater Solutions Inc., 2015

U.S. NAVY	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, Alaska	**Figure 4-5** **Explosive Anchorage No.2,** **Magnetometer Survey Data Overlain** **with Sidescan Target Locations**

Document Path: J:\GIS\Projects\NAVY\SeaDefense\MXD\SI_Report\Kodiak\Figure4-6 Explosive Anchorage 3.mxd

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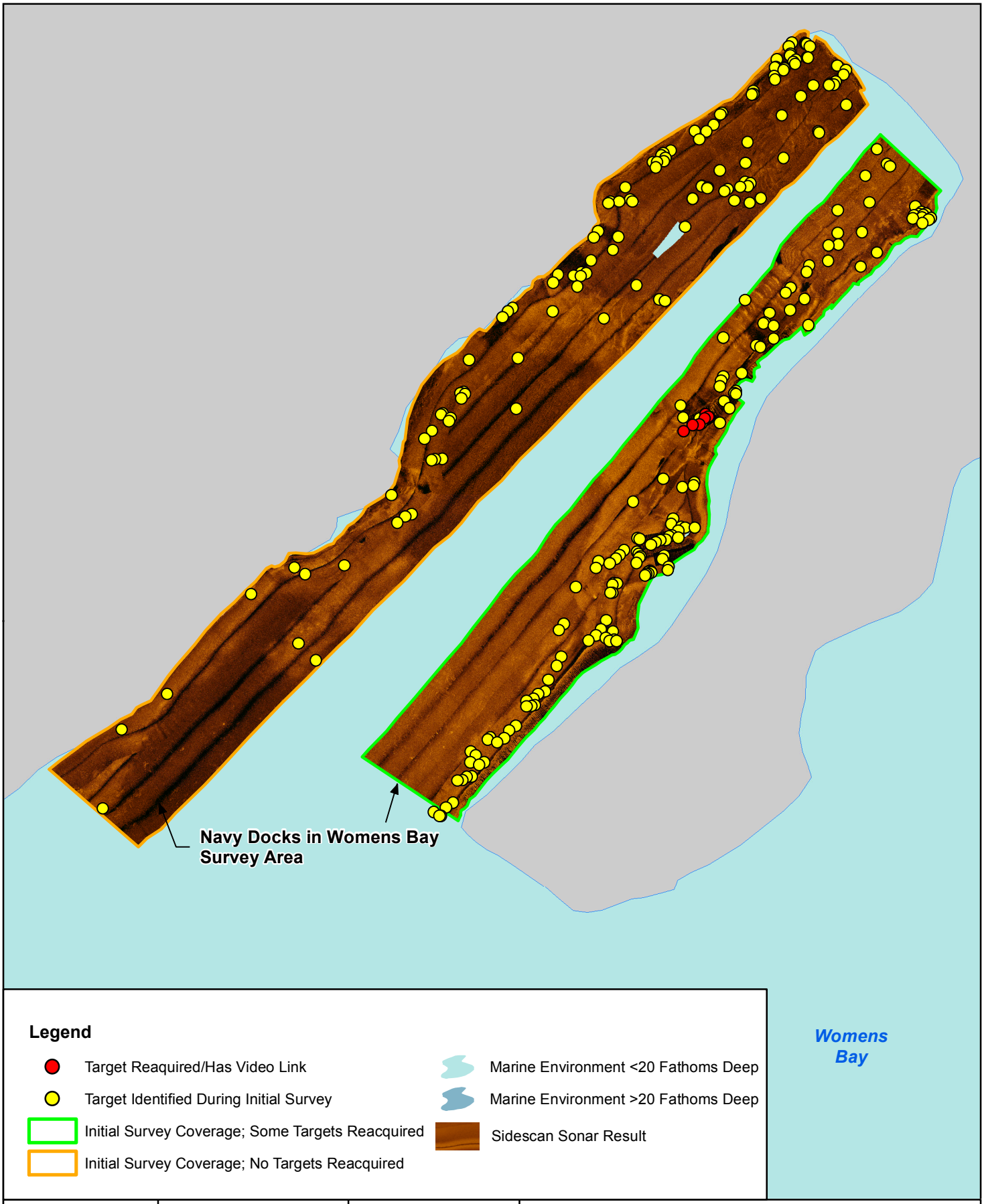
Sea Area
Kodiak Island, Alaska

0 450 900
Scale In Feet

Figure 4-6
Explosive Anchorage No. 3, Sidescan Sonar Results and Target Locations



Document Path: J:\GIS\Projects\NAVY\SeaDefense\MXD\SI_Report\Kodiak\Figure4-7 Navy Dock in Womens Bay.mxd

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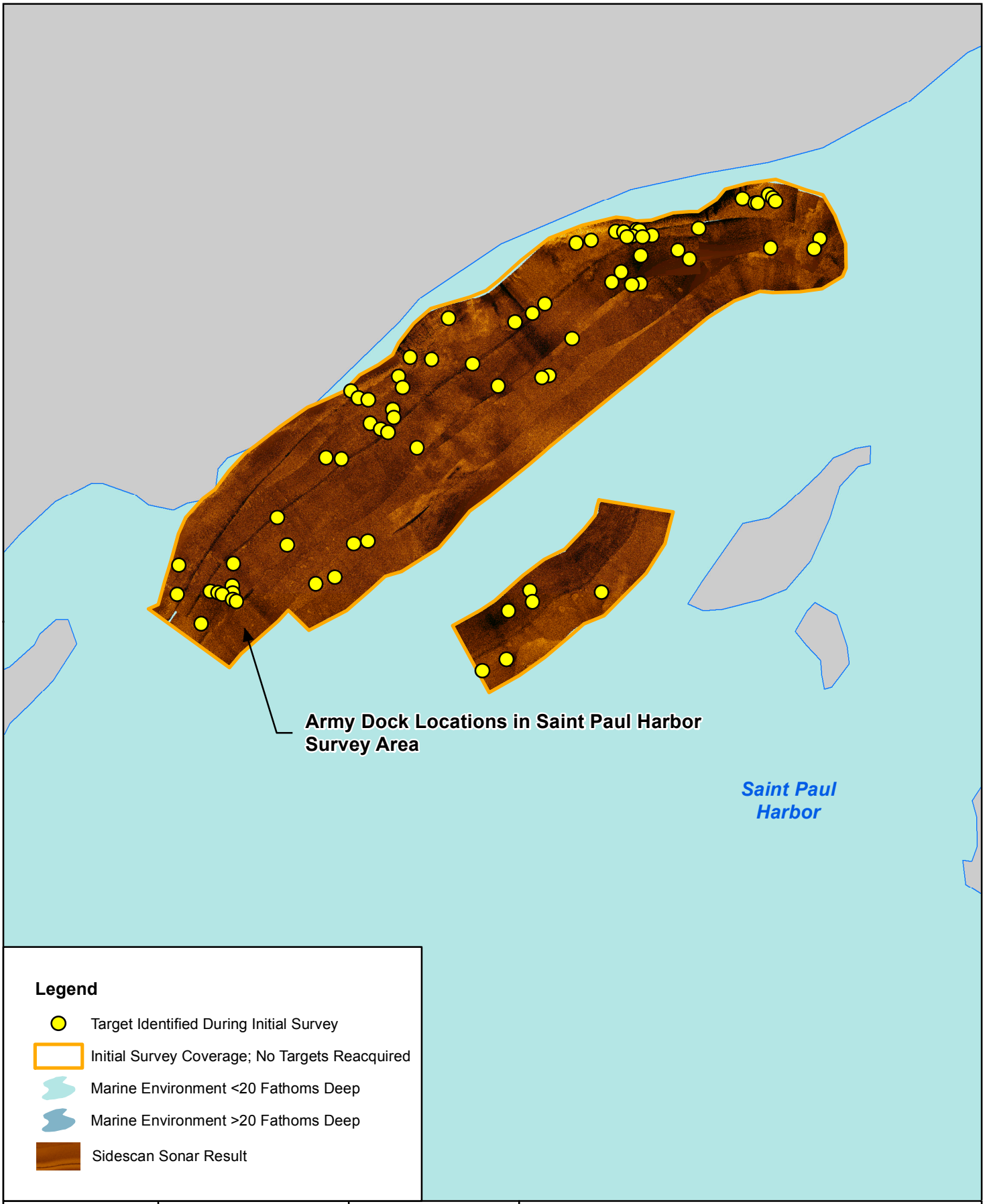
Figure 4-7
Navy Dock Locations in Womens Bay, Sidescan Sonar Results and Target Locations



Document Path: J:\GIS\Projects\NAVY\SeaDefense\MXD\SI_Report\Kodiak\Figure4-8 Army Dock in Saint Paul Harbor.mxd

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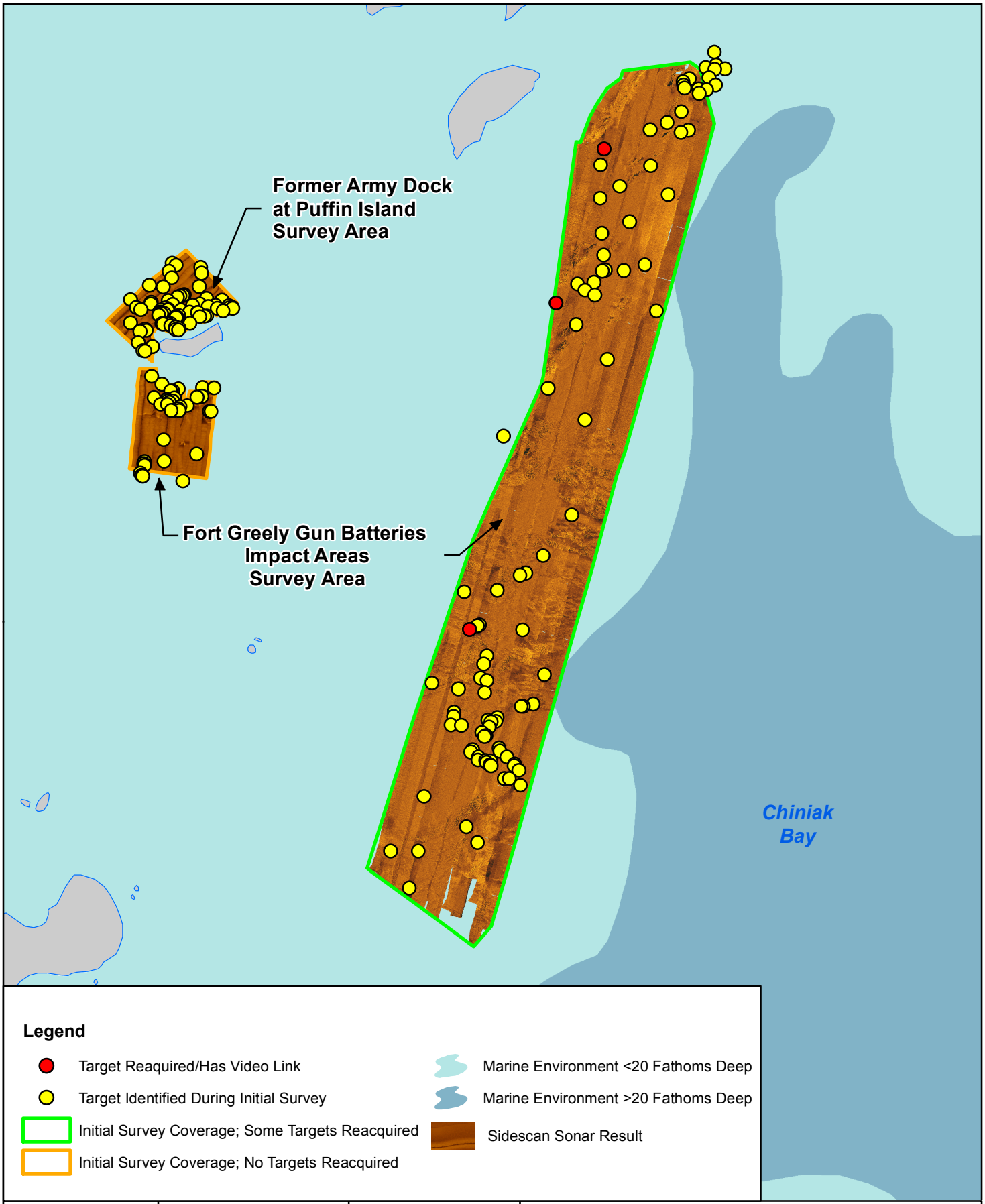
Figure 4-8
Army Dock Locations in Saint Paul Harbor, Sidescan Sonar Results and Target Locations



Document Path: J:\GIS\Projects\NAVY\SeaDefense\MXD\SI_Report\Kodiak\Figure4-9 Fort Greely Gun Batteries Impact Area.mxd

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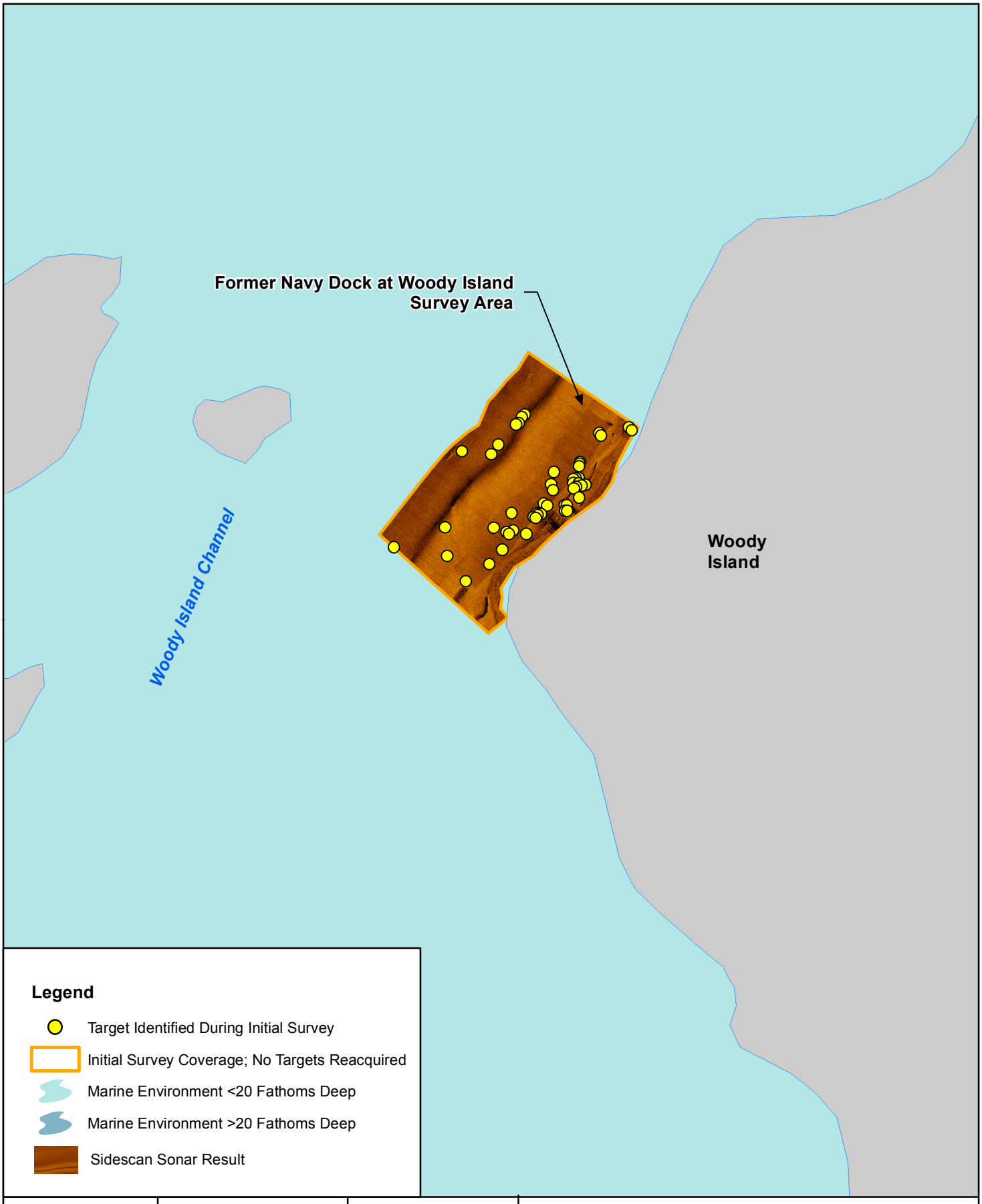
Kodiak Island, Alaska

0 1,000 2,000
Scale In Feet

Figure 4-9
Former Army Dock at Puffin Island and Fort Greely Gun Batteries Impact Areas, Sidescan Sonar Results and Target Locations



Document Path: J:\GIS\Projects\NAVY\SeaDefense\MXD\SI_Report\Kodiak\Figure4-10 Former Navy Dock at Woody Island.mxd

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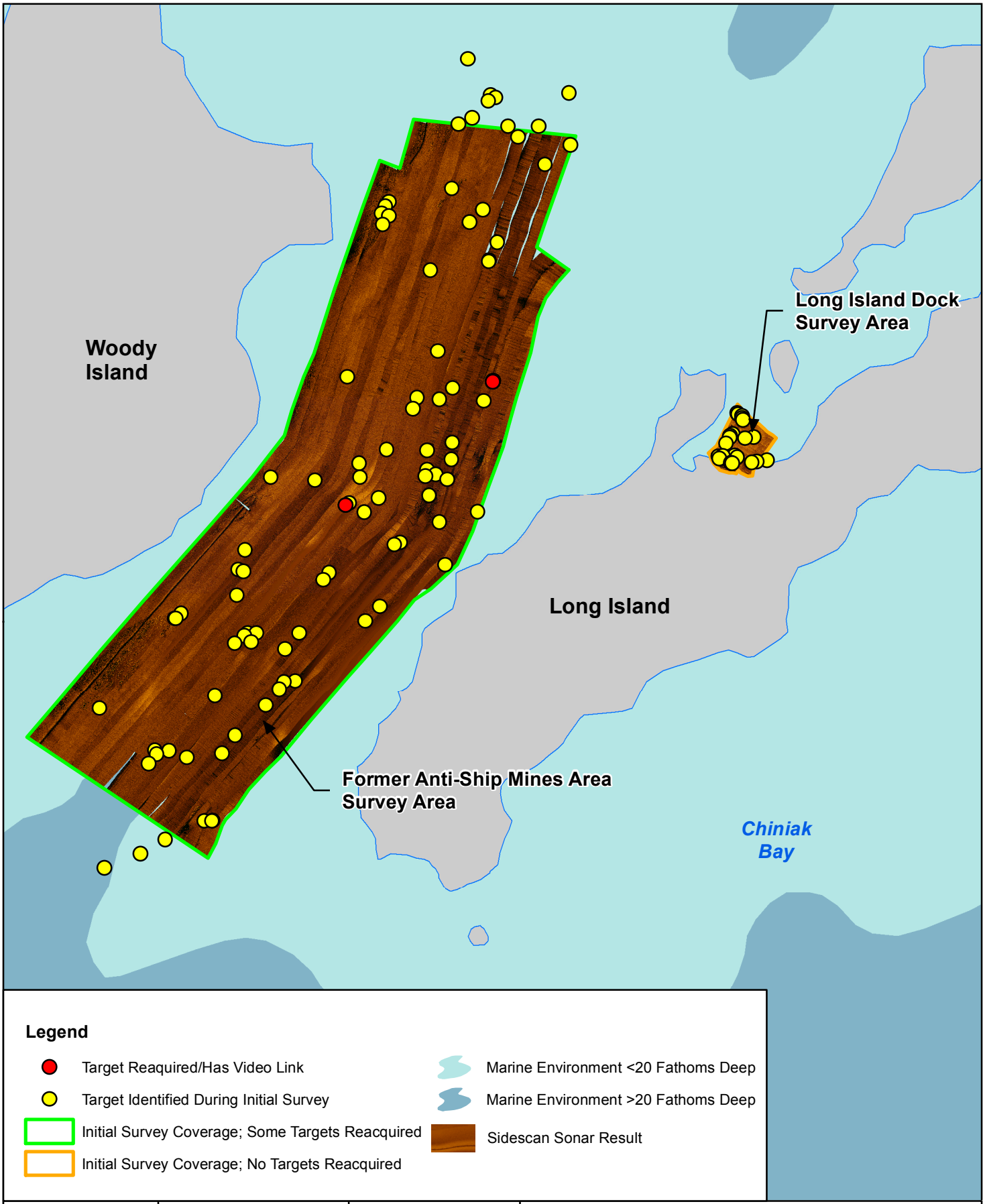
Figure 4-10
Former Navy Dock at Woody Island,
Sidescan Sonar Results and Target Locations



Document Path: J:\GIS\Projects\NAVY\SeaDefense\MXD\SI_Report\Kodiak\Figure4-11 Former Anti-Ship Mines Area.mxd

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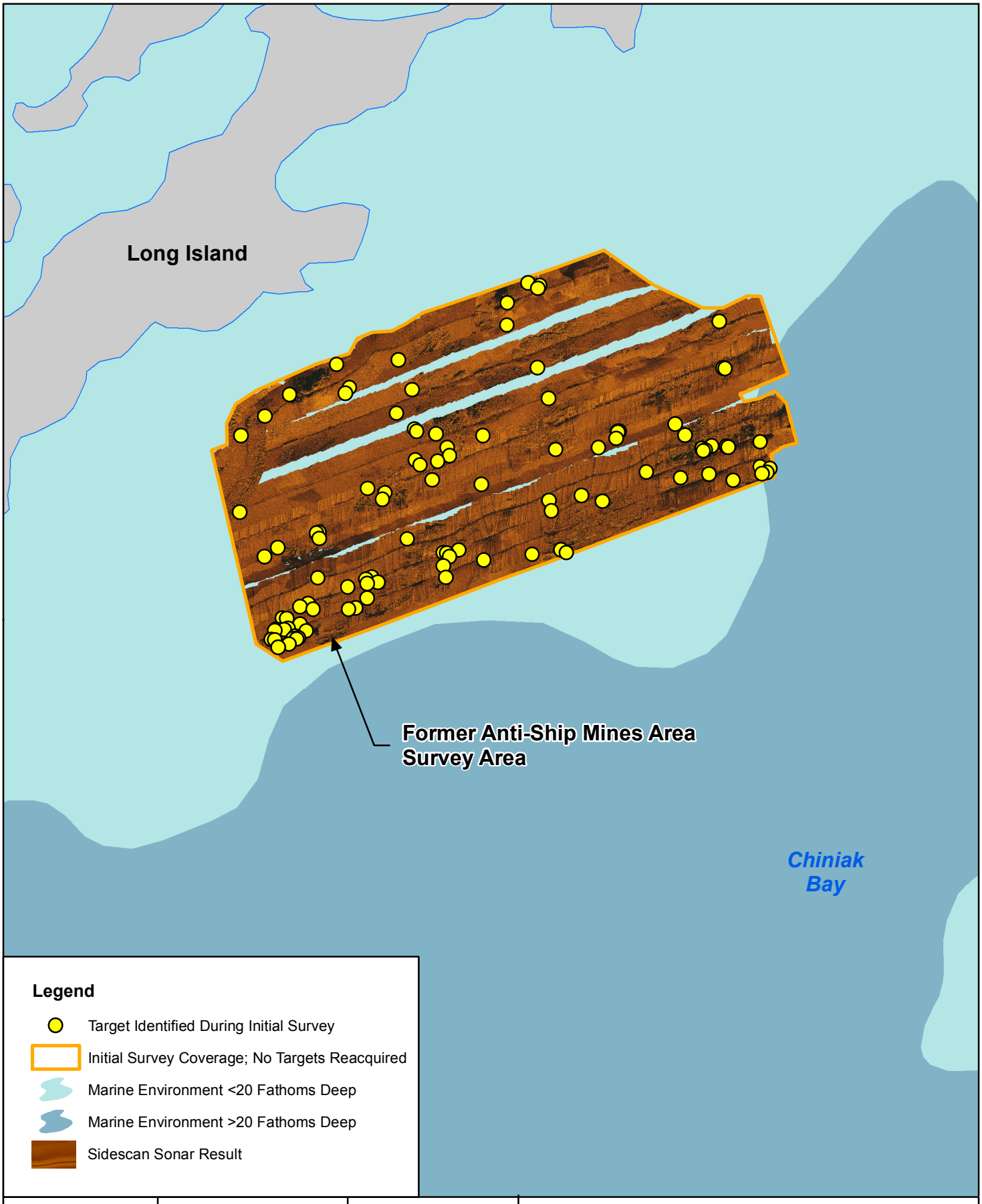
Kodiak Island, Alaska

0 1,000 2,000
Scale In Feet

Figure 4-11
Former Anti-Ship Mines Area between Long and Woody Islands and Long Island Dock, Sidescan Sonar Results and Target Locations



Document Path: J:\GIS\Projects\NAVY\SeaDefense\MXD\SI_Report\Kodiak\Figure4-12 Former Anti-Ship Mines Area(2).mxd

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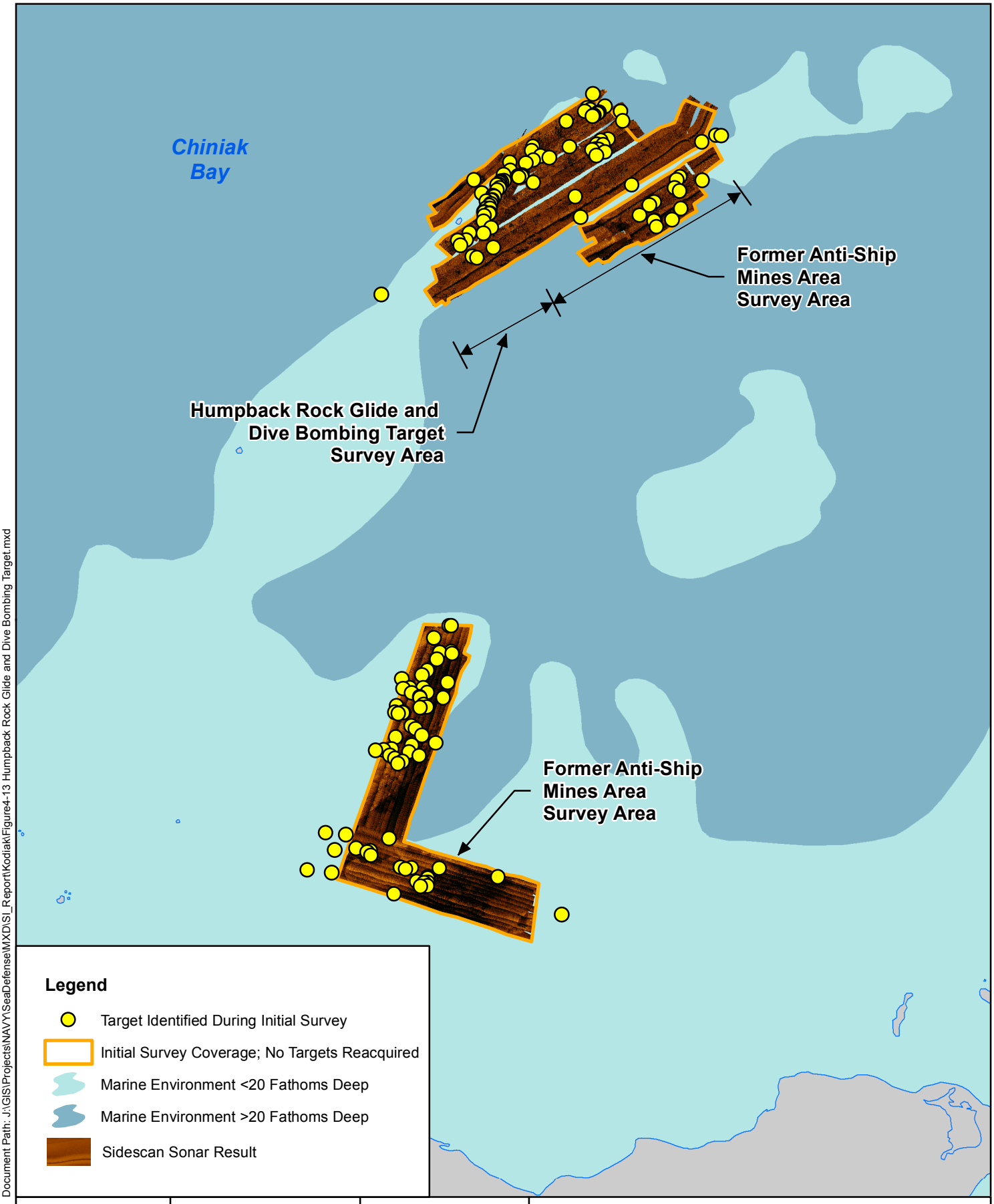
Figure 4-12
Former Anit-Ship Mines Area
East of Long Island,
Sidescan Sonar Results and Target Locations



Document Path: J:\GIS\Projects\NAVY\SeaDefense\MXD\SI_Report\Kodiak\Figure4-13 Humpback Rock Glide and Dive Bombing Target.mxd

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Figure 4-13
Humpback Rock Glide and Dive Bombing Target and Former Anti-Ship Mines Area in Southeastern Chiniak Bay, Sidescan Sonar Results and Target Locations

Table 4-1
Schedule of Survey Areas During Kodiak NDSA SI Surveys

Date	Vessel	Survey Area at Kodiak NSDA	Survey Type
5/1/2015	R/V *Thunder*	Fort Greely Gun Batteries Impact Areas (main area) (start)	Sidescan sonar
	Blackfoot	Army Dock Locations in Saint Paul Harbor (start)	Interferometric sonar
5/2/2015	R/V *Thunder*	Former Anti-Ship Mines Area (east side Long Island)	sidescan sonar
	Blackfoot	Army Dock Locations in Saint Paul Harbor (finish)	Interferometric sonar
5/3/2015	R/V *Thunder*	Fort Greely Gun Batteries Impact Areas (main area) (finish)	Sidescan sonar
	Blackfoot	Former Army Dock at Puffin Island	Interferometric sonar
5/4/2015	R/V *Thunder*	Humpback Rock Glide and Dive Bombing Target and adjacent former Anti-Ship Mines Area	Sidescan sonar
	Blackfoot	Fort Greely Gun Batteries Impact Areas near Puffin Island (attempted, returned to dock, rough seas)	Interferometric sonar
5/5/2015	R/V *Thunder*	Former Anti-Ship Mines Area (between Woody Island and Long Island) (start)	Sidescan sonar
	Blackfoot	Explosive Anchorage Area No. 2 (start)	Interferometric sonar
5/6/2015	R/V *Thunder*	Former Anti-Ship Mines Area (between Woody Island and Long Island) (finish)	Sidescan sonar
	Blackfoot	Explosive Anchorage Area No. 2 (end) Explosive Anchorage Area No. 3 (start)	Interferometric sonar
5/7/2015	R/V *Thunder*	Former Anti-Ship Mines Area (southernmost area) (start)	Sidescan sonar
	Blackfoot	Former Navy Dock Locations in Womens Bay (northwest shoreline)	Interferometric sonar
5/8/2015	R/V *Thunder*	Explosive Anchorage Area No. 1 QA testing	Sidescan sonar
	Blackfoot	Explosive Anchorage Area No. 3 (end) Former Navy Dock Locations in Womens Bay (southeast shoreline)	Interferometric sonar
5/9/2015	R/V *Thunder*	Resurveyed Army Dock Locations in Saint Paul Harbor Fort Greely Gun Batteries Impact Areas (RV survey)	Sidescan sonar ROV with/Blue View sonar
	Blackfoot	Former Navy Dock Locations in Womens Bay (southeast shoreline)	Interferometric sonar
5/10/2015	R/V *Thunder*	Former Anti-Ship Mines Area (between Woody Island and Long Island) (RV survey, hampered by rough seas and strong currents) Explosive Anchorage Area No. 1 (RV survey) Additional QA testing with sidescan sonar	Sidescan sonar ROV with/triTech sonar
	Blackfoot	Resurveyed Former Navy Dock Locations in Womens Bay (northwest shoreline)	Interferometric sonar

Table 4-1 (Continued)
Schedule of Survey Areas During Kodiak NDSA SI Surveys

Date	Vessel	Survey Area at Kodiak NSDA	Survey Type
5/11/2015	R/V *Thunder*	QA testing Explosive Anchorage Area No. 1	Magnetometer
	Blackfoot	None due to sea conditions - onshore maintenance	Not applicable
5/12/2015	R/V *Thunder*	Explosive Anchorage Area No. 1 (RV survey) Explosive Anchorage Area No. 2 (RV survey)	ROV magnetometer
	Blackfoot	Former Army Dock at Puffin Island (resurvey) Fort Greely Gun Batteries Impact Areas (small area south of Puffin Island) Former Navy Dock at Woody Island	Interferometric sonar
5/13/2015	R/V *Thunder*	Explosive Anchorage Area No. 2 (RV survey) Explosive Anchorage Area No. 3 (RV survey)	ROV
	Blackfoot	Long Island Dock	Interferometric sonar
5/14/2015	R/V *Thunder*	Anchorage 2 (RV survey) Former Navy Dock Locations in Womens Bay (southeast shoreline) (RV survey)	ROV
	Blackfoot	Pack up equipment for demobilizing	None
5/15/2015	R/V *Thunder*	Start mobilization to Unalaska Island (no surveying); Blackfoot loaded onto R/V Thunder	None

Notes:
NSDA - Naval Defense Sea Area
ROV - remotely operated vehicle
R/V - research vessel

Table 4-2
Summary of Targets Identified and Reacquired During Kodiak NDSA WAA and RV Surveys

Survey Area	WAA Survey Date	Targets Identified	RV Survey Date	Targets Reacquired
Northwestern Chiniak Bay, Saint Paul Harbor and Womens Bay				
Explosive Anchorage No. 1	5/8/15	54	5/10/15–5/12/15	12
Explosive Anchorage No. 2	5/5/15–5/6/15	29	5/12/15–5/14/15	14
Explosive Anchorage No. 3	5/6/15, 5/8/15	23	5/13/15	7
Navy Dock Locations in Womens Bay[a]	5/7/15, 5/9/15	128 (west side, Navy Dock 1); 149 (east side, Navy Dock 2)	5/14/15	6
Army Dock Locations in Saint Paul Harbor	5/9/15	74	NA	NA
Former Army Dock at Puffin Island	5/3/15, 5/12/15	76	NA	NA
Former Navy Dock at Woody Island	5/12/15	52	NA	NA
Happy Beach AATC Impact Areas	NA	NA	NA	NA
Fort Greely Gun Batteries Impact Areas[b]	5/1/15, 5/3/15, 5/12/15	100 (main area); 35 (smaller portion of area south of Puffin Island)	5/9/15	3
Northeastern Chiniak Bay				
Long Island Dock	5/13/15	23	NA	NA
Former Anti-Ship Mines Area between Long and Woody Islands	5/5/15–5/6/15	92	5/10/15	3
Former Anti-Ship Mines Area East of Long Island	5/2/15	105	NA	NA
Fort Abercrombie Gun Batteries Impact Area	NA	NA	NA	NA
Southeastern Chiniak Bay				
Humpback Rock Glide and Dive Bombing Target and adjacent Former Anti-Ship Mines Area	5/4/15	92	NA	NA
Former Anti-Ship Mines Area[c]	5/7/15	67	NA	NA

Table 4-2 (Continued)
Summary of Targets Identified and Reacquired During WAA and RV Surveys, Kodiak NDSA

Survey Area	WAA Survey Date	Targets Identified	RV Survey Date	Targets Reacquired
Entrance Point				
Entrance Point AATC Dock	NA	NA	NA	NA
Entrance Point AATC Impact Area	NA	NA	NA	NA
Total		1,099		45

[a]The geophysical subcontractor (Gravity/SeaVision) recorded "Navy Dock Locations in Womens Bay" as two separate areas: "Navy Dock 1" on the northwest shoreline of Womens Bay and "Navy Dock 2" on the southeast shoreline.
[b]Includes Fort Greely area and an area referred to as Puffin Island South in Gravity's report and data.
[c]This area is referred to as Midway Point in Gravity's report and data.

Notes:
NA - not applicable
NDSA - Naval Defensive Sea Area
RV - reacquisition and verification
WAA - Wide Area Assessment

Table 4-3
Summary of Initial Target Classification Based on WAA Survey

Survey Area[a]	6-Inch Shell	Anchor	Anchor Block	Cable	Fish Trap(s)	Ladder	Mine-Like Object	Navigation Buoy Anchor	Otter Trawl Door	Piling	Skiff	Tires	Unknown (includes Blank, Cluster, Elongated and Proud)	Wreck	Total
Northwestern Chiniak Bay, Saint Paul Harbor and Womens Bay															
Explosive Anchorage No. 1	0	0	0	0	1	0	7	0	0	0	0	1	45	0	54
Explosive Anchorage No. 2	0	0	0	0	2	0	0	0	0	1	0	0	26	0	29
Explosive Anchorage No. 3	0	1	0	0	0	0	0	0	0	0	0	2	20	0	23
Navy Dock Locations in Womens Bay[a]	0	0	0	0	7	1	2	0	0	60	0	2	204	1	277
Army Dock Locations in Saint Paul Harbor	0	0	0	1	7	0	1	0	0	20	0	0	44	1	74
Former Army Dock at Puffin Island	0	0	0	0	7	0	0	0	0	8	0	0	61	0	76
Former Navy Dock at Woody Island	0	0	0	0	0	0	0	0	0	2	0	0	50	0	52
Happy Beach AATC Impact Area	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fort Greely Gun Batteries Impact Area[b]	1	0	1	0	24	0	5	1	1	5	2	0	93	2	135
Long Island Dock	0	0	0	0	1	0	0	0	0	3	0	0	19	0	23
Former Anti-Ship Mines Area between Long and Woody Islands	0	0	0	0	14	0	26	0	0	0	0	0	52	0	92
Former Anti-Ship Mines Area East of Long Island	0	0	0	0	2	0	0	0	0	9	0	1	91	2	105
Fort Abercrombie Gun Batteries Impact Area	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Humpback Rock Glide and Dive Bombing Target and adjacent former Anti-Ship Mine Areas	0	0	0	0	2	0	8	0	0	0	0	0	80	2	92
Former Anti-Ship Mines Area[c]	0	0	0	0	4	0	4	0	0	0	0	0	59	0	67
Entrance Point AATC Dock	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Entrance Point AATC Impact Area	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total	1	1	1	1	71	1	53	1	1	108	2	6	844	8	1,099

[a]The geophysical subcontractor (Gravity/SeaVision) recorded “Navy Dock Locations in Womens Bay” as two separate areas: “Navy Dock 1” on the northwest shoreline of Womens Bay and “Navy Dock 2” on the southeast shoreline.
[b]Includes Fort Greely area and an area referred to as Puffin Island South in Gravity’s report and data.
[c]This area is referred to as Midway Point in Gravity’s report and data

Notes:
NA - not applicable
WAA - Wide Area Assessment

Table 4-4
Reacquired Targets and Related Characteristics

Survey Area	WAA Target ID	RV Target ID	Easting[a]	Northing[a]	Height (feet)	Length (feet)	Width (feet)	Classification
Explosive Anchorage No. 1	WAA_SSS_400kHz_ExplosiveAnchorage1_0003	RI_ROV_ExplosiveAnchorage1_Target_0003	7815691.2	3213419.8	1.5	4.2	2.2	Concrete anchor block
	WAA_SSS_400kHz_ExplosiveAnchorage1_0006	RI_ROV_ExplosiveAnchorage1_Target_0006	7815861.2	3213424.0	1.9	3.4	2.7	Crab pot
	WAA_SSS_400kHz_ExplosiveAnchorage1_0014	RI_ROV_ExplosiveAnchorage1_Target_0014	7815127.3	3212854.7	1.7	4.4	3.9	Timber crate or timber debris
	WAA_SSS_400kHz_ExplosiveAnchorage1_0015	RI_ROV_ExplosiveAnchorage1_Target_0015	7815678.3	3213019.0	1.4	4.2	2.4	Unknown
	WAA_SSS_400kHz_ExplosiveAnchorage1_0017	RI_ROV_ExplosiveAnchorage1_Target_0017	7815355.3	3212898.4	1.6	2.6	2.4	Unknown
	WAA_SSS_400kHz_ExplosiveAnchorage1_0022	RI_ROV_ExplosiveAnchorage1_Target_0022	7815319.1	3212723.6	1.5	8.0	1.8	Concrete plank
	WAA_SSS_400kHz_ExplosiveAnchorage1_0031	RI_ROV_ExplosiveAnchorage1_Target_0031	7817203.1	3212385.8	1.3	2.8	1.1	Crab pot
	WAA_SSS_400kHz_ExplosiveAnchorage1_0033	RI_ROV_ExplosiveAnchorage1_Target_0033	7816904.7	3212249.3	1.1	2.5	1.7	Possible ammunition crate
	WAA_SSS_400kHz_ExplosiveAnchorage1_0044	RI_ROV_ExplosiveAnchorage1_Target_0044	7818311.4	3212153.2	1.8	2.1	1.5	Rock
	WAA_SSS_400kHz_ExplosiveAnchorage1_0050	RI_ROV_ExplosiveAnchorage1_Target_0050	7818277.9	3211997.5	1.0	5.7	2.8	Rock
	WAA_SSS_400kHz_ExplosiveAnchorage1_0051	RI_ROV_ExplosiveAnchorage1_Target_0051	7818194.0	3211961.0	0.8	2.5	2.3	Rock
	WAA_SSS_400kHz_ExplosiveAnchorage1_0054	RI_ROV_ExplosiveAnchorage1_Target_0054	7818403.2	3211990.6	0.7	10.2	5.0	Rock
Explosive Anchorage No. 2	WAA_SSS_400kHz_ExplosiveAnchorage2_0002	RI_ROV_ExplosiveAnchorage2_Target_0002	7809776.5	3203573.1	5.7	32.0	17.2	Timber pilings up to 6 feet above mudline
	WAA_SSS_400kHz_ExplosiveAnchorage2_0003	RI_ROV_ExplosiveAnchorage2_Target_0003	7809773.4	3203555.0	10.7	41.8	25.0	Timber pilings up to 6 feet above mudline
	WAA_SSS_400kHz_ExplosiveAnchorage2_0004	RI_ROV_ExplosiveAnchorage2_Target_0004	7809719.7	3203516.3	1.4	4.7	3.5	Conical fish pot
	WAA_SSS_400kHz_ExplosiveAnchorage2_0008	RI_ROV_ExplosiveAnchorage2_Target_0008	7809714.1	3202611.8	2.2	5.2	2.5	Rock
	WAA_SSS_400kHz_ExplosiveAnchorage2_0009	RI_ROV_ExplosiveAnchorage2_Target_0009	7810002.8	3202703.3	3.0	5.6	3.8	Possible ammunition crate
	WAA_SSS_400kHz_ExplosiveAnchorage2_0010	RI_ROV_ExplosiveAnchorage2_Target_0010	7811116.2	3203080.7	0.7	7.6	2.9	Unknown block.
	WAA_SSS_400kHz_ExplosiveAnchorage2_0011	RI_ROV_ExplosiveAnchorage2_Target_0011	7809099.2	3202236.2	1.1	3.0	2.5	Unknown block.
	WAA_SSS_400kHz_ExplosiveAnchorage2_0013	RI_ROV_ExplosiveAnchorage2_Target_0013	7811296.0	3202961.5	2.3	19.6	6.5	Possible ammunition crate
	WAA_SSS_400kHz_ExplosiveAnchorage2_0014	RI_ROV_ExplosiveAnchorage2_Target_0014	7811258.5	3202918.4	2.2	2.1	3.0	Possible ammunition crate
	WAA_SSS_400kHz_ExplosiveAnchorage2_0015	RI_ROV_ExplosiveAnchorage2_Target_0015	7809412.2	3202268.5	0.6	11.4	1.0	Empty drum or expended shell
	WAA_SSS_400kHz_ExplosiveAnchorage2_0016	RI_ROV_ExplosiveAnchorage2_Target_0016	7810049.4	3202439.5	2.2	4.8	4.6	Unknown debris
	WAA_SSS_400kHz_ExplosiveAnchorage2_0023	RI_ROV_ExplosiveAnchorage2_Target_0023	7809089.6	3201590.0	0.4	21.0	0.7	Crab pot
	WAA_SSS_400kHz_ExplosiveAnchorage2_0024	RI_ROV_ExplosiveAnchorage2_Target_0024	7810079.0	3201894.5	1.1	28.7	2.4	Crab pot
	WAA_SSS_400kHz_ExplosiveAnchorage2_0025	RI_ROV_ExplosiveAnchorage2_Target_0025	7809027.1	3201468.0	2.2	5.9	1.7	Crab pot

Table 4-4(Continued)
Reacquired Targets and Related Characteristics

Survey Area	WAA Target ID	RV Target ID	Easting[a]	Northing[a]	Height (feet)	Length (feet)	Width (feet)	Classification
Explosive Anchorage No. 3	WAA_SSS_400kHz_ExplosiveAnchorage3_0009	RI_ROV_ExplosiveAnchorage3_Target_0009	7802468.7	3197248.2	0.9	4.9	3.9	Fish trap
	WAA_SSS_400kHz_ExplosiveAnchorage3_0010	RI_ROV_ExplosiveAnchorage3_Target_0010	7802439.3	3197231.6	1.9	34.6	6.7	Corroded drum
	WAA_SSS_400kHz_ExplosiveAnchorage3_0013	RI_ROV_ExplosiveAnchorage3_Target_0013	7804142.8	3197470.3	1.3	2.9	2.9	Navy anchor
	WAA_SSS_400kHz_ExplosiveAnchorage3_0015	RI_ROV_ExplosiveAnchorage3_Target_0015	7804920.1	3197316.8	1.8	9.5	4.1	Fish trap
	WAA_SSS_400kHz_ExplosiveAnchorage3_0016	RI_ROV_ExplosiveAnchorage3_Target_0016	7804623.6	3197186.7	2.0	5.0	2.5	Fish trap
	WAA_SSS_400kHz_ExplosiveAnchorage3_0017	RI_ROV_ExplosiveAnchorage3_Target_0017	7803244.3	3196516.6	1.8	15.3	3.2	Fish trap
	WAA_SSS_400kHz_ExplosiveAnchorage3_0021	RI_ROV_ExplosiveAnchorage3_Target_0021	7804702.1	3196063.0	0.9	7.4	2.3	Deteriorated timber frame
Fort Greely Gun Batteries Impact Area[b]	WAA_SSS_400kHz_FtGreely_0020	RI_ROV_FtGreely_Target_0020	7825034.2	3225128.5	2.1	20.9	11.4	Unknown
	WAA_SSS_400kHz_FtGreely_0037	RI_ROV_FtGreely_Target_0037	7825040.9	3221985.2	1.1	6.7	0.8	Tire
	WAA_SSS_400kHz_FtGreely_0052	RI_ROV_FtGreely_Target_0052	7825339.0	3215404.0	0.9	12.4	2.6	Fishing net
Former Anti-Ship Mines Area between Long and Woody Islands	WAA_SSS_400kHz_LWIsland0027	RI_ROV_LWIsland_Target_0027	7841810.5	3234443.3	2.3	15.4	8.3	Unknown
	WAA_SSS_400kHz_LWIsland0028	RI_ROV_LWIsland_Target_0028	7841810.5	3234422.3	2.3	8.1	7.2	Unknown
	WAA_SSS_400kHz_LWIsland0049	RI_ROV_LWIsland_Target_0049	7839931.0	3231475.6	2.3	4.4	3.2	Cable and fish trap
Navy Dock Locations in Womens Bay[c]	WAA_SSS_400kHz_NavyDock2_0051	RI_ROV_NavyDock2_Target_0051	7806432.6	3205295.0	0.3	10.2	1.1	Large capacity battery
	WAA_SSS_400kHz_NavyDock2_0052	RI_ROV_NavyDock2_Target_0052	7806458.7	3205280.7	0.9	5.6	1.8	Ladder
	WAA_SSS_400kHz_NavyDock2_0054	RI_ROV_NavyDock2_Target_0054	7806435.0	3205260.1	3.2	26.4	4.0	Gangway from ship
	WAA_SSS_400kHz_NavyDock2_0058	RI_ROV_NavyDock2_Target_0058	7806408.2	3205201.3	0.8	5.2	2.2	5-gallon bucket
	WAA_SSS_400kHz_NavyDock2_0059	RI_ROV_NavyDock2_Target_0059	7806362.0	3205183.8	0.4	17.1	2.6	Fish trap
	WAA_SSS_400kHz_NavyDock2_0060	RI_ROV_NavyDock2_Target_0060	7806311.5	3205115.2	0.3	8.4	3.3	Tire and metal debris

[a]North American Datum of 1983, Alaska (Zone 10) State Plane in feet
[b]Includes Fort Greely area and an area referred to as Puffin Island South in the geophysical subcontractor's (Gravity/SeaVision) report and data.
[c]Gravity recorded "Navy Dock Locations in Womens Bay" as two separate areas: "Navy Dock 1" on the northwest shoreline of Womens Bay and "Navy Dock 2" on the southeast shoreline.

Notes:
ID - identification
RV - reacquisition and verification
WAA - wide area assessment

Table 4-5
Summary of Targets Initially Classified as "Unknown," "Mine-Like Object," or "6-Inch Shell" That Were Reacquired

Survey Area	All Targets Identified	Targets Initially Classified as Other than Unknown, Mine-Like Object or 6-Inch Shell (Likely Inert)	Targets Initially Classified as Unknown, Mine-Like Object or 6-Inch Shell	Total Targets Reacquired	Reacquired Targets Initially Classified as Unknown, Mine-Like Object or 6-Inch Shell	Percent of All Targets That Were Reacquired	Percent of Targets Initially Classified as Unknown, Mine-Like Object or 6-Inch Shell That Were Reacquired	Targets Initially Classified as Unknown, Mine-Like Object or 6-Inch Shell That Were Not Reacquired and Less Than 5 Feet in All Direction
Northwestern Chiniak Bay, Saint Paul Harbor and Womens Bay								
Explosive Anchorage No. 1	54	2	52	12	12	22%	23%	23
Explosive Anchorage No. 2	29	3	26	14	13	48%	50%	3
Explosive Anchorage No. 3	23	3	20	7	7	30%	35%	2
Navy Dock Locations in Womens Bay[a]	277	71	206	6	3	2%	1%	74
Army Dock Locations in Saint Paul Harbor	74	29	45	NA	0	NA	NA	5
Former Army Dock at Puffin Island	76	15	61	NA	0	NA	NA	11
Former Navy Dock at Woody Island	52	2	50	NA	0	NA	NA	24
Happy Beach AATC Impact Area	NA	NA	NA	NA	NA	NA	NA	NA
Fort Greely Gun Batteries Impact Area[b]	135	36	99	3	2	2%	2%	35
Northeastern Chiniak Bay								
Long Island Dock	23	4	19	NA	0	NA	NA	8
Former Anti-Ship Mines Area between Long and Woody Islands	92	14	78	3	3	3%	4%	10
Former Anti-Ship Mines Area East of Long Island	105	14	91	NA	0	NA	NA	2
Fort Abercrombie Gun Batteries Impact Area	NA	NA	NA	NA	NA	NA	NA	NA
Southeastern Chiniak Bay								
Humpback Rock Glide and Dive Bombing Target and adjacent former Anti-Ship Mine Areas	92	4	88	NA	0	NA	NA	11
Former Anti-Ship Mines Area[c]	67	4	63	NA	0	NA	NA	2
Entrance Point								
Entrance Point AATC Dock	NA	NA	NA	NA	NA	NA	NA	NA
Entrance Point AATC Impact Area	NA	NA	NA	NA	NA	NA	NA	NA
Total	1,099	201	898	45	40	4%	4%	210

[a]The geophysical subcontractor (Gravity/SeaVision) recorded "Navy Dock Locations in Womens Bay" as two separate areas: "Navy Dock 1" on the northwest shoreline of Womens Bay and "Navy Dock 2" on the southeast shoreline.
[b]Includes Fort Greely area and an area referred to as Puffin Island South in Gravity's report and data.
[c]This area is referred to as Midway Point in Gravity's report and data

Note: NA - not applicable

5.0 CONCEPTUAL SITE MODEL

The releases of MEC into marine surface water at Kodiak Island resulted from the following activities:

- Ordnance fired over water from CDA and AA gun batteries during target training and gun function testing
- Ordnance lost into the water during transfer from transport ships to the shore, either at a fixed dock or at anchorage in Chiniak Bay
- Anti-ship mines that were not accounted for or that sank during mine clearing activities
- Ordnance fired or dropped from aircraft during bombing target training

The field effort did not positively identify MEC on the seafloor. However, this does not mean that MEC are not present. Of the 1,099 targets identified, the survey team had time to reacquire 45 targets in 6 survey areas (Table 4-2). Some of the targets that were not reacquired may have been MEC items. MEC has been pulled up in nets in Kodiak waters, as reported in the PA for the NDSA at Kodiak Island (U.S. Navy 2013). Therefore, MEC likely exists, but does not appear to be prevalent on the seafloor in the areas at least in the explosive anchorage areas where several targets were reacquired as part of the RV surveys.

Currents and depositional environment may affect the transport and burial of the MEC items that have been deposited of the seafloor. Studies of MEC on the seafloor confirm the movement and burial of MEC under certain conditions (Wilson et al. 2008).

A number of complex factors affect the fate and transport of MCs released in the underwater environment. These factors include the nature of the delivery of the ordnance item to the underwater environment, its potential for corrosion, and associated release of MCs.

Underwater releases of MCs can occur when casings deteriorate (most notably from corrosion), rupture upon impact, or undergo a low-order detonation. MCs may be released immediately after impact, or may be only partially contained within the remains of the delivery system. When ordnance undergoes a low-order detonation or breaks apart upon impact, the MCs, such as bulk explosives, can be scattered over the impact area (USEPA 2003).

The conceptual site model of the Kodiak Island NDSA is presented as Figure 5-1. There has been no new information found during the field effort that would suggest revision to the CSM. The populations of potential exposure to MEC are discussed in the following sections.

5.1 HUMAN EXPOSURE PATHWAYS AND RECEPTORS

The physical explosive hazard is a complete pathway for fishers (recreational or commercial) who may accidently detonate MEC. Commercial fishers could potentially bring up MEC in their fishing nets, which occurred as recently as June 2012 (U.S. Navy 2013) near Dutch Harbor, Alaska, and near Kodiak in 1974 (U.S. Navy 2013). In addition, a vessel's anchor could potentially detonate or get caught on MEC on the seafloor. Therefore, potential physical explosive hazards for recreational and commercial fishers are considered complete and could potentially be significant.

Recreational or commercial divers could come into direct contact with MEC during an underwater dive. Recreational or commercial divers will usually descend to a maximum of 20 fathoms (120 feet). Divers could encounter MEC in these shallow waters, particularly within sheltered areas such as Chiniak Bay. There is a reasonable likelihood that a diver could come into physical contact with MEC in the Kodiak area. Currently, active diving occurs around the Kodiak area by the local diving community. Therefore, potential physical explosive hazards for recreational and commercial divers are considered complete and could be significant.

Recreational beach users could come into direct contact with MEC. Although there have been no reports of UXO or DMM being recovered along the shoreline of Kodiak Island, DMM or UXO could possibly wash ashore onto one of the recreational beachcombing or tide-pooling areas of Kodiak Island. No documentation was found during the PA records search that indicated MEC disposal in the shallow marine environment around Kodiak Island (U.S. Navy 2013). Kodiak is a populated location, and in the absence of any report of items washing up or being discovered on the beach, there is no evidence that this is a complete exposure pathway. Therefore, the physical explosive hazard is considered an incomplete pathway for recreational beach users who might encounter and accidently detonate MEC.

Initial munitions hazard screening may be completed for MEC sites on land where MEC is identified, and soil and sediment samples can be collected for analysis so that results may be evaluated against screening criteria. Because this project was performed for in-water areas and no samples were collected, screening analytical values against screening criteria is not feasible for this project.

Another type of evaluation to address human health and safety concerns at munitions response sites on land is referred to as MEC hazard assessment, which has been presented in interim guidance (USEPA and USDoD 2008). The MEC hazard assessment is used to assess acute MEC explosive hazards and not chronic environmental contaminant exposure risk. This methodology is primarily designed to be used at two points in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process: at the end of a removal investigation to assess baseline explosive hazards and relative hazard reductions associated with removal alternatives in an engineering evaluation/cost analysis report, or at the end of a remedial investigation to assess baseline explosive hazards and relative hazard reductions associated with remedial alternatives in the remedial investigation/feasibility study report. Because the MEC hazard assessment was designed for land sites, the fact that no MEC was positively identified in the water, and the CERCLA process has not progressed to an engineering evaluation/cost analysis or remedial investigation/feasibility study, the MEC hazard assessment is not applicable to this project.

In the six areas where RV surveys were performed in 2015, no MEC was positively identified on the seafloor. There were a few instances of what appeared to be wooden crates possibly containing ammunition in Explosive Anchorages No. 1 and No. 2. However, there was no visible sign of the crate contents or contamination on the surrounding sediment. The survey team was not able to perform an RV survey to reacquire representative targets in 7 of the 13 areas where WAA surveys were performed (Table 4-2) because of time limitations.

Based on the results of the RV survey of the three explosive anchorage areas where representative targets were reacquired, it appears that the relative risk of encountering MEC is minimal. However, it is possible that some MEC items that are smaller and relatively heavy may have been buried in the sediment over the past several decades. If burial of MEC has occurred, it would not be accessible on the surface of the seafloor for human exposure.

If larger, somewhat lighter MEC items, such as anti-ship mines, are present on the seafloor in the former anti-ship mine areas, they would be of greater risk to human health. These types of items would be accessible to divers or could be accidentally caught in fishing equipment.

5.2 MARINE EXPOSURE PATHWAYS AND RECEPTORS

Exposure to MEC in the surface water of the Kodiak Island NDSA is limited to mammals, birds, fish, and benthic creatures found in the marine environment, which could have potential daily exposure to any MEC lost or discarded there. The risk to these creatures from detonation of the ordnance is remote and considered incomplete for the purposes of this evaluation. However, release of the constituents contained in the munitions could potentially impact the quality of the

surface water and sediments and present a potential hazard to the marine environment. Direct exposure of munitions constituents by marine receptors could occur wherever munitions exist in the marine environment: washed up onto beaches, on the surface of the seafloor, or buried in sediment. Therefore, exposure to chemical constituents of the explosives within the ordnance can be considered a potentially complete pathway as the marine environment slowly corrodes the metal casings.

The MCs (including the most common ones, trinitrotoluene, cyclotrimethylene trinitramine [RDX], and cyclotetramethylene tetranitramine) are likely to present low ecological risk under expected exposure scenarios in the marine environment. Although there is not extensive research on the toxicological effects of munitions in the marine environment, a study in 2005 concluded that exposure to RDX did not cause toxicity in amphipods (U.S. Navy 2013). Furthermore, MCs typically undergo extensive transformation upon contact with marine sediment and have low potential for bioaccumulation in aquatic organisms. Therefore, the exposures of terrestrial and aquatic populations to MCs via sediment and surface water at Kodiak Island are considered complete yet insignificant.

No MEC was positively identified in the marine environment. There were a few instances of possible ammunition crates in Explosive Anchorages No. 1 and No. 2. However, there was no visible sign of the crate contents or contamination on the surrounding sediment. The survey team was not able to perform an RV survey to reacquire representative targets in 7 of the 13 areas where WAA surveys were performed (Table 4-2) because of time limitations. Based on the observations to date, the risk to the biota in the marine environment appears negligible.

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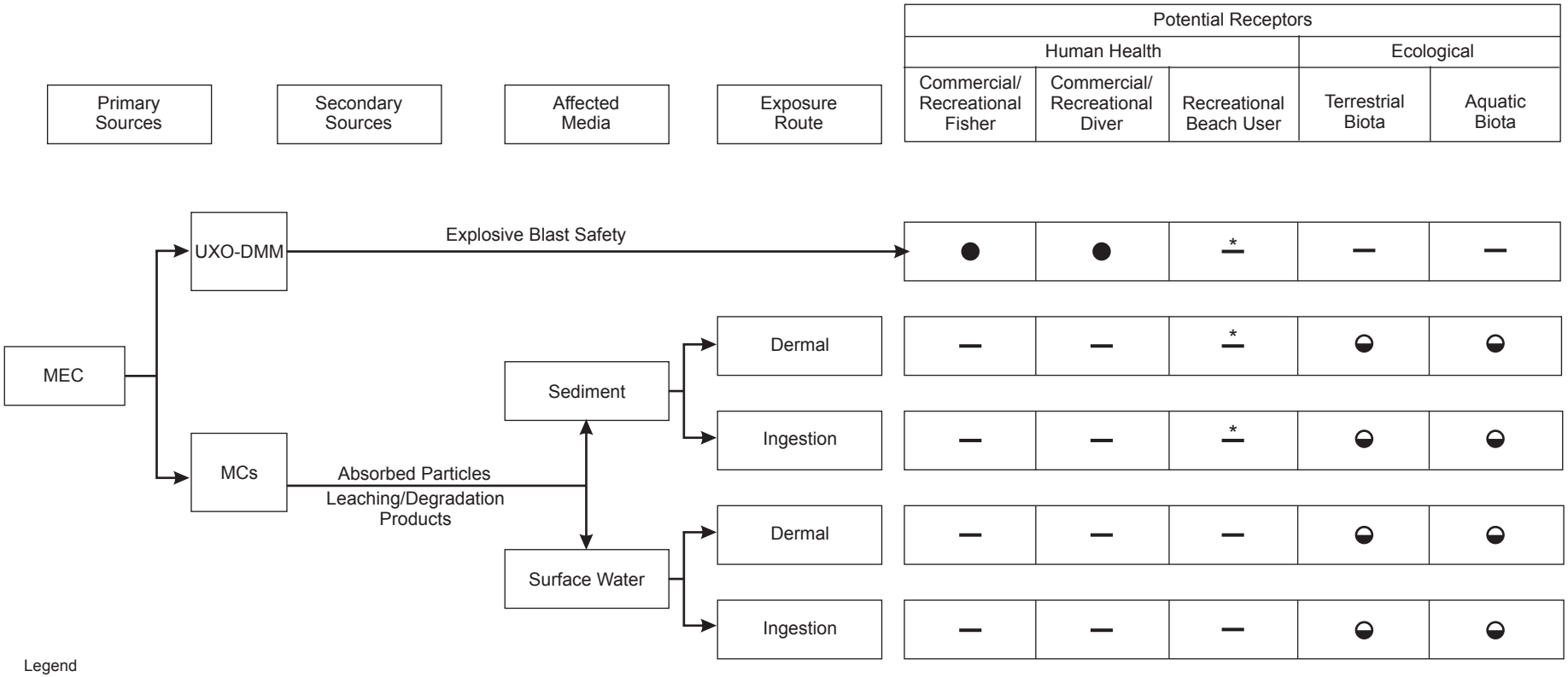

Legend

- ● Complete pathway
- ◒ Complete yet insignificant pathway
- — Incomplete pathway
- * Considered complete only if MEC are washed near or onto shoreline.

MEC - munitions and explosives of concern

DMM - discarded military munitions

UXO - unexploded ordnance

MCs - munitions constituents

U.S. NAVY	**Figure 5-1** **Conceptual Site Model**	Delivery Order 0080 SI Report Naval Defensive Sea Area Kodiak Island, AK

6.0 CONCLUSIONS AND RECOMMENDATIONS

In May 2015, a survey team performed the SI field work at the NDSA at Kodiak Island. The planned field work consisted of geophysical surveying at 17 in-water areas. The first phase of surveying that included WAA surveying using sidescan sonar was conducted at 13 of the areas. A total of 1,099 targets were identified.

No WAA survey was conducted at the following four areas that were originally planned to be surveyed:

- Happy Beach AATC Impact Area
- Fort Abercrombie Gun Batteries Impact Area
- Entrance Point AATC Dock
- Entrance Point AATC Impact Area

Two of the areas not surveyed were AATC areas that fired smaller rounds (i.e., 40-mm anti-aircraft rounds). The two smaller QA/QC test shapes, the mock .50-caliber round and the 25-pound mortar shell, were not observed during QA/QC testing of the sidescan sonar and marine magnetometer. Therefore, WAA surveying would not have been helpful in the AATC areas and gun batteries impact area because of the expected size of munitions used.

The survey team performed the second phase of RV surveying at 6 areas using a combination of the ROV and marine magnetometer and attempted to reacquire 45 targets, or approximately 4 percent of the identified targets. No target was positively identified as a MEC item. However, that does not discount the presence of MEC. In two of the explosive anchorage areas, four targets appeared to be crates that could have contained ammunition. No RV sampling was performed at 7 of the 13 areas where WAA surveys were performed. The survey team was unable to perform more RV surveying because of the 14-day period allotted for the field work. The survey team on the R/V *Thunder* had no stand-down days resulting from poor weather and was able to survey on all 14 days.

MEC items may not have been positively identified for four reasons. First, the equipment deployed was not able to identify smaller items on the seafloor, such as the two smaller QA/QC test shapes (the mock .50-caliber round and 25-pound mortar shell). Secondly, it is possible that some MEC items that are smaller with a greater mass (i.e., smaller projectiles) may have been buried in the sediment over the past several decades. If burial of MEC has occurred, it would not be accessible on the surface of the seafloor for human exposure. Thirdly, there may not be MEC on the surface to be detected. Lastly, the MEC could have been identified as a target, but was not reacquired and verified during the limited RV survey phase.

It appears that the relative risk of encountering MEC is minimal at the three explosive anchorage areas where representative targets were reacquired. At former Navy Dock Locations in Womens Bay, Fort Greely Gun Batteries Impact Areas, Former Anti-Ship Mines Area between Long and Woody Islands, very few targets were reacquired (12 attempted reacquisitions).

It is unlikely that anti-ship mines, if they are present, have been buried in the sediment and should be detectable on the sea floor in the former anti-ship mine areas. This type of MEC is larger and less dense than smaller projectiles, such as 40-mm and 8-inch-diameter artillery rounds, that may become buried in the sediment over time. If present, anti-ship mines could be accessible to divers, or could be caught accidentally in fishing equipment. Therefore, the MEC in the former anti-ship mines areas appear to be of greater potential risk to human health than the areas that may have smaller projectiles, which may be buried in the sediment. The survey team will likely find the cradle/anchor/spools that were deployed with the mines because they should remain on the seafloor and provide a geophysical signature. Appendix B includes a description of the sea mines possibly used at Kodiak in the anti-ship mine areas.

Based on the results of the 2015 SI surveys at the Kodiak Island NDSA, recommendations for each individual survey area are summarized on Table 6-1. In summary, no further action is recommended at 2 areas, and further action is recommended at 15 areas. RV surveying is recommended at 12 areas to reacquire and verify targets identified during the WAA phase, and additional WAA surveying followed by RV surveying is recommended at 3 areas. The use of a small magnetometer on the ROV is highly recommended to verify whether the target is ferrous or nonferrous material. This additional line of evidence would improve the identification of the target, because the presence of biological growth sometimes inhibits positive identification of the targets. For the sites where RV surveying is recommended, the surveying will be limited to targets that meet the size criterion (less than 5 feet in all directions) and were initially classified as “6-inch shell,” “mine-like object,” or “unknown”. RV surveying goals for targets at a site that meet these two criteria are as follows:

0 – 10 targets: reacquire 100%
11 – 30 targets: reacquire 80%
31 – 75 targets: reacquire 60%

As part of the additional RV surveying, the Navy will plan to perform QA testing of additional test shapes representing 155-mm and 8-inch artillery projectiles in the supplemental SI field work. Additionally, an ROV configured with a subsea acoustic positioning system will be used to confirm placement of the QA shapes on the seafloor during the supplemental SI surveys.

A magnetometer will be attached to the ROV to reacquire any possible ammunition crates so that the survey team can identify the presence or absence of ferrous metal. Possible ammunition crates (Targets 14 and 33 in Explosive Anchorage No.1 and Targets 9, 13, and 14 in Explosive Anchorage No. 2.) will be reacquired during the additional RV surveying and evaluated for the presence of ferrous metal.

After the additional RV surveying is completed, either no further action or remedial investigation can be recommended. If the additional RV surveying can be completed in the 2016 season, the project work plans could be minimally amended and the results could easily be included in the SI report.

A cost estimate to perform the additional RV surveying work at the 15 survey areas is $367,000 (Table 6-2).

Table 6-1
Summary of Recommendations for Each Survey Area

Survey Area	Recommendation	Rationale
Northwestern Chiniak Bay, Saint Paul Harbor and Womens Bay		
Explosive Anchorage No. 1	Additional RV surveying	• No possible MEC item was identified. • 2 of the 54 targets appeared inert based on the initial classification from the WAA survey characteristics. • Of the 52 targets initially classified as a 6-inch shell, mine-like object, or unknown, 12 (23%) were reacquired. Of those 40 remaining targets that were not reacquired, 23 met the size criterion of interest. • RV surveying should be conducted to reacquire 18 of the remaining targets (80%) that meet the size criterion. • The Possible ammunition crates (Targets 14 and 33 in Explosive Anchorage No.1) will also be reacquired during the additional RV surveying and evaluated for the presence of ferrous metal.
Explosive Anchorage No. 2	Additional WAA and RV surveying	• No possible MEC item was identified. • 3 of the 29 targets appeared inert based on the initial classification from the WAA survey characteristics. • Of the 26 targets initially classified as a 6-inch shell, mine-like object , or unknown, 13 (50%) were reacquired. Of those 13 remaining targets that were not reacquired, 3 met the size criterion of interest. • The data for the southeastern portion of the survey area was corrupted, and because there were several targets identified in the northwest portion of this survey area, completing the WAA survey followed by a RV survey of this area is recommended. • The number of targets reacquired during the RV survey will be based on the number of targets that meet the classification and size criteria, and surveying goals described in Section 6.0. • Possible ammunition crates (Targets 9, 13, and 14 in Explosive Anchorage No. 2.) will also be reacquired during the additional RV surveying and evaluated for the presence of ferrous metal.

Table 6-1 (Continued)
Summary of Recommendations for Each Survey Area

Survey Area	Recommendation	Rationale
Explosive Anchorage No. 3	Additional RV surveying	• No possible MEC item was identified. • 3 of the 23 targets appeared inert based on the initial classification from the WAA survey characteristics. • Of the 20 targets initially classified as a 6-inch shell, mine-like object, or unknown, 7 (35%) were reacquired. Of those 13 remaining targets that were not reacquired, 2 met the size criterion of interest. • RV surveying should be conducted to reacquire the 2 remaining targets (100%) that meet the size criterion.
Navy Dock Locations in Womens Bay	Additional RV surveying	• No possible MEC item was identified. • 71 of the 277 targets appeared inert based on the initial classification from the WAA survey characteristics. • Of the 206 targets initially classified as a 6-inch shell, mine-like object, or unknown, 3 (1%) were reacquired. Of those 203 remaining targets that were not reacquired, 74 met the size criterion of interest. • RV surveying should be conducted to reacquire 44 of the remaining targets (60%) that meet the size criterion.
Army Dock Locations in Saint Paul Harbor	Additional RV surveying	• 29 of the 74 targets appeared inert based on the initial classification from the WAA survey characteristics, but none of the targets was reacquired as no RV survey was conducted. • Of the 45 targets initially classified as a 6-inch shell, mine-like object, 5 met the size criterion of interest. • RV surveying should be conducted to reacquire the 5 targets (100%) that meet the size criterion.
Former Army Dock at Puffin Island	Additional RV surveying	• 15 of the 76 targets appeared inert based on the initial classification from the WAA survey characteristics, but none of the targets was reacquired as no RV survey was conducted. • Of the 61 targets initially classified as a 6-inch shell, mine-like object, or unknown, 11 met the size criterion of interest.

Table 6-1 (Continued)
Summary of Recommendations for Each Survey Area

Survey Area	Recommendation	Rationale
Former Army Dock at Puffin Island (Con't)		• RV surveying should be conducted to reacquire 9 of the targets (80%) that meet the size criterion.
Former Navy Dock at Woody Island	Additional RV surveying	• 2 of the 52 targets appeared inert based on the initial classification from the WAA survey characteristics, but none of the targets was reacquired as no RV survey was conducted. • Of the 50 targets initially classified as a 6-inch shell, mine-like object, or unknown, 24 met the size criterion of interest. • RV surveying should be conducted to reacquire 19 of the targets (80%) that meet the size criterion.
Happy Beach AATC Impact Area	No further action	• Projectiles (i.e., 40-mm) used during AATC exercises are too small to be detected using reasonable WAA detection methods, and projectiles may have become buried in the sediment.
Fort Greely Gun Batteries Impact Areas	Additional RV surveying	• No possible MEC item was identified. • 36 of the 135 targets appeared inert based on the initial classification from the WAA survey characteristics. • Of the 99 targets initially classified as a 6-inch shell, mine-like object, or unknown, 2 (2%) were reacquired. Of those 94 remaining targets that were not reacquired, 35 met the size criterion of interest. • RV surveying should be conducted to reacquire 21 of the remaining targets (60%) that meet the size criterion.
Northeastern Chiniak Bay		
Long Island Dock	Additional RV surveying	• 4 of the 23 targets appeared inert based on the initial classification from the WAA survey characteristics, but none of the targets was reacquired as no RV survey was conducted. • Of the 19 targets initially classified as a 6-inch shell, mine-like object, or unknown, 8 met the size criterion of interest. • RV surveying should be conducted to reacquire the 8 targets (100%) that meet the size criterion.

Table 6-1 (Continued)
Summary of Recommendations for Each Survey Area

Survey Area	Recommendation	Rationale
Former Anti-Ship Mines Area between Long and Woody Islands	Additional RV surveying	• No possible MEC item was identified. • 14 of the 92 targets appeared inert based on the initial classification from the WAA survey characteristics. • Of the 78 targets initially classified as a 6-inch shell, mine-like object, or unknown, 3 (4%) were reacquired. Of those 75 remaining targets that were not reacquired, 10 met the size criterion of interest. • RV surveying should be conducted to reacquire the 10 remaining targets (100%) that meet the size criterion. The currents in this area are very strong between the islands. A larger, more powerful ROV is recommended for this area. Additionally, the use of a multiple magnetometer system (either a 3-axis gradiometer or a large horizontal gradiometer) is recommended to detect potential sea mines.
Former Anti-Ship Mines Area East of Long Island	Additional RV surveying	• 14 of the 105 targets appeared inert based on the initial classification from the WAA survey characteristics, but none of the targets was reacquired as no RV survey was conducted. • Of the 91 targets initially classified as a 6-inch shell, mine-like object, or unknown, 2 met the size criterion of interest. • RV surveying should be conducted to reacquire the 2 targets (100%) that meet the size criterion.
Fort Abercrombie Gun Batteries Impact Area	WAA survey and subsequent RV surveying	• A WAA survey followed by a RV survey of this area is recommended. • The number of targets reacquired during the RV survey will be based on the number of targets that meet the classification and size criteria, and surveying goals described in Section 6.0.
Southeastern Chiniak Bay		
Humpback Rock Glide and Dive Bombing Target and adjacent former Anti-Ship Mines Area	Additional RV surveying	• 4 of the 92 targets appeared inert based on the initial classification from the WAA survey characteristics, but none of the targets was reacquired as no RV survey was conducted. • Of the 88 targets initially classified as a 6-inch shell, mine-like object, or unknown, 11 met the size criterion of interest.

Table 6-1 (Continued)
Summary of Recommendations for Each Survey Area

Survey Area	Recommendation	Rationale
Humpback Rock Glide and Dive Bombing Target and adjacent former Anti-Ship Mines Area (Con't)		• RV surveying should be conducted to reacquire 9 of the targets (80%) that meet the size criterion.
Former Anti-Ship Mines Area	Additional RV surveying	• 4 of the 67 targets appeared inert based on the initial classification from the WAA survey characteristics, but none of the targets was reacquired as no RV survey was conducted. • Of the 63 targets initially classified 6-inch shell, mine-like object, or unknown, 2 met the size criterion of interest. • RV surveying should be conducted to reacquire the 2 targets (100%) that meet the size criterion.
Entrance Point		
Entrance Point AATC Dock	WAA survey and subsequent RV surveying	• Small projectiles (i.e., 40-mm) that may have been off-loaded and accidentally dropped off the dock for use during AATC exercises are too small to be detected using reasonable detection methods, and projectiles may have become buried in the sediment, but clusters or intact cases could be detectable. • A WAA survey followed by a RV survey of this area is recommended. • The number of targets reacquired during the RV survey will be based on the number of targets that meet the classification and size criteria, and surveying goals described in Section 6.0.
Entrance Point AATC Impact Area	No further action	• Small projectiles (i.e., 40-mm) used during AATC exercises are too small to be detected using reasonable detection methods, and projectiles may have become buried in the sediment.

Notes:
AATC - anti-aircraft training center
MEC - munitions and explosives of concern
mm - millimeter
RV - reacquisition and verification
WAA - wide-area assessment

Table 6-2
Cost Estimate for Additional Recommended Action at Nine Survey Areas

Item	Unit Cost	Unit	Quantity	Cost (rounded to the nearest $1,000)
Project management	$125	HR	236	$30,000
Update to existing work plans/meetings	$125	HR	146	$18,000
Coordinate and supervise RV survey	$140	HR	315	$44,000
Travel costs for prime contractor	$6,500	LS	1	$7,000
Vessel service (18 days)[a]	$7,600	DY	18	$137,000
Geophysical subcontractor surveying (18 days)[a] and reporting	$84,150	LS	1	$84,000
NIRIS/GIS Support and Updates	$85	HR	158	$13,000
Reporting	$125	HR	270	$34,000
TOTAL				**$367,000**

[a]12 days based on reacquiring 149 targets meeting classification and size criteria in 12 areas recommended for further RV surveying. Assuming that 12 targets can be reacquired per day, it would take approximately 12 days to reacquire 149 targets. It is estimated that 6 days would be required to complete the WAA surveying at Explosive Anchorage No. 2, Gun Batteries Impact Area, and Entrance Point AATC Dock and reacquire targets meeting classification and size criteria in these three areas.

Notes:
DY - day
GIS - geographic information system
HR - hour
LS - lump sum
RV - reacquisition and verification
WAA - wide-area assessment

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APPENDIX A

Field Notes

Tom Abbott
DO 80
May 2015

DO 80 SI Surveys - Kodiak + Dutch Harbor

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Project DO 80 SI at Kodiak

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CONTENTS

PAGE	REFERENCE	DATE

Location Kodiak Date 4/30/15

Project / Client DO 80 SI Field Work

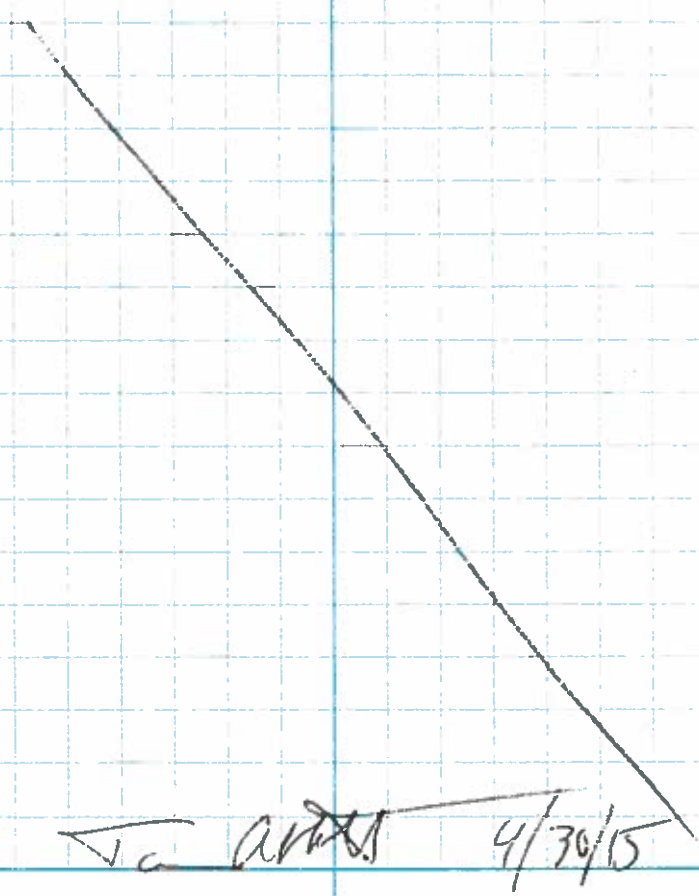
0730 Arrive at SeaTac to depart to Alaska
1700
~~1500~~ Arrive on Kodiak

Open House - Kodiak Public Library 1900 - 2100

1800 Set up 11 posters

# of visitors:

IIII



4/30/15

Location Kodiak Date 5/1/15

Project / Client DO 80-S1 Field Work
NAVFAC NW

0700 Arrive to slip L22 where RV Thunder is located, Dog Bay

0725 Vessel Orientation - Joe
David - chief eng - ex USCG, medic
Eric - mechanic, boat captain
Nicole - bridge + salon
Chris - deck boss
Joe - master
Tom to do float plan with Lon White
Shawn discussed operations for data collection

0845 End Vessel orientation and drills
Crew prep Vessel

~~0913~~ Talk through communications

0930 Shawn, Rene, Jeff went to small craft to set up + place 3 seed for QA "100 pound", 50 mm, 100 pound is mostly shell only and not really 100 pounds

Called Lon White - harbormaster 907.486.8050
Derrik Magnuson
8:00-5:00 office open
Lon cell 654.8100
sent e-mail asking him to accept float plan
Tom called

Location Kodiak Date 5/1/15

Project / Client DO 80-S1 Field Work
NAVFAC NW

1030 Grady called Joe to set up weekly status meetings
set up meeting for Tuesday 5-11-15
Grady to send text to verify time

1045 Leave dock
motor to Greely Practice fire area while small craft does QA with interferometric sonar w/ 3 UXO dummie bombs.

1130 Deploy Edgetech sidescan sonar (towfish)
Traveling about 4 knots
Vessel following track lines very well
105' of cable for towfish
horizontal black lines indicate motion (very few observed due to little motion)
Some track lines off to avoid buoys

1200 Dropped line to 125'
Speed 4.3 knots

1300 Pull up towfish to head back for meeting Coast Guard + head back to shore

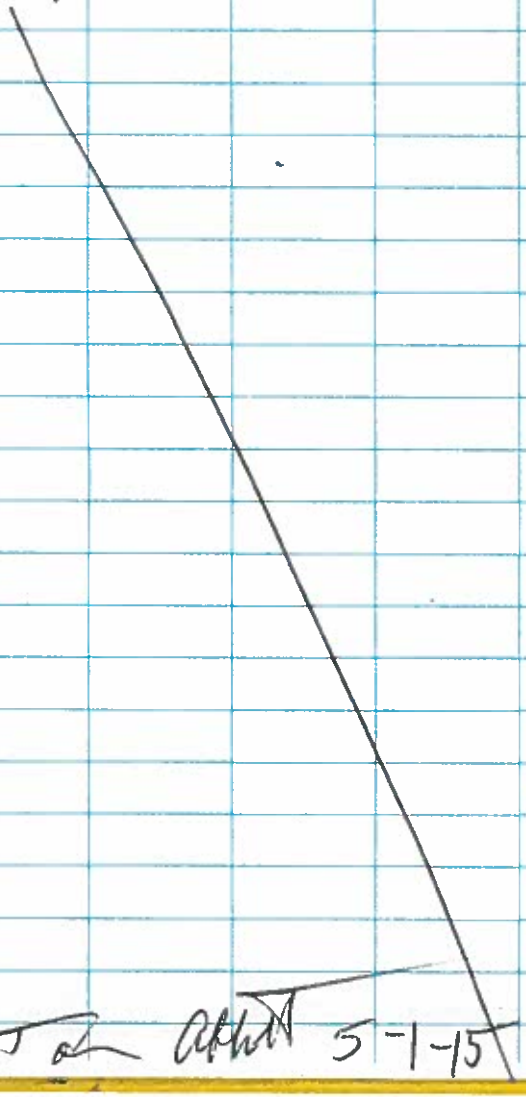
1400 Meet Corey Grigi at USCG - call Corey morning of/on survey day
1530 Harbor master Kodiak - drop off, have Joe call harbormaster - USCG cutters
Tom called

Location Kodiak Date 5-1-15

Project / Client DO 80 - S1 field work
NAVFAC NW

each night ~~at~~ when arriving to dock on channel 12.

1400 Arrive at hotel & work on computer.



Tom Acker 5-1-15

Location Kodiak Date 5-2-15

Project / Client DO 80 - S1 Field work
NAVFAC NW

0700 Arrive on R/V Thunder
Weather: cloudy, calm, 35°F

0720 Tailgate and work improvement meeting
communication - improve
small vessel - no issues

0730 End meeting, Rene, Jeff W, and Jeff Snyder left for small vessel
Small vessel to work/survey in St. Paul Harbor docks and explosive anchorage area within reprioritized area 1 near Puffin Island

0855 Arriving at mike area at NE portion of Long Island

0905 Set out sidescan towfish 50' line
many rock hazards closer to shore
Wind + waves picked up slightly and noise (horizontal black lines) appear on display. Moving in SW direction, there is much less noise

1345 Up to 3-4' seas up to 15° pitch and 6° roll heading NE - poor data

1500 Let out 100' line
Several areas are very rocky on bottom & appear rounded, at the surface

Tom Acker

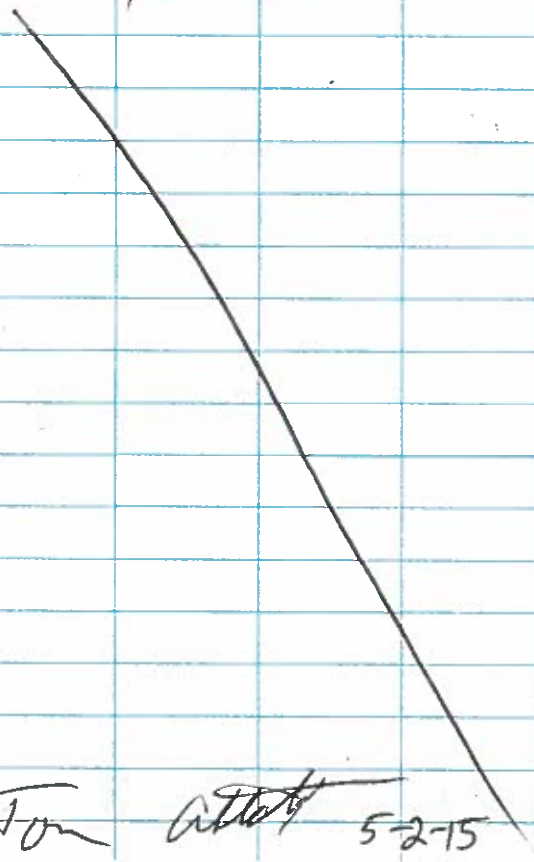
Location Kodiak Date 5-2-15

Project / Client DO 80-S1 Field Work
NAVFAC NW

several targets have been marked
It is much easier to see anomalies
in sandy areas. Send ripples
are evident on display

1745 Finish last track + head back
to dock

1800 Arrive at dock. AECOM, Sonbision, +
Gruzny leave for hotel. NTC stays aboard



Tom Abbott 5-2-15

Location Kodiak Date 5-2-15

Project / Client DO 80-S1 Field Work
NAVFAC NW

Weather: 45°, 4mph E, cloudy

0700 - Arrive on board
- small boat (Rene + Jeff W.) work around Puffin Island (Battery #7) and maybe explosive area #1
- HV to finish tracks at battery 3 practice target area (Fort Gnaely)

0730 - Tailgate and Work Plan meeting

0745 - depart dock for survey areas
- Joe gave vessel orientation to Jeff Snyder (first day on HV Thunder) David did fine drill info.

0830 Deploy tow fish @ 100' line

0915 finish first mods + raise to 50' line due to shallower waters

0933 Let out total 120' line
Sea floor appears mostly sandy/fine sediments with several occasions of rock formations (25%)

1120 Line let out to 120'
Ditch + roll to 10° each side 1-2' seas especially further west in less protected area.
3.6 knots towing speed

1511 Let out 125' line

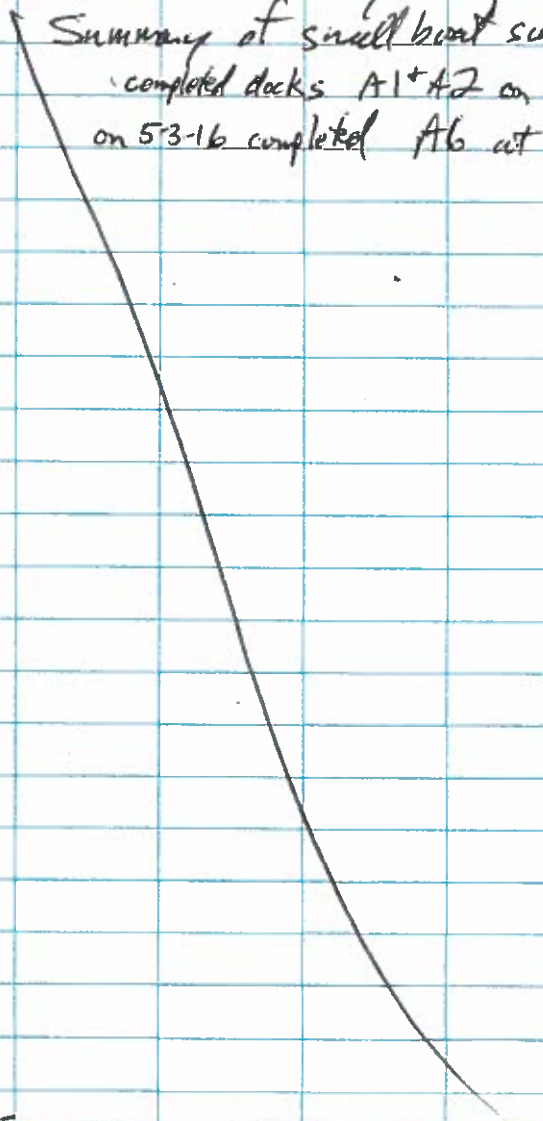
Tom Abbott

Location Kodiak Date 5-3-15

Project / Client DO 80-S1 Field work
NAVFAC NW

1820 removed towfish out of water, Head back
1900 Return to dock. Day complete

Summary of small boat survey:
completed docks A1+A2 on 5-2-15
on 5-3-16 completed A6 at Puffin Island



Tom Abbott 5-3-15

Location Kodiak Date 5-4-15

Project / Client DO 80-S1 Field Work
NAVFAC NW

Weather: 37°, calm, partly sunny
0700 Arrive on R/V Thunder
0720 Tailgate meeting
Jeff Snyder on shore processing
Rene & Jeff Wilson on small vessel
0855 Arrive near Humback Rock area
(low tide) Humpback rock juts out of water about 15' high. Estimated size 50'x50'
0913 Deployed Edgetech sidescan sonar on NE side of Humpback rock going NE-SW tracks. Water
1030 is deeper than 120 (more like 150-200) shown on navigable charts. Therefore may move to other tracks closer to Humpback Rock. Photo 1946-depth
1120 Shawn creating connector to attach screen to ship's depth finder to record the depth data because much of the existing data on nav charts is so inaccurate. Several track lines are deeper than 120'.
1541 At high tide, only a few feet appears at Humpback Rock. Track 300' on NW side
1620 Added transects to get away from Humpback closer to Humpback Rock

Location Kodiak Date 5-4-15

Project / Client DO 80 – S1 Field Work
NAVFAC NW

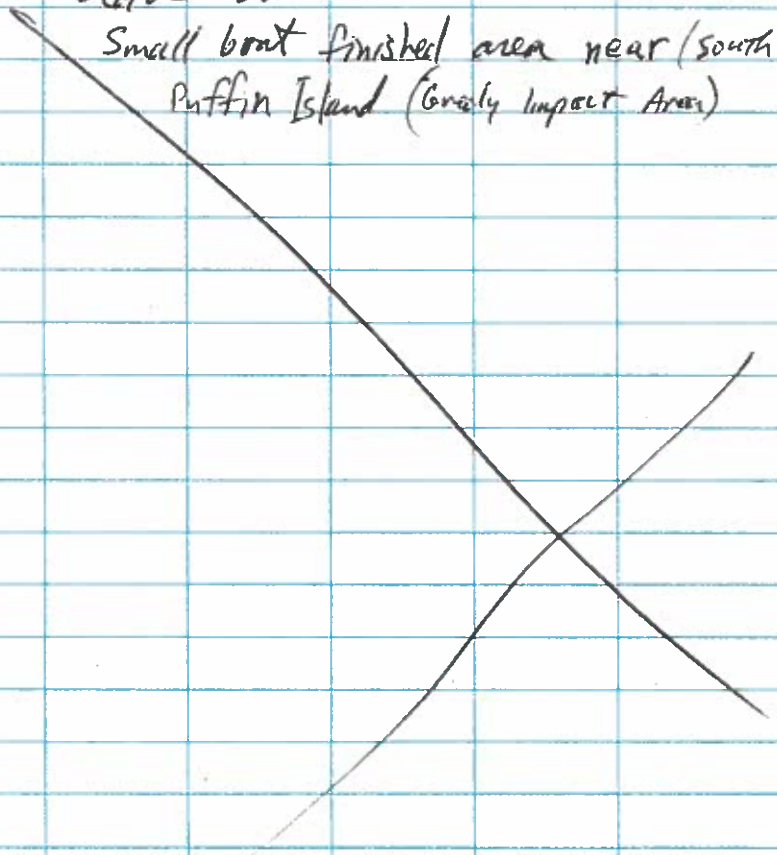
because closest transects were about 100 yards from Humpback Rock

1750 finished last transect at Humpback rock & headed to dock

1900 Arrive at the dock

1930 Leave boat

Small boat finished area near (south of Puffin Island (Gravity Impact Area)



Tom Arndt 5-4-15

Location Kodiak Date 5-5-15

Project / Client DO 80 – S1 Field Work
NAVFAC NW

0700 Arrive on boat

Weather 42°F, cloudy, calm

Jeff G. + Shawn getting trying to connect their software/computer to depth finders on vessel because nav charts are off significantly 50' in area of Humpback Rock

0743 Tailgate meeting

small vessel – Jeff W. + Rene

RV Thuba – Joe L, Nicole L, David G, Eric S, Chris Burt of NTC
Shawn H, Erika of Gravity
Tom A. at AECOM

Float plan remains in effect with harbor master call in at 700 PM each day

0840 Leave dock for

Shawn tried to connect depth finder to PC

Survey area

0955 Deployed fish to begin tracks in former mine area between Woody + Long Islands

started in center between Islands

Bottom appears very smooth + uniform soft bottom, making it easier to identify targets

Location Kodiak Date 5-5-15

Project / Client DO 80-S1 Field Work
NAVFAC NW

Chris mentioned safety observation. Small boat person should tell R/V captain where they are moving small boat in the morning. R/V Thunder captain did not realize that small boat detached from the Thunder in morning and moved into front of boat at the dock. Cannot see over bow of boat when small vessel was present.

1015 Photo 1950 - clear image of ~~to~~ cubical item starboard side

Seas to be up to 6', but water is protected between islands and ~~is~~ we ~~giving~~ are getting good data.

Photo 1951 - Image of sidescan screen display showing sand waves + rocks. Location between Woody + Long Islands, closer to Woody Island

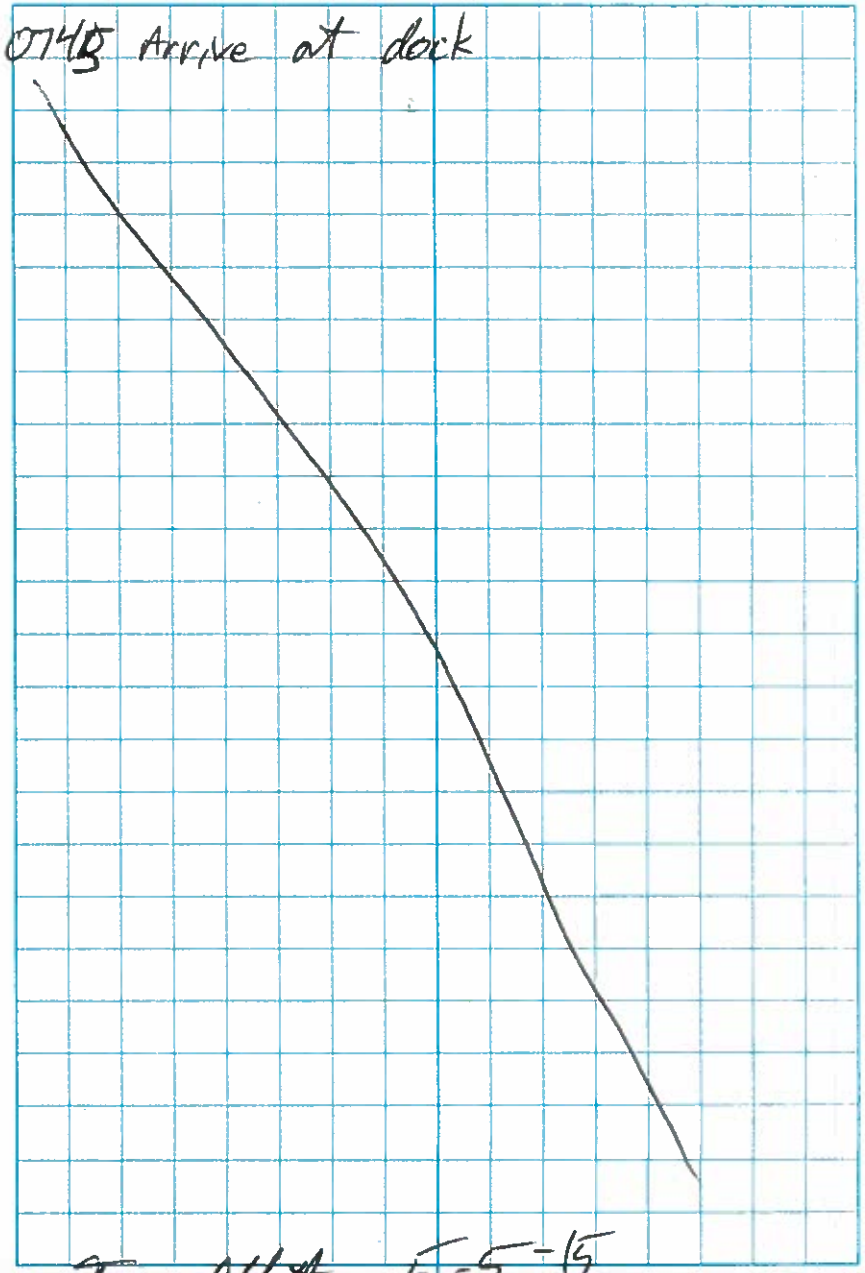
Tracks closer to Woody Island show rockier bottom and shallower

1850 Completed last track line
Approx ½ of area was between Woody and Long Island was completed

Location Kodiak Date 5-5-15

Project / Client DO 80-S1 Field Work
NAVFAC NW

0745 Arrive at dock



Tom Abbott 5-5-15

16

Location Kodiak Date 5-6-15

Project / Client DO 80 - S1 Field Work
NAVFAC NW

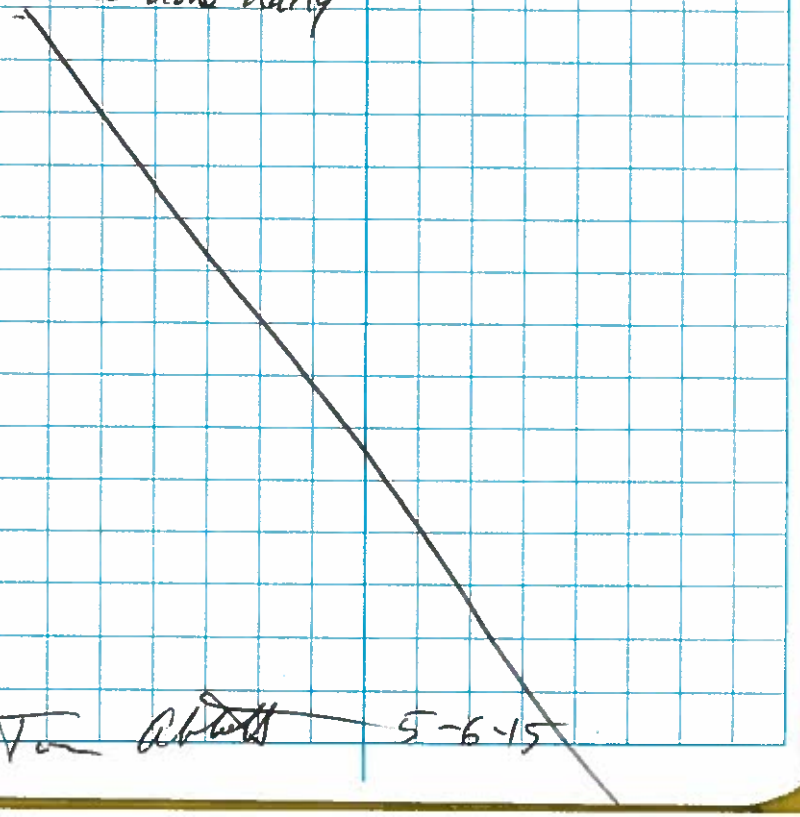
0700 Arrive on vessel
Weather - rainy, 44°F, slightly breezy
Vessel crew doing checks as done each day. Tailgate meeting
Shawn leaving Kodiak today @ 12:00
Rene & Jeff W. - small vessel by USCG dock
Shawn & Jeff S. trying to connect vessel depth finder to their computer logger
Depth data does not appear to come through
0810 Leave dock, head towards the area between Woody Island and Long Island to work on remaining ½ area closer to Long Island
0900 Arrive at survey area
0919 Drop fish in water
Conditions are slightly rougher today. Data is noisier (black lines on screen)
Depths of this survey area appear to be shallower than 120' with the exception of far south end of survey area
1315 Waves increasing in area to about 4' se from the north. Tracking with

Location Kodiak Date 5-6-15

17

Project / Client DO 80 - S1 Field Work
NAVFAC NW

the waves (south), we collect good data, but track lines moving north creates very dirty data. Some areas of 8' seas, but we avoided them.
1833 Fish pulled out of water, Head back to shore.
0715 Arrive at dock. Captain to call in to harbor master per float plan as done daily



T. Abbott 5-6-15

Location Kodiak Date 5-7-15

Project / Client DO 80 - S1 Field Work
NAVFAC NW

0700 Arrive on R/V Thunder
Weather: 42°F, cloudy, calm
Found out that small vessel went to Anchorage Area #2 (start) on and Anchorage Area #3 (start) and Anch Area #2 (end) yesterday

0725 Tailgate meeting
small vessel interferiometric sonar having issues - crew has to restart frequently which decreases production. Shawn said manufacturer is coming to help today on Kodiak.

0735 Leave dock to nearby dock to load fresh water

0820 Leave dock to southern-most mine area in Chiniak Bay
another group is conducting an oil spill drill with 6 (six) barges. This may interfere with the ~~area~~ surveying in certain areas in Womens Bay. The drill may last only 1-2 days.

0940 Arrive at site - 2' swells

0950 Deploy towfish
some swells greater than 2' up to 4'

Location Kodiak Date 5-7-15

Project / Client DO 80 - S1 Field Work
NAVFAC NW

data is noisy
north end of area is >200', may reduce length of lines because we are concerned with only 120' depths max. Still not able to get depths logged.
Northward track lines are noisy; southward track lines provide less noisy data due to waves

1300 Swells are calming down

1700 Swells are about ~~less than~~ 1' (seemed like this going in direction of waves) but are about 2' going against swells
Most of area is about 100' deep, some is > 120'. Rocky bottom towards shore. Otherwise sand w/ large sand waves, rock & smaller grain-size sediment (clay-silt)

1734 Pulled up fish and head back to dock.

0700 Arrived at dock
Called in float plan to harbormaster

Jon Albert 5-7-15

Location Kodiak Date 5-8-15

Project / Client DO 80 — S1 Field Work
NAVFAC NW

Weather: Rainy, breezy WNW 15 to 23 mph, 39°F

0700 Arrive on board

0730 Tailgate meeting
Rene + Jeff on skiff in Womens Bay. Manufacturer/tech person of interferometric sonar still here to improve system. They will survey inner part of Womens Bay USCG side
Enika, Jeff S. Seaview
David, Nicole, Joe, Eric, Chris of R/V Thunder
Tom AECOM on board R/V Thunder
Air cond arrived yesterday at hotel

0820 Vessel leaves dock for survey area

0850 Arrive in area for survey

0900 set out fish at 70'
at about 0843 called BMC Greg Giggi to let him know that R/V Thunder would be in Explosive Anch. Area #1 near entrance of USCG property.
Area is relatively flat, few rocks, ~30'-40' deep, sandy, few sand ripples

1258 Cannot run some track lines because rocks are evidently shallow #'d grounds

Location Kodiak Date 5-8-15

Project / Client DO 80 - S1 Field Work
NAVFAC NW

nearby island, in 30' depth now

1300 Called Greg to confirm receipt of emails and "me of meeting with Guy

1315 Dropped large "100 pound bomb" in waters to see on screen using sidescan

1350 After a few passes, we were not able to detect "100-lb bomb" possibly due to nature of item (only skin - hollow and not heavy (~15 pounds) We will try smaller 25 lb item.

1410 ~~0210~~ Threw in 25-lb dummy bomb
We are able to see the hammer, dresser 25-lb dummy bomb ~2' long by 5" Making several passes, saw only few times Jeff S. said small vessel has (too small) now started Explosive Anchorage Area #3.

1530 Added depressor wing to sidescan Sonar
Photos 1956 - 1962 Deploying "100-lb bomb"
Photos 1965 - 1967 Deploying "25-lb dummy bomb"
Photos 1970 - 1972 Pulling fish w/ A-arm
Photos 1973 - 1978 Installing depressor + deploy Dummy bomb QA within Expl. Anch Area #3

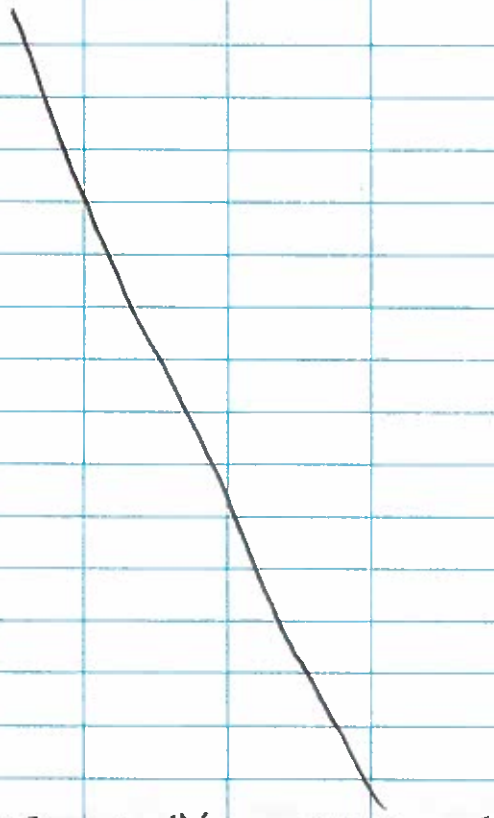
Location Kodiak Date 5-8-15

Project / Client DO 80 - S1 Field Work
NAVFAC NW

1650 Leave Explosive Anchorage Area No. 1 and go to dock to work on robots

1730 Arrive at dock fill 100-lb bomb w/ gravel to run test on Jeff S. setting up ROV. He got it working

~~0730~~ 1915 Leave boat



Tom Collett 5-8-15

Location Kodiak Date 5-9-15

Project / Client DO 80 - S1 Field Work
NAVFAC NW

Weather: cloudy, raining hard, windy 18-31 kt knots, Temp = 43°

0700 Arrive on board

0735 Tailgate safety meeting
Erika will not be on board, will process on shore
R/V Thunder will survey old Army docks A1 and A2 on site figure 6-1
Because of high winds, small boat may not be able to safely survey
Initial survey data using interferometric sonar is not good, R/V will resurvey A1 + A2
Vessel keeps logbooks of all personel aboard each day.
Received + plugged in hotspot
wi Fi name: Unifye-A7A3
wi Fi password: 38866517

0800 Leave dock

0820 Deploy fish 30' line w/ depressor using high freq 900 and low 400 seeing a lot of debris on bottom

0953 finish survey at dock, pick up weights for ROV from dock
Weather seems to be calming down.

Location Kodiak Date 5-9-15

Project / Client DO 80 Field Work
NAVFAC NW

1115 Weather has significantly calmed down, we will move to Fort Greely range (closer than others areas) and use ROV to ~~re~~ evaluate targets

1135 Over first target. Testing vessel stability in ~~the~~ stationary position

1210 Tried to send ROV down but had to pull back up because vessel could not stay stationary. Will go upwind and put down anchor.

≈1308 Target 37 acquired/video - tire
Target 52 near] iPhone photo

1340 Arrive at target 52
drop anchor, drifted too far away

14:10 drop anchor 2nd time, not holding

1425 drop anchor 3rd time, holding

1500 located target 52 = bundles fishing gear
took photo on iPhone

1523 move target 20 < skiff-like object
maybe target practice

1544 Drop Anchor ≈100' depth

1720 Because ROV screen has been acting up, ~~we~~ we could not find target

Location Kodiak Date 5-9-15

Project / Client DO 80 Field Work
NAVFAC NW

and headed back to dock so that Jeff can get other ROV working.

1815 Arrived back to dock
Jeff worked on getting 2nd ROV operational
Go to hotel + package posters to Fed Ex to Grady at Dutch

added: small vessel USCG side of Womens Bay

Jon [signature] 5-9-15

Location Kodiak Date 5-10-15

Project / Client DO 80 - 51 Field Work
NAVFAC NW

0700 Arrive on boat
Weather - 45°F, partly cloudy, VAE 14 mph
0730 Tailgate meeting
Small vessel plan - move skiff from Women Bay & survey area south of Puffin Island
R/V Thunder plan - use second ROV to look for targets
0745 Leave dock
0810 Arrive at Explosive Anchorage Area No. 1
0830 Drop 100 lb bombs for QA testing with sidescan sonar. Hollow dummy bombs filled w/ gravel.
30' line out w/ depressor so target would show up very close to stern
Could slightly see bomb in ~~N-S~~ E-W tracks. Can see better in N-S
Buoys have ~70', 30' water
1002 Pull up fish and motor to area between Woody and Long Islands
Joe mentioned that the crew reviews at least two safety SOPs each day

Location Kodiak Date 5-10-15

Project / Client DO 80 - 51 Field Work
NAVFAC NW

1055 Went to north side of mine area and seas were ~ 4'-5'. Not conducive to acquiring targets. Will move to more protected part of this area.
1109 Anchored closer to Long Island seems to be holding own target
Target 0049
1215 Encountered target
Was small square fish trap and steel cable
1240 Pulled anchor & headed to target 0027 located between islands, SW
1504 Arrived at target
slack tide, 2-3' swells
1525 Drop ROV into water. Could not find
1408 Pull out ROV - move to 0072
Small vessel is cannot survey south of Puffin Island because of waves
1440 Arrive at next target 0072
1445 Drop anchor
Wind blowing south, current tide going North
R/V Thunder has to keep power on to hold steady.
1505 Deployed ROV. Current to strong

Location Kodiak Date 5-10-15

Project / Client DO 80-S1 Field Work
NAVFAC NW

to control ROV. Abandon area
and go to Explosive Anchorage Area 1
1515 Pull anchor + leave
1600 Arrive at Expl. Anchorage Area 1 and
~~1625~~ Drop anchor, not holding, drop again
1625 Drop ROV water depth 38
Target 51 = large round rock ≈1.5' diam
54 = " " " ≈1.5' diam
44 = " " "
50 = " " "
These targets were close to the
shallow rocks to the east. We
will move closer to the center of
the area. Photos 1989-1993 + iPhone
1706 Pull anchor + move
1720 Find location
1730 Drop fish
Target 31 - fish trap, small (≈2x3'
Photo of Target 31 w/ iPhone
Target 32 - rock
1810 Retrieved ROV
1850 Arrive on the dock

Jen away 5-10-15

Location Kodiak Date 5-11-15

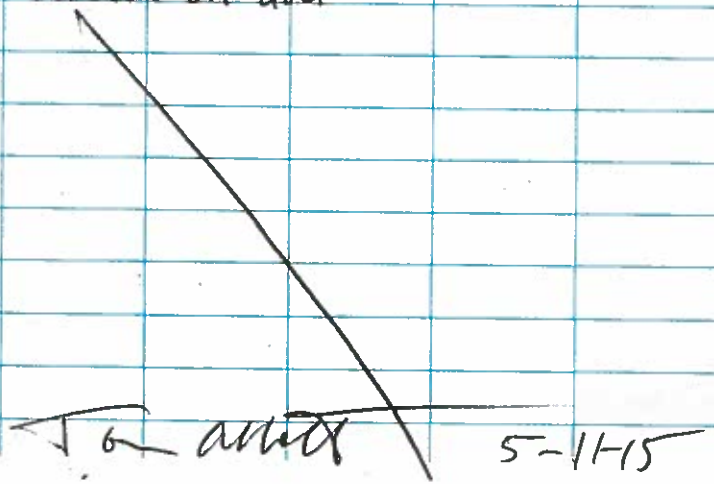
Project / Client DO 80-S1 Field Work
NAVFAC NW

Weather - 45°F, NNE 17 mph,
small skiff plans for today: Rene to
maintain boat + generator. Not on water
yesterday - too rough to ~~survey~~ At dock
survey South of Puffin Island. Motored from
USCG dock to Nog Bay Harbor. Woody Island dock too rough
R/V Thunder plans: go to Explosive Anchorage
areas and use magnetometer to
do QA and go over targets to
identify ~~not ferrous~~ targets that
are ferrous. May use ROV
Jeff W. to stay on R/V Thunder
0740 Safety meeting
Yesterday skiff recovered NW
Womens Bay due to rough conditions
outside Womens Bay, got better data
Setting up SeaSpy magnetometer before
leaving dock
0803 Small skiff away, R/V Thunder leave dock
0825 Arrived at site
0845 Place 25 lb pound dummy bomb in water
100-pound dummy bomb already in
water from yesterday
0910 Deploy magnetometer Photos 1994-1995

Location Kodiak Date 5-11-15

Project / Client DO 80-51 Field Work
NAVFAC NW

0925 Start first track line for QA
will drop 1.5" solid pipe, simulated
towing @ 4 knots, magnetometer at
about 18' below surface
25-pound dummy bomb placed in area
where no targets were previously noted
Ran grid across entire
Explosives Anchorage Area No.1
1730 1830 Found small metal "dummy seed"
over and ran a few lines
near it. Not much response
seen by magnetometer.
18:15 Pull in magnetometer and
round up buoys w/ 25 & 100-pound
dummy bombs.
1900 Arrive on dock



Tom Arndt 5-11-15

Location Kodiak Date 5-12-15

Project / Client DO 80-51 Field Work
NAVFAC NW

Weather: Sunny, 45°F, WNW 12 mph wind
0700 Arrive on board
R/V Plans: Jeff S. & Tom on board
w/ crew. ROV in Anch. No.1
magnetometer in Expl. Anch No. 2+3
Enika data processing
Skiff plans: Jeff W. & Rene - South
Puffin Island & Woody dock
initial survey
0745 Tailgate meeting
0756 Leave dock for Expl Anch Area No.1
0824 Arrive at Targets 3 & 6 in
Explosives Anchorage area No.1
Testing drift to determine where to
set anchor
0835 Set anchor & drift into place
consider wind, currents, waves
0844 drop in ROV, look for Target 006
Photos 2006-2007 dropping anchor
Photos 2008-2011 nav screens
showing anchor/target areas and
track lines for Expl. Anch. Area #1
strong current affecting ROV
0855 See Target 6 - fish trap Photo 2013

Location Kodiak Date 5-13-15

Project / Client NAVFAC NW / DO 80-51 Fieldwork

0700 Arrive on R/V Thunder
Weather: mostly cloudy, 46°F, wind S at 5 mph
0725 Safety meeting
Erika - processing onboard land
Joe - on land today
Jeff W. + Rene on skiff - go to Long Island dock
Other R/V crew + Tom + Jeff S on board
0955 ~~Arrive~~ Leave dock
0824 Arrive at Anch Area No. 2 for ROV to observe selected targets per processed interferometric sonar data
During tailgate meeting Tom got Chris Burt's number to let Tom know when they the R/V Thunder would arrive in Dutch Harbor so that Tom will send out e-mail to inform Gravity/SeaVision crew
0840 Deploy ROV over Targets ~~2, 3, + 4~~
Targets numbering to be revised
also saw concrete block
Target 14 = rock
Target 13 = rock

Location Kodiak Date 5-13-15

Project / Client DO 80-51 Fieldwork / NAVFAC NW

Target 10 - fish trap w/ gear
or nearby item could be Target 10 which is a ~~cube~~ cube shaped item with significant biological growth ~~one~~ one side is sloped like a rock but one edge is flat. Covered with large sea anemones - about 15" x 15" x 12", Covered w/ crustaceans part looks like volcanic rock
Video recording
Target 20 = rock
Target 18 = fish trap
1000 Move to Target 11
1020 Fly by ROV
Target 11 - somewhat cube shape, unknown - could be rock. Most rocks are lighter, This is dark has dark encrustation. Size ~9"x9"x9"
Target 15 - hollow metal item, 9" in diameter, Looks like rusty cylindrical item, Thin metal shell - like drum significant bio. growth, Phone Photos

Location Kodiak Date 5-13-15

Project / Client DO 80 - Kodiak field work
NAVFAC NW

shiny - possibly spent shell, 3 iPhone photos

1115 Up anchor and move to Targets 23 & 25

1140 Anchor at Targets 23 & 25

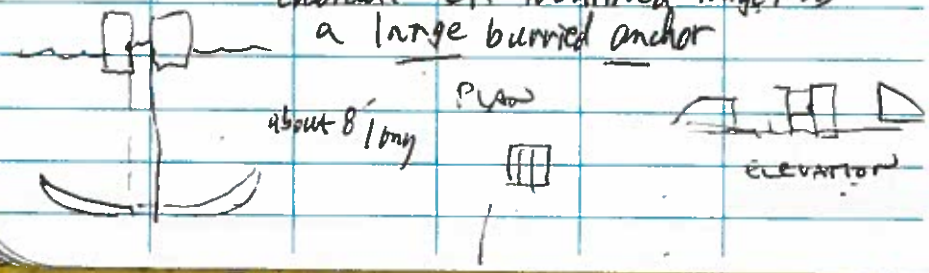
1149 ~~Target 25~~ trap took photo (side Target)
Target 25 - fishing gear
Target 23

1218 Move to Explosives Anchorage Area 3

1238 Drop Anchor at Target 16
Target 16 - basket fish trap
Target 15 - fish trap

1300 Vessel stopped - had to repair issue in engine room. Jeff's repaired/maintenanced ROV.

1354 Drop anchor at Target 13
consist of three items in a triangular spacing. Two items are disk-like and one is cubical. Jeff identified target as a large buried anchor



Location Kodiak Date 5-13-15

Project / Client DO 80 - Kodiak field work
NAVFAC NW

1500 drop anchor at Target 17
Target 17 = boulder

1530 Drop ROV in new location Target 21-23
Target 21-23 no items seen
Expl. Anch Area No. 3 is also very murkier with abundant sea life.
saw sunken wood (tree limbs) that were not much above seafloor, but showed up well on sonar

0400 Move to Targets 9, 10
Target 10 fish pot
Target 9 10 round hollow corroded object Photo 2017-2019 & iPhone Photos
ROV stuck - line to ROV wrapped around another old line in water
ROV was retrieved, Jeff performed maintenance on ROV.

1805 Moved back to Explosives Anchorage No. 2 to Target 16

1828 Drop ROV in water
Target 16 = fish trap

1925 Leave dock

5-13-15

Location 5-14 Kodiak Date 5-14-15

Project / Client DO 80 - Kodiak S1 Fieldwork
NAVFAC NW

0700 Turn in car at airport and wait for flight to Dutch Harbor
Today is last day of Kodiak field work. Jeff S. & Jeff W. on R/V Thunder for surveys
Jeff S. to e-mail report

1530 Arrive at Dutch Harbor
Arrive at Grand Aleutian hotel
Meet, Mike & Grady (Navy) at cafe before public open house

1900 Set up and hold public open house. Had 5 or 6 attendees. 4 were divers and were very interested.

2200 End open house

5-14-15

Location Unalaska/Dutch Harbor Date 5-17-15

Project / Client DC SC - S1 Field Work
NAVFAC NW

1056 Called Shawn because I saw voice mail pop up on phone from He left it yesterday.
We were expecting the R/V Thunder to arrive today. Shawn/Jeff S. were expecting 24 hour check ins from R/V Thunder. It has been over 48 hours.
Jeff S. checked in w/ Kodiak Harbormaster and USCG Kodiak
I checked in w/ harbormaster. He did not see R/V Thunder on AIS system for Alaska. I called local USCG. They said to call USCG Anchorage sector. I called them & they said they just spoke with Jeff S. & that R/V Thunder was in safe harbor on North side of Kodiak. Sat phone would not get reception.

1327 I called back Shawn & he said it will likely be a week at the earliest before getting to Dutch. Forecast looks bad until Wednesday.

Location Dutch Harbor Date 5-17-15

Project / Client DC SD - S1 Fieldwork
NAVFAC NW

≈1340 I booked flight back home to Seattle. Leave Dutch at 1615 and arrive Seattle ≈ 0130 on 5-18-15, Home at 0300 5-18-15

5-18-15

Location Unalaska/Dutch Harbor Date 5/26/15

Project / Client DC SD - Unalaska S1 Field Work
NAVFAC NW

Mobilization day to Unalaska
M/V Island C (hired by Gravity) arrival at noon and moored at Carl Moses docks
1530 AECOM and Gravity/SeaVision arrived in island - went to hotel then boat
AECOM set up equipment on boat

5/26/15

APPENDIX B

Ammunition Data Sheets for Ordnance Used at Unalaska NDSA

Appendix B Introduction

According to the historical documents reviewed during the preliminary assessment, the following types of weapons/ammunition were used within the Kodiak Island NDSA:

- sea mines (likely contact type)
- 20-mm AA guns
- 40-mm AA guns
- 90-mm projectiles
- 155-mm coastal defense artillery guns
- 6-inch coastal defense artillery guns
- 8-inch coastal defense artillery guns
- .30-caliber machine guns
- .50-caliber machine guns
- Bombs (unknown type)

This appendix includes ammunition data sheets (in the order listed above) that that provide details about the related ammunition. Information comes primarily from *Mine Disposal Handbook* (U.S. Navy Bomb Disposal School 1945), *War Department Technical Manual 9-1901 Artillery Ammunition* dated June 29, 1944. Information for 6-inch rounds is from *Archive Search Report, Findings, Ft. Leonard, Eider Point, Alaska* (USACE 2003). General information about bombs used during the early 1940s is also included from *War Department Technical Manual 9-1900 Ammunition General* dated June 1945.

MINE DISPOSAL HANDBOOK

Contact Mines

PART II

UNITED STATES UNDERWATER ORDNANCE

. . . . . .

CHAPTER 2

U. S. CONTACT MINES

Mark	Laid By	How Fired	Length (in.)	Diameter (in.)	Case Depth (ft.)	Type & Wt. of Charge (lbs.)	Total Wt. (lbs.)	Extender	Notes
5	Surface Craft	Chem. Horn	40 5/8	36	25 to 500	500 TNT	800 (appr)		
6	Surface Craft	Sea Battery		34 1/4	15 to 320	300 TNT	495	Mk. 6-2	All Mods. of Mk. 6 use K2-2, K2-3, K3 K4 and K4-1.
6-2	Surface Craft	Sea Battery		34 1/4	15 to 320	300 TNT	495	Mk. 6-2	Rising mine
6-3	Surface Craft	Sea Battery		35 13/16	15 to 320	300 TNT	540	Mk. 6-2	Lower Antenna
6-4	Surface Craft	Sea Battery		34 1/4	15 to 320	300 TNT	495	Mk. 6-2	"
7	Surface Craft	Sea Battery		34 1/4	15 to 320	300 TNT	495	Mk. 6-2	Drifter
10-1	Sub-marine	Chem. Horn	91 5/8	20 3/4	10 to 65	300 TNT	700	Mk. 6-4	
11-1	Sub. or Surface Craft	Sea Battery	40	35 3/4		500 TNT	700 approx.	Mk. 6-3	Uses K3-1A
19	Aircraft	Impact Inertia	67	18 5/8		210 TPX	550	Mk. 14-5	Drifting Oscillator
23	Surface Craft	Impact	44	18 maximum	18 to 30	2 TNT	77		Sweep Obstructor

Table II--Contact Mines

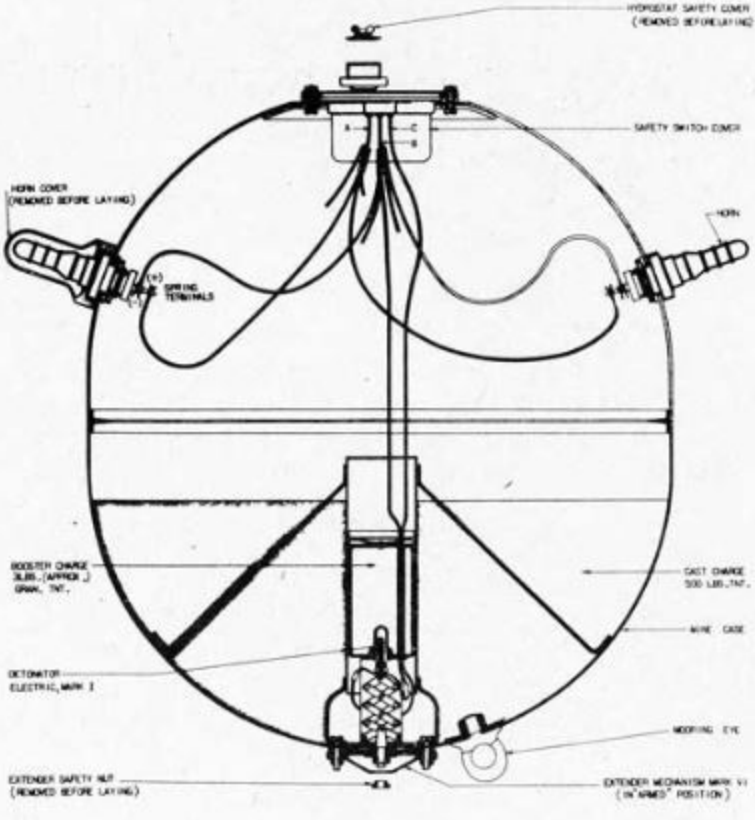


Fig. 1-- Mk. 5 Mine, Sectional View

Introduction

1. Most of the mines are spherical or cylindrical in shape, and have four copper horns equally spaced around the upper hemisphere. A "K" device is fitted in the top of the mine, and an extender in the base, both depending on hydrostatic action for their operation. Copper antennae, both upper and lower, may be fitted.

2. The firing mechanisms depend upon galvanic action for operation, with the exception of those fitted in the Mk. 5 and Mk. 10-1 which use chemical horns.

3. All mines laid from surface craft take depth by means of a plummet fitted on the anchor, while the submarine-laid mines take depth by means of a loose bight-hydrostat system.

4. All mines have mild steel cases, and the explosive train is made up as listed below:

(a)	Detonator	Mercury fulminate
(b)	Booster	Granular TNT
(c)	Main charge	Cast Grade A TNT or Torpex

5. All mines, whatever the firing device fitted, depend upon hydrostatic action for arming and disarming. The safety switches and extenders tend to jam due to marine growth after they have been planted for a short time, and cannot be depended upon to disarm the mine upon release of hydrostatic pressure. Therefore, all mines found must be considered dangerous until they are proven by inspection to be otherwise. When possible, a mine that is found in the armed condition should not be rendered safe, but should be countermined or sunk in deep water.

Mark 5

General

1. Moored, contact, chemical horn mine.

2. Laid by surface craft.

3. Laid defensively in depths of water from 40 to 2800 ft. against surface craft or submarines. Case depth is from 25 to 500 ft.

Description

1. Case

Shape	Two hemispheres with a cylindrical mid-section 4 5/8" wide
Color	Black
Material	Steel
Diameter	36"
Length	40 5/8"
Charge	500 lbs. TNT with granular TNT booster
Total weight in air	800 lbs. (approx.).

2. External fittings

Horns	Four, lead, evenly spaced around upper hemisphere
Lifting lug	One, on lower hemisphere
Hydrostatic safety switch	Mk. 1, fitted to opening on top
Extender	Fitted to opening on bottom.

3. Anchor

Mk. 6 anchor is used.

Operation

1. Mine takes depth by plummet. Extender operates in 24 ft. of water,

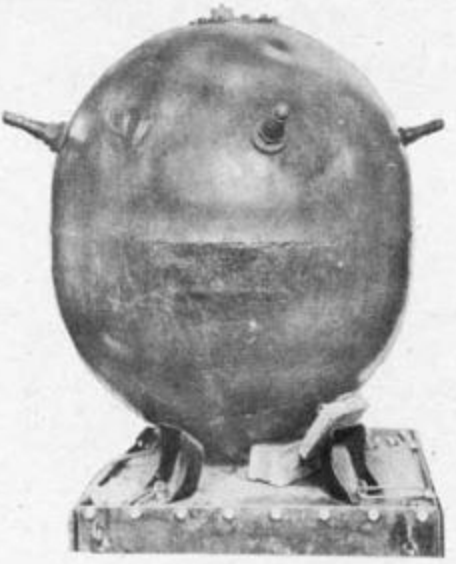


Fig. 2-- Mk. 5 Mine

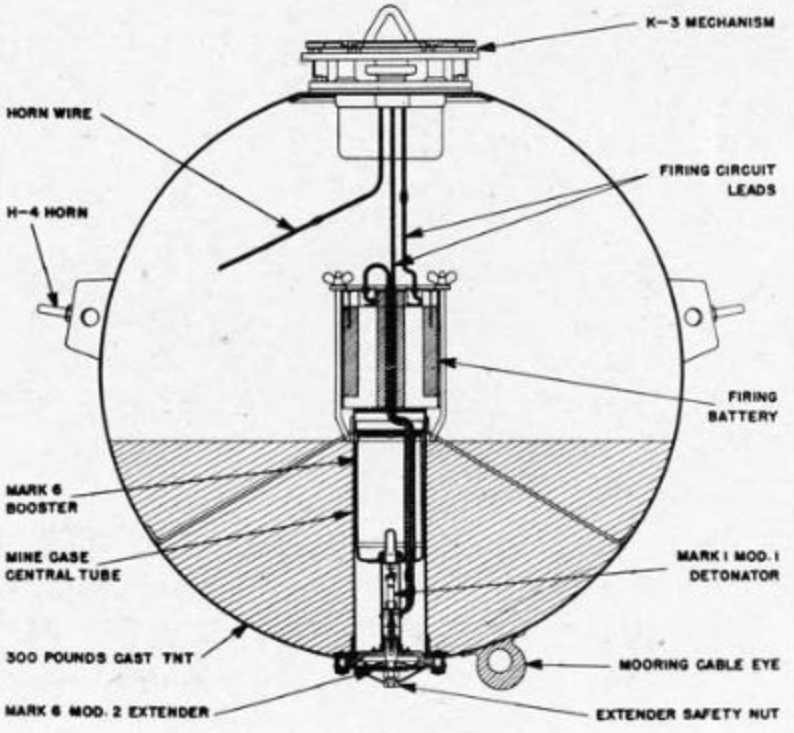


Fig. 3-- Mk. 6 Mine, Sectional View

and, after the soluble washer dissolves, the hydrostatic safety switch will close, and the mine is armed.

2. Mine fires when the glass vial in a chemical horn is broken.

3. The hydrostatic safety switch and extender are designed to retract upon release of hydrostatic pressure.

Precautions

1. Take care not to damage the horns in any way.

2. Hydrostatic safety switch and extender may fail to retract upon release of hydrostatic pressure.

RMS

1. Retract and lock out the hydrostatic safety switch by screwing the soluble washer cap and nut down, or by using the dummy soluble washer from the Mk. 6 tool kit.

2. Retract and lock out the extender.

3. Remove the extender.

4 Cut and tape the detonator leads separately.

5. Dispose of detonator, booster and charge.

Mark 6

General

1. Moored, contact, antenna mine.

2. Laid by surface craft.

3. Laid offensively or defensively in depths of water from 40 to 2800 ft. against surface craft or submarines. Case depth is from 15 to 320 ft.

4. The Mk. 6 may be modified for planting in depths shallower than 15 ft. by removing the springs from the hydrostatic safety switch and extender.

Description

1. Case

Shape	Spherical
Color	Black
Material	Steel
Diameter	34 1/4"
Charge	300 lbs. TNT with granular TNT booster
Total weight in air	495 lbs.

2. External fittings

K device	K2-2, 2-3, 3, or 4, fitted to the upper end of the central tube
Extender	Mk. 6-2, fitted to lower end of central tube
Horns	Four, H-4, evenly spaced around upper hemisphere
Antenna	Connects eye in K device with the antenna float
Hydrostatic safety switch	On K device
Mooring cable eye	One, on lower hemisphere
Lifting eye	One, on upper hemisphere

3. Anchor

Mk. 6 anchor is used.

Fig. 4-- Mk. 6 Mine

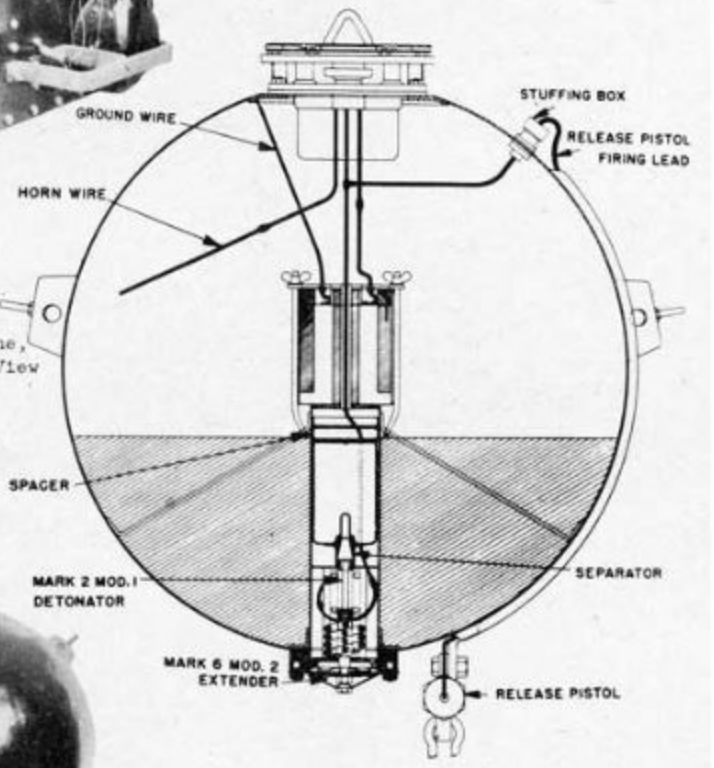


Fig. 5-- Mk. 6-2 Mine, Sectional View

Fig. 6-- Mk. 6-2 Mine

4. The antenna floats used with the Mk 6 are the D-4, D-4-3 and D 4-6. The D-4 is a small float 20" long and 10" in diameter, consisting of two hemispheres joined by a cylindrical mid-section. The D-4-3 and D-4-6 differ from the D-4 in that they are fitted with three and four H-6 horns respectively which are electrically connected to the antenna.

Operation

1. Mine takes depth by plummet. The extender operates in 24 ft. of water, and after the soluble washer dissolves, the hydrostatic safety switch will close, and the mine is armed.

2. Mine fires when a steel object contacts the antenna or an H-4 horn, or when an H-4 or H-6 horn is forced against its horn guard. This creates a sea battery, the current from which will operate a relay and close the firing circuit.

3. The hydrostatic safety switch and extender are designed to retract upon release of hydrostatic pressure.

Precautions

1. Do not allow the horns or antenna to contact any metallic objects.

2. Hydrostatic safety switch and extender may fail to retract upon release of hydrostatic pressure.

RMS

1. Place a copper short-circuiting clip on the K device, being certain that contact is made with both copper plates. (See note below).

2. Retract and lock out the extender. Any necessary movement of the mine must be done from a safe distance.

3. Retract and lock out the hydrostatic safety switch using the appropriate device, whether it be the retracting tool, splash cap or dummy soluble washer with nut.

4. Remove the extender.

5. Cut and tape the detonator leads separately.

6. Remove the K device.

7. Dispose of detonator, booster and charge.

Note: Any U. S. antenna mine may be fitted with an anti-sweeping crown, which so modifies the K device that a short-circuiting clip cannot be used. In this case, the K device should be short-circuited by thrusting a non-magnetic screwdriver firmly between the two plates. The screwdriver should be of the standard beryllium-copper type issued in the RMS tool kit. The K-4, which has a layer of plastic between the plates and cannot be shorted with a screwdriver, may be disarmed by contacting both plates with a bent piece of copper wire in the shape of a "V".

Mark 6-2

General

1. Same as the Mk. 6 except that it is a rising mine.

Description

1. Mk 6 case is used.

2. External fittings

Release pistol	On bottom of case near extender
Stuffing box	On side of upper hemisphere
Firing lead	On outside of case, runs from stuffing box to release pistol

All other fittings are the same as on the Mk. 6

Operation

1. Same as the Mk. 6, except that when contact is made, the release pistol is fired, opening a release hook, and freeing the mine, which rises approximately 34 ft. before the delay detonator fires.

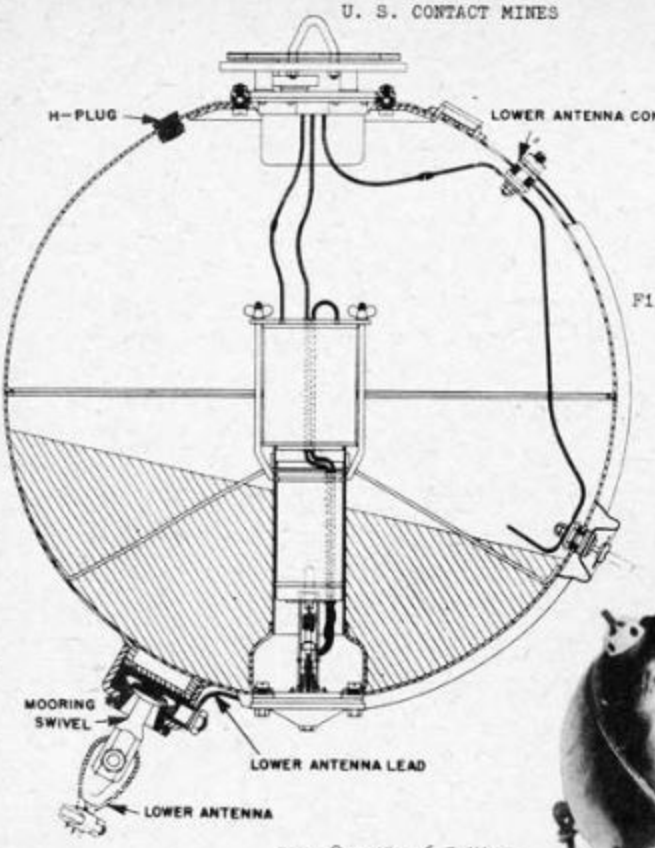


Fig. 7-- Mk. 6-3 Mine, Sectional View

Fig. 8-- Mk. 6-3 Mine

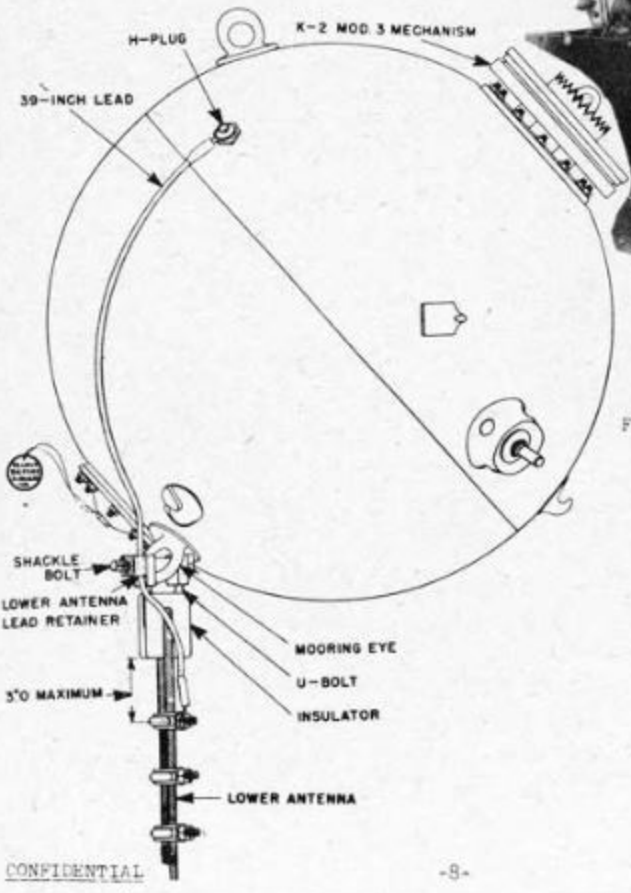


Fig. 9-- Mk. 6-4 Mine, Sectional View

Precautions

1. Same as the Mk. 6, except that additional care must be exercised when handling the release pistol.

RMS

1. Same as the Mk. 6.

Mark 6-3

General

1. Moored, contact, upper and lower antenna mine.
2. Laid by surface craft.
3. Laid defensively in depths of water from 40 to 2800 ft. primarily against submarines. Case depth is from 15 to 320 ft.

Description

1. Case (Mk 9 modified)

Shape	Spherical
Color	Black
Material	Steel
Diameter	35 13/16"
Charge	300 lbs. TNT with granular TNT booster
Total weight in air	540 lbs.

2. External fittings

Mooring swivel	Near extender
Lower antenna	Streamed from mooring swivel
Stuffing box	Near K device
Lower antenna lead	Runs along case from lower antenna to the lower antenna connection, and is electrically insulated from case.
Horns	Four, H-4, two above and two below the center weld

All other fittings are the same as on the Mk. 6.

3. Anchor

Mark 6-3 anchor is used.

Operation

1. Same as the Mk. 6 except that the firing device may also be actuated by a steel contact on the lower antenna.

Precautions and RMS

1. Same as the Mk. 6.

Mark 6-4

General

1. Same as the Mk. 6-3.

Description

1. Mk. 6 case is used.
2. External fittings

Horns	Three, H-4, on upper hemisphere
Stuffing box	In place of removed horn

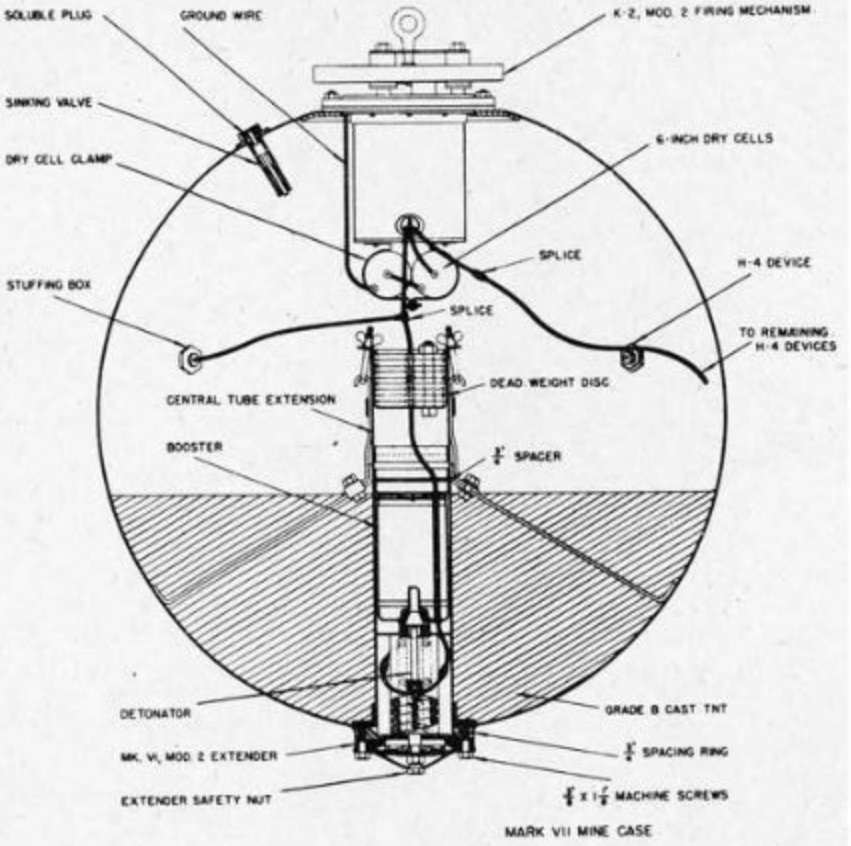


Fig. 10-- Mk. 7 Mine, Sectional View

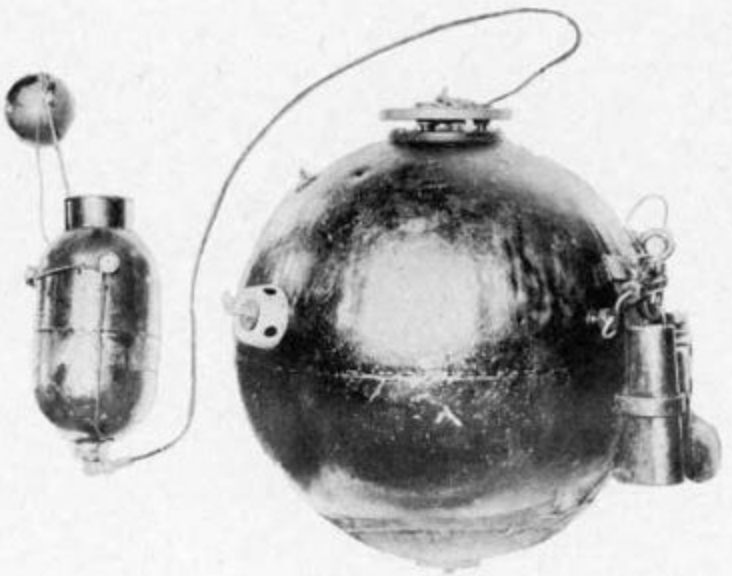


Fig. 11-- Mk. 7 Mine

Insulator	On mooring attachment
Lower antenna lead	Runs outside case from lower antenna to stuffing box

All other fittings are the same as on the Mk. 6.

3. Anchor

Mk. 6 anchor is used.

Operation, Precautions and RMS

1. Same as the Mk. 6.

Mark 7

General

1. Drifting, tactical mine.
2. Laid by surface craft.
3. Laid tactically or offensively against surface craft and designed to float about 37 ft. below the surface.

Description

1. Mk. 6 case is used.
2. External fittings

Horns	Three, H-4, around upper hemisphere
Stuffing box	In place of removed horn
Ballaster depth taking device	Directly below lifting eye
Flooder valve	Near K device on upper hemisphere
Release pistol	Secured to bracket

All other fittings are the same as on the Mk. 6.

3. Anchor

A special truck or dolly is used to launch the mine and assist in initial depth taking.

4. An additional D-8 spherical float, 5" in diameter, is connected to the top of the D-4-3 float by 10 ft. of white line.

Operation

1. Mine takes depth by the hydrostatically controlled ballister device, and the depth is maintained by the positive buoyancy of the D-8 float.
2. When contact with the antenna or D-4-3 float is made, the release pistol fires, releasing an attached weight, and allowing the mine to rise about 34 ft. before the delay detonator fires.
3. If the mine has not fired one hour after laying, a soluble washer in the flooder valve dissolves, allowing water pressure to depress the valve and flood the mine.
4. The safety features are the same as in the Mk. 6.

Precautions and RMS

1. Same as for the Mk. 6.

Mark 10-1

General

1. Moored, contact, chemical horn mine.
2. Laid by submarine.

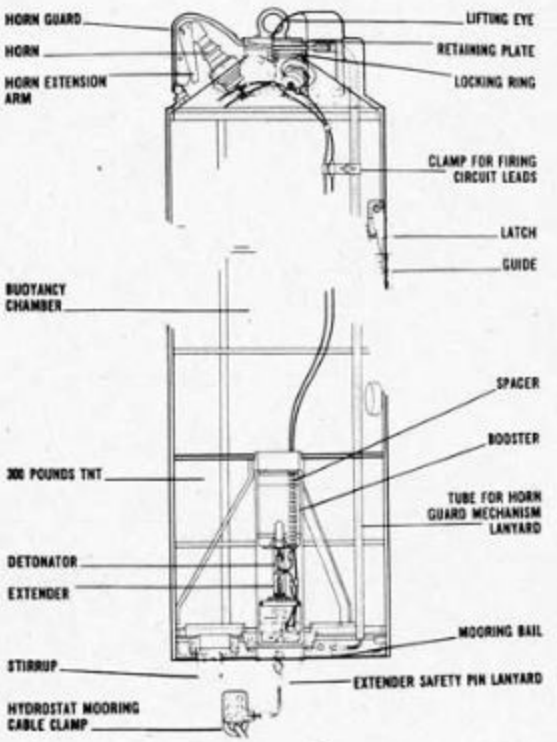


Fig. 12-- Mk. 10-1 Mine, Sectional View

Fig. 13-- Mk. 10-1 Mine

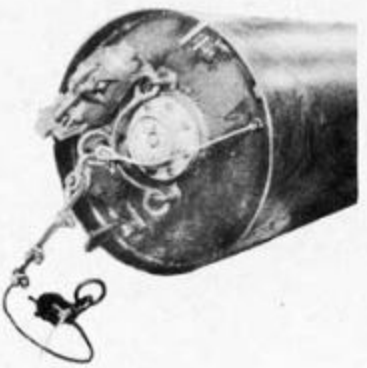


Fig. 14-- Mk. 10-1 Mine, Bottom View

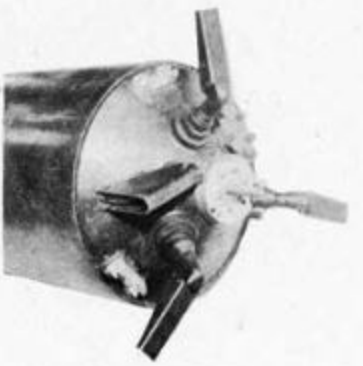


Fig. 15-- Mk. 10-1 Mine, Top View

3. Laid offensively in depths of water from 50 to 500 ft. against surface craft. Case depth is from 10 to 65 ft.

Description

1. Case

Shape	Cylindrical with conical nose
Color	Black
Material	Steel
Diameter	20 3/4"
Length	91 5/8"
Charge	300 lbs. TNT with granular TNT booster
Total weight in air	About 700 lbs.

2. External fittings

Horns	Three, lead, extension type, on top
Extender	Mk. 6-4 on bottom
Depth taking hydrostat	Mk. 1, on bottom
Mooring eye	Bail type, on bottom
Lifting eye	On top

3. Anchor

Mk. 10-1 anchor is used.

Operation

1. Mine takes depth by the loose bight hydrostat system. Extender operates in 15 ft. of water, and releases clockwork. Clock runs off in a maximum of 52 min. and mine is armed.
2. Mine fires when the glass vial in a chemical horn is broken.
3. Extender is designed to retract upon release of hydrostatic pressure.

Precautions

1. Take care not to damage the horns in any way.
2. Extender may fail to retract upon release of hydrostatic pressure.

RMS

1. Retract the extender, close the jaws around the hydrostatic piston, and insert a cotter key or pin in the hole provided.
2. Remove the extender.
3. Cut and tape the detonator leads separately.
4. Dispose of detonator, booster and charge.

Mark 11-1

General

1. Moored, contact antenna mine.
2. Designed to be laid offensively from a special submarine, but may be laid from surface craft.

Description

1. Case

Shape	Two hemispheres, joined by a cylindrical mid-section 4 1/4" wide
Color	Black
Material	Steel

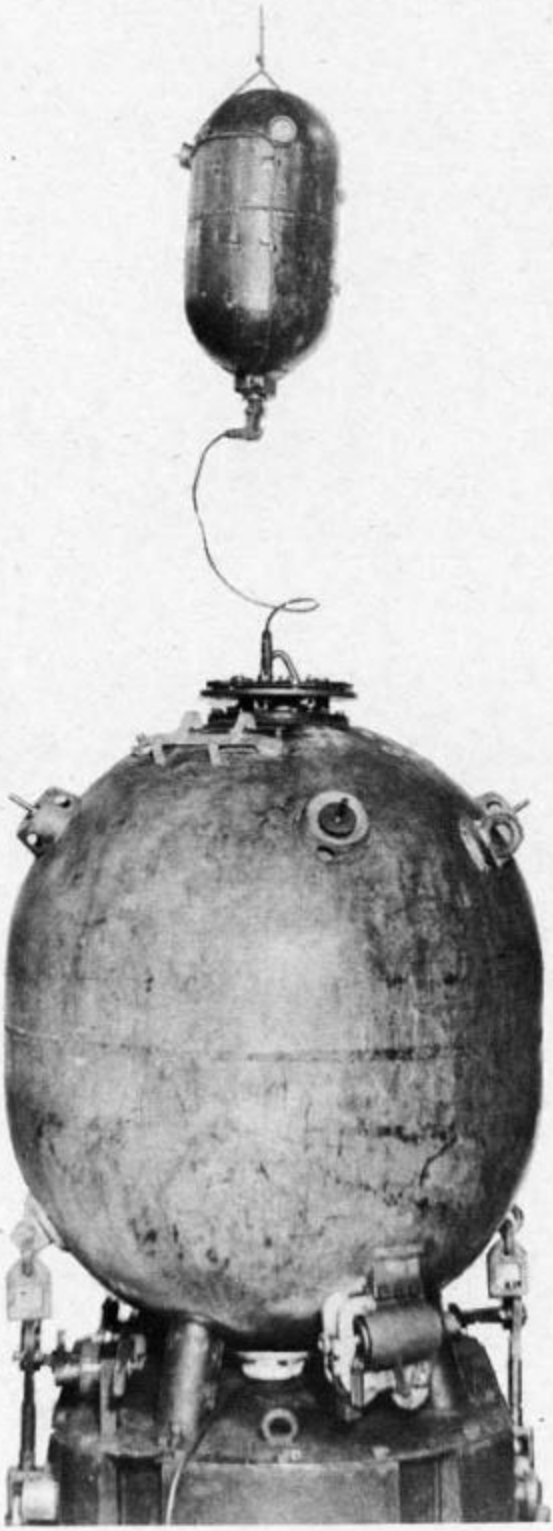


Fig. 16 – Mk 11-1 Mine

Diameter	35 3/4"
Length	40"
Charge	500 lbs. TNT with granular TNT booster
Total weight in air	About 700 lbs.

2. External fittings

Horns	Four, H-4, evenly spaced around upper hemisphere
K device	K-3-1, fitted to top of central tube
Extender	Mk. 6-3, fitted to bottom of central tube
Hydrostatic safety switch	On K device
Lifting eyes	Two, on lower hemisphere
Depth-taking hydrostat	Mk. 1, on lower hemisphere near extender

Operation

1. Mine takes depth by the loose bight hydrostat system. Extender operates in 24 ft. of water. Hydrostat in K device releases clockwork. Clock runs off in maximum of one hour and mine is armed.
2. Mine fires in the same manner as the Mk. 6 except that there is no float or antenna firing.
3. The safety features are the same as in the Mk. 6.

Precautions

1. Same as the Mk. 6.

RMS

1. Place a short-circuiting clip on the K device.
2. Retract and lock out the hydrostatic safety switch.
3. Retract and lock out the extender as on the Mk. 10-1.
4. Remove the extender.
5. Cut and tape the detonator leads separately.
6. Remove the K device.
7. Dispose of detonator, booster and charge.

CHAPTER 2

FIXED AND SEMIFIXED ROUNDS AND SEPARATE-LOADING PROJECTILES

Section I

AMMUNITION FOR 20-MM GUNS

18. GENERAL.

a. **General Discussion.** The present 20-mm Guns M1, AN-M2, M3, and Br. H.S./A/ (British Hispano-Suiza, Aircraft) are automatic aircraft cannon for use against ground targets and other aircraft. There are several types of these guns, dependent upon the type of adapter used. However, since they are similarly chambered it is possible to use the same ammunition. Ammunition manufactured in the U.S. must be proof-fired in British guns to determine whether the lot develops sufficiently low chamber pressure for acceptance for firing in British weapons. If the ammunition is accepted by both U.S. and British services, the words "COMMON AMMN" are marked or printed on the packing boxes. The ammunition is fed into the guns by means of link belts (fig. 23) or a 60-round drum-type magazine. High explosive-incendiary (HE-I), armor-piercing with tracer (AP-T), incendiary, practice, ball, and drill ammunition types are provided for the guns, all issued in the form of fixed complete rounds known as cartridges. There are two sets of 20-mm rounds. Rounds of older manufacture are the HE-I Mk. I, w/FUZE, P.D., 253 Mk. II-III; AP-T, M75; and ball (figs. 24, 25, and 26). The exterior ballistics of the projectiles of these rounds differ from each other because of differences in weight and shape. The recent rounds, developed to have matched ballistics, are the AP-T, T9E5 (M95); incendiary, T18 (M96); HE-I, T23 (M97), w/FUZE, P.D., T71E4 (M75); and practice, T24 (M99) (figs. 27, 28, 29, and 30). The shape, length, and weight of these rounds are approximately the same, and all have a purple annulus about the primer at the head of the cartridge case. The trajectories of these new rounds cross at 1,000 yards, at which range the time of flight for each projectile is approximately 1.66 seconds when fired from a stationary weapon with a muzzle velocity of 2,800 feet per second. The incendiary cartridge is slightly lighter in weight than the other projectiles, hence has a muzzle velocity of 2,840 feet per second.

b. **Identification.** Painting and marking of 20-mm cartridges for purposes of identification differ from the basic color scheme prescribed in TM 9-1900 but all essential information is provided. The HE-I

projectile has a yellow ogive and a red body; the AP-T, ball, and practice projectiles are painted black; the incendiary projectile is painted gray with the tip painted blue. See figures 24 to 31, inclusive.

c. Fuzes. The HE-I round, Mk. I, is fitted with FUZE, P. D., 253 Mk. III or Mk. II. These point detonating fuzes of British origin are direct-action superquick types and are not boresafe. The HE-I round, T23 (M97) is fitted with FUZE, P.D., T71E4 (M75), similar in internal details, but not in shape, to the Mk. III Fuze. See chapter 3, section I, for a complete description of these fuzes.

d. Cartridge Cases. The standard cartridge case is the M21A1, weighing approximately 0.205 pound; the substitute standard is the M21A1B1. The M21A1B1 is a steel case with a deeper extracting groove machined in the head, and is about 0.017 pound lighter than the standard M21A1 Brass Case. Rounds assembled with steel cases are only for ground and target use within continental U.S. The earlier standard M21 Case is no longer manufactured. It differs from the M21A1 in that the primer recess is adapted to hold the M37 (Berdan) Primer. The anvil is not present in this type of primer but is instead a component of the cartridge case. Also, the M21 has several flash vents instead of the single vent found in the M21A1 Case.

e. Primers. The M36-type Primer, containing a 2.1-grain charge of primer mixture, is standard for the 20-mm ammunition (ch. 3, sec. III).

f. Disintegrating Belt Links. These links, center and end, are considered as ammunition components similar to small-arms ammunition links (fig. 23). They are stored, issued, and reviewed in ORD 11 SNL R-1. They are issued when right- or left-hand Feed Mechanisms M1, M1A1, and T15 are required, except the M7 Link which is issued for the M2 Feed Mechanism. Their nomenclatures and piece marks are as follows:

LINK, disintegrating belt, 20-mm, M7
LINK, disintegrating belt, 20-mm, M3, C70661
LINK, end, disintegrating belt, 20-mm, M4, B163774
LINK, end, disintegrating belt, 20-mm, M5 (alternative), B163775

19. COMPLETE ROUND TABLE.

a. Data concerning the 20-mm complete rounds and components therefor are given in table 8, chapter 5.

20. PACKING AND SHIPPING DATA.

a. Data concerning 20-mm rounds are given in ORD 11 SNL's R-1 and R-6.

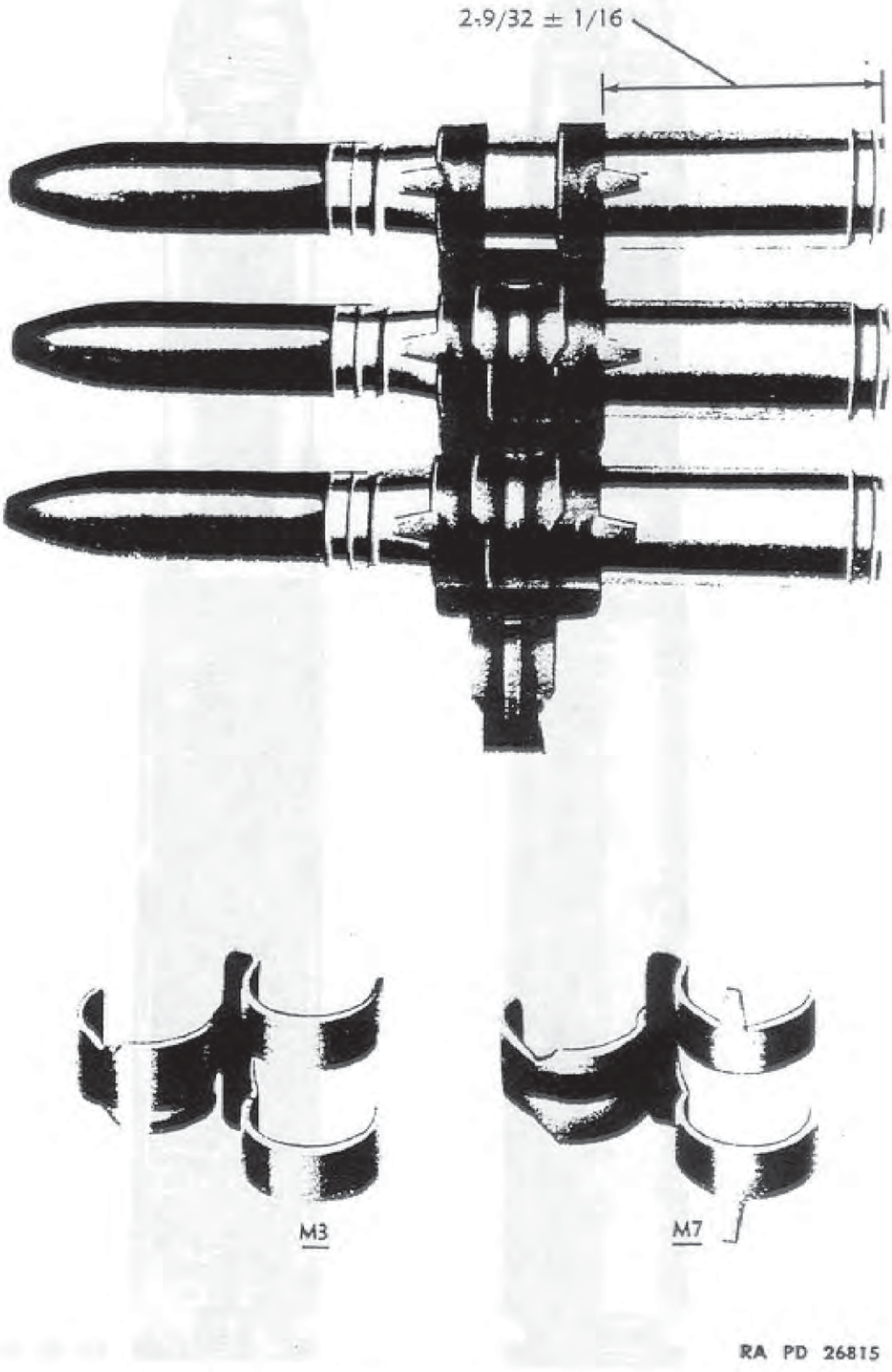


Figure 23 — 20-mm Cartridges in Link Belt and 20-mm Links

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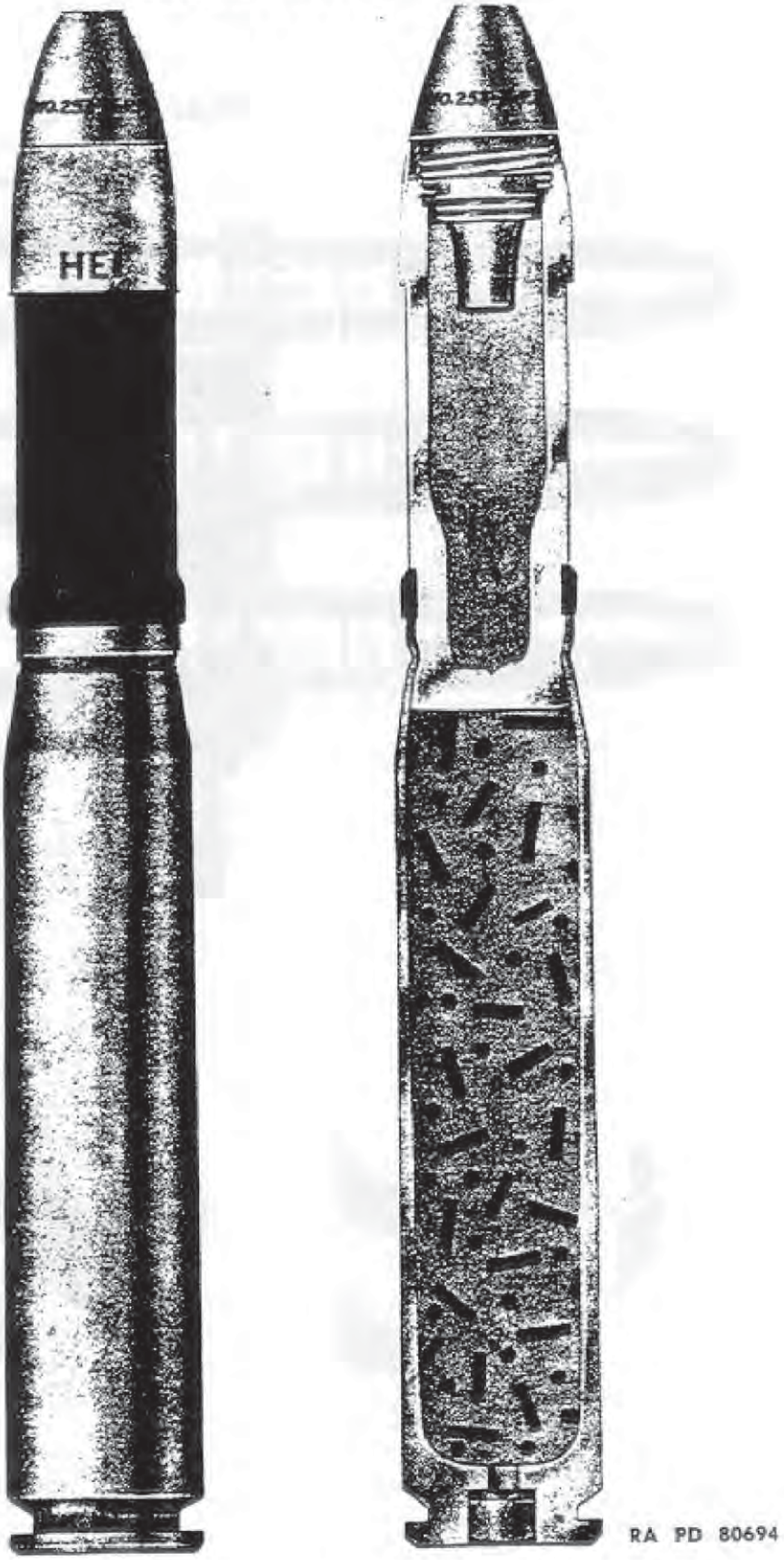


Figure 24 — CARTRIDGE, HE-I, Mk. I, w/FUZE, P. D., 253 Mk. II-III, 20-mm Guns, M1, AN-M2, M3, and Br. H.S./A/

FIXED AND SEMIFIXED ROUNDS AND SEPARATE-LOADING PROJECTILES

21. CARTRIDGE, HE-I, MK. I, W/FUZE, P. D., 253 MK. II-III, 20-MM GUNS, M1, AN-M2, M3, AND BR. H.S./A/ (fig. 24), is for use against aircraft and light materiel targets, functioning with both explosive and incendiary effect. The explosive filler is tetryl and the incendiary mixture is located in the base of the shell. After the shell penetrates the target, the high-explosive filler is detonated, the shell is shattered, and the incendiary composition is ignited. Its fuze is an instantaneous percussion fuze of the impact type. The thickness of the base is only 0.15 inch and a base cover is present for additional protection.

DATA

Weight of complete round	0.57 lb	Width of rotating band	0.203 in.
Length of complete round	7.19 in.	Type of base	Square
Length of fuzed projectile	3.22 in.	Radius of ogive	3.27 cal.
Length of cartridge case	4.34 in.	Muzzle velocity	2,800 ft per sec
		Maximum range	5,100 yd

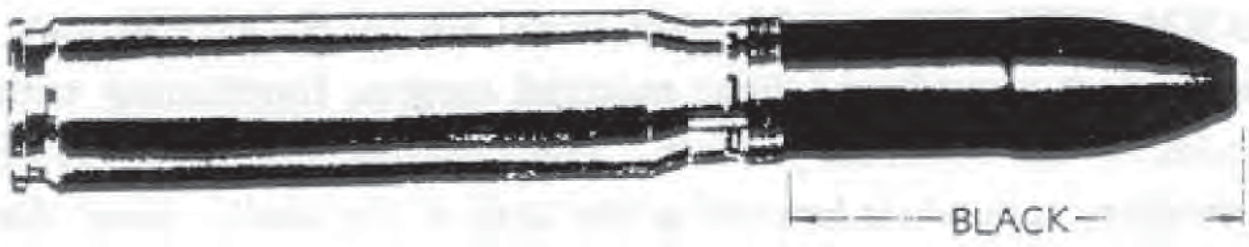
RA PD 80695

Figure 25 — CARTRIDGE, AP-T, M75, 20-mm Guns, M1, AN-M2, M3, and Br. H.S./A/

22. CARTRIDGE, AP-T, M75, 20-MM GUNS, M1, AN-M2, M3, AND BR. H.S./A/ (fig. 25), is for use against armored targets. The projectile is a solid steel shot, turned from cold-drawn steel bar stock. The base of the projectile contains a red tracer composition which is sealed in by means of a metal closing cup. When ignited, the tracer burns for about 4 seconds, equivalent to a range of about 3,000 yards.

DATA

Weight of complete round	0.639 lb	Radius of ogive	2.39 cal.
Length of complete round	7.22 in.	Muzzle velocity	2,615 ft per sec
Length of projectile	3.25 in.	Maximum range	6,300 yd
Length of cartridge case	4.34 in.	Penetration (in. at 0-deg obliquity of face-hardened plate at 1,000 yd)	0.6
Width of rotating band	0.203 in.		
Type of base	Square		



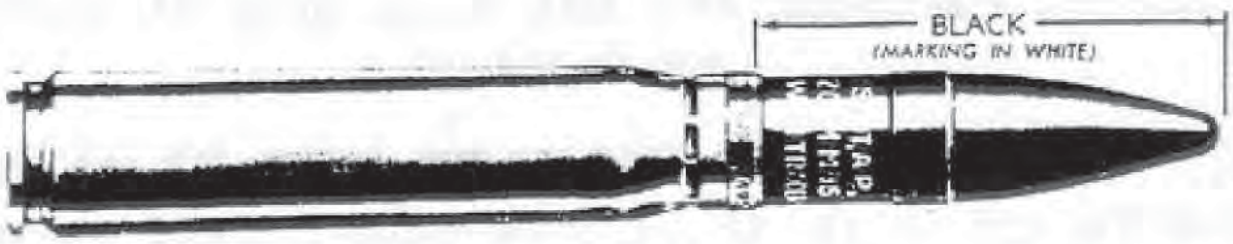
RA PD 80696

Figure 26 — CARTRIDGE, Ball, 20-mm Guns, M1, AN-M2, M3, and Br. H.S./A/

23. CARTRIDGE, BALL, 20-MM GUNS, M1, AN-M2, M3, AND BR. H.S./A/ (fig. 26), is for service firing against personnel and light materiel targets, for practice, and for proof-firing. The projectile is similar in shape and ballistic properties to the HE-I projectile, but is hollow and contains no explosive or tracer. It is rolled from steel bar stock. A steel closing disk with a 45-degree chamfer is fitted into the recesses in the base of projectile.

DATA

Weight of complete round	0.56 lb	Width of rotating band	0.203 in.
Length of complete round	7.23 in.	Type of base	Square
Length of projectile	3.31 in.	Radius of ogive	3.27 cal.
Length of cartridge case	4.34 in.	Muzzle velocity	2,850 ft per sec
Maximum range	6,000 yd		



RA PD 65139

Figure 27 — CARTRIDGE, AP-T, T9E5 (M95), 20-mm Guns, M1, AN-M2, M3, and Br. H.S./A/

24. CARTRIDGE, AP-T, T9E5 (M95), 20-MM GUNS, M1, AN-M2, M3, AND BR. H.S./A/ (fig. 27), is for use against armored targets. The projectile is a solid shot made from bar or forged steel. A drawn steel windshield is crimped into rolled or stamped grooves in the projectile body, the portion of the windshield over the crimping acting as the bourrelet of the projectile. The base of the projectile contains a red tracer composition, sealed in by means of a

metal closing cup. The tracer burns for about 2.25 seconds, equivalent to a range of about 1,400 yards.

DATA

Weight of complete round	0.57 lb	Muzzle velocity	2,800 ft per sec
Length of complete round	7.22 in.	Maximum range	5,900 yd
Length of projectile	3.27 in.	Penetration (in. at 0-deg obliquity of face-hardened plate at 400 yd)	3/4
Length of cartridge case	4.34 in.	Penetration (in. at 0-deg obliquity of homogeneous plate at 400 yd)	7/8
Width of rotating band	0.203 in.		
Type of base	Square		
Radius of ogive	2.3 cal.		

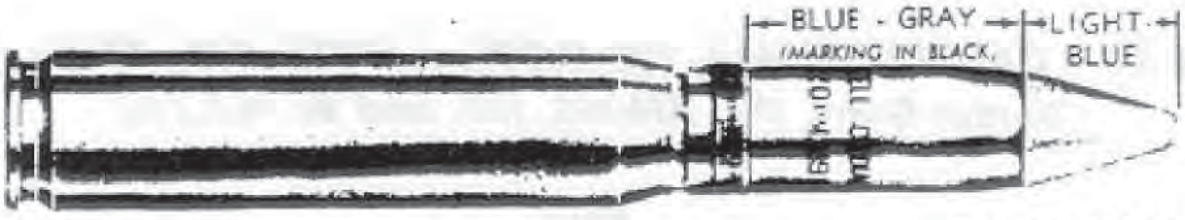


Figure 28 — CARTRIDGE, Incendiary, T18 (M96), 20-mm Guns, M1, AN-M2, M3, and Br. H.S./A/

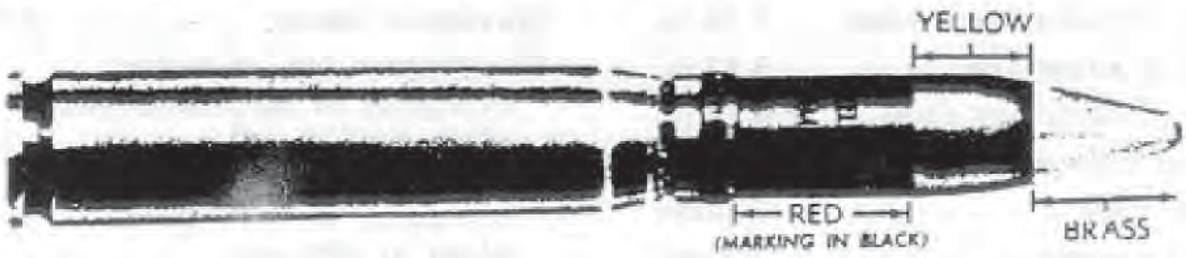
25. CARTRIDGE, INCENDIARY, T18 (M96), 20-MM GUNS, M1, AN-M2, M3, AND BR. H.S./A/ (fig. 28), is for use against aircraft, functioning with incendiary effect, similar to cal. .50 incendiary cartridges. The body is made of cold-drawn steel. The nose, threaded to screw into body, is made of a die-cast zinc alloy; it is painted light blue for identification similar to small-arms cartridges. Both the body and nose are filled with incendiary materiel. This round does not require a fuze, as functioning is initiated by impact of nose upon target.

DATA

Weight of complete round	0.55 lb	Width of rotating band	0.203 in.
Length of complete round	7.20 in.	Type of base	Square
Length of projectile	3.245 in.	Radius of ogive	2.54 cal.
Length of cartridge case	4.34 in.	Muzzle velocity	2,840 ft per sec
		Maximum range	5,700 yd

26. CARTRIDGE, HE-I, T23 (M97), W/FUZE, P. D., T71E4 (M95), 20-MM GUNS, M1, AN-M2, M3, AND BR. H.S./A/ (fig. 29), is for use against aircraft and light materiel targets, functioning with both explosive and incendiary effect. The explosive filler is tetryl and the incendiary mixture is located in the base of the shell. After the shell penetrates the target, its filler is detonated, the shell shattered, and the incendiary composition ignited. Its fuze is an instantaneous

percussion fuze of the impact type. The thickness of the base is approximately 0.2 inch, and a base cover is welded thereon for additional protection. This cartridge differs basically from the HE-I cartridge, described in paragraph 21, by having a pointed fuze.



RA PD 65137

Figure 29 — CARTRIDGE, HE-I, T23 (M97), w/FUZE, P.D., T71E4 (M75), 20-mm Guns, M1, AN-M2, M3, and Br. H.S./A/

DATA

Weight of complete round	0.57 lb	Width of rotating band	0.203 in.
Length of complete round	7.22 in.	Type of base	Square
Length of fuzed projectile	3.28 in.	Radius of ogive	2.54 cal.
Length of cartridge case	4.34 in.	Muzzle velocity	2,800 ft per sec
Maximum range	5,750 yd		

RA PD 65136

Figure 30 — CARTRIDGE, Practice, T24 (M99), 20-mm Guns, M1, AN-M2, M3, and Br. H.S./A/

27. CARTRIDGE, PRACTICE, T24 (M99), 20-MM GUNS, M1, AN-M2, M3, AND BR. H.S./A/

(fig. 30), is for practice firing. The projectile is similar in shape and ballistic properties to the T18 (M96) Incendiary Projectile but is hollow and contains no explosive. The nose consists of a zinc die casting as in the T18 (M96) Incendiary but its weight is adjusted to give the projectile a weight of 2,000 grains (0.29 lb). The projectile body is made of cold-drawn steel.

DATA

Weight of complete round	0.57 lb	Width of rotating band	0.203 in.
Length of complete round	7.22 in.	Type of base	Square
Length of projectile	3.27 in.	Radius of ogive	2.54 cal.
Length of cartridge case	4.34 in.	Muzzle velocity	2,800 ft per sec
Maximum range	5,750 yd		

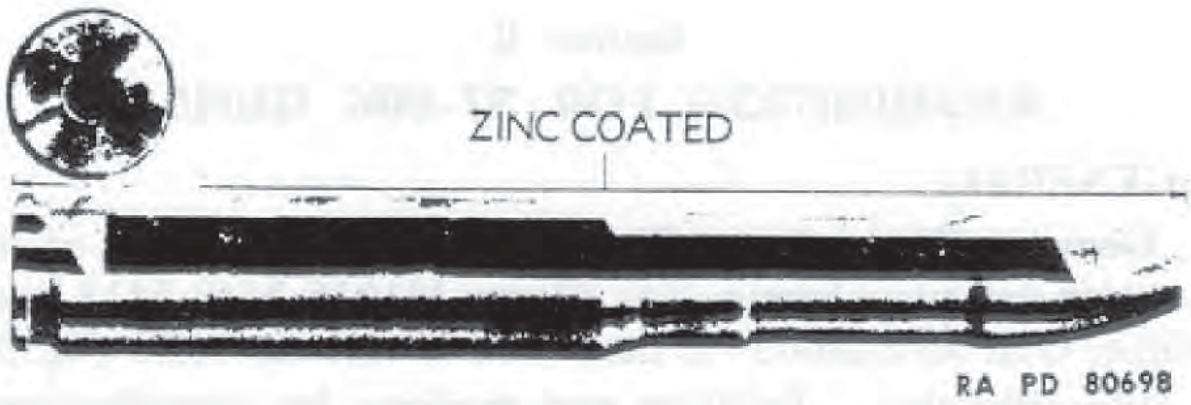


Figure 31 — CARTRIDGE, Drill, M18A1, 20-mm Auto. Guns, M1, AN-M2, and Br. H.S./A/

28. CARTRIDGE, DRILL, M18A1, 20-MM GUNS, M1, AN-M2, AND BR. H.S./A/ (fig. 25), is a completely inert assembly intended to provide a simulated service cartridge for drill purposes and for testing feed mechanism of the weapon. The service projectile and cartridge case are simulated by a 1-piece casing made of steel, cold-drawn to size, shape, and weight. The base is threaded to hold a steel base plug, flanged to provide an extractor groove like that on service ammunition. Alternative manufacturing designs for this drill cartridge have a steel body plug secured in the nose of the cartridge. Weight is 0.57 pound; length is 7.20 inches.

29. CARTRIDGE, DRILL, M18, 20-MM GUNS, M1, AN-M2, AND BR. H.S./A/, differs from the M18A1 Drill Cartridge (par. 28) in minor internal details of the body and the base plug.

Section III

AMMUNITION FOR 40-MM GUNS

56. GENERAL.

a. General Discussion. Sometimes referred to as the "Bofors" gun, GUN, automatic, 40-mm, M1, is primarily a rapid-fire automatic gun for antiaircraft defense, but can be set for a single shot. The gun is fed by an automatic mechanism into which 4-round charger clips are loaded by hand. Use of the word "cartridge" to indicate a complete round of 40-mm fixed ammunition resulted from a joint agreement of the U.S. Army, the U.S. Navy and the British.

b. Interchangeability. Since the M1 Gun is basically the same as Navy and British 40-mm guns, the ammunition may be interchanged.

c. Identification. Rounds of Army procurement are painted and marked for identification in accordance with basic color scheme prescribed in TM 9-1900 and in figures 48, 49, and 50. In other cases, painting and marking may follow practices of other services.

d. Fuzes. Four models of supersensitive point-detonating fuzes have been used with 40-mm high-explosive shell—FUZE, P. D., Mk. 27 (Navy), FUZE, P.D., M71, FUZE, P.D., M64A1, and FUZE, P. D., 251, Mk. I (ch. 3, sec. I, and par. 61).

e. Cartridge Cases. CASE, cartridge, 40-mm, M25, or M25B1, is used with 40-mm ammunition of Army procurement. The M25B1 Case, made of steel, differs from the M25 in having a thinner head and primer seat, and weighs approximately 0.31 pound less. Ammunition of Navy design will have the Mk. 2 or Mk. 2-Mod. 1 Brass Case or the Mk. 3 Steel Case; the brass case weighs 1.89 pounds and the steel case weighs 0.36 pound less. Ammunition of British design will have the M22 Case, which differs from the American standard case in that the primer hole is threaded to fit the British primer.

f. Primers. PRIMER, percussion, 55-grain, M38A1, is standard for rounds of Army procurement, but the earlier standard 20-grain M23A1 Primer may still be found in rounds of less recent manufacture. Alternative primers are the Mk. 22 Navy Primer and the M38B2 Percussion Primer. Rounds with CASE, cartridge, 40-mm, M22, and those manufactured according to British design, will have PRIMER, percussion, Q.F. cartridges, No. 12, Mk. II/L. For descriptions of these primers see chapter 3, section III.

57. COMPLETE ROUND TABLE.

a. Data concerning the 40-mm complete rounds and components thereof are given in table 10, chapter 5.

58. PACKING AND SHIPPING DATA.

a. Packing and shipping data are given in ORD 11 SNL's P-5 and P-8.

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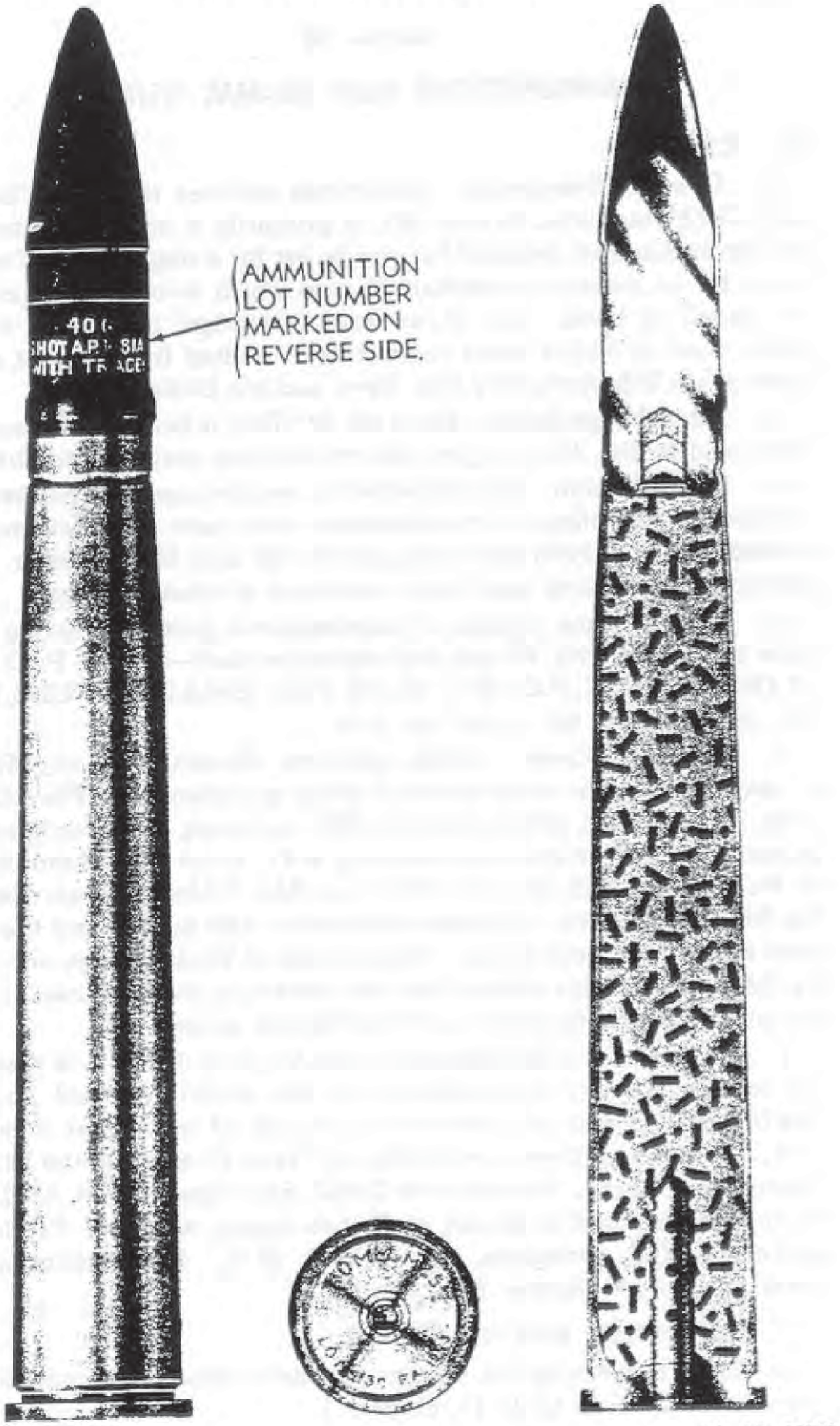


RA PD 80721

Figure 48 — CARTRIDGE, AP-T, M81A1, 40-mm AA. Guns

FIXED AND SEMIFIXED ROUNDS AND SEPARATE-LOADING PROJECTILES

59. CARTRIDGE, AP-T, M81A1, 40-MM AA. GUNS (fig. 48), is provided for the 40-mm guns for firing against armored targets. The projectile is a monobloc type, of solid steel. A tracer cavity in the base holds a red tracer composition. The nose of the body proper is shaped to a relatively blunt ogive. However, a long false ogive is provided, for better ballistics, by securing a light-weight windshield or false ogive to the shot body by a 360-degree crimp just forward of the bourrelet. The M81A1 Shot has no armor-piercing cap. The length of trace is 12 seconds.

DATA

Weight of complete round	4.57 lb	Muzzle velocity	2,870 ft per sec
Length of complete round	17.62 in.	Maximum range	9,475 yd
Length of projectile	6.19 in.	Penetration (in. at 0-deg obliquity of face-hardened plate at 1,000 yd	1.7
Length of cartridge case	12.24 in.	Penetration (in. at 0-deg obliquity of homogeneous plate at 1,000 yd	1.8
Width of rotating band	0.64 in.		
Type of base	Square		
Radius of ogive	5.78 cal.		

60. CARTRIDGE, AP-T, M81, 40-MM AA. GUNS, is an earlier design of armor-piercing shot which is identical with that described in paragraph 59 except that the windshield is secured to the body of the shot by means of an adapter. For data refer to paragraph 59.

61. CARTRIDGE, H.E., MK. I (NAVY), W/FUZE, MK. 27 (NAVY), 40-MM AA. GUNS, has a shell very similar to the Mk. II Shell (described in par. 62) used with rounds of Army manufacture, and functions like it. For Navy procurement, the shell is fuzed with the Mk. 27 Navy Fuze and Cartridge Case Mk. 1 or Mk. 2. Standard Navy primer is the Mk. 22, a press-in type; earlier standard was the Mk. 21* which screwed into the base of the cartridge case. The Shell-destroying Tracer Mk. 8 or Mk. 10 may be assembled in the base of the shell.

DATA

Weight of complete round	4.60 lb	Width of rotating band	0.60 in.
Length of complete round	17.60 in.	Type of base	Boat-tailed
Length of fuzed projectile	7.10 in.	Muzzle velocity	2,800 ft per sec
Length of cartridge case	12.24 in.	Maximum range	10,800 yd

*—Rounds assembled with the Mk. 21 Primer have been declared unsafe to fire.

ARTILLERY AMMUNITION

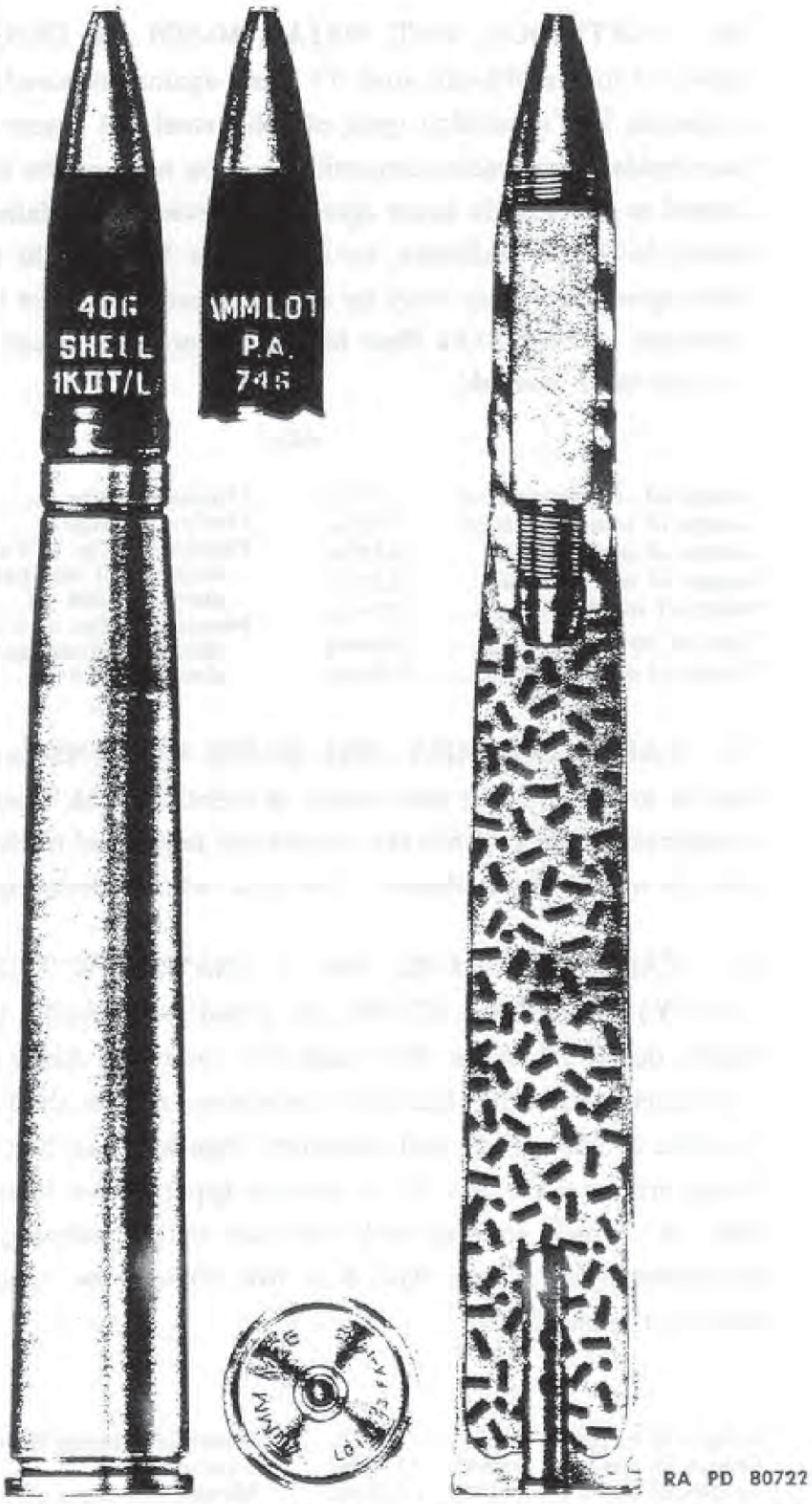


Figure 49 — CARTRIDGE, HE-T (SD, Mk. 11 or Mk. 11-Mod. 2), Mk. II, w/FUZE, P.D., Mk. 27 (Navy), 40-mm AA. Guns

FIXED AND SEMIFIXED ROUNDS AND SEPARATE-LOADING PROJECTILES

62. CARTRIDGE, HE-T (SD, MK. 11 OR MK. 11-MOD. 2), MK. II, W/FUZE, P.D., MK. 27 (NAVY), 40-MM AA. GUNS (fig. 49), consists of the M25 brass or M25B1 alternative steel Cartridge Case with the M38A1 Primer and an FNH powder charge crimped rigidly to a Mk. II High-explosive Shell fitted with the Mk. 27 supersensitive Fuze. The Mk. II Shell consists of three principal parts—a hollow steel casing containing a high-explosive bursting charge of pressed TNT, the point-detonating fuze, and a shell-destroying (SD) tracer. The nose of the shell is conical, with a 7-degree 45-minute taper, and is cut and threaded internally to receive the fuze. The base is boat-tailed (conical) with an 8-degree 15-minute taper, and is threaded internally to accommodate the shell-destroying Tracer Assembly Mk. 11 or Mk. 11-Mod. 2, of Navy origin, which protrudes beyond the base of the shell for approximately 0.56 inch. The tracer consists of an igniting charge, a red tracer composition, and a relay igniting charge of black powder. The red tracer composition burns with a visible trace for 9 to 12 seconds, equivalent to a range of 4,300 to 5,200 yards. As the tracer burns out, the relay igniting charge is ignited, detonating the bursting charge of the shell unless prior detonation has been caused by functioning of the fuze. The Mk. 11 and Mk. 11-Mod. 2 Tracers are similar to the M3 Tracer except for details of the relay igniting assembly.

DATA

Weight of complete round	4.70 lb	Type of base	Boat-tailed
Length of complete round	17.60 in.	Degree of taper	8 deg 15 min
Length of fuzed projectile	7.64 in.	Muzzle velocity	2,870 ft per sec
Length of cartridge case	12.24 in.	Maximum range, horizontal	5,200 yd*
Width of rotating band	0.64 in.	Maximum range, vertical	5,100 yd*

*—Limited by shell-destroying tracer. Theoretical maximum: 10,850 yards, horizontal, and 7,625 yards, vertical.

63. CARTRIDGE, HE-T (SD), MK. II, OF EARLIER MANUFACTURE are listed in ORD 11 SNL P-5 and their data presented in table 9, chapter 5, and the subparagraphs below. The standard Mk. II HE-T Round is described in paragraph 62.

a. The first rounds used in 40-mm guns were adapted from British ammunition. These Mk. II Shell are loaded with TNT and fitted with the TRACER and IGNITER, shell, No. 12, Mk. I/L/, internal. The fuze used is the No. 251 Mk. I, which was replaced by the

M64A1, this fuze in turn being replaced by the Mk. 27 (Navy) Fuze. The muzzle velocity of these rounds is 2,870 feet per second. The No. 12 tracer, of British origin, consists of a primer, an igniting charge, a red tracer composition, and a relay igniting charge. The primer strikes a firing pin by set-back upon firing, igniting the red tracer composition. This burns for about 9 seconds, equivalent to a range of about 3,500 to 4,000 yards. As the tracer burns out, the relay igniting charge is ignited, detonating the bursting charge of the shell unless prior detonation has been caused by functioning of the fuze. Weights of these complete rounds are approximately 4.82 pounds. Length of the projectile with the No. 12 tracer is 7.08 inches.

b. The muzzle velocity of the Mk. II HE-T Rounds was reduced from 2,870 feet per second to 2,700 feet per second. Rounds manufactured with this velocity contained the No. 12 tracer and the M64A1, Mk. 27, and M71 Fuzes.

c. An improved tracer, TRACER, SD, M3, of American manufacture was adopted to replace the No. 12 tracer. The M3 Tracer differs from the No. 12 in that the primer and firing pin are omitted, the powder train consisting of an igniter charge, three charges of red tracer composition pressed at various loads in a steel body, and a relay igniting charge. The body is threaded externally to screw into the base of the shell. Unlike the tracer No. 12, which is flush with the rear surface of the shell when fully inserted, the M3 Tracer protrudes for about 0.75 inch. The bursting charge used in shell with the M3 Tracer is tetryl in preliminary design shell, and explosive D in the base and tetryl in the rest of shell of subsequent manufacture. A black powder wafer is also loaded in the base of the shell adjacent to the tracer relay charge to cause detonation of the bursting charge. The M3 Tracer has a burning time of 12 to 14 seconds, corresponding to a maximum horizontal range of 6,000 yards and a maximum vertical range of 5,750 yards (based on 2,870 ft per sec muzzle velocity). Rounds manufactured with the M3 Tracer have the Mk. 27 and M64A1 Fuzes. The Mk. 27 fuzed shell have a muzzle velocity of 2,700 feet per second, but shell fuzed with the M64A1 have been manufactured with both the 2,700 and 2,870 feet per second muzzle velocity. Weights of these complete rounds are approximately 4.82 pounds. Length of the fuzed projectile with the M3 Tracer is 7.88 inches. Maximum horizontal range is 6,000 yards and maximum vertical range is 5,750.

d. The next development was an improved tracer, the M3A1. Details of these rounds with the M3A1 are the same as described in subparagraph c, above, except that only the muzzle velocity of 2,700 feet per second is applicable. Rounds with the M3A1 Tracer are also assembled with the Mk. 27 and M64A1 Fuzes. The TRACER, SD, M3A1, differs from the M3 in having an initiator and the same tracer and igniter composition as in the Mk. 11 Navy tracer.

e. The earlier types described in subparagraphs a to d, above, are superseded by the present standard round, described in paragraph 62, which has the Mk. 11 or Mk. 11-Mod. 2 tracer and the muzzle velocity of 2,870 feet per second. Rounds with these tracers are assembled with the Mk. 27 and M71 Fuzes, and the bursting charge is pressed TNT.

Figure 50 — CARTRIDGE, TP-T, M91, w/FUZE, Dummy or Inert, M___, 40-mm AA. Guns

64. CARTRIDGE, TP-T, M91, W/FUZE, DUMMY OR INERT, M___, 40-MM AA. GUNS (fig. 50), has a projectile which resembles the high-explosive shell in the Mk. II Cartridge but has a solid base except for a small tracer cavity. The shell-destroying tracer is replaced in the practice projectile by a burning composition for observation only, and the bursting charge cavity is empty. The shell may be fitted with FUZE, dummy, M69, or M69B1, which simulates the supersensitive point-detonating fuzes or may be an inert service fuze unserviceable for high-explosive loading.

DATA

Weight of complete round	4.72 lb	Type of base	Boat-tailed
Length of complete round	17.60 in.	Degree of taper	8 deg 15 min
Length of fuzed projectile	7.08 in.	Muzzle velocity	2,870 ft per sec
Length of cartridge case	12.24 in.	Maximum range, horizontal	10,850 yd
Width of rotating band	0.64 in.	Maximum range, vertical	7,625 yd

65. CARTRIDGE, HE-T, MK. II, INERT LOADED, W/FUZE, DUMMY OR INERT, M__, 40-MM AA. GUNS, is an alternative practice round to CARTRIDGE, TP-T, M91, w/FUZE, dummy or inert, M__, 40-mm AA. Guns. It consists of a service cartridge case, primer, and propelling charge; an inert-loaded Mk. II High-explosive Shell; and an inert fuze. FUZE, dummy, M69 or M69B1, or an inert service fuze (the M71 or Mk. 27 (Navy)) may be assembled to the shell.

66. CARTRIDGE, DRILL, M17, 40-MM GUNS, is a completely inert assembly for drill purposes. The iron body is shaped in the general form of a service projectile and a fixed cartridge case. The nose end of the assembly may be left open and threaded to hold an iron plug resembling a service fuze, or the body and nose may be made in one piece. The base end of the body is closed by an iron base plate which screws into the body and has a flange to provide for extraction of the cartridge after loading in the gun. The complete assembly weighs approximately 4.53 pounds and is 17.62 inches long.

Section XII

AMMUNITION FOR 90-MM GUNS

190. GENERAL.

a. General. Originally intended for antiaircraft defense, the 90-mm gun has since been adapted, by the use of various types of mounts, for use also against ground and water-borne targets. Of the several models of 90-mm guns now in use, all have the same type of chamber and can fire the same ammunition. The ammunition is of the fixed type, that is the rounds have propelling charges which are not adjustable and are loaded into the cannon in one operation. Armor-piercing, high-explosive, practice, blank, and drill rounds are provided. Rounds requiring fuzes are shipped with fuzes assembled. Once removed from packing materials, the rounds require only adjustment of the fuzes to be ready for firing.

b. Identification. Painting and marking for identification is in accordance with the basic color scheme as prescribed in TM 9-1900.

c. Fuzes. Shell for antiaircraft use are fitted with the M43 Mechanical Time Fuze (all modifications), which permits adjustment of setting to 30 seconds but has no impact element. Shell for ground fire or anti-motor-torpedo-boat defense are shipped fuzed with M48 series fuzes. These provide for selective superquick or delay setting, for surface burst or for detonation after penetration or upon ricochet with either 0.05-second or 0.15-second delay. The modification, M48A2, is manufactured with either delay, depending on the lot. The M48 and M48A1 Fuzes are manufactured with 0.05-second and 0.15-second delay, respectively, but some M48A1 Fuzes modified to have 0.05-second delay elements are in existence. Fuzes with 0.15-second delay are used in anti-motor-torpedo-boat firing, while models with the short (0.05-sec) delay are used against ground targets. Loaded armor-piercing projectiles are fitted with FUZE, B.D., M68, a base-detonating fuze which functions with delay action. Practice and drill rounds are fitted with either dummy or inert service fuzes. For a complete description of fuzes, see chapter 3, section I.

d. Cartridge Cases. CASE, cartridge, 90-mm, M19, made of brass, is standard for all ammunition except blank. Substitute standard is CASE, cartridge, 90-mm, M19B1. The M19B1 is a steel case weighing 10.1 pounds whereas the brass case weighs 11 pounds. CASE, cartridge, M27 or M27B1, is used with 90-mm blank ammunition.

e. NH (nonhygroscopic, flashing) propellent powder has been established as standard for all 90-mm ammunition except time-fuzed rounds, which, for AA. fire, will be loaded with FNH (flashless nonhygroscopic) powder. Impact-fuzed rounds with FNH powder are to be reserved for target-practice firing insofar as is practicable. Time-fuzed NH rounds will be used for daytime fire or for practice until supplies are exhausted and replaced by rounds with the standard propellant.

f. **Primers.** PRIMER, percussion, 300-grain, M28A2, is standard for all ammunition for 90-mm guns except blank ammunition. Alternative primer is PRIMER, percussion, 300-grain, M28B2 (steel). Rounds of earlier manufacture may have PRIMER, percussion, 300-grain, M28A1 or M28B1A1. PRIMER, percussion, 100-grain, M1B1A2, is used with blank ammunition (ch. 3, sec. III).

191. COMPLETE ROUND TABLE.

a. Data concerning complete rounds for 90-mm guns, and components thereof, are given in table 18, chapter 5.

192. PACKING AND SHIPPING DATA.

a. Packing and shipping data for 90-mm ammunition are given in ORD 11 SNL's P-5, P-7, and P-8.

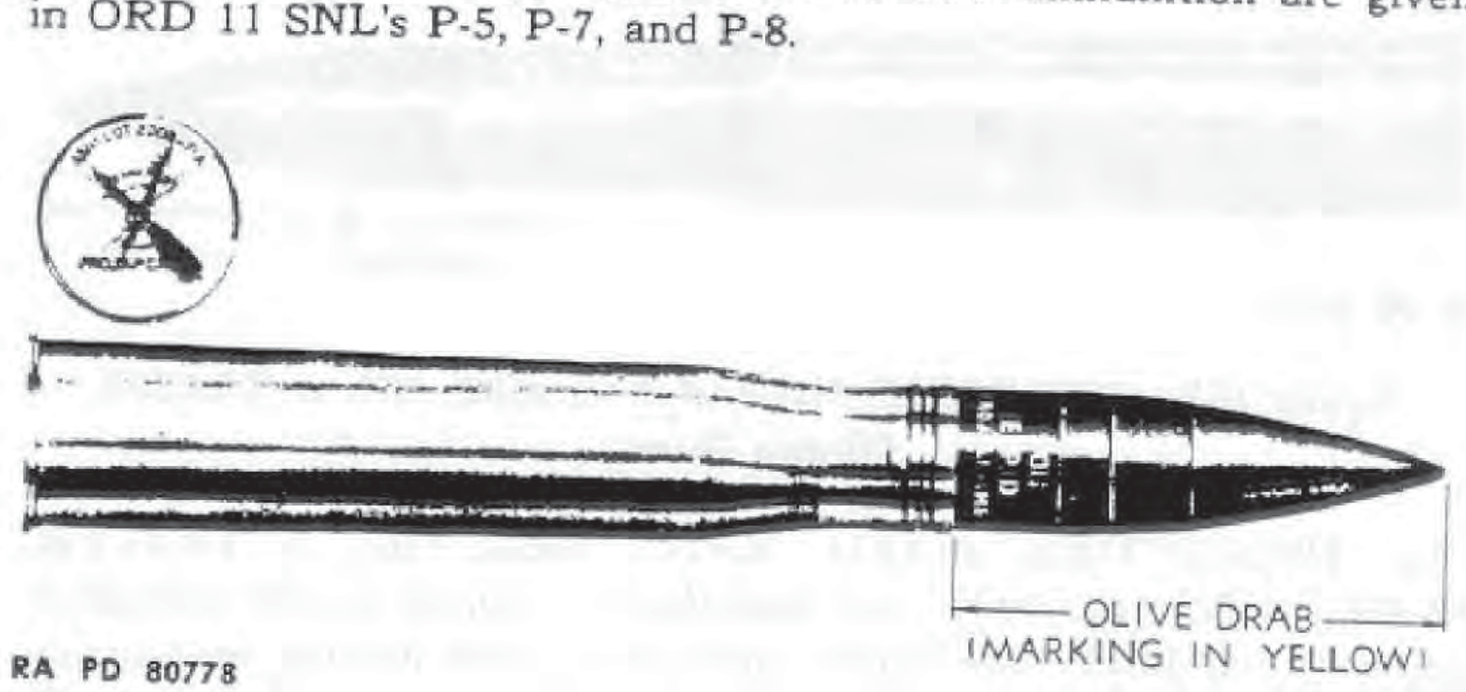


Figure 106 — PROJECTILE, Fixed, A.P.C., M82, NH, w/FUZE, B.D., M68, and TRACER, 90-mm Guns

193. PROJECTILE, FIXED, A.P.C., M82, NH, W/FUZE, B.D., M68, AND TRACER, 90-MM GUNS

(fig. 106), is provided for 90-mm guns for use against ground targets, particularly armored materiel. The projectile, which has been manufactured both with and without a high-explosive charge (par. 194) is similar to other standard types especially adapted for combating face-hardened armor. The body proper is made of hard steel, with a square base and a nose

shaped to a relatively short ogive. The nose is sweated to a softer steel cap, on which in turn is screwed a light-weight steel ballistic cap or windshield. The rear portion of the body contains a small cavity which, in the loaded projectile, holds a small charge of explosive D. The base hole is threaded to receive the M68 Base-detonating Fuze. This fuze, a simple inertia type, functions with delay action. The rear housing of the fuze extends approximately ¾ inch beyond the rear surface of the projectile base. This portion of the fuze contains a red tracer for observation purposes. Operating independent of the fuze mechanism, the tracer composition is ignited by the propelling charge when the round is fired. It burns with a visible tracer for about 3 seconds, equivalent to a range of about 2,400 yards.

DATA

Weight of complete round	42.75 lb	Radius of ogive (false ogive)	9.09 cal.
Length of complete round	38.24 in.	Muzzle velocity	2,650 ft per sec
Length of fuzed projectile	16.19 in.	Maximum range	13,540 yd
Length of cartridge case	23.70 in.	Penetration (in. at 0-deg obliquity of face-hardened plate at 1,000 yd)	6.0
Width of rotating band	1.20 in.		
Type of base	Square		
Penetration (in. at 0-deg obliquity of homogeneous plate at 1,000 yd)	5.5		

RA PD 80779

Figure 107 — PROJECTILE, Fixed, A.P.C., M82, NH, w/TRACER, 90-mm Guns

194. PROJECTILE, FIXED, A.P.C., M82, NH, W/TRACER, 90-MM GUNS (fig. 107), was manufactured prior to the standardization of the M68 Base Fuze, which permitted loading and fuzing the projectile for blast as well as penetrating effect. In this round, the projectile bursting charge cavity is left empty. The base hole is plugged with a steel plug which contains a tracer similar to that in the fuze of the loaded projectile. Weight of the complete round is 42.04 pounds; over-all length of the projectile is 15.49 inches, 0.70 inch less than the fuzed propectile due to the omission of the fuze, otherwise, the data in paragraph 193 is applicable to this round.

195. SHOT, FIXED, A.P., M77, NH, W/TRACER, 90-MM GUNS (fig. 108), has the same components, other than the projectile, as the M82 Armor-piercing-capped Round, and is used for the same purpose. The shot is a solid steel slug similar in contour to the body of the

M82 Projectile but lacking the armor-piercing cap and ballistic windshield of the standard projectile and without explosive. The base is drilled to provide a small cavity for holding a red tracer. The tracer is similar to that in the loaded and fuzed round and burns for approximately 3 seconds.

RA PD 80782

Figure 108 — SHOT, Fixed, A.P., M77, NH, w/TRACER, 90-mm Guns

DATA

Weight of complete round	42.04 lb	Radius of ogive	1.51 cal.
Length of complete round	32.75 in.	Muzzle velocity	2,700 ft per sec
Length of projectile	10.00 in.	Maximum range	12,790 yd
Length of cartridge case	23.70 in.	Penetration (in. at 0-deg obliquity of face-hardened plate at 1,000 yd)	4.5
Width of rotating band	1.20 in.		
Type of base	Square		

Penetration (in. at 0-deg obliquity of homogeneous plate at 1,000 yd) 5.5

RA PD 80781

Figure 109 — SHELL, Fixed, H.E., M71, w/FUZE, Time, Mechanical, M43 (All Modifications), 90-mm Guns

196. SHELL, FIXED, H.E., M71, W/FUZE, TIME, MECHANICAL, M43 (ALL MODIFICATIONS), 90-MM GUNS (fig. 109), consists of a hollowed steel casing containing a high-explosive filler and a booster, and fitted with a point fuze. The bursting charge cavity tapers in conical fashion over the lower half of the cavity and is hemispherical at the bottom. The result is a relatively small cavity, with comparatively thick walls, for a high-explosive shell. The base is boat-tailed and the nose formed to a long ogive, the sweep of which is continued by the contour of the fuze. When to be fired against aircraft, the projectile is fitted with the M43 Mechanical Time Fuze. This fuze gives selective time setting up to 30 seconds but has no impact element. To obtain the desired fragmentation and blast effect, the shell is loaded with TNT; an alternative high-explosive is 50-50

amatol. The high-explosive charge is shaped at the front end to provide for a booster well. When 50-50 amatol is used, an additional booster is provided by surrounding the booster well with TNT. BOOSTER, M20A1, is a manufacturing component of the shell, being inserted after loading and staked permanently in position.

DATA

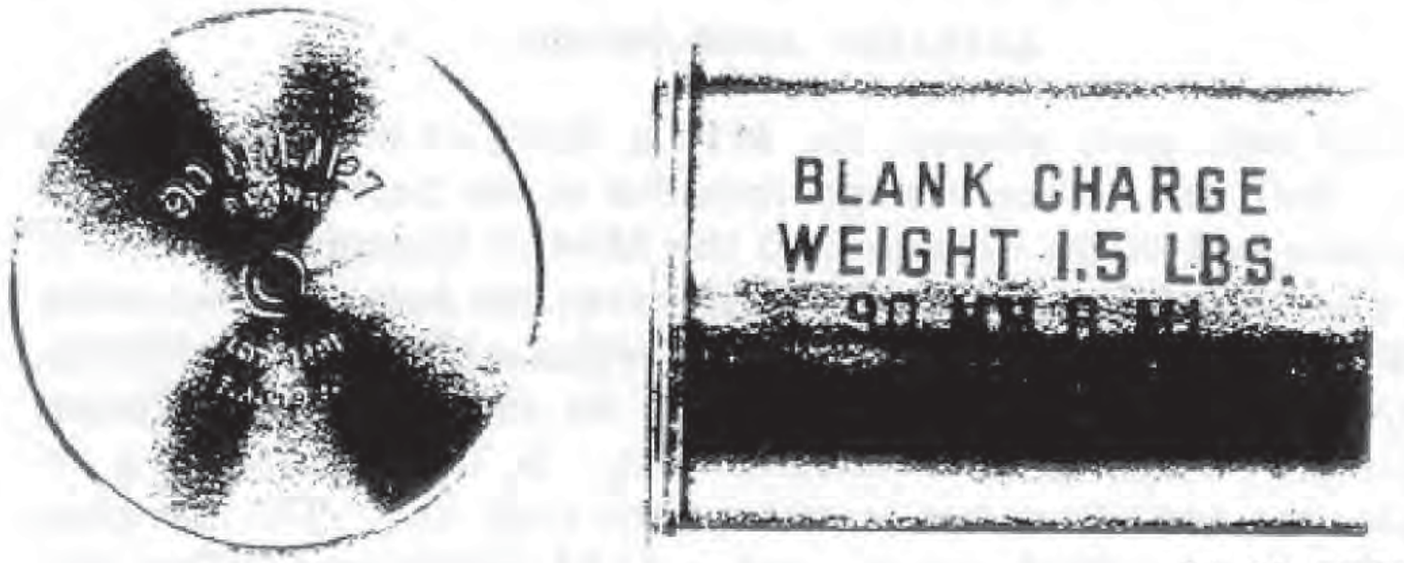
Weight of complete round	42.04 lb	Degree of taper	7 deg 15 min
Length of complete round	37.44 in.	Radius of ogive	9.01 cal.
Length of fuzed projectile	16.37 in.	Muzzle velocity	2,700 ft per sec
Length of cartridge case	23.70 in.	Maximum range (at 45 deg)	19,560 yd*†
Width of rotating band	1.20 in.		
Type of base	Boat-tailed		

*—Effective maximum range limited by fuze time limits to around 13,000 yards.
†—Range shown in horizontal range; maximum vertical height is about 12,000 yards.

197. SHELL, FIXED, H.E., M71, NH, W/FUZE, P.D., M48A2, SQ & 0.05-SEC. DELAY, 90-MM GUNS, has the same components as the round described in paragraph 196, except for the fuze. Since this round is intended for use against ground targets, the shell is fuzed with an impact type fuze, either **FUZE, P.D., M48A2, M48A1,** or M48. The M48A2 Fuze is manufactured with 0.05-second delay, the M48A1 with 0.15-second delay (although modified fuzes with 0.05-sec delay are in existence), and the M48 with 0.05-second delay. The short-delay models are prescribed for batteries firing against ground targets. As loaded with a 7.31-pound propelling charge of NH powder, the projectile has a muzzle velocity of 2,700 feet per second and a maximum range of approximately 19,500 yards (at approx 45 deg 45 min). Other data is the same as that given in paragraph 196 for the time-fuzed AA. round.

198. SHELL, FIXED, H.E., M71, NH, W/FUZE, P.D., M48A2, SQ & 0.15-SEC. DELAY, 90-MM GUNS, is exactly the same as the M71 Round described in paragraph 197 except for the delay element in the fuze. The data described in paragraphs 196 and 197 are applicable. This long-delay fuze (0.15-sec delay) is for use in rounds to be fired in anti-motor-torpedo-batteries.

199. SHELL, FIXED, PRACTICE, INERT LOADED, M71, NH, W/FUZE, DUMMY OR INERT, M _, 90-MM GUNS, is provided for training in marksmanship in anti-motor-torpedo-boat firing. It differs from the M71 Service Round in that the shell is loaded with inert material and fuzed with an inert service M48A1 Fuze or **FUZE,** dummy, M73. Data for the practice round is the same as that for the M71 Round given in paragraphs 197 and 196.



RA PD 80783

Figure 110 — AMMUNITION, Blank, 90-mm Guns

200. AMMUNITION, BLANK, 90-MM GUNS (fig. 110), consists of the M27 or M27B1 (steel) Cartridge Case, similar to a service case but shortened to 7.25 inches; a 100-grain M1B1A2 Primer or alternative PRIMER, percussion, 100-grain, M1A2; and a 1.5-pound charge of black powder (sodium nitrate). The round is constructed like other standard types of blank ammunition, the blank charge being held in a cotton bag which is so loaded into the cartridge case as to surround the primer. The charge is held firmly in position at the base of the case by a closing cup assembly. For 90-mm blank ammunition, the closing cup assembly consists of two pulpboard disks glued one to each surface of a felt disk or wad. The assembly is inserted into the case and glued securely in position about 2.42 inches from the mouth of the case. Weight of complete round is 8.23 pounds and length is 7.27 inches.

RA PD 80784

Figure 111 — CARTRIDGE, Drill, M12, w/FUZE, Dummy, M44A2, 90-mm Guns

201. CARTRIDGE, DRILL, M12, W/FUZE, DUMMY, M44A2, 90-MM GUNS (fig. 111), may be stamped either M12 or M12B1. Both are functionally alike and completely inert. However, the M12B1, which is being manufactured at present, is made of malleable

iron and steel parts whereas the M12 is made of bronze and brass parts. Both are 1-piece castings threaded at the base to receive the base plate and at the nose to hold the M44A2 Dummy Fuze. The base plate is held in position by a set screw; the fuze, by a set screw and shoe arrangement. Both parts are replaceable. FUZE, dummy, M44A2, used with this cartridge, may be made of bronze, brass, aluminum, copper alloy or sintered iron. In form, the casting resembles the M43 Fuze but is without the time ring. The complete assembly weighs 39.15 pounds, and is 37.44 inches long. This drill cartridge is not used in the 90-mm M2 Gun which has a power-operated rammer.

Section XVIII

AMMUNITION FOR 155-MM GUNS

260. GENERAL.

a. The 155-mm Guns M1917-17A1-18MI, M1, and M1A1, being chambered alike, fire the same projectiles. The projectiles for these guns are of two general design types, those of earlier design distinguished by two narrow rotating bands, each approximately 0.6 inch wide, and those of current design which have a broad rotating band approximately 2 inches wide. Only those of current design are authorized for use in the 155-mm Guns M1 and M1A1. However, there are certain cases of emergency interchangeability, which may be followed only in accordance with specific regulations permitting same. Although projectiles for the 155-mm guns and the 155-mm howitzers are of the same size and shape, they are readily distinguished by the marking as well as by the rotating bands. The howitzer projectiles have rotating bands 0.6 inch or 1.02 inches wide; the gun projectiles have two bands, 0.6 inch wide, or one band 2 inches wide.

b. Identification. The ammunition, including components, for the 155-mm guns, is completely identified by the painting and marking on the items themselves.

c. **Fuzes.** See chapter 3, section I.

d. **Propelling Charges.** The propelling charge for the 155-mm Guns M1 and M1A1 is of the base and increment type, approximately 6½ inches in diameter. This charge should not be confused with the 155-mm gun Propelling Charge M1917-17A1-18MI, which is of approximately the same over-all length, but somewhat smaller in diameter (approx 5¾ in.). The FLASH REDUCER, M1, is for use with the propelling charges for 155-mm guns. It greatly reduces the flash and is primarily intended for night firing (ch. 3, sec. II).

e. **Primers.** See chapter 3, section III.

f. **Interchangeability.**

(1) The H.E. M101 and H.E. Mk. IIIA1 Shell are authorized for emergency use in the 155-mm Guns M1 and M1A1 with the propelling charge intended for the M1917-17A1-18MI Guns (full charge only).

(2) The H.E. Mk. IIIA1 Shell is authorized for emergency use in the 155-mm Guns M1 and M1A1 with the propelling charge standard for these weapons (base section only, or in case of extreme emergency, the full charge).

ARTILLERY AMMUNITION

261. COMPLETE ROUND TABLE.

a. Data concerning complete rounds for 155-mm Guns M1917-17A1, 18MI, M1, and M1A1, are given in table 24, chapter 5.

262. PACKING AND SHIPPING DATA.

a. Packing and shipping data concerning 155-mm gun rounds are given in ORD 11 SNL's P-1, P-2, and P-8.

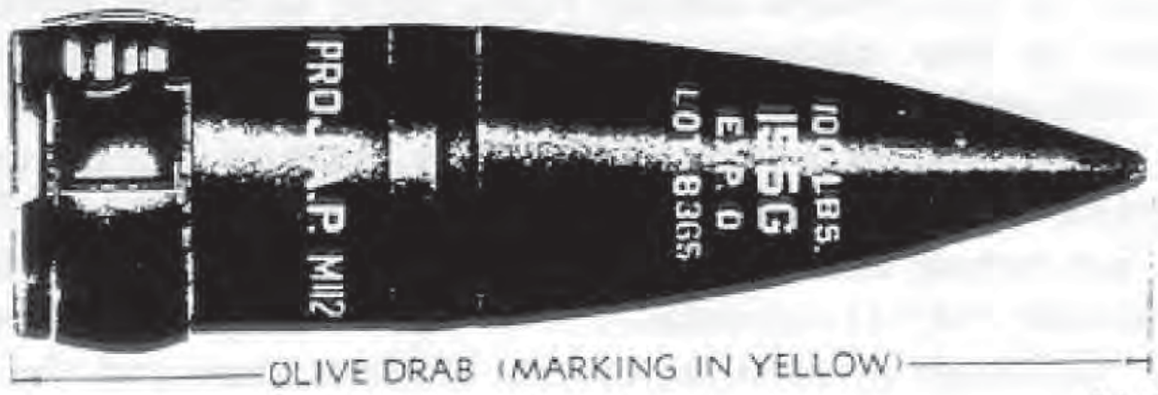


Figure 134 — PROJECTILE, A.P., 100-lb., M112, w/FUZE, B.D., M60, 155-mm Guns, M1917-17A1-18MI, M1, and M1A1

263. PROJECTILE, A.P., 100-LB., M112, W/FUZE, B.D., M60, 155-MM GUNS, M1917-17A1-18MI, M1, AND M1A1 (fig. 134), is intended for use against armored targets, concrete emplacements, and similar targets. It consists of a hardened steel body which contains a cavity in the base filled with explosive D, a base-detonating fuze with delay action, and a ballistic cap or windshield. A base cover is fitted over the fuze in the base of the projectile.

DATA

Length of projectile	23.62 in.
Width of rotating band	2.00 in.
Type of base	Square
Radius of ogive	10.70 cal.
Muzzle velocity (supercharge)	2,740*; 2,360 ft per sec†
Maximum range, supercharge	24,075*; 19,200 yd†
Penetration (in. at 0-deg obliquity of homogeneous plate at 1,000 yd)	7.5*
Penetration (in. of reinforced concrete at 1,000 yd)	60

*—In M1 and M1A1 Guns.
†—In M1917-17A1-18 MI Guns.

264. SHELL, H.E., M101, UNFUZED, 155-MM GUNS, M1917-17A1-18MI, M1, AND M1A1 (fig. 135), was developed from the Mk. IIIA1 Shell described in paragraph 265, differing chiefly in that it has a single wide rotating band, and the angle of taper of the boat-tailed base is 0.5 degree greater. The rear of the rotating band is located approximately 3.48 inches forward of the base. The shell is adapted for either the P.D. M51 Fuze and modifications, or the M67 Mechanical Time Fuze and modifications.

RA PD 80812

Figure 135 — SHELL, H.E., M1C1, Unfuzed, 155-mm Guns, M1917-17A1-18MI, M1, and M1A1 (Early Type Grommet Fastening Shown)

DATA

Length of projectile*..... 26.88 in.
Width of rotating band..... 2.00 in.
Type of base ..... Boat-tailed
Degree of taper..... 8.5 deg
Radius of ogive..... 10.75 cal.
Muzzle velocity:
Maximum charge, M1 and M1A1 Guns ..... 2,800 ft per sec
Maximum charge, M1917-17A1-18 Guns .... 2,410 ft per sec
Maximum range:
M1A1 Gun (at 46 deg 49 min) ..... 25,715 yd
M1917-17A1-18 Guns (at 35 deg 24 min)..... 20,100 yd

*—With eyebolt-lifting plug.

RA PD 80813

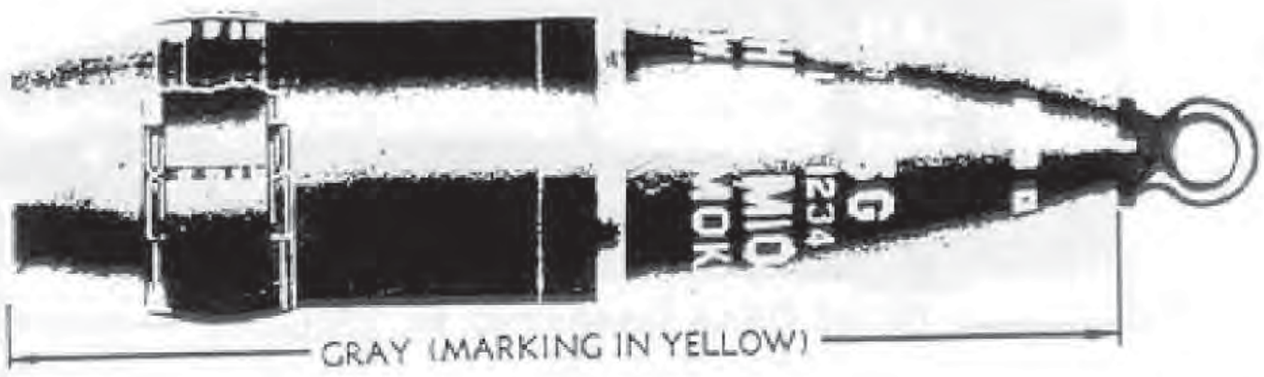
Figure 136 — SHELL, H.E., Mk. IIIA1, Unfuzed, 155-mm Guns, M1917-17A1-18MI

265. SHELL, H.E., MK. IIIA1, UNFUZED, 155-MM GUNS, M1917-17A1-18MI (fig. 136), being of earlier design than projectiles for 155-mm Guns M1 and M1A1, is distinguished by two narrow rotating bands. It is a modification of the earlier Mk. III Projectile, the nose being adapted to the new type fuzes. This modification of ogive and use of a standard contour fuze improve the ballistic characteristics.

DATA

Length of projectile*..... 26.88 in.
Width of rotating bands (two each) ..... 0.59 in.
Type of base.....8 deg —boat-tailed
Radius of ogive ..... 10.75 cal.
Muzzle velocity, supercharge ..... 2,410*; 2,800 ft per sec††
Maximum range, supercharge:
(35 deg 22 min)..... 19,100 yd†
(35 deg) ..... 22,450 yd††

*—With eyebolt-lifting plug. †—In M1917-17A1-18MI Guns. ††—In M1 and M1A1 Guns.



RA PD 80817

Figure 137 — SHELL, Smoke, Phosphorus, WP, M104, Unfuzed, 155-mm Guns, M1917-17A1-18MI, M1, and M1A1 (Early Type Grommet Shown)

266. SHELL, M104, GAS AND SMOKE, have the same contour as the H.E. M101 Shell described in paragraph 264. The M104 WP Phosphorus Smoke Shell is shown in figure 137. The explosive charge of the burster which is contained in a cardboard or thin aluminum casing, is held in place in the casing by the fuze well cup. One end of the burster casing is fastened to an adapter in the nose cavity. The shell is adapted for the P.D. M51 Fuze and modifications. The various types of gas and smoke shell using the M104 body and burster are:

SHELL, gas, persistent, H, M104, unfuzed, 155-mm guns, M1917-17A1-18MI, M1, and M1A1

SHELL, smoke, FS, H104, unfuzed, 155-mm guns, M1917-17A1-18MI, and M1A1

SHELL, smoke, phosphorus, WP, M104, unfuzed, 155-mm guns, M1917-17A1-18MI, M1, and M1A1

DATA

Length of projectile*.....	26.78 in.
Width of rotating band.....	2.00 in.
Type of base.....	Boat-tailed
Degree of taper.....	8.5 deg
Radius of ogive.....	10.75 cal.
Muzzle velocity, supercharge:	2,410†; 2,800 feet per sec††
Maximum range, supercharge:	
(at 35 deg 15 min).....	20,247 yd†
(at 46 deg 45 min).....	25,940 yd††

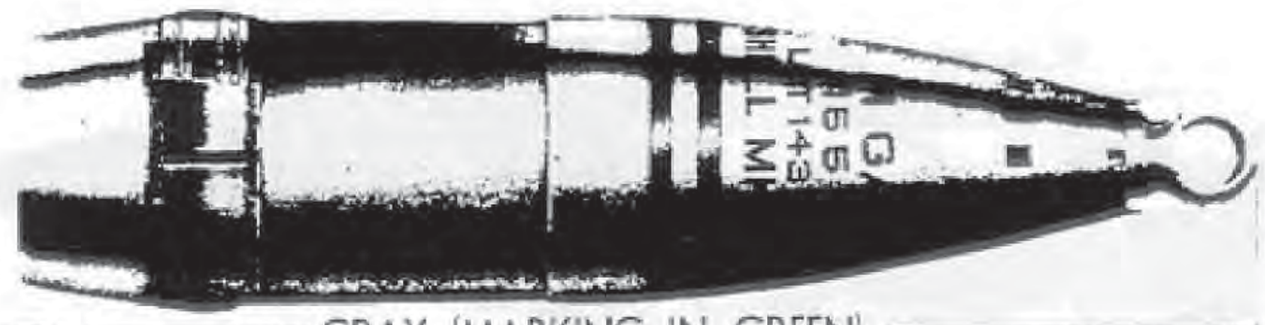
*—With eyebolt-lifting plug. †—In M1917-17A1-18MI Guns. ††—In M1 and M1A1 Guns.

267. SHELL, MK. VIIA1, GAS AND SMOKE, are modifications of the Mk. VII Shell described in paragraph 268, the adapter being changed to take the P.D. M51 Fuze, or modifications. The Mk. VIIA1 H Gas Shell is shown in figure 138. The various types of gas and smoke shell using the Mk. VIIA1 Shell body are:

SHELL, gas, persistent, H, Mk. VIIA1, unfuzed, 155-mm guns, M1917-17A1-18MI

SHELL, smoke, FS, Mk. VIIA1, unfuzed, 155-mm guns, M1917-17A1-18MI

SHELL, smoke, phosphorus, WP, Mk. VIIA1, unfuzed, 155-mm guns, M1917-17A1-18MI



RA PD 80816

Figure 138 — SHELL, Gas, Persistent, H, Mk. VIIA1, Unfuzed, 155-mm Guns, M1917-17A1-18MI (Early Type Grommet Fastening Shown)

DATA

Length of projectile*	26.82 in.	Degree of taper	8 deg
Width of rotating band (two each)	0.59 in.	Radius of ogive	10.75 cal.
Type of base	Boat-tailed	Muzzle velocity, supercharge	2,385 ft per sec
Maximum range, supercharge (at 34 deg 15 min)			20,247 yd

*—With eyebolt-lifting plug.

268. SHELL, MK. VII, GAS AND SMOKE, are adapted for the P.D. M46 Fuze. They have tapered or pipe threads, and do not have a base cover. The adapter-booster is tightly screwed into place, forming a gastight seal for the filler. The two types of gas and smoke shell using the Mk. VII Shell body are:

SHELL, gas, persistent, H, Mk. VII, unfuzed, 155-mm guns, M1917-17A1-18MI

SHELL, smoke, phosphorus, WP, Mk. VII, unfuzed, 155-mm guns, M1917-17A1-18MI

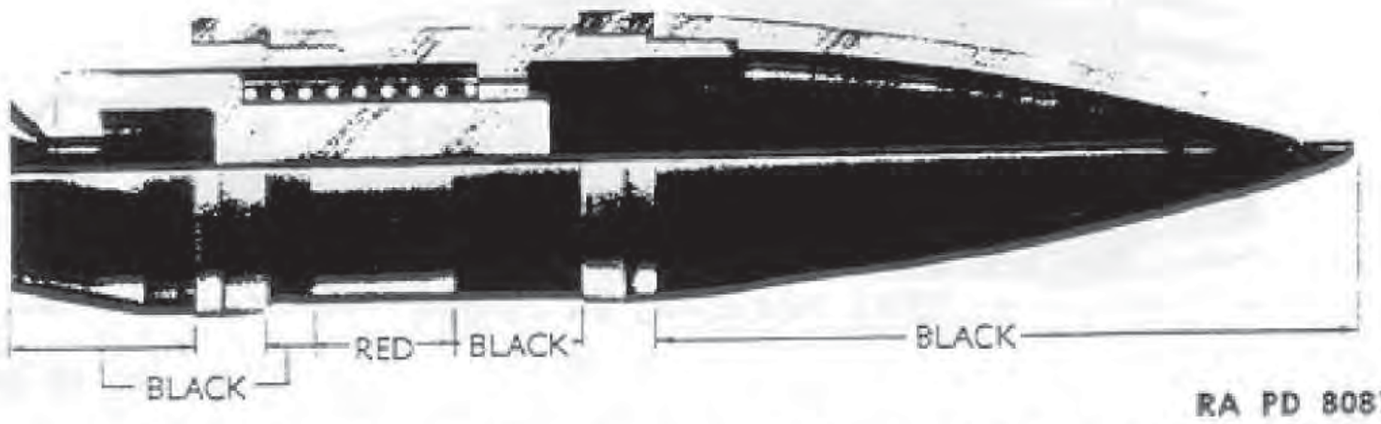
DATA

Length of projectile*	26.82 in.	Radius of ogive	10.75 cal.
Width of rotating band	2.00 in.	Muzzle velocity, supercharge	2,410 ft per sec
Type of base	Boat-tailed	Maximum range	17,900 yd
Degree of taper	8 deg		

*—With eyebolt-lifting plug.

269. SHELL, TARGET-PRACTICE, FOR SAND LOADING, UNFUZED, 155-MM GUNS, M1917-17A1-18MI, M1, AND M1A1, consists of a M101 Shell body, inert adapter-booster, and inert fuze. Shell is shipped empty and sand-loaded to weight at point of use.

270. PROJECTILE, DUMMY, 95-LB., MK. I, 155-MM GUNS, is provided for training in the service of the 155-mm howitzer as well as the gun. However, when used with the gun, the projectile is fitted with a rotating band having a maximum diameter of 6.5 inches; when used with the howitzer the band has a diameter of 6.1 inches. For further details, see paragraph 258 and figure 133.



RA PD 80818

Figure 139 — PROJECTILE, Dummy, 95-lb., M7, 155-mm Gun or How.

271. **PROJECTILE, DUMMY, 95-LB., M7, 155-MM GUN OR HOW.** (fig. 139), is intended for practice in loading and handling of the 155-mm howitzer, as well as the gun. It is of the type having a fully enclosed spring-cushioned plunger, which kicks the projectile loose from the forcing cone of the gun on the rebound upon ramming. It has a malleable iron cap, steel body, bronze front band, steel base, and bronze rear band. The bronze front band simulates the bourrelet of a service projectile. The bronze rear band simulates the rotating band of a service projectile. The several parts are replaceable. The projectile is 27.56 inches long.

Section XX

AMMUNITION FOR 8-INCH GUNS

280. GENERAL.

a. The 8-inch Field Gun M1 is a long-barrelled weapon. It is manually operated and uses separate-loading ammunition. The projectiles authorized for use in this weapon comprise a high-explosive type fitted with a point-detonating fuze, and a dummy type used for training in service of the piece. Rounds for the 8-inch Seacoast Guns, M1888-88MI-88MII, and Mk. VI-Mod. 3A2 (Navy) only, are not discussed in this manual (TM 4-205, Coast Artillery Ammunition).

b. **Identification.** The ammunition, including components, is completely identified by means of the painting and marking on the items themselves.

c. **Fuzes.** See chapter 3, section I.

d. **Propelling Charges.** See chapter 3, section II.

e. **Primers.** See chapter 3, section III.

281. COMPLETE ROUND TABLE.

a. Data concerning 8-inch complete rounds and components therefor are given in table 26, chapter 5.

282. PACKING AND SHIPPING DATA.

a. Data concerning 8-inch rounds are given in ORD 11 SNL's P-1, P-2, and P-8.

283. SHELL, H.E., 240-LB., M103, W/FUZE, P.D., M51A1-MOD. 3, W/BOOSTER, M20A1, OR M51A3-MOD. 3, W/BOOSTER, M21A2, 8" GUNS, MK. VI-MOD. 3A2 (NAVY), MK. IX-MOD. 2 (NAVY), AND M1

(fig. 143), is fitted with a false ogive (windshield). The shell has two bourrelets of 7.990 inches diameter; one (front bourrelet) is just to the rear of the windshield; the other (rear bourrelet) is at the rear of the projectile body. The rotating band, 3.3 inches wide, is located approximately 6 inches forward of the base and within the rear bourrelet. This shell contains a filler of 21 pounds of TNT. A base cover is calked or welded to the base of the shell. The FUZE, time, mechanical, M67, and modifications, is authorized for use with this shell when fired from the 8-inch Gun M1 and is assembled in place of the M51A1 Mod. 3, or M51A3-Mod. 3 Fuze, at point of use.

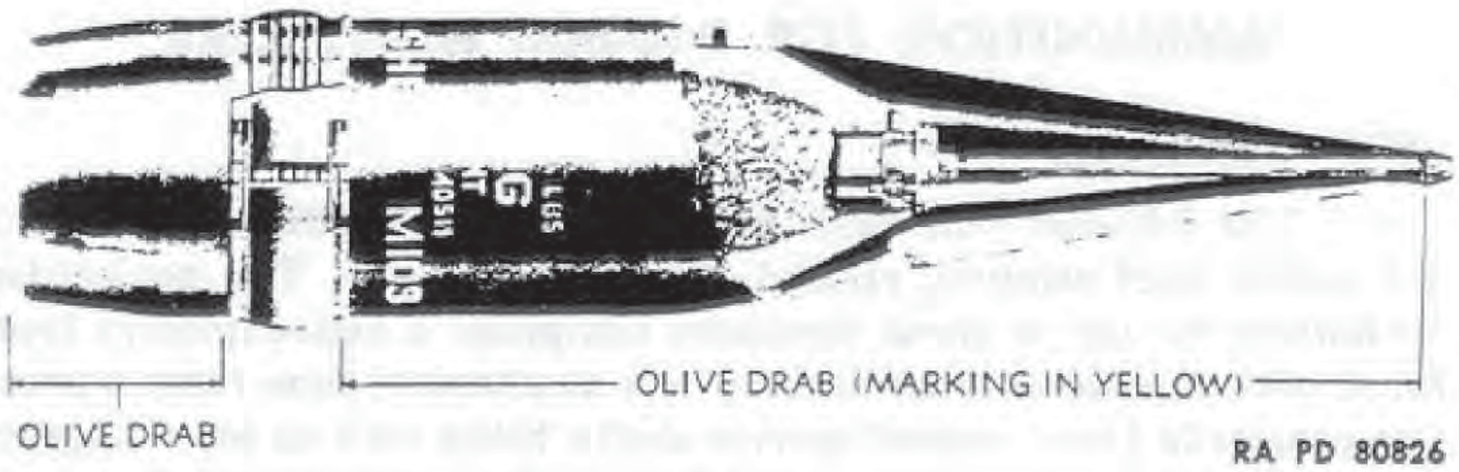


Figure 143 — SHELL, H.E., 240-lb., M103, w/FUZE, P.D., M51A1-Mod. 3, w/BOOSTER, M20A1, or M51A3-Mod. 3, w/BOOSTER, M21A2, 8" Guns, Mk. VI-Mod. 3A2 (Navy), Mk. IX-Mod. 2 (Navy), and M1

DATA

Length of projectile ..... 40.95 in.	Ogive ..... Conical
Width of rotating band ..... 3.31 in.	Muzzle velocity (supercharge) ..... 2,850 ft per sec
Type of base ..... Boat-tailed	Maximum range ..... 35,635 yd
Degree of taper ..... 6 deg	

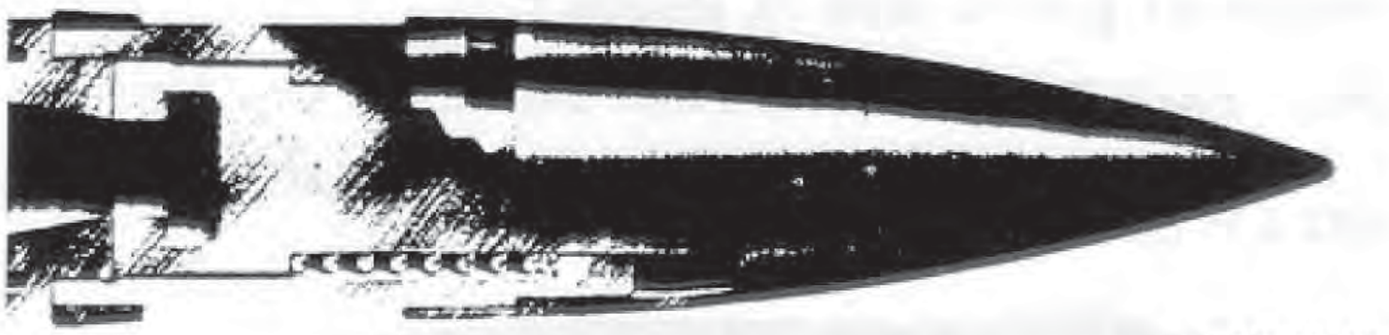
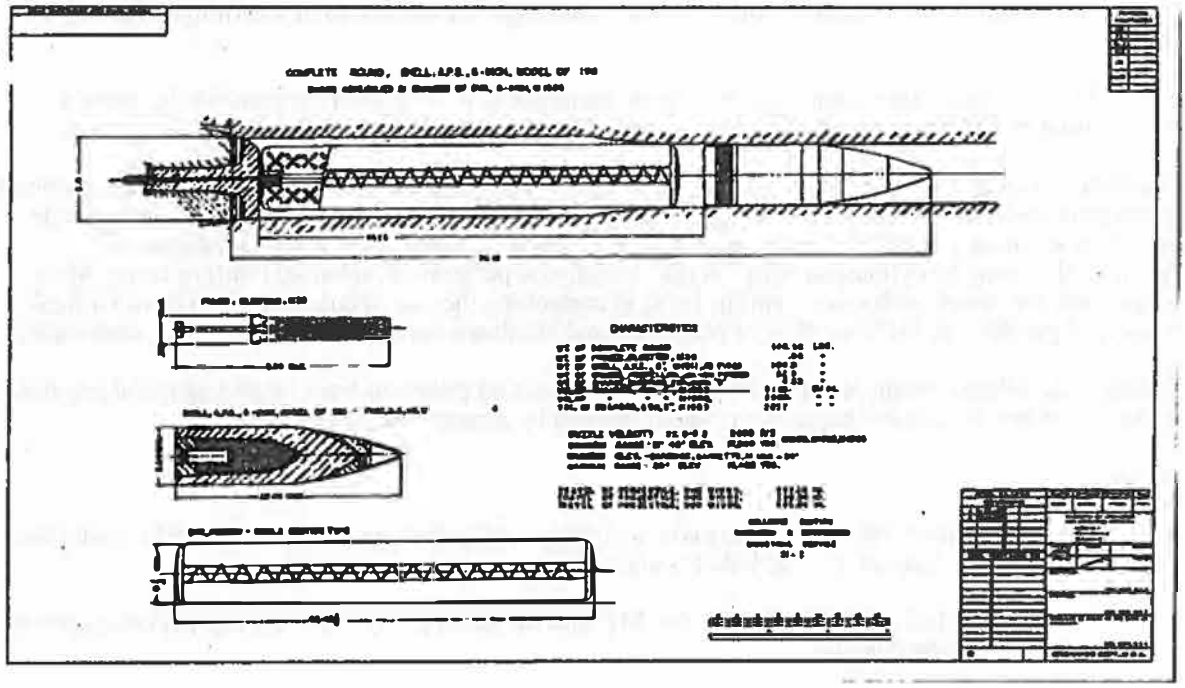


Figure 144 — PROJECTILE, Dummy, 240-lb., M13, 8" Gun

284. PROJECTILE, DUMMY, 240-LB., M13, 8" GUN, M1 (fig. 144) simulates the H.E. Shell, M103 described in paragraph 283, and is intended for training in service of the piece. It is 35.90 inches long and is of the type having a fully enclosed spring-cushioned plunger, which loosens the projectile in the forcing cone of the gun on rebound resulting from ramming. It has a malleable iron cap, steel body, bronze front band, steel base, and bronze rear band. The iron cap is ogival in shape and is attached to the forward end of the body. The bronze front band simulates the bourrelet of a service projectile. The bronze rear band simulates the rotating band of the service projectile. The several parts are replaceable.

COMPLETE ROUND, AP, 6-INCH, Model 1911



Use: This is the armor piercing used with the 6-inch Coast Artillery.

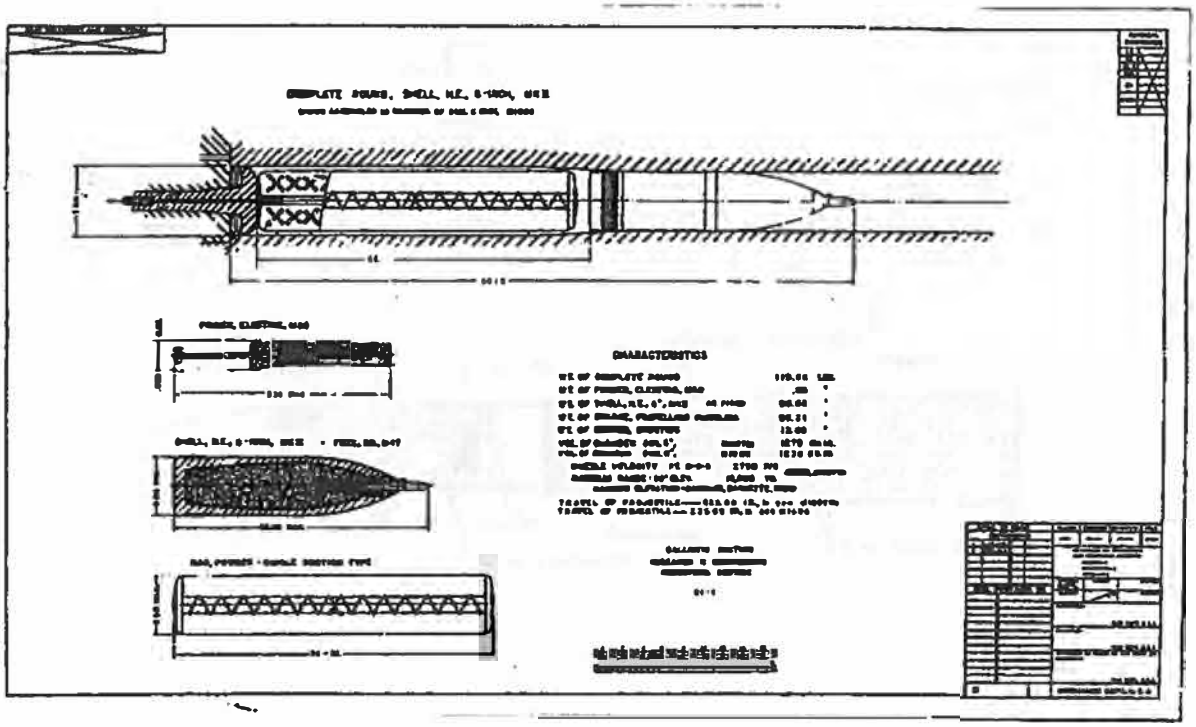
Description: The MK II is a separate loaded, armor piercing munitions which is used by the Coast Artillery against ship targets. A single rotating band is located near the base of the projectile.

Weight of Projectile as fired..... 140.55 pounds
Length of Projectile w/fuze ..... 22.65 inches
Filler and Weight ..... 4.53 lbs, Explosive D
Fuzes..... Base Detonating
Propelling charges..... 32.5 lbs
Color ..... Unknown

Reference: Complete Round Charts and Drawings, 1945

Source: *ARCHIVES SEARCH REPORT – FINDINGS*
Fort Learnard
Eider Point, AK

COMPLETE ROUND, HE, 6-INCH, MK II



Use: This is the high explosive round used with the 6-inch Coast Artillery.

Description: The MK II is a separate loaded, high explosive (or common) munitions which is used by the Coast Artillery against ship targets. A single rotating band is located near the base of the projectile.

Weight of Projectile as fired..... 119.96 pounds
Length of Projectile w/fuze ..... 25.6 inches
Filler and Weight ..... 13.69 lbs, TNT
Fuzes..... PD
Propelling charges..... 29.3 lbs
Color ..... Unknown

Reference: Complete Round Charts and Drawings, 1945

Source: *ARCHIVES SEARCH REPORT – FINDINGS*
Fort Learnard
Eider Point, AK

Section XXII

AMMUNITION FOR SUBCALIBER WEAPONS

294. GENERAL.

a. Subcaliber ammunition is intended for use in subcaliber guns for training personnel in target practice. For small caliber weapons, interior type subcaliber guns are provided which fire small-arms ammunition, such as cal. .22 and cal. .30 cartridges. Cal. .30 and cal. .50 cartridges are also used in machine guns on exterior subcaliber mounts on the 37-mm Antiaircraft Gun M1A2, and on medium caliber antitank weapons. For the remaining medium and heavy weapons, the 37-mm Subcaliber Guns M12, M13, M14, and M1916 and modifications are used on appropriate subcaliber mounts. See table 2 for a list of weapons and their subcaliber weapons and ammunition. This section deals primarily with ammunition for the 37-mm Subcaliber Guns M12, M13, M14, and M1916. Also described in this section is the Field Artillery Trainer M3, which, although not subcaliber equipment, simulates field artillery firings.

b. **Identification.** The 37-mm subcaliber rounds are completely identified by means of the painting and marking on the items themselves.

c. **Fuzes.** See chapter 3, section I.

d. **Cartridge Cases.** The standard 37-mm cartridge case for ammunition used in 37-mm Subcaliber Gun M1916 is the Mk. IA2. The Mk. IA2B1 Case is a steel case alternate and is 0.02 pound lighter than the Mk. IA2 Case, which is made of drawn brass.

e. **Primers.** See chapter 3, section III.

295. COMPLETE ROUND TABLE.

a. Data concerning the 37-mm subcaliber rounds are given in table 28, chapter 5.

296. PACKING AND SHIPPING DATA.

a. Data concerning the 37-mm subcaliber rounds are given in ORD 11 SNL R-1.

FIXED AND SEMIFIXED ROUNDS AND SEPARATE-LOADING PROJECTILES

TABLE 2
SUBCALIBER MATERIEL AND AMMUNITION

Weapon and Mount	Subcaliber Weapon and Mount	Subcaliber Ammunition
37-mm guns, M3, M3A1, on CARRIAGE, gun, 37-mm, M4 CARRIAGE, gun, 37-mm, M4A1 CARRIAGE, motor, 37-mm gun, M6 57-mm gun M1, on CARRIAGE, gun, 57-mm, M1A3	RIFLE, subcaliber, cal. .22, M2A1 MOUNT, subcaliber, cal. .22-.30, M6* MOUNT, subcaliber, cal. .22-.30, M7* MOUNT, subcaliber, cal. .22-.30, M7A1* MOUNT, subcaliber, cal. .22-.30, M14*	CARTRIDGE, ball, cal. .22, long rifle
37-mm gun, M6, in light, medium, and heavy tanks	RIFLE, subcaliber, cal. .22, M5 MOUNT, subcaliber*	
37-mm guns, M3, M3A1, on CARRIAGE, gun, 37-mm, M4 CARRIAGE, gun, 37-mm, M4A1 CARRIAGE, motor, 37-mm gun, M6 57-mm gun, M1, on CARRIAGE, 57-mm, M1A3	RIFLE, subcaliber, cal. .30, M1903A2 MOUNT, subcaliber, cal. .22-.30, M6 MOUNT, subcaliber, cal. .22-.30, M7* MOUNT, subcaliber, cal. .22-.30, M7A1* MOUNT, subcaliber, cal. .22-.30, M14*	CARTRIDGE, ball, cal. .30, M2 CARTRIDGE, ball, cal. .30, M1
37-mm auto. gun, M1A2, on CARRIAGE, automatic, 37-mm, M3	GUN, machine, cal. .30, Browning, M1917A1 MOUNT, subcaliber, cal. .30, M8†	
76-mm gun, M1, M1A1, M1A2, on CARRIAGE, motor, 76-mm gun, M18 3-inch gun, M7, on CARRIAGE, motor, 3-inch gun, M10, M10A1 3-inch gun, M5, on CARRIAGE, gun, 3-inch, M1	GUN, machine, cal. .50, Browning, M2, HB (flexible) MOUNT, subcaliber, cal. .50, M10† MOUNT, subcaliber, cal. .50, M9† MOUNT, subcaliber, cal. .50, M12†	CARTRIDGE, ball, cal. .50, M2

ARTILLERY AMMUNITION

Weapon and Mount	Subcaliber Weapon and Mount	Subcaliber Ammunition
75-mm gun, M1917, on CARRIAGE, gun, 75-mm, M1917A1	GUN, subcaliber, 37-mm, M1916A1 MOUNT, subcaliber (interior type)*	SHELL, fixed, practice, M92, w/ FUZE, P.D., M74, 37-mm sub-caliber guns, M12, M13, M14, and M1916†† SHELL, fixed, practice, M63-Mod. 1, w/FUZE, base, practice, M58, 37-mm subcaliber guns, M12, M13, M14, and M1916†† SHELL, fixed, practice, Mk. IIA1, w/FUZE, base, practice, M38, 37-mm subcaliber gun, M1916†† §
75-mm gun, M1897, on CARRIAGE, gun, 75-mm, M1897MIA2, M1897A4 CARRIAGE, gun, 75-mm, M2, M2A1, M2A2, M2A3 ..... CARRIAGE, gun, 75-mm, M1897MI, M1897A4 .... 75-mm gun, M1916, on CARRIAGE, gun, 75-mm, M1916A1 ..... 75-mm how., M1, M1A1, on CARRIAGE, how., 75-mm, M1, M2A1, M3, M3A2, M3A3 ..... 105-mm how., M2, M2A1, on CARRIAGE, how., 105-mm, M2, M2A1, M2A2, and CARRIAGE, motor, 105-mm how., M7.... 4.5-inch gun, M1, on CARRIAGE, gun, 4.5-inch, M1 ..... 155-mm how., M1, on CARRIAGE, how., 155-mm, M1 ..... 155-mm how., M1917-17A1-18, on CARRIAGE, how., 155-mm, M1917A4 or M1918A3 ..... 155-mm gun, M1917-17A1-18MI, on CARRIAGE, gun, 155-mm, M1917-17A1-M1918-18A1, M2, M3.... 155-mm gun, M1, M1A1, on CARRIAGE, gun, 155-mm, M1 ..... 8-inch how., M1, on CARRIAGE, how., 8-inch, M1	GUN, 37-mm, M1916 MOUNT, subcaliber, 37-mm, M2† MOUNT, subcaliber, 37-mm, M7† MOUNT, subcaliber, 37-mm, M8† MOUNT, subcaliber, 37-mm, M9† MOUNT, subcaliber, 37-mm, M5† MOUNT, subcaliber, 37-mm, M16† MOUNT, subcaliber, 37-mm, M13A1† MOUNT, subcaliber, 37-mm, M13A1† MOUNT, subcaliber, 37-mm, M4† MOUNT, subcaliber, 37-mm, M1† MOUNT, subcaliber, 37-mm, M10† MOUNT, subcaliber, 37-mm, M10†	

FIXED AND SEMIFIXED ROUNDS AND SEPARATE-LOADING PROJECTILES

Weapon and Mount	Subcaliber Weapon and Mount	Subcaliber Ammunition
75-mm how., M1, M1A1, on CARRIAGE, how., 75-mm, M1A1 75-mm how., M2 and M3, on CARRIAGE, motor, 75-mm how., M8	GUN, subcaliber, 37-mm, M12*	SHELL, fixed, practice, M92, w/FUZE, P.D., M74, 37-mm subcaliber guns, M12, M13, M14, and M1916†† SHELL, fixed, practice, M63-Mod. 1, w/FUZE, base, practice, M58, 37-mm subcaliber guns, M12, M13, M14, and M1916††
105-mm how., M2, M2A1, on CARRIAGE, how., 105-mm, M2A2 105-mm, how., M3, on CARRIAGE, how., 105-mm, M3, M3A1 105-mm how., M4, on CARRIAGE, motor, 105-mm how., T76, M7 medium tanks, M4, M4A3	GUN, subcaliber, 37-mm, M13*	
90-mm gun, M1, on CARRIAGE, gun, 90-mm, M3	GUN, subcaliber, 37-mm, M14*	
76-mm gun, M1A1, M1A2, on CARRIAGE, motor, 76-mm gun, M18	GUN, subcaliber, 37-mm, T34*	SHELL, fixed, practice, Mk. IIA1, w/FUZE, base, practice, M38, 37-mm subcaliber gun, M1916†† §
3-inch gun, M5, on CARRIAGE, gun, 3-inch, M1, M1A1, M6	GUN, subcaliber, 37-mm, T36*	

*—Interior mount. †—Exterior mount. ††—Also assembled with "steel case".
§—This round is not to be fired over the heads of troops, and no personnel in the vicinity of the gun are to be forward of a line perpendicular to the muzzle.

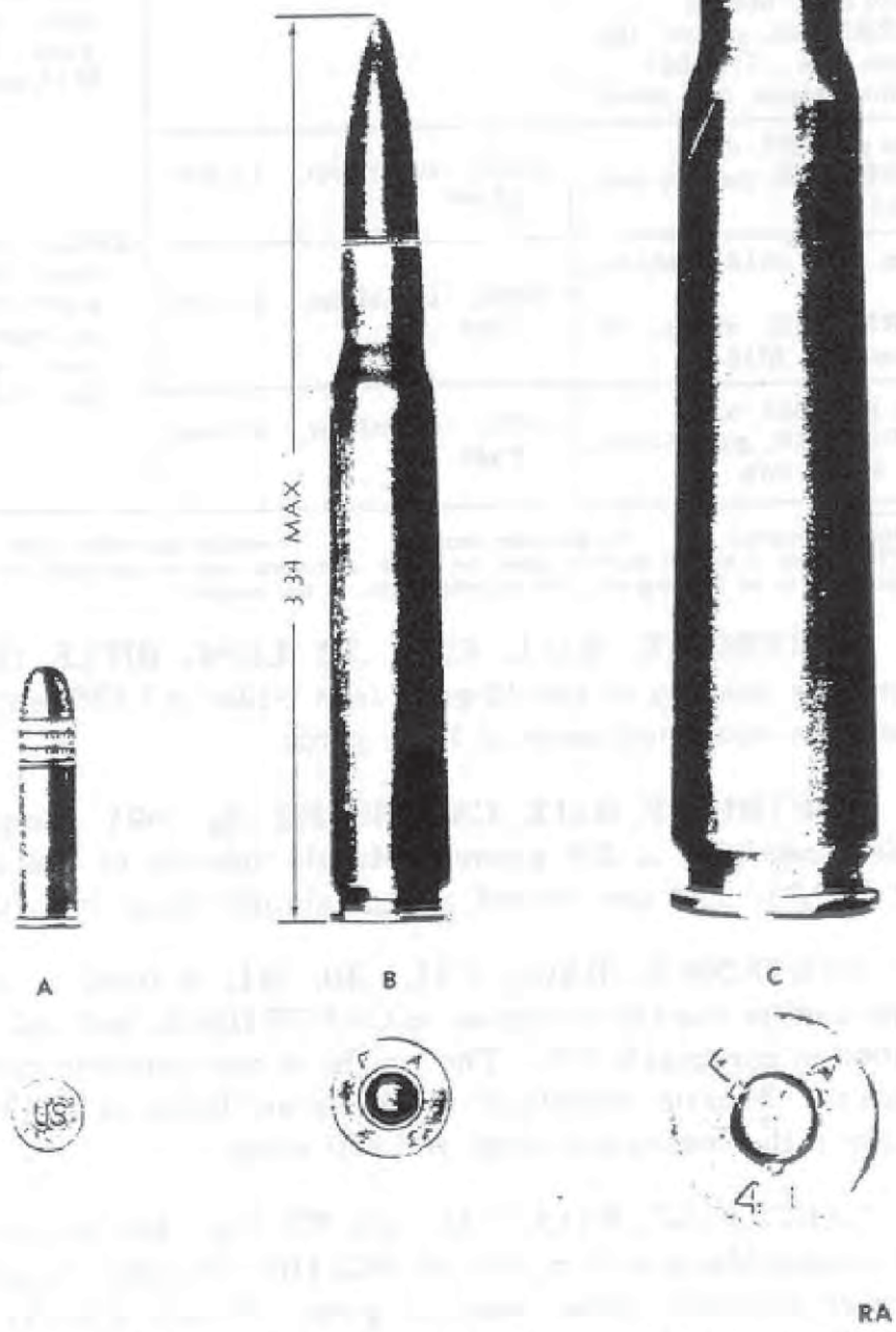
297. CARTRIDGE, BALL, CAL. .22, LONG RIFLE (fig. 149). The muzzle velocity of the 40-grain lead bullet is 1,130 feet per second and the maximum range is 1,350 yards.

298. CARTRIDGE, BALL, CAL. .30, M2 (fig. 149). Weight of the complete cartridge is 396 grains. Muzzle velocity of the 150-grain bullet is 2,760 feet per second and maximum range is 4,700 yards.

299. CARTRIDGE, BALL, CAL. .30, M1, is used in the same weapon and for the same purpose as CARTRIDGE, ball, cal. .30, M2, described in paragraph 298. The weight of the complete cartridge is 420 grains. Muzzle velocity of the 174-grain bullet is 2,647 feet per second and the maximum range is 4,950 yards.

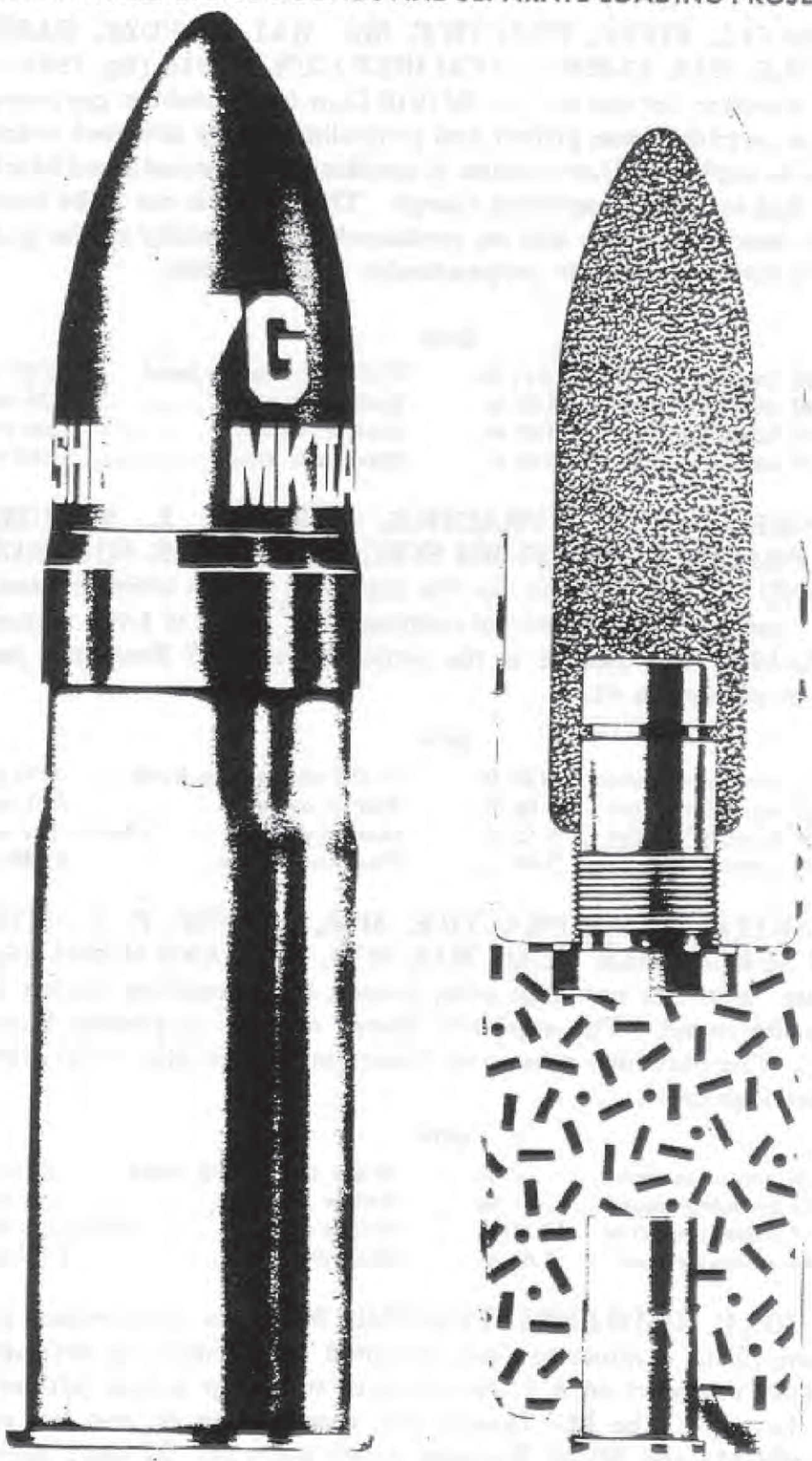
300. CARTRIDGE, BALL, CAL. .50, M2 (fig. 149), is for use with the Browning Machine Gun, cal. .50, M2, HB (flexible), on subcaliber mounts on medium caliber antitank guns. Muzzle velocity of 698-grain bullet is 2,935 feet per second in a 45-inch barrel, and maximum range is 7,600 yards.

A — CARTRIDGE, BALL, CAL. .22, LONG RIFLE
B — CARTRIDGE, BALL, CAL. .30, M2
C — CARTRIDGE, BALL, CAL. .50, M2



RA PD 80834

Figure 149 — Cal. .22, cal. .30, and cal. .50 Subcaliber Ammunition



RA PD 80700

Figure 150 — SHELL, Fixed, Practice, Mk. IIA1, w/FUZE, Base, Practice, M38, 37-mm Subcaliber Gun, M1916

ARTILLERY AMMUNITION

301. SHELL, FIXED, PRACTICE, MK. IIA1, W/FUZE, BASE, PRACTICE, M38, 37-MM SUBCALIBER GUN, M1916 (fig. 150), is limited standard for use only in M1916 Gun for subcaliber purposes. A service cartridge case, primer and propelling charge are used in the round. The explosive filler consists of graphite (15 percent) and black powder and serves as a spotting charge. This round is not to be fired over the heads of troops, and no personnel in the vicinity of the gun are to be forward of a line perpendicular to the muzzle.

DATA

Weight of complete round	1.61 lb	Width of rotating band	0.74 in.
Length of complete round	6.92 in.	Radius of ogive	2.24 cal.
Length of fuzed projectile	4.60 in.	Muzzle velocity	1,276 ft per sec
Length of cartridge case	3.64 in.	Maximum range	4,915 yd

302. SHELL, FIXED, PRACTICE, M63-MOD. 1, W/FUZE, BASE, PRACTICE, M58, 37-MM SUBCALIBER GUNS, M12, M13, M14, AND M1916. Except for the explosive charge which consists of black powder and diameter of rotating band which is 1.491 inches, the M63-Mod. 1 Projectile is the same as the M63 Projectile described in paragraph 41.

DATA

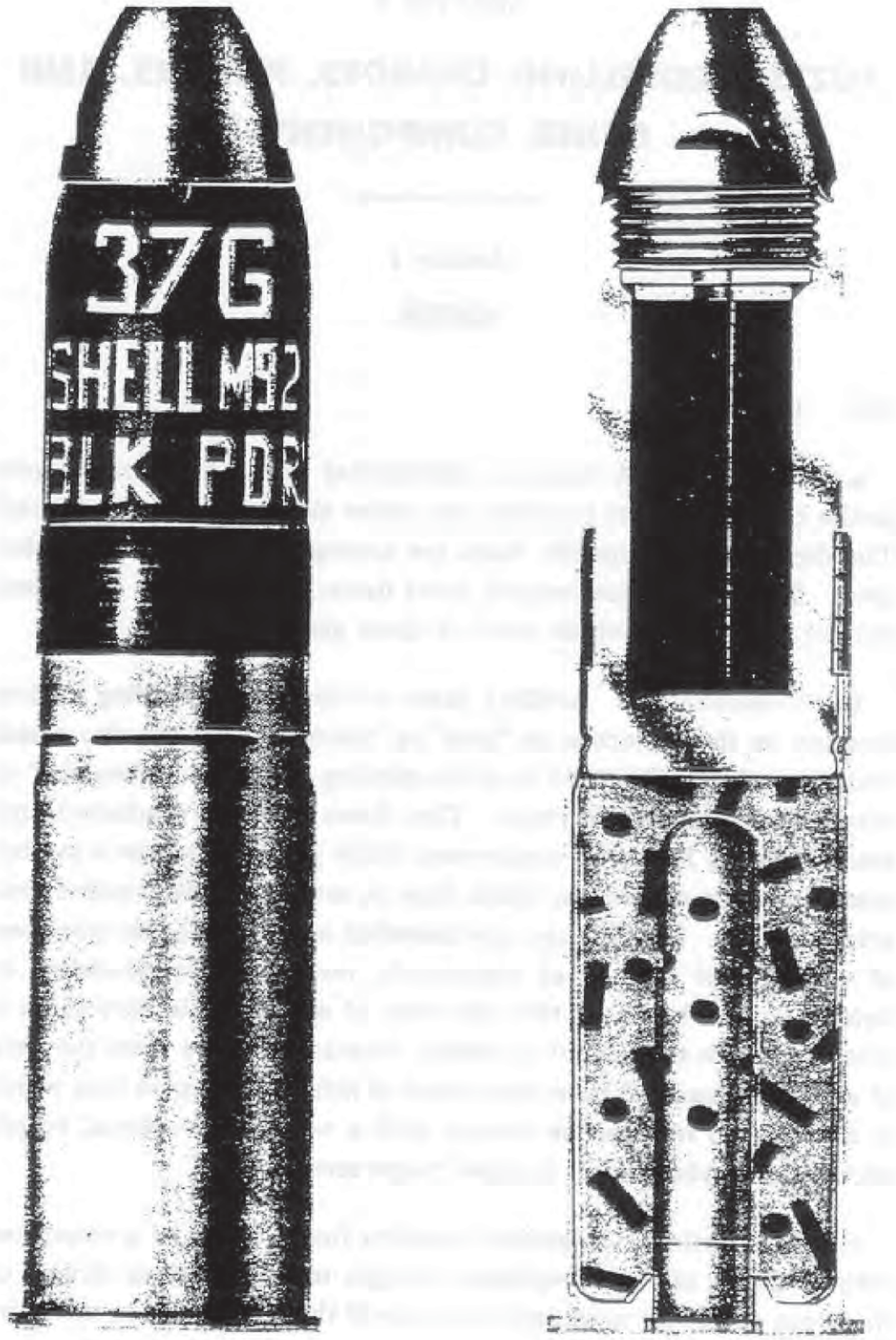
Weight of complete round	2.01 lb	Width of rotating band	0.76 in.
Length of complete round	8.98 in.	Radius of ogive	8.97 cal.
Length of fuzed projectile	6.15 in.	Muzzle velocity	1,100 ft per sec
Length of cartridge case	3.64 in.	Maximum range	4,980 yd

303. SHELL, FIXED, PRACTICE, M92, W/FUZE, P. D., M74, 37-MM SUBCALIBER GUNS, M12, M13, M14, AND M1916 (fig. 151), uses a service cartridge case, primer, and propelling charge as used in the round. The explosive charge consists of pressed black powder. The cartridge case is of brass; rounds are also made with steel cartridge cases.

DATA

Weight of complete round	.65 lb	Width of rotating band	0.74 in.
Length of complete round	7.21 in.	Radius of ogive	2.24 cal.
Length of fuzed projectile	4.175 in.	Muzzle velocity	1,276 ft per sec
Length of cartridge case	3.64 in.	Maximum range	5,165 yd

304. FIELD ARTILLERY TRAINER, M3, is a compressed air unit comprising a miniature gun mounted on a miniature carriage. Four units mounted on a firing platform make up a field artillery trainer battery. The M3 Trainer is a modification of, and has replaced, the M2 and M2A1 Trainers, which use a cal. .22 short blank cartridge as propellant. The projectile is a 1-inch commercial steel ball weighing approximately 1,024 grains. The range is 90 yards.



RA PD 80888

Figure 151 — SHELL, Fixed, Practice, M92, w/FUZE, P.D., M74, 37-mm Subcaliber Guns, M12, M13, M14, and M1916

are used in the interior of the container to prevent sideward motion, upper and lower guide rings are provided on the interior of the container.

c. **Metal cans.** A sealed metal can (fig. 72) with metal tear strips is used to pack separate-loading artillery primers. These cans are packed, in turn, in a wooden box.

d. **Waterproof bags.** Propelling charges may be packed in waterproof bag in fiber containers (fig. 77).

Section V

BOMBS

109. GENERAL.

a. A bomb is a stream-lined container of explosives or chemicals intended for release from aircraft. It consists of a body containing the charge and a device to explode or scatter the charge at the target. Aircraft torpedoes, submarine mines planted by aircraft, rockets, pyrotechnics, and mortar bombs, although similar in nature, are not classified as bombs.

b. For reasons of safety, the components of a bomb are usually stored and shipped separately, and must be assembled prior to use. The components of bombs (fig. 82) differ (depending on the particular type and model) but, in general, they consist of:

(1) The unfuzed bomb body containing explosive, incendiary, or chemical filler.

(2) The fuze, or fuzes.

(3) The fin assembly (assembled to smaller bombs as shipped).

(4) The arming wire assembly.

c. Bombs are installed in airplanes by means of suspension lugs. Bombs of 100 pounds and more have the suspension lugs on the side of the body, arranged for horizontal suspension of the bomb. Some smaller bombs have one lug on the side and another on the tail end, which permits the bomb to be installed either in a horizontal or vertical bomb rack; others are strapped in clusters of several bombs and suspended as a unit. Some AN bombs have three suspension lugs, two on one side of the bomb body and one on the opposite side to provide for use in both Army and Navy aircraft.

d. The functioning of bombs depends primarily upon the action of the fuze, which may be superquick, delay, or time. The terms "superquick" (instantaneous) and "delay" refer to the action at the instant of fuze impact, whereas "time" refers to the time from the release of the bomb to the instant of function.

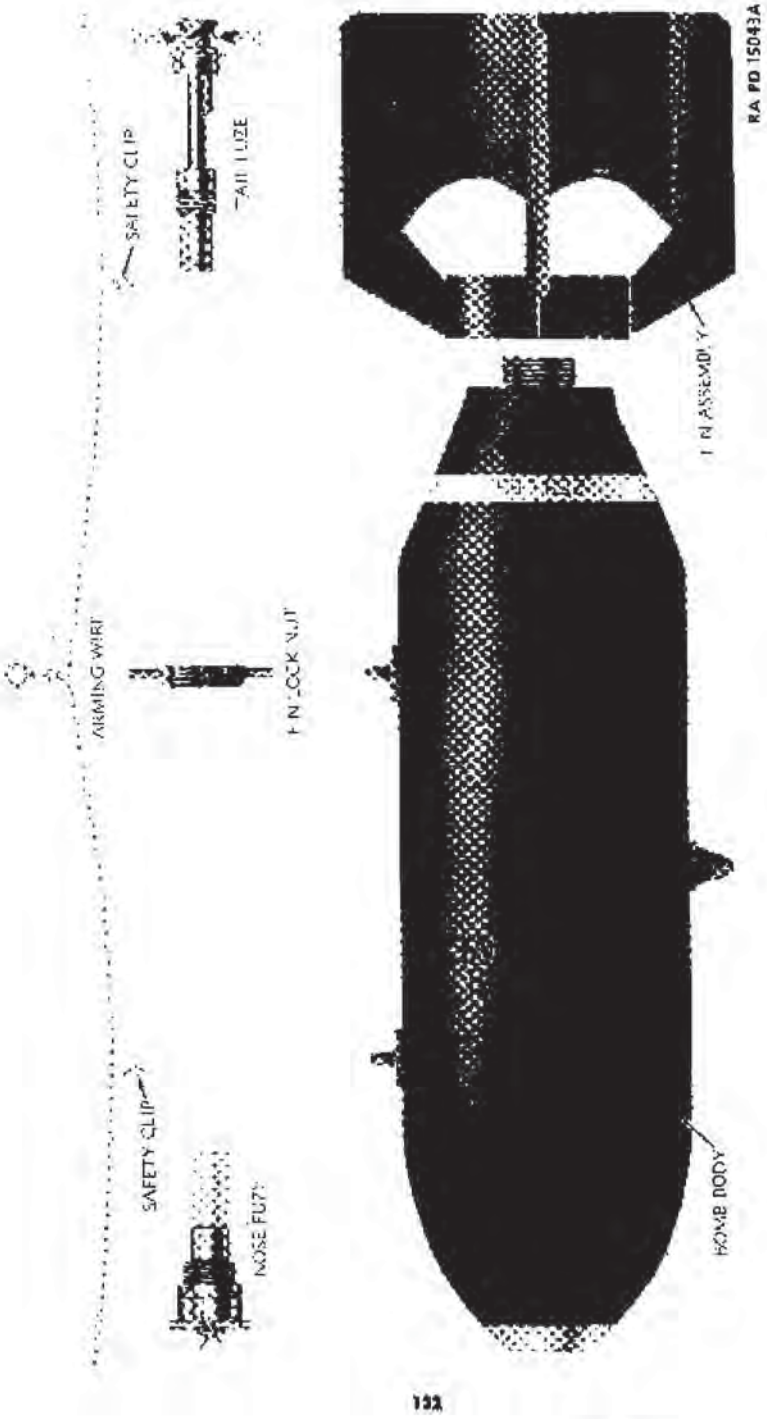


Figure 82 — Components of Bombs

e. Bomb fuzes, after assembly into the bombs, are prevented from arming or functioning during handling by means of an arming wire which is normally removed by the bomb's release from the airplane. When it is necessary to remove the arming wire to unfuze a bomb, instructions attached to the fuze should be followed closely. Provision is made for releasing the bomb "safe" from the airplane without removing the arming wire from the fuze when it is desired that the bomb should land without functioning.

f. A general description of the several types of bombs is included in the following paragraphs.

110. IDENTIFICATION. Bombs are painted in accordance with the basic color scheme outlined in chapter 1, section II and illustrated in figures 9 and 10. Bombs are marked to indicate type, weight, model, filler, lot number, and loading plant and date loaded. In addition, the AIC symbol is stenciled on uncrated bombs.

111. CLASSIFICATION. Because of the many uses for bombs dropped from aircraft, there are many types and sizes of bombs, ranging in weight from 2 to 4,000 pounds. In common with other types of ammunition, bombs are classified according to filler as explosive, chemical, incendiary, pyrotechnic, and inert. Explosive bombs are classified according to use as general-purpose (GP) (demolition), light case (LC), armor-piercing (AP), semi-armor-piercing (SAP), fragmentation, and depth. Chemical bombs are classified according to type of filler as gas or smoke. Inert bombs are used for practice and drill.

112. EXPLOSIVE BOMBS.

a. These bombs are intended for the destruction or demolition of materiel targets. The destructive effect is produced by the violence of the detonation, "blast effect"; by projection of pieces of the case, "fragmentation"; and by displacement of earth and buildings, "mining." An explosive train for bombs is illustrated in figure 83.

b. **General-purpose.** The general-purpose (GP) bomb (fig. 84) meets the requirements of most bombing missions. The various models range in weight from 100 to 2,000 pounds and the quantity of explosive in this type averages 55 percent by weight. General-purpose bombs may be used for blast, fragmentation, or mining effect. They use both nose and tail fuzes. Nose fuzes produce more efficient surface effect, and tail fuzes produce more efficient mining and penetration effect. Both fuzes are generally used, the secondary fuze as insurance against malfunctioning. The metal case is strong enough to withstand impact with ordinary materials when released from high altitude, but it may fail on impact with heavy armor or heavily reinforced concrete structures.

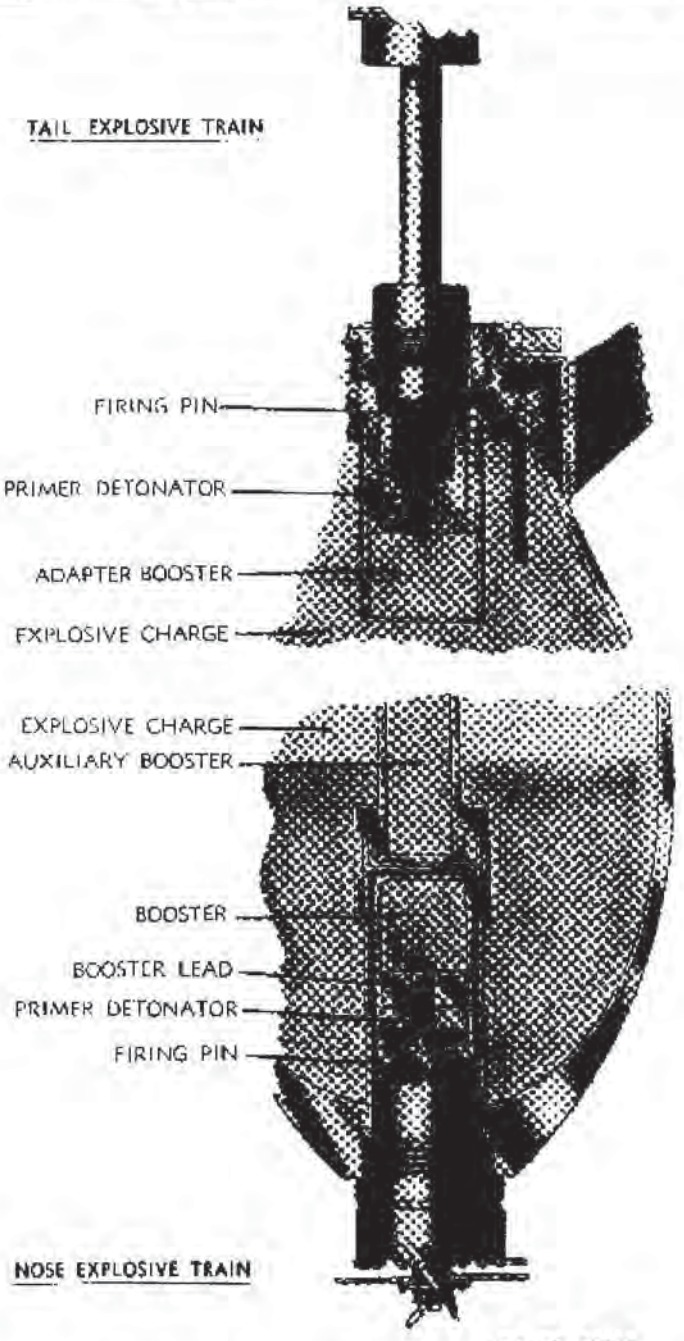
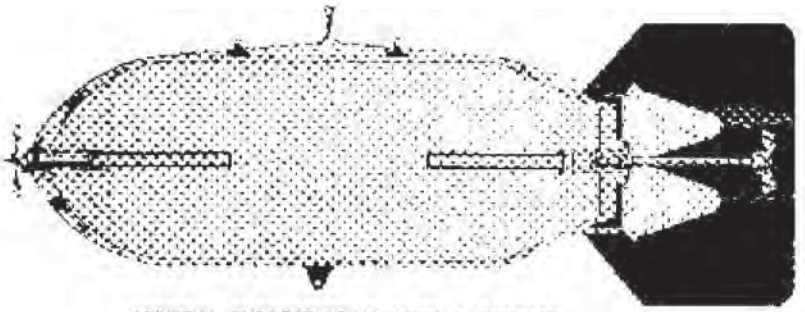
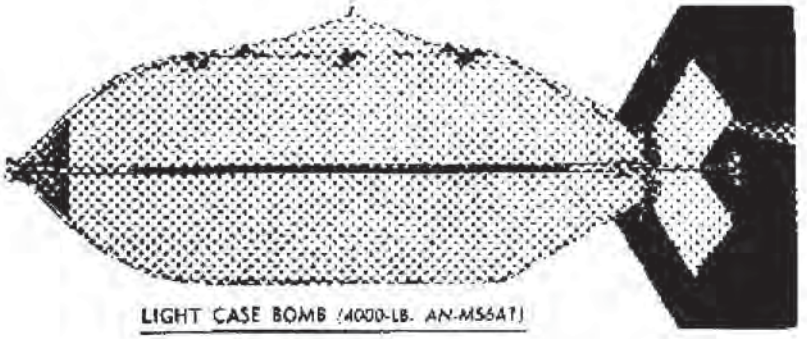


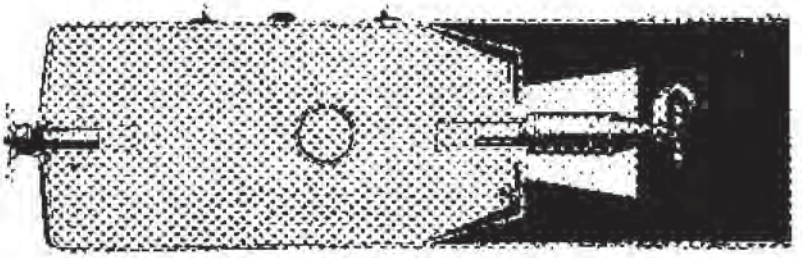
Figure 83 – Bomb Explosive Trains



GENERAL PURPOSE BOMB (1000-LB. AN-M65)



LIGHT CASE BOMB (4000-LB. AN-M56A1)



DEPTH BOMB (650-LB. MK. 29)

RA PD 89357

Figure 84 — Types of Bombs

c. **Light-case.** The light-case (LC) bomb (fig. 84) is similar in appearance to the general-purpose bomb but has a thinner, lighter case and contains a higher percentage of explosive filler by weight. Since strength of case has been sacrificed, this bomb cannot be used for penetration and must be fuzed to explode before the case breaks up on impact. Approximately 75 percent of the total weight is high-explosive filler.

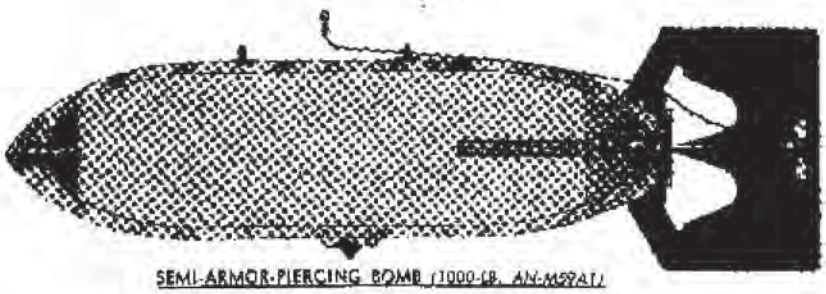
d. **Armor-piercing.** The armor-piercing (AP) bomb (fig. 85) is used to pierce deck armor of battleships, heavy concrete structures, and similar highly resistant targets. The nose of the AP bomb is solid and sometimes is fitted with an armor-piercing cap (APC) (fig. 85). These bombs are effective against heavy deck armor when dropped from sufficient altitude to attain their rated velocity. They contain a relatively small percentage (8 to 18 percent) of explosive filler and use tail fuzes of the delay type.

e. **Semi-armor-piercing.** The semi-armor-piercing (SAP) bomb (fig. 85) is conventional in outline, resembling the cylindrical GP bomb. However, the SAP bomb has a heavy case of steel which is drawn into a thickened nose and contains approximately 30 percent by weight of explosive filler. It may be used against concrete pill boxes or other targets of moderately high resistance.

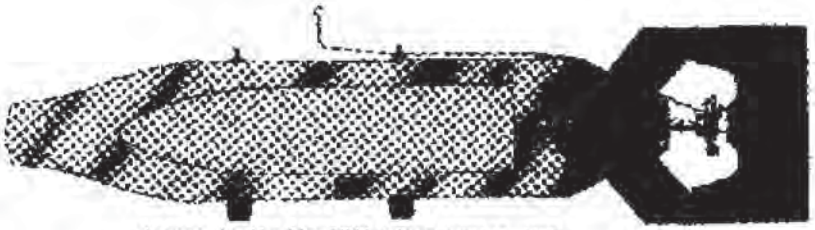
f. **Depth.** The depth bomb (fig. 84) is a special light-case bomb for use against submarines and surface craft. It averages 70 percent by weight of explosive. When detonated by a hydrostatic fuze, the effect of this bomb does not depend upon hitting the target directly but upon the shock of detonation of the explosive being transmitted through the water. The hydrostatic fuze functions at a predetermined depth rather than on impact. If it is desired to use these bombs for demolition effect only, they may be equipped with nose fuzes which function on impact. Fuzes may be of the nose or tail type or installed in a cavity running transversely through the bomb body.

g. **Fragmentation bombs.**

(1) Fragmentation bombs are for use against personnel and light materiel targets. The effect is produced primarily by the fragments of the bomb body projected at high velocity. The blast at the point of impact will cause additional damage to nearby objects. Some fragmentation bombs have stabilizing fins, others, for low-altitude bombing, have parachutes for retarding rate of fall (fig. 86). The design of the bomb body is such as to produce the greatest number of effective fragments. The body walls are of uniform thickness and may be made up of coiled helix springs. Any fragment having 60 foot-pounds of energy will disable personnel. Most types of fragmentation bombs are fitted with a nose fuze only. The weight of the high explosive in these bombs is about 15 percent by weight. Since the fragments are projected at approximately

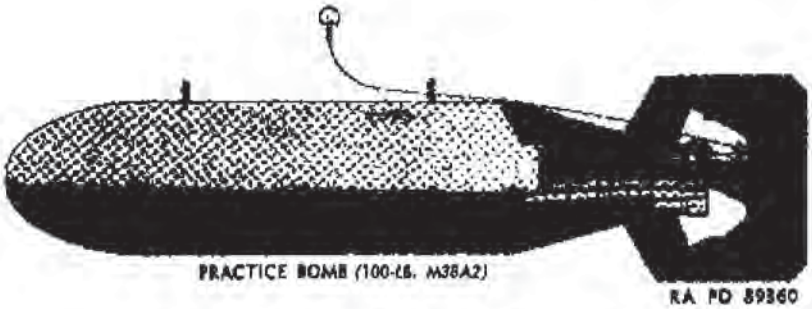


SEMI-ARMOR-PIERCING BOMB (1000-LB. AN-M59A1)



CAPPED ARMOR-PIERCING BOMB (1000-LB. M52)

ARMOR-PIERCING BOMB (1000-LB. AN-MK.33)



PRACTICE BOMB (100-LB. M38A2)

RA PD 89360

Figure 85 — Types of Bombs (Continued)

APPENDIX C

Characteristics of Targets Identified During the WAA Survey

Object ID	WAA Target ID	Latitude	Longitude	Height (feet)	Length (feet)	Width (feet)	Shadow (feet)	Initial Classification
1	WAA_SSS_400kHz_ExplosiveAnchorage1_0001	57.7428882	-152.4486788	0.940	8.850	2.950	4.870	unknown
2	WAA_SSS_400kHz_ExplosiveAnchorage1_0002	57.7423718	-152.4510420	1.600	3.730	1.280	3.250	unknown
3	WAA_SSS_400kHz_ExplosiveAnchorage1_0003	57.7423285	-152.4578842	1.500	4.150	2.170	4.830	unknown
4	WAA_SSS_400kHz_ExplosiveAnchorage1_0004	57.7422211	-152.4554436	0.740	6.740	2.400	3.770	mine like object
5	WAA_SSS_400kHz_ExplosiveAnchorage1_0005	57.7421927	-152.4524339	0.600	5.740	1.680	2.850	unknown
6	WAA_SSS_400kHz_ExplosiveAnchorage1_0006	57.7421903	-152.4570563	1.940	3.370	2.680	7.110	mine like object
7	WAA_SSS_400kHz_ExplosiveAnchorage1_0007	57.7420886	-152.4506653	0.950	16.230	2.440	5.260	unknown
8	WAA_SSS_400kHz_ExplosiveAnchorage1_0008	57.7419722	-152.4470859	0.990	6.580	1.940	4.690	unknown
9	WAA_SSS_400kHz_ExplosiveAnchorage1_0009	57.7416685	-152.4562206	0.790	6.460	5.810	2.740	unknown
10	WAA_SSS_400kHz_ExplosiveAnchorage1_0010	57.7415861	-152.4554215	2.270	2.540	2.110	9.930	unknown
11	WAA_SSS_400kHz_ExplosiveAnchorage1_0011	57.7415569	-152.4506906	2.350	5.140	2.580	3.350	mine like object
12	WAA_SSS_400kHz_ExplosiveAnchorage1_0012	57.7414651	-152.4542102	1.780	6.780	4.710	8.480	unknown
13	WAA_SSS_400kHz_ExplosiveAnchorage1_0013	57.7413690	-152.4628728	1.500	2.280	1.590	5.460	unknown
14	WAA_SSS_400kHz_ExplosiveAnchorage1_0014	57.7413639	-152.4615333	1.710	4.370	3.950	5.990	unknown
15	WAA_SSS_400kHz_ExplosiveAnchorage1_0015	57.7413049	-152.4586036	1.420	4.160	2.450	4.380	unknown
16	WAA_SSS_400kHz_ExplosiveAnchorage1_0016	57.7412865	-152.4548446	1.100	4.150	2.350	3.500	unknown
17	WAA_SSS_400kHz_ExplosiveAnchorage1_0017	57.7412770	-152.4603609	1.630	2.640	2.430	3.970	unknown
18	WAA_SSS_400kHz_ExplosiveAnchorage1_0018	57.7411585	-152.4560364	2.300	2.330	3.110	2.810	unknown
19	WAA_SSS_400kHz_ExplosiveAnchorage1_0019	57.7411398	-152.4624297	1.330	3.180	1.690	3.590	unknown
20	WAA_SSS_400kHz_ExplosiveAnchorage1_0020	57.7410065	-152.4421803	1.360	6.980	4.640	3.190	unknown
21	WAA_SSS_400kHz_ExplosiveAnchorage1_0021	57.7409593	-152.4519702	1.010	2.340	1.920	2.980	unknown
22	WAA_SSS_400kHz_ExplosiveAnchorage1_0022	57.7408574	-152.4608223	1.510	8.000	1.830	1.810	unknown
23	WAA_SSS_400kHz_ExplosiveAnchorage1_0023	57.7407109	-152.4507158	1.870	3.490	2.380	10.320	unknown
24	WAA_SSS_400kHz_ExplosiveAnchorage1_0024	57.7401239	-152.4530363	1.280	2.900	2.310	3.820	unknown
25	WAA_SSS_400kHz_ExplosiveAnchorage1_0025	57.7392106	-152.4548543	0.820	4.080	2.530	3.570	unknown
27	WAA_SSS_400kHz_ExplosiveAnchorage1_0027	57.7390747	-152.4446531	4.830	3.530	3.280	13.780	unknown
28	WAA_SSS_400kHz_ExplosiveAnchorage1_0028	57.7387709	-152.4553463	1.960	2.180	1.720	5.180	unknown
29	WAA_SSS_400kHz_ExplosiveAnchorage1_0029	57.7387636	-152.4487615	0.000	0.000	0.000	0.000	
30	WAA_SSS_400kHz_ExplosiveAnchorage1_0030	57.7386602	-152.4552539	1.010	9.360	3.850	4.120	unknown
31	WAA_SSS_400kHz_ExplosiveAnchorage1_0031	57.7383328	-152.4522808	1.290	2.800	1.120	2.640	unknown
32	WAA_SSS_400kHz_ExplosiveAnchorage1_0032	57.7383109	-152.4507030	0.840	6.530	2.600	1.580	mine like object
33	WAA_SSS_400kHz_ExplosiveAnchorage1_0033	57.7382421	-152.4539451	1.150	2.510	1.680	3.080	unknown
34	WAA_SSS_400kHz_ExplosiveAnchorage1_0034	57.7377415	-152.4592987	0.980	10.840	4.450	2.220	unknown
35	WAA_SSS_400kHz_ExplosiveAnchorage1_0035	57.7375290	-152.4553868	0.620	4.460	1.470	2.550	unknown
36	WAA_SSS_400kHz_ExplosiveAnchorage1_0036	57.7372372	-152.4599098	0.630	2.770	2.540	2.500	unknown
37	WAA_SSS_400kHz_ExplosiveAnchorage1_0037	57.7372092	-152.4459270	0.810	3.840	2.320	2.710	unknown
38	WAA_SSS_400kHz_ExplosiveAnchorage1_0038	57.7371818	-152.4569473	0.720	6.370	1.540	2.750	unknown
39	WAA_SSS_400kHz_ExplosiveAnchorage1_0039	57.7371595	-152.4581309	1.860	5.940	2.140	11.160	unknown
40	WAA_SSS_400kHz_ExplosiveAnchorage1_0040	57.7371542	-152.4584140	0.980	3.730	1.270	5.200	unknown
41	WAA_SSS_400kHz_ExplosiveAnchorage1_0041	57.7371339	-152.4510201	1.560	3.650	2.570	4.970	unknown
42	WAA_SSS_400kHz_ExplosiveAnchorage1_0042	57.7369957	-152.4587350	0.730	4.700	2.580	2.030	unknown
43	WAA_SSS_400kHz_ExplosiveAnchorage1_0043	57.7368179	-152.4592852	0.590	5.160	3.240	2.960	unknown
44	WAA_SSS_400kHz_ExplosiveAnchorage1_0044	57.7367601	-152.4473120	1.830	2.080	1.450	4.140	unknown
45	WAA_SSS_400kHz_ExplosiveAnchorage1_0045	57.7366234	-152.4533190	2.170	14.720	5.430	3.220	unknown
46	WAA_SSS_400kHz_ExplosiveAnchorage1_0046	57.7364780	-152.4513366	1.160	3.360	1.880	4.340	unknown
47	WAA_SSS_400kHz_ExplosiveAnchorage1_0047	57.7364676	-152.4588323	0.530	3.000	2.350	2.540	mine like object
48	WAA_SSS_400kHz_ExplosiveAnchorage1_0048	57.7364532	-152.4580941	0.500	5.440	1.770	2.450	tires
49	WAA_SSS_400kHz_ExplosiveAnchorage1_0049	57.7364168	-152.4566112	0.700	2.880	1.260	2.340	mine like object
50	WAA_SSS_400kHz_ExplosiveAnchorage1_0050	57.7363875	-152.4477290	1.050	5.720	2.780	2.910	Unknown
51	WAA_SSS_400kHz_ExplosiveAnchorage1_0051	57.7363668	-152.4481943	0.820	2.500	2.260	2.500	mine like object
52	WAA_SSS_400kHz_ExplosiveAnchorage1_0052	57.7363233	-152.4548972	0.510	2.440	3.180	1.950	unknown
53	WAA_SSS_400kHz_ExplosiveAnchorage1_0053	57.7363185	-152.4492684	0.930	7.280	1.900	4.940	unknown
54	WAA_SSS_400kHz_ExplosiveAnchorage1_0054	57.7362595	-152.4471355	0.750	10.240	5.020	3.350	
55	WAA_SSS_400kHz_ExplosiveAnchorage2_0001	57.7224330	-152.5004559	0.880	9.040	4.130	1.900	unknown
58	WAA_SSS_400kHz_ExplosiveAnchorage2_0004	57.7219881	-152.5029334	1.420	4.680	3.500	3.290	unknown
60	WAA_SSS_400kHz_ExplosiveAnchorage2_0006	57.7203624	-152.5027301	0.970	8.870	5.330	2.840	unknown
62	WAA_SSS_400kHz_ExplosiveAnchorage2_0008	57.7196570	-152.5044399	2.200	5.210	2.460	6.260	unknown
63	WAA_SSS_400kHz_ExplosiveAnchorage2_0009	57.7196407	-152.5028973	2.990	5.570	3.770	3.710	unknown
64	WAA_SSS_400kHz_ExplosiveAnchorage2_0010	57.7196405	-152.4969059	0.670	7.570	2.910	3.150	unknown
65	WAA_SSS_400kHz_ExplosiveAnchorage2_0011	57.7192253	-152.5080223	1.130	3.040	2.500	3.540	unknown
66	WAA_SSS_400kHz_ExplosiveAnchorage2_0012	57.7191761	-152.5050897	2.190	5.690	2.240	2.680	unknown
67	WAA_SSS_400kHz_ExplosiveAnchorage2_0013	57.7191750	-152.4962333	2.300	19.600	6.520	16.780	unknown
68	WAA_SSS_400kHz_ExplosiveAnchorage2_0014	57.7190968	-152.4964849	2.170	2.150	3.020	13.140	unknown
69	WAA_SSS_400kHz_ExplosiveAnchorage2_0015	57.7190347	-152.5064586	0.640	11.440	1.040	1.380	unknown
70	WAA_SSS_400kHz_ExplosiveAnchorage2_0016	57.7189186	-152.5031037	2.200	4.770	4.590	6.410	unknown
71	WAA_SSS_400kHz_ExplosiveAnchorage2_0017	57.7185154	-152.5109447	0.830	5.690	3.360	5.020	unknown
72	WAA_SSS_400kHz_ExplosiveAnchorage2_0018	57.7184664	-152.4997017	1.860	42.680	25.910	3.620	unknown
73	WAA_SSS_400kHz_ExplosiveAnchorage2_0019	57.7183784	-152.5055171	1.730	7.270	3.810	4.140	unknown
74	WAA_SSS_400kHz_ExplosiveAnchorage2_0020	57.7182430	-152.4986358	2.250	6.280	6.120	4.940	fish trap
75	WAA_SSS_400kHz_ExplosiveAnchorage2_0021	57.7181404	-152.5115615	0.580	4.680	2.560	3.030	unknown
76	WAA_SSS_400kHz_ExplosiveAnchorage2_0022	57.7179162	-152.5011032	1.250	7.780	4.700	2.700	unknown
77	WAA_SSS_400kHz_ExplosiveAnchorage2_0023	57.7175648	-152.5091256	0.440	20.970	0.680	1.360	piling
78	WAA_SSS_400kHz_ExplosiveAnchorage2_0024	57.7174852	-152.5038524	1.100	28.710	2.420	3.110	unknown
79	WAA_SSS_400kHz_ExplosiveAnchorage2_0025	57.7173044	-152.5096266	2.200	5.910	1.660	5.650	unknown
80	WAA_SSS_400kHz_ExplosiveAnchorage2_0026	57.7170954	-152.5044125	2.370	4.750	4.020	5.360	unknown
81	WAA_SSS_400kHz_ExplosiveAnchorage2_0027	57.7169698	-152.5051373	2.470	4.070	4.140	3.350	unknown
82	WAA_SSS_400kHz_ExplosiveAnchorage2_0028	57.7168763	-152.5068174	3.730	9.810	4.910	5.560	unknown
84	WAA_SSS_400kHz_ExplosiveAnchorage3_0001	57.7160301	-152.5399335	1.750	4.400	2.420	3.570	unknown
85	WAA_SSS_400kHz_ExplosiveAnchorage3_0002	57.7156823	-152.5409437	1.630	8.760	4.030	3.100	unknown
86	WAA_SSS_400kHz_ExplosiveAnchorage3_0003	57.7131939	-152.5423788	0.000	57.870	11.910	0.000	anchor
87	WAA_SSS_400kHz_ExplosiveAnchorage3_0004	57.7131230	-152.5423482	0.000	13.130	6.030	0.000	unknown
88	WAA_SSS_400kHz_ExplosiveAnchorage3_0005	57.7128696	-152.5401802	1.320	19.650	9.530	2.930	unknown
89	WAA_SSS_400kHz_ExplosiveAnchorage3_0006	57.7128186	-152.5402496	1.490	7.390	5.770	3.200	unknown
90	WAA_SSS_400kHz_ExplosiveAnchorage3_0007	57.7124108	-152.5436337	0.000	6.320	6.940	0.000	tires

91	WAA_SSS_400kHz_ExplosiveAnchorage3_0008	57.7122567	-152.5435699	0.000	4.120	3.810	0.000	tires
92	WAA_SSS_400kHz_ExplosiveAnchorage3_0009	57.7121404	-152.5481748	0.860	4.850	3.870	2.320	unknown
93	WAA_SSS_400kHz_ExplosiveAnchorage3_0010	57.7121231	-152.5483440	1.930	34.620	6.690	6.170	unknown
94	WAA_SSS_400kHz_ExplosiveAnchorage3_0011	57.7117846	-152.5294173	1.790	32.070	12.370	2.710	unknown
95	WAA_SSS_400kHz_ExplosiveAnchorage3_0012	57.7116576	-152.5473820	1.600	5.510	4.720	3.410	unknown
96	WAA_SSS_400kHz_ExplosiveAnchorage3_0013	57.7112509	-152.5397326	1.310	2.890	2.870	1.780	unknown
97	WAA_SSS_400kHz_ExplosiveAnchorage3_0014	57.7107004	-152.5477802	1.340	2.980	3.760	9.460	unknown
98	WAA_SSS_400kHz_ExplosiveAnchorage3_0015	57.7101751	-152.5362319	1.800	9.460	4.130	6.310	unknown
99	WAA_SSS_400kHz_ExplosiveAnchorage3_0016	57.7100982	-152.5378754	2.020	4.970	2.540	4.690	unknown
100	WAA_SSS_400kHz_ExplosiveAnchorage3_0017	57.7095729	-152.5456264	1.760	15.280	3.160	6.330	unknown
101	WAA_SSS_400kHz_ExplosiveAnchorage3_0018	57.7082543	-152.5439092	0.960	7.440	2.990	4.700	unknown
102	WAA_SSS_400kHz_ExplosiveAnchorage3_0019	57.7081617	-152.5440070	1.610	6.030	2.430	8.950	unknown
103	WAA_SSS_400kHz_ExplosiveAnchorage3_0020	57.7079529	-152.5387100	0.330	7.280	0.900	1.070	unknown
104	WAA_SSS_400kHz_ExplosiveAnchorage3_0021	57.7071270	-152.5393316	0.920	7.400	2.250	4.750	unknown
105	WAA_SSS_400kHz_ExplosiveAnchorage3_0022	57.7070782	-152.5389795	0.470	8.610	2.940	4.190	unknown
106	WAA_SSS_400kHz_ExplosiveAnchorage3_0023	57.7070015	-152.5390268	0.500	8.300	2.580	5.080	unknown
107	WAA_SSS_400kHz_FtGreely_0001	57.7693781	-152.3823438	2.100	16.330	8.150	6.520	
108	WAA_SSS_400kHz_FtGreely_0002	57.7686847	-152.3821747	3.580	8.780	6.640	5.860	
110	WAA_SSS_400kHz_FtGreely_0004	57.7684649	-152.3813065	2.290	6.490	4.880	2.870	
112	WAA_SSS_400kHz_FtGreely_0006	57.7680095	-152.3829334	3.650	5.640	7.990	9.400	
113	WAA_SSS_400kHz_FtGreely_0007	57.7679943	-152.3849217	2.060	8.020	6.080	4.490	fish trap
114	WAA_SSS_400kHz_FtGreely_0008	57.7678329	-152.3854992	2.370	5.760	9.220	7.670	Fish trap
115	WAA_SSS_400kHz_FtGreely_0009	57.7676470	-152.3854881	1.500	10.940	7.970	3.980	Fish trap
118	WAA_SSS_400kHz_FtGreely_0012	57.7674298	-152.3839981	3.020	6.870	5.080	4.340	
122	WAA_SSS_400kHz_FtGreely_0016	57.7656872	-152.3871694	3.240	3.540	1.960	14.210	Unknown
125	WAA_SSS_400kHz_FtGreely_0019	57.7651406	-152.3858260	3.570	3.020	1.100	6.050	Proud target
126	WAA_SSS_400kHz_FtGreely_0020	57.7643494	-152.3935353	2.090	20.910	11.360	4.170	Wreck
127	WAA_SSS_400kHz_FtGreely_0021	57.7635193	-152.3938809	1.760	12.970	9.090	3.780	Unknown
128	WAA_SSS_400kHz_FtGreely_0022	57.7634123	-152.3889351	0.780	6.280	6.280	2.770	
129	WAA_SSS_400kHz_FtGreely_0023	57.7623473	-152.3920771	1.730	6.320	2.650	3.120	
130	WAA_SSS_400kHz_FtGreely_0024	57.7618538	-152.3872681	2.020	9.910	9.160	6.940	Fish trap
131	WAA_SSS_400kHz_FtGreely_0025	57.7617503	-152.3940004	1.980	14.770	10.990	6.030	fish trap
132	WAA_SSS_400kHz_FtGreely_0026	57.7604747	-152.3911645	2.610	4.750	7.750	8.250	Fish trap
136	WAA_SSS_400kHz_FtGreely_0030	57.7579335	-152.3937291	2.340	9.810	7.240	8.250	fish trap
138	WAA_SSS_400kHz_FtGreely_0032	57.7578702	-152.3918320	1.400	7.620	4.420	2.190	Skiff
139	WAA_SSS_400kHz_FtGreely_0033	57.7573052	-152.3948707	2.430	6.310	8.190	8.230	fish trap
140	WAA_SSS_400kHz_FtGreely_0034	57.7572386	-152.3964807	2.740	8.910	6.120	4.930	fish trap
141	WAA_SSS_400kHz_FtGreely_0035	57.7568749	-152.3957929	1.950	7.980	11.530	10.640	fish trap
143	WAA_SSS_400kHz_FtGreely_0037	57.7562304	-152.3986736	1.130	6.660	0.780	1.960	6-Inch Shell
144	WAA_SSS_400kHz_FtGreely_0038	57.7556940	-152.3886907	2.800	9.830	9.510	8.320	
146	WAA_SSS_400kHz_FtGreely_0040	57.7531817	-152.3937057	2.090	4.580	4.880	2.440	
147	WAA_SSS_400kHz_FtGreely_0041	57.7517130	-152.3996804	1.850	5.760	5.770	4.950	Navigation buoy anch
148	WAA_SSS_400kHz_FtGreely_0042	57.7500027	-152.3960773	2.720	12.540	9.610	10.110	Unknown
149	WAA_SSS_400kHz_FtGreely_0043	57.7492241	-152.4042126	1.460	6.580	2.800	5.590	Unknown
150	WAA_SSS_400kHz_FtGreely_0044	57.7449592	-152.3976133	0.000	52.650	9.870	0.000	Wreck
151	WAA_SSS_400kHz_FtGreely_0045	57.7428251	-152.4005394	1.200	1.830	1.440	1.800	
152	WAA_SSS_400kHz_FtGreely_0046	57.7419302	-152.4023294	0.000	0.000	0.000	0.000	Unknown
153	WAA_SSS_400kHz_FtGreely_0047	57.7418213	-152.4028783	2.440	7.070	2.150	3.760	Unknown
154	WAA_SSS_400kHz_FtGreely_0048	57.7410541	-152.4051593	3.400	8.400	5.180	12.990	Unknown
155	WAA_SSS_400kHz_FtGreely_0049	57.7410151	-152.4084566	0.000	17.970	0.000	0.000	Unknown
156	WAA_SSS_400kHz_FtGreely_0050	57.7392291	-152.4070346	1.550	14.330	2.470	3.400	Unknown
157	WAA_SSS_400kHz_FtGreely_0051	57.7391864	-152.4072109	1.290	1.450	1.940	2.420	Unknown
158	WAA_SSS_400kHz_FtGreely_0052	57.7389812	-152.4080529	0.900	12.370	2.570	1.990	mine like object
159	WAA_SSS_400kHz_FtGreely_0053	57.7388991	-152.4027577	1.560	4.930	2.120	2.440	
160	WAA_SSS_400kHz_FtGreely_0054	57.7375816	-152.4063360	3.250	16.970	5.200	6.470	Seine skiff
161	WAA_SSS_400kHz_FtGreely_0055	57.7371559	-152.4067136	1.110	5.560	0.430	2.560	
162	WAA_SSS_400kHz_FtGreely_0056	57.7365138	-152.4007020	1.800	5.670	2.170	2.600	
163	WAA_SSS_400kHz_FtGreely_0057	57.7364048	-152.4070630	1.040	4.800	3.580	3.540	Unknown
164	WAA_SSS_400kHz_FtGreely_0058	57.7362652	-152.4064222	1.010	4.580	3.040	2.020	Unknown
165	WAA_SSS_400kHz_FtGreely_0059	57.7361859	-152.4118600	0.830	19.000	2.380	3.330	Unknown
166	WAA_SSS_400kHz_FtGreely_0060	57.7358558	-152.4092948	2.230	6.000	5.720	7.610	fish trap
167	WAA_SSS_400kHz_FtGreely_0061	57.7356129	-152.4066635	1.550	6.510	3.160	3.000	Unknown
168	WAA_SSS_400kHz_FtGreely_0062	57.7349623	-152.4018766	0.850	1.850	1.450	1.160	
170	WAA_SSS_400kHz_FtGreely_0064	57.7348497	-152.4030808	1.890	6.200	1.420	2.840	
171	WAA_SSS_400kHz_FtGreely_0065	57.7346399	-152.4097844	1.260	10.930	2.640	2.450	Unknown
172	WAA_SSS_400kHz_FtGreely_0066	57.7344130	-152.4098236	2.030	10.240	1.950	4.390	Unknown
173	WAA_SSS_400kHz_FtGreely_0067	57.7342739	-152.4054643	4.260	3.590	4.110	12.230	mine like object
174	WAA_SSS_400kHz_FtGreely_0068	57.7341534	-152.4064015	1.540	4.100	5.120	2.040	mine like object
176	WAA_SSS_400kHz_FtGreely_0070	57.7340614	-152.4061416	3.510	9.300	3.720	12.170	
177	WAA_SSS_400kHz_FtGreely_0071	57.7339649	-152.4100889	3.340	8.470	7.840	7.820	fish trap
178	WAA_SSS_400kHz_FtGreely_0072	57.7339138	-152.4090657	1.210	2.850	1.370	3.490	Unknown
179	WAA_SSS_400kHz_FtGreely_0073	57.7338013	-152.4063198	1.380	3.380	3.270	3.920	mine like object
180	WAA_SSS_400kHz_FtGreely_0074	57.7335011	-152.4070468	1.700	4.250	3.070	4.890	
181	WAA_SSS_400kHz_FtGreely_0075	57.7333395	-152.4066333	1.100	6.010	2.450	4.830	
182	WAA_SSS_400kHz_FtGreely_0076	57.7332894	-152.4068051	1.540	3.500	2.180	2.100	Unknown
183	WAA_SSS_400kHz_FtGreely_0077	57.7326722	-152.4053908	1.380	5.640	1.750	2.450	
184	WAA_SSS_400kHz_FtGreely_0078	57.7326046	-152.4080109	0.880	7.970	0.910	1.370	
185	WAA_SSS_400kHz_FtGreely_0079	57.7325002	-152.4053114	1.850	5.950	2.450	2.450	
187	WAA_SSS_400kHz_FtGreely_0081	57.7321979	-152.4074388	2.780	2.420	2.060	3.830	Unknown target adja
189	WAA_SSS_400kHz_FtGreely_0083	57.7320537	-152.4074858	1.850	15.500	1.460	2.340	Elongated target
190	WAA_SSS_400kHz_FtGreely_0084	57.7320260	-152.4067101	1.400	4.260	1.250	5.160	
191	WAA_SSS_400kHz_FtGreely_0085	57.7319849	-152.4062633	1.240	5.920	1.220	6.400	
192	WAA_SSS_400kHz_FtGreely_0086	57.7319330	-152.4066306	1.310	14.790	1.470	2.350	cluster of three targe
193	WAA_SSS_400kHz_FtGreely_0087	57.7317976	-152.4038854	1.790	5.020	1.900	4.990	
194	WAA_SSS_400kHz_FtGreely_0088	57.7317818	-152.4062903	1.520	9.900	3.400	7.740	
195	WAA_SSS_400kHz_FtGreely_0089	57.7317478	-152.4062186	1.500	2.340	2.040	4.380	Unknown
196	WAA_SSS_400kHz_FtGreely_0090	57.7317089	-152.4039215	1.660	5.930	1.550	4.660	
198	WAA_SSS_400kHz_FtGreely_0092	57.7310459	-152.4049543	1.770	3.800	1.500	5.470	
199	WAA_SSS_400kHz_FtGreely_0093	57.7310390	-152.4044385	1.030	5.160	0.910	2.430	
200	WAA_SSS_400kHz_FtGreely_0094	57.7306606	-152.4033087	1.240	7.430	5.100	2.260	

201	WAA_SSS_400kHz_FtGreely_0095	57.7301701	-152.4129407	1.410	4.210	11.190	3.190	otter trawl door
202	WAA_SSS_400kHz_FtGreely_0096	57.7285314	-152.4087816	3.080	1.820	1.290	4.330	Unknown
203	WAA_SSS_400kHz_FtGreely_0097	57.7276814	-152.4077437	2.530	2.370	1.170	4.110	
204	WAA_SSS_400kHz_FtGreely_0098	57.7273183	-152.4164157	2.770	5.220	12.340	7.610	Unknown
205	WAA_SSS_400kHz_FtGreely_0099	57.7272909	-152.4136064	1.030	8.510	1.890	2.840	Unknown
207	WAA_SSS_400kHz_HumpbackRock_0001	57.7192989	-152.2262215	2.700	8.780	1.860	3.280	unknown
208	WAA_SSS_400kHz_HumpbackRock_0002	57.7181107	-152.2241523	2.120	7.660	3.230	4.540	unknown
209	WAA_SSS_400kHz_HumpbackRock_0003	57.7179894	-152.2272658	1.560	20.350	2.440	2.730	unknown
210	WAA_SSS_400kHz_HumpbackRock_0004	57.7177990	-152.2267448	2.650	10.630	1.850	2.920	unknown
211	WAA_SSS_400kHz_HumpbackRock_0005	57.7176486	-152.2277445	1.630	9.100	3.260	2.270	unknown
213	WAA_SSS_400kHz_HumpbackRock_0007	57.7175340	-152.2251480	1.600	7.020	2.330	2.910	unknown
214	WAA_SSS_400kHz_HumpbackRock_0008	57.7175004	-152.2254299	1.350	9.780	6.350	2.150	unknown
215	WAA_SSS_400kHz_HumpbackRock_0009	57.7174174	-152.2255120	1.420	4.760	1.960	2.800	unknown
216	WAA_SSS_400kHz_HumpbackRock_0010	57.7172419	-152.2261519	1.510	4.170	3.270	2.960	mine like object
217	WAA_SSS_400kHz_HumpbackRock_0011	57.7171830	-152.2264074	1.150	26.000	7.960	2.140	unknown
218	WAA_SSS_400kHz_HumpbackRock_0012	57.7167342	-152.2311195	1.330	9.320	4.290	2.610	unknown
219	WAA_SSS_400kHz_HumpbackRock_0013	57.7166630	-152.2209627	2.430	6.330	2.750	3.110	unknown
220	WAA_SSS_400kHz_HumpbackRock_0014	57.7150327	-152.2043703	1.970	7.870	1.970	3.280	unknown
221	WAA_SSS_400kHz_HumpbackRock_0015	57.7149703	-152.2034101	0.000	0.000	0.000	0.000	
222	WAA_SSS_400kHz_HumpbackRock_0016	57.7149163	-152.2237323	4.350	4.110	4.020	4.990	mine like object
223	WAA_SSS_400kHz_HumpbackRock_0017	57.7148143	-152.2250228	0.000	14.620	1.030	0.000	unknown
224	WAA_SSS_400kHz_HumpbackRock_0018	57.7144758	-152.2257624	4.490	5.510	3.280	6.440	unknown
225	WAA_SSS_400kHz_HumpbackRock_0019	57.7144340	-152.2372529	3.250	12.260	4.280	5.800	unknown
226	WAA_SSS_400kHz_HumpbackRock_0020	57.7144199	-152.2069328	2.910	5.390	3.410	5.360	unknown
228	WAA_SSS_400kHz_HumpbackRock_0022	57.7142953	-152.2306882	2.330	8.080	2.030	3.010	unknown
230	WAA_SSS_400kHz_HumpbackRock_0024	57.7140105	-152.2375016	2.070	20.930	5.450	4.730	unknown
231	WAA_SSS_400kHz_HumpbackRock_0025	57.7139701	-152.2254471	1.790	7.390	4.830	2.250	wreck
232	WAA_SSS_400kHz_HumpbackRock_0026	57.7139321	-152.2266156	1.360	9.400	3.260	2.430	unknown
233	WAA_SSS_400kHz_HumpbackRock_0027	57.7137050	-152.2243311	2.950	11.140	4.390	4.370	unknown
234	WAA_SSS_400kHz_HumpbackRock_0028	57.7134783	-152.2358988	3.300	4.820	4.240	3.720	unknown
235	WAA_SSS_400kHz_HumpbackRock_0029	57.7133731	-152.2259049	3.730	7.790	5.350	4.380	unknown
236	WAA_SSS_400kHz_HumpbackRock_0030	57.7133255	-152.2343504	2.270	4.040	2.920	3.980	mine like object
237	WAA_SSS_400kHz_HumpbackRock_0031	57.7130945	-152.2371774	1.140	7.570	1.820	1.770	unknown
238	WAA_SSS_400kHz_HumpbackRock_0032	57.7129543	-152.2413961	1.430	10.970	1.650	1.610	unknown
239	WAA_SSS_400kHz_HumpbackRock_0033	57.7128417	-152.2386093	2.190	15.710	5.620	4.840	unknown
240	WAA_SSS_400kHz_HumpbackRock_0034	57.7121768	-152.2414243	2.310	10.930	3.600	2.940	unknown
241	WAA_SSS_400kHz_HumpbackRock_0035	57.7117632	-152.2426467	1.620	10.560	2.240	1.920	unknown
242	WAA_SSS_400kHz_HumpbackRock_0036	57.7116826	-152.2392671	1.600	5.920	4.750	4.750	mine like object
243	WAA_SSS_400kHz_HumpbackRock_0037	57.7116035	-152.2400344	2.330	7.620	2.390	3.770	mine like object
244	WAA_SSS_400kHz_HumpbackRock_0038	57.7115842	-152.2393334	3.080	6.010	2.830	4.010	unknown
245	WAA_SSS_400kHz_HumpbackRock_0039	57.7114887	-152.2399144	2.640	9.630	2.860	5.220	unknown
246	WAA_SSS_400kHz_HumpbackRock_0040	57.7113473	-152.2479849	2.880	8.010	3.610	5.920	unknown
247	WAA_SSS_400kHz_HumpbackRock_0041	57.7112147	-152.2426123	3.250	9.430	3.330	3.560	unknown
249	WAA_SSS_400kHz_HumpbackRock_0043	57.7111155	-152.2109472	3.340	6.330	2.520	6.630	unknown
250	WAA_SSS_400kHz_HumpbackRock_0044	57.7110571	-152.2430763	2.740	4.810	3.660	6.010	unknown
252	WAA_SSS_400kHz_HumpbackRock_0046	57.7109526	-152.2372750	3.900	16.600	2.960	10.070	unknown
253	WAA_SSS_400kHz_HumpbackRock_0047	57.7108631	-152.2434305	2.180	11.380	6.930	2.500	unknown
255	WAA_SSS_400kHz_HumpbackRock_0049	57.7107950	-152.2438211	2.070	6.990	4.790	3.080	unknown
256	WAA_SSS_400kHz_HumpbackRock_0050	57.7107639	-152.2070110	1.690	9.140	2.110	3.520	unknown
257	WAA_SSS_400kHz_HumpbackRock_0051	57.7105280	-152.2434219	2.460	7.830	2.600	3.870	unknown
258	WAA_SSS_400kHz_HumpbackRock_0052	57.7104686	-152.2197037	2.030	11.230	3.250	4.650	unknown
259	WAA_SSS_400kHz_HumpbackRock_0053	57.7103125	-152.2438459	4.410	9.890	4.980	5.860	unknown
260	WAA_SSS_400kHz_HumpbackRock_0054	57.7100940	-152.2120538	4.240	7.790	6.830	5.090	unknown
261	WAA_SSS_400kHz_HumpbackRock_0055	57.7100825	-152.2466289	2.600	12.950	6.890	6.270	unknown
262	WAA_SSS_400kHz_HumpbackRock_0056	57.7097919	-152.2111000	1.020	22.130	23.480	1.370	unknown
263	WAA_SSS_400kHz_HumpbackRock_0057	57.7097776	-152.2446800	3.050	3.960	2.760	3.970	mine like object
265	WAA_SSS_400kHz_HumpbackRock_0059	57.7095205	-152.2298402	1.970	11.250	6.490	3.030	unknown
266	WAA_SSS_400kHz_HumpbackRock_0060	57.7093927	-152.2447995	1.630	5.110	4.830	2.880	mine like object
267	WAA_SSS_400kHz_HumpbackRock_0061	57.7093637	-152.2450900	1.230	9.690	3.240	2.580	unknown
268	WAA_SSS_400kHz_HumpbackRock_0062	57.7093316	-152.2449976	1.680	11.320	2.580	3.230	unknown
269	WAA_SSS_400kHz_HumpbackRock_0063	57.7092764	-152.2458409	1.640	2.260	2.490	4.120	mine like object
270	WAA_SSS_400kHz_HumpbackRock_0064	57.7090325	-152.2450584	3.030	9.520	2.210	3.290	unknown
271	WAA_SSS_400kHz_HumpbackRock_0065	57.7088401	-152.2452894	1.980	12.430	2.220	2.210	unknown
273	WAA_SSS_400kHz_HumpbackRock_0067	57.7085820	-152.2459180	1.650	11.100	2.070	3.450	unknown
274	WAA_SSS_400kHz_HumpbackRock_0068	57.7085680	-152.2452563	2.540	4.910	2.770	3.090	unknown
275	WAA_SSS_400kHz_HumpbackRock_0069	57.7085122	-152.2166718	1.080	17.880	1.410	1.410	unknown
276	WAA_SSS_400kHz_HumpbackRock_0070	57.7082466	-152.2463411	2.330	10.830	3.590	5.380	unknown
277	WAA_SSS_400kHz_HumpbackRock_0071	57.7082326	-152.2462639	1.500	11.490	1.430	3.230	unknown
278	WAA_SSS_400kHz_HumpbackRock_0072	57.7081017	-152.2452340	3.330	14.290	5.680	5.330	unknown
279	WAA_SSS_400kHz_HumpbackRock_0073	57.7080922	-152.2109643	2.940	10.540	2.890	3.970	unknown
280	WAA_SSS_400kHz_HumpbackRock_0074	57.7080827	-152.2453611	1.810	10.890	8.010	2.560	unknown
281	WAA_SSS_400kHz_HumpbackRock_0075	57.7079023	-152.2462965	2.870	7.910	3.320	3.580	unknown
282	WAA_SSS_400kHz_HumpbackRock_0076	57.7075417	-152.2184133	4.300	8.750	5.360	5.040	unknown
284	WAA_SSS_400kHz_HumpbackRock_0078	57.7073436	-152.2464682	1.370	9.650	1.630	2.610	unknown
286	WAA_SSS_400kHz_HumpbackRock_0080	57.7070016	-152.2156732	2.260	8.690	2.410	4.030	unknown
287	WAA_SSS_400kHz_HumpbackRock_0081	57.7069707	-152.2158740	2.800	12.390	1.980	3.100	unknown
288	WAA_SSS_400kHz_HumpbackRock_0082	57.7067281	-152.2451341	1.300	10.460	2.830	1.490	unknown
289	WAA_SSS_400kHz_HumpbackRock_0083	57.7064064	-152.2154344	2.530	4.660	3.570	3.880	unknown
290	WAA_SSS_400kHz_HumpbackRock_0084	57.7062763	-152.2490629	2.370	15.070	6.820	3.030	unknown
291	WAA_SSS_400kHz_HumpbackRock_0085	57.7062236	-152.2465178	1.690	21.470	5.820	2.330	unknown
292	WAA_SSS_400kHz_HumpbackRock_0086	57.7055964	-152.2496341	2.280	8.190	3.640	2.850	unknown
293	WAA_SSS_400kHz_HumpbackRock_0087	57.7055526	-152.2511354	1.380	8.270	5.740	3.230	unknown
294	WAA_SSS_400kHz_HumpbackRock_0088	57.7051204	-152.2507342	3.390	5.250	4.220	5.050	unknown
296	WAA_SSS_400kHz_HumpbackRock_0090	57.7040354	-152.2486091	4.120	8.510	6.360	4.880	unknown
297	WAA_SSS_400kHz_HumpbackRock_0091	57.7038760	-152.2477611	1.400	16.300	1.310	1.750	unknown
298	WAA_SSS_400kHz_HumpbackRock_0092	57.7005974	-152.2651379	1.130	11.140	2.070	2.070	unknown
299	WAA_SSS_400kHz_LongIslandChiniakBay-0001	57.7702492	-152.2269186	1.910	20.400	2.450	4.090	unknown
300	WAA_SSS_400kHz_LongIslandChiniakBay-0002	57.7701217	-152.2259406	1.400	10.420	2.290	1.800	unknown
301	WAA_SSS_400kHz_LongIslandChiniakBay-0003	57.7699790	-152.2261049	2.490	12.470	2.430	2.700	unknown
302	WAA_SSS_400kHz_LongIslandChiniakBay-0004	57.7693702	-152.2286614	3.000	17.740	6.790	6.030	unknown

303	WAA_SSS_400kHz_LongIslandChiniakBay-0005	57.7683827	-152.2287697	2.380	7.340	4.630	5.020	unknown
304	WAA_SSS_400kHz_LongIslandChiniakBay-0006	57.7683188	-152.2111107	2.570	12.800	4.170	3.540	unknown
305	WAA_SSS_400kHz_LongIslandChiniakBay-0007	57.7669832	-152.2378503	1.420	19.110	10.690	3.720	unknown
306	WAA_SSS_400kHz_LongIslandChiniakBay-0008	57.7668431	-152.2429786	3.140	119.810	11.900	11.050	unknown
307	WAA_SSS_400kHz_LongIslandChiniakBay-0009	57.7664668	-152.2263142	0.930	25.790	8.420	2.950	unknown
308	WAA_SSS_400kHz_LongIslandChiniakBay-0010	57.7662416	-152.2108846	1.700	42.510	5.470	2.600	piling
309	WAA_SSS_400kHz_LongIslandChiniakBay-0011	57.7662229	-152.2107342	2.620	11.820	6.110	3.920	unknown
311	WAA_SSS_400kHz_LongIslandChiniakBay-0013	57.7656319	-152.2367873	2.050	8.860	7.550	3.420	unknown
315	WAA_SSS_400kHz_LongIslandChiniakBay-0017	57.7646291	-152.2490905	2.110	13.330	9.290	2.700	unknown
316	WAA_SSS_400kHz_LongIslandChiniakBay-0018	57.7645968	-152.2381063	2.340	25.070	14.440	4.790	unknown
318	WAA_SSS_400kHz_LongIslandChiniakBay-0020	57.7638035	-152.2149982	2.520	15.740	5.240	5.970	unknown
320	WAA_SSS_400kHz_LongIslandChiniakBay-0022	57.7637749	-152.2364924	2.950	25.290	7.510	6.990	unknown
322	WAA_SSS_400kHz_LongIslandChiniakBay-0024	57.7635523	-152.2197747	3.680	21.820	8.900	4.190	unknown
323	WAA_SSS_400kHz_LongIslandChiniakBay-0025	57.7635507	-152.2196477	2.520	16.340	3.440	2.920	unknown
324	WAA_SSS_400kHz_LongIslandChiniakBay-0026	57.7635244	-152.2310009	3.080	11.680	13.000	8.960	unknown
325	WAA_SSS_400kHz_LongIslandChiniakBay-0027	57.7635154	-152.2197971	0.850	25.230	2.300	1.840	piling
326	WAA_SSS_400kHz_LongIslandChiniakBay-0028	57.7632898	-152.2142039	4.150	9.530	5.830	8.790	unknown
327	WAA_SSS_400kHz_LongIslandChiniakBay-0029	57.7632292	-152.2199355	5.090	10.330	3.920	9.350	unknown
328	WAA_SSS_400kHz_LongIslandChiniakBay-0030	57.7630228	-152.2339996	0.990	14.860	3.750	2.790	unknown
329	WAA_SSS_400kHz_LongIslandChiniakBay-0031	57.7629118	-152.2079757	1.300	19.480	6.110	3.600	unknown
330	WAA_SSS_400kHz_LongIslandChiniakBay-0032	57.7628529	-152.2214187	2.230	13.840	3.780	4.610	unknown
331	WAA_SSS_400kHz_LongIslandChiniakBay-0033	57.7628044	-152.2249803	2.260	15.420	4.900	3.950	unknown
332	WAA_SSS_400kHz_LongIslandChiniakBay-0034	57.7627957	-152.2120003	4.840	23.040	4.960	6.030	unknown
333	WAA_SSS_400kHz_LongIslandChiniakBay-0035	57.7627543	-152.2107804	3.110	16.620	3.330	4.750	unknown
334	WAA_SSS_400kHz_LongIslandChiniakBay-0036	57.7627142	-152.2106535	2.420	16.180	5.240	3.340	unknown
335	WAA_SSS_400kHz_LongIslandChiniakBay-0037	57.7626847	-152.2127998	3.510	15.410	5.510	9.830	unknown
336	WAA_SSS_400kHz_LongIslandChiniakBay-0038	57.7626682	-152.2337890	4.700	35.060	14.600	12.950	unknown
337	WAA_SSS_400kHz_LongIslandChiniakBay-0039	57.7626133	-152.2125816	4.190	12.710	7.160	10.330	unknown
338	WAA_SSS_400kHz_LongIslandChiniakBay-0040	57.7625798	-152.2127034	2.800	14.460	3.130	6.650	unknown
339	WAA_SSS_400kHz_LongIslandChiniakBay-0041	57.7625023	-152.2366512	1.290	8.980	2.840	3.310	unknown
341	WAA_SSS_400kHz_LongIslandChiniakBay-0043	57.7622726	-152.2362627	1.500	8.140	2.810	3.840	unknown
342	WAA_SSS_400kHz_LongIslandChiniakBay-0044	57.7618001	-152.2080339	2.530	18.370	2.950	2.800	unknown
343	WAA_SSS_400kHz_LongIslandChiniakBay-0045	57.7617106	-152.2071950	4.220	7.700	4.290	6.160	unknown
345	WAA_SSS_400kHz_LongIslandChiniakBay-0047	57.7615914	-152.2353060	2.640	7.290	4.310	4.230	unknown
346	WAA_SSS_400kHz_LongIslandChiniakBay-0048	57.7615550	-152.2074811	1.760	18.460	4.270	2.840	unknown
347	WAA_SSS_400kHz_LongIslandChiniakBay-0049	57.7615462	-152.2122867	3.130	13.520	5.470	6.190	unknown
348	WAA_SSS_400kHz_LongIslandChiniakBay-0050	57.7614973	-152.2078847	1.400	36.670	5.110	2.280	unknown
349	WAA_SSS_400kHz_LongIslandChiniakBay-0051	57.7614127	-152.2146486	2.220	12.840	1.930	2.710	unknown
350	WAA_SSS_400kHz_LongIslandChiniakBay-0052	57.7613564	-152.2312386	4.110	6.650	6.190	5.280	unknown
351	WAA_SSS_400kHz_LongIslandChiniakBay-0053	57.7612914	-152.2406873	1.810	36.750	12.380	6.010	tires
352	WAA_SSS_400kHz_LongIslandChiniakBay-0054	57.7612382	-152.2102996	3.390	12.800	4.690	4.610	unknown
353	WAA_SSS_400kHz_LongIslandChiniakBay-0055	57.7610838	-152.2392371	4.660	10.330	6.010	5.670	unknown
354	WAA_SSS_400kHz_LongIslandChiniakBay-0056	57.7608057	-152.2394652	3.210	16.900	5.340	3.670	unknown
355	WAA_SSS_400kHz_LongIslandChiniakBay-0057	57.7607483	-152.2229478	3.530	10.120	3.640	9.700	unknown
356	WAA_SSS_400kHz_LongIslandChiniakBay-0058	57.7605544	-152.2256592	2.730	6.930	6.050	3.180	unknown
357	WAA_SSS_400kHz_LongIslandChiniakBay-0059	57.7604421	-152.2212054	1.030	12.240	2.860	2.450	unknown
359	WAA_SSS_400kHz_LongIslandChiniakBay-0061	57.7600840	-152.2254543	0.780	19.980	2.040	1.630	piling
361	WAA_SSS_400kHz_LongIslandChiniakBay-0063	57.7593855	-152.2450338	4.230	5.890	3.470	9.630	unknown
362	WAA_SSS_400kHz_LongIslandChiniakBay-0064	57.7591226	-152.2448374	1.340	10.870	2.950	2.500	unknown
363	WAA_SSS_400kHz_LongIslandChiniakBay-0065	57.7590047	-152.2374992	2.160	18.090	18.140	2.950	cluster
364	WAA_SSS_400kHz_LongIslandChiniakBay-0066	57.7587830	-152.2482789	3.250	8.610	4.310	7.830	unknown
365	WAA_SSS_400kHz_LongIslandChiniakBay-0067	57.7584549	-152.2332766	2.980	14.660	3.130	6.580	unknown
367	WAA_SSS_400kHz_LongIslandChiniakBay-0069	57.7583575	-152.2345403	3.210	12.570	3.340	5.430	unknown
368	WAA_SSS_400kHz_LongIslandChiniakBay-0070	57.7583535	-152.2247627	3.160	14.000	2.650	9.570	unknown
369	WAA_SSS_400kHz_LongIslandChiniakBay-0071	57.7583337	-152.2342779	1.960	13.380	2.540	2.920	unknown
370	WAA_SSS_400kHz_LongIslandChiniakBay-0072	57.7582196	-152.2243066	1.180	14.040	1.800	4.370	piling
371	WAA_SSS_400kHz_LongIslandChiniakBay-0073	57.7581826	-152.2340236	3.750	12.080	5.080	4.170	unknown
372	WAA_SSS_400kHz_LongIslandChiniakBay-0074	57.7581754	-152.2271677	2.050	11.210	3.180	2.700	unknown
373	WAA_SSS_400kHz_LongIslandChiniakBay-0075	57.7579800	-152.2311780	2.610	7.790	2.280	3.190	unknown
375	WAA_SSS_400kHz_LongIslandChiniakBay-0077	57.7573835	-152.2450222	3.650	3.500	2.850	7.650	unknown
376	WAA_SSS_400kHz_LongIslandChiniakBay-0078	57.7573550	-152.2405427	3.300	12.280	6.140	5.260	unknown
377	WAA_SSS_400kHz_LongIslandChiniakBay-0079	57.7572654	-152.2410541	2.420	11.110	3.950	5.140	unknown
378	WAA_SSS_400kHz_LongIslandChiniakBay-0080	57.7572431	-152.2343841	3.250	8.260	3.650	3.620	unknown
379	WAA_SSS_400kHz_LongIslandChiniakBay-0081	57.7571173	-152.2400540	2.050	21.470	4.390	5.260	piling
380	WAA_SSS_400kHz_LongIslandChiniakBay-0082	57.7570810	-152.2409361	3.090	13.710	3.460	4.720	unknown
381	WAA_SSS_400kHz_LongIslandChiniakBay-0083	57.7569478	-152.2425353	2.290	18.300	2.230	4.020	piling
382	WAA_SSS_400kHz_LongIslandChiniakBay-0084	57.7564239	-152.2409698	2.860	14.060	4.170	4.840	unknown
383	WAA_SSS_400kHz_LongIslandChiniakBay-0085	57.7562477	-152.2458783	3.130	128.870	13.640	13.080	unknown
385	WAA_SSS_400kHz_LongIslandChiniakBay-0087	57.7560152	-152.2419408	0.760	13.900	1.790	1.790	unknown
386	WAA_SSS_400kHz_LongIslandChiniakBay-0088	57.7559960	-152.2454915	1.300	9.370	2.440	3.020	unknown
387	WAA_SSS_400kHz_LongIslandChiniakBay-0089	57.7559583	-152.2425159	1.600	21.420	2.670	3.570	piling
388	WAA_SSS_400kHz_LongIslandChiniakBay-0090	57.7556424	-152.2480648	1.780	11.350	1.680	4.610	unknown
389	WAA_SSS_400kHz_LongIslandChiniakBay-0091	57.7556072	-152.2476962	2.120	9.230	2.970	6.290	unknown
390	WAA_SSS_400kHz_LongIslandChiniakBay-0092	57.7553466	-152.2466098	3.740	6.850	3.520	7.210	unknown
391	WAA_SSS_400kHz_LongIslandChiniakBay-0093	57.7551680	-152.2475956	3.320	10.350	2.950	3.520	unknown
392	WAA_SSS_400kHz_LongIslandChiniakBay-0094	57.7551527	-152.2486045	0.980	14.310	6.020	2.310	unknown
393	WAA_SSS_400kHz_LongIslandChiniakBay-0095	57.7551138	-152.2479211	2.640	11.690	4.690	5.160	unknown
395	WAA_SSS_400kHz_LongIslandChiniakBay-0097	57.7550417	-152.2460825	2.300	10.690	3.420	4.500	unknown
396	WAA_SSS_400kHz_LongIslandChiniakBay-0098	57.7548279	-152.2470117	1.170	14.430	1.940	2.240	unknown
397	WAA_SSS_400kHz_LongIslandChiniakBay-0099	57.7547336	-152.2467731	1.370	6.540	4.410	3.340	unknown
398	WAA_SSS_400kHz_LongIslandChiniakBay-0100	57.7547095	-152.2472188	2.590	8.040	3.210	5.780	unknown
400	WAA_SSS_400kHz_LongIslandChiniakBay-0102	57.7546915	-152.2469372	3.230	14.340	2.230	7.980	unknown
401	WAA_SSS_400kHz_LongIslandChiniakBay-0103	57.7546676	-152.2487274	2.630	7.440	3.800	3.770	unknown
402	WAA_SSS_400kHz_LongIslandChiniakBay-0104	57.7544607	-152.2475916	2.560	7.740	4.360	7.370	unknown
403	WAA_SSS_400kHz_LongIslandChiniakBay-0105	57.7543559	-152.2484857	2.480	3.700	2.990	6.350	unknown
404	WAA_SSS_400kHz_LongIslandArmyDock_0001	57.7716936	-152.2745764	1.010	2.960	2.750	5.180	unknown
405	WAA_SSS_400kHz_LongIslandArmyDock_0002	57.7716785	-152.2745463	0.910	2.210	1.510	4.650	unknown
406	WAA_SSS_400kHz_LongIslandArmyDock_0003	57.7716602	-152.2745309	0.790	2.230	1.490	3.950	unknown
407	WAA_SSS_400kHz_LongIslandArmyDock_0004	57.7716388	-152.2745153	0.730	2.490	1.780	3.370	unknown
408	WAA_SSS_400kHz_LongIslandArmyDock_0005	57.7715397	-152.2741386	1.550	3.130	2.460	3.770	unknown

409	WAA_SSS_400kHz_LongIslandArmyDock_0006	57.7714355	-152.2741455	1.160	4.880	1.170	1.950	unknown
410	WAA_SSS_400kHz_LongIslandArmyDock_0007	57.7713497	-152.2741030	1.650	2.730	2.150	2.080	unknown
412	WAA_SSS_400kHz_LongIslandArmyDock_0009	57.7705890	-152.2753280	0.380	7.020	1.840	3.490	unknown
413	WAA_SSS_400kHz_LongIslandArmyDock_0010	57.7704973	-152.2753411	0.880	13.970	3.280	5.240	unknown
415	WAA_SSS_400kHz_LongIslandArmyDock_0012	57.7704448	-152.2739460	0.000	19.010	1.070	0.000	unknown
416	WAA_SSS_400kHz_LongIslandArmyDock_0013	57.7701995	-152.2756873	0.490	7.630	1.670	4.570	unknown
417	WAA_SSS_400kHz_LongIslandArmyDock_0014	57.7696084	-152.2749201	0.500	8.480	2.670	6.660	unknown
418	WAA_SSS_400kHz_LongIslandArmyDock_0015	57.7695864	-152.2764523	3.250	5.150	1.980	12.900	unknown
419	WAA_SSS_400kHz_LongIslandArmyDock_0016	57.7695846	-152.2760294	0.460	12.710	2.630	1.750	unknown
420	WAA_SSS_400kHz_LongIslandArmyDock_0017	57.7695129	-152.2746978	1.340	7.050	1.190	1.680	unknown
421	WAA_SSS_400kHz_LongIslandArmyDock_0018	57.7694755	-152.2763726	0.000	8.910	1.170	0.000	piling
422	WAA_SSS_400kHz_LongIslandArmyDock_0019	57.7693245	-152.2719676	2.430	4.410	1.100	45.530	piling
423	WAA_SSS_400kHz_LongIslandArmyDock_0020	57.7692634	-152.2729248	0.790	3.130	2.670	3.770	unknown
424	WAA_SSS_400kHz_LongIslandArmyDock_0021	57.7692486	-152.2752959	0.330	9.310	2.760	1.470	unknown
425	WAA_SSS_400kHz_LongIslandArmyDock_0022	57.7692368	-152.2733443	0.780	24.360	4.220	6.750	unknown
426	WAA_SSS_400kHz_LongIslandArmyDock_0023	57.7692146	-152.2751780	0.370	5.560	1.530	1.680	unknown
428	WAA_SSS_400kHz_LWIsland0002	57.7877918	-152.2894373	3.560	4.560	3.740	5.690	mine like object
429	WAA_SSS_400kHz_LWIsland0003	57.7877865	-152.2967429	0.920	20.820	10.690	1.780	unknown
430	WAA_SSS_400kHz_LWIsland0004	57.7876435	-152.2962895	1.930	14.010	4.930	2.490	unknown
431	WAA_SSS_400kHz_LWIsland0005	57.7874810	-152.2969511	1.070	15.210	2.220	2.170	mine like object
432	WAA_SSS_400kHz_LWIsland0006	57.7866833	-152.2984995	2.970	12.550	4.260	4.770	mine like object
433	WAA_SSS_400kHz_LWIsland0007	57.7863717	-152.2997938	2.130	15.980	2.760	5.530	unknown
434	WAA_SSS_400kHz_LWIsland0008	57.7861932	-152.2951805	1.170	20.600	4.360	2.180	unknown
435	WAA_SSS_400kHz_LWIsland0009	57.7861594	-152.2923654	2.870	4.380	2.910	3.300	unknown
436	WAA_SSS_400kHz_LWIsland0010	57.7856494	-152.2942726	1.630	6.390	5.030	3.200	mine like object
437	WAA_SSS_400kHz_LWIsland0011	57.7852035	-152.2894367	1.870	15.400	5.490	3.800	unknown
438	WAA_SSS_400kHz_LWIsland0012	57.7842613	-152.2918267	1.220	6.530	3.140	1.730	mine like object
439	WAA_SSS_400kHz_LWIsland0013	57.7831916	-152.3005579	1.000	10.880	4.720	2.540	unknown
441	WAA_SSS_400kHz_LWIsland0015	57.7824063	-152.3067739	4.510	6.170	5.310	9.970	mine like object
442	WAA_SSS_400kHz_LWIsland0016	57.7821128	-152.2977375	2.840	18.510	13.190	3.180	unknown
443	WAA_SSS_400kHz_LWIsland0017	57.7820391	-152.3071299	4.950	13.210	7.570	13.250	unknown
444	WAA_SSS_400kHz_LWIsland0018	57.7819036	-152.3064600	2.190	9.520	4.780	4.760	unknown
445	WAA_SSS_400kHz_LWIsland0019	57.7815047	-152.2989829	0.970	4.360	2.380	1.590	mine like object
446	WAA_SSS_400kHz_LWIsland0020	57.7814820	-152.3070362	2.990	5.610	6.170	4.620	mine like object
447	WAA_SSS_400kHz_LWIsland0021	57.7804615	-152.2964506	2.460	6.990	6.920	3.560	unknown
448	WAA_SSS_400kHz_LWIsland0022	57.7795887	-152.2972573	1.570	8.720	5.990	1.940	unknown
449	WAA_SSS_400kHz_LWIsland0023	57.7795316	-152.2972965	3.460	9.220	6.370	4.360	unknown
450	WAA_SSS_400kHz_LWIsland0024	57.7791691	-152.3027439	2.060	20.250	2.900	4.140	unknown
452	WAA_SSS_400kHz_LWIsland0026	57.7739758	-152.3106909	0.920	18.030	1.920	2.260	unknown
453	WAA_SSS_400kHz_LWIsland0027	57.7736052	-152.2971665	2.300	15.380	8.300	4.640	unknown
454	WAA_SSS_400kHz_LWIsland0028	57.7735511	-152.2972010	2.310	8.080	7.190	4.650	unknown
455	WAA_SSS_400kHz_LWIsland0029	57.7732951	-152.3009222	1.370	5.560	2.890	2.260	unknown
456	WAA_SSS_400kHz_LWIsland0030	57.7728586	-152.3042615	1.960	8.700	7.570	2.890	unknown
457	WAA_SSS_400kHz_LWIsland0031	57.7727593	-152.3022013	0.000	14.140	4.720	4.690	unknown
458	WAA_SSS_400kHz_LWIsland0032	57.7726078	-152.2980905	2.280	6.300	6.650	4.060	unknown
459	WAA_SSS_400kHz_LWIsland0033	57.7723141	-152.3046939	1.610	17.550	10.290	2.690	unknown
460	WAA_SSS_400kHz_LWIsland0034	57.7705840	-152.3010924	1.180	9.820	2.640	1.510	unknown
461	WAA_SSS_400kHz_LWIsland0035	57.7703272	-152.3072078	1.250	3.110	1.560	1.790	mine like object
462	WAA_SSS_400kHz_LWIsland0036	57.7702481	-152.3034478	0.000	5.000	5.820	5.710	fish trap
463	WAA_SSS_400kHz_LWIsland0037	57.7697656	-152.3012085	3.740	13.440	8.750	4.510	unknown
464	WAA_SSS_400kHz_LWIsland0038	57.7696763	-152.3097895	0.900	12.460	2.880	2.880	unknown
465	WAA_SSS_400kHz_LWIsland0039	57.7692813	-152.3035122	0.800	12.620	1.520	1.140	unknown
466	WAA_SSS_400kHz_LWIsland0040	57.7690873	-152.3180143	2.650	12.570	2.590	5.610	unknown
467	WAA_SSS_400kHz_LWIsland0041	57.7690333	-152.3027359	1.440	20.550	2.380	3.370	unknown
468	WAA_SSS_400kHz_LWIsland0042	57.7689828	-152.3097291	1.280	8.740	2.350	1.840	mine like object
469	WAA_SSS_400kHz_LWIsland0043	57.7689724	-152.3036755	1.220	5.040	2.720	3.100	mine like object
470	WAA_SSS_400kHz_LWIsland0044	57.7688914	-152.3139273	2.430	8.630	8.090	7.010	mine like object
472	WAA_SSS_400kHz_LWIsland0046	57.7679939	-152.3033781	3.440	9.930	3.290	4.090	unknown
473	WAA_SSS_400kHz_LWIsland0047	57.7679294	-152.3080918	1.690	6.400	4.080	1.980	mine like object
474	WAA_SSS_400kHz_LWIsland0048	57.7677088	-152.3108044	2.600	8.250	5.650	8.260	mine like object
475	WAA_SSS_400kHz_LWIsland0049	57.7676074	-152.3111422	2.320	4.390	3.210	5.840	mine like object
476	WAA_SSS_400kHz_LWIsland0050	57.7672442	-152.3094064	2.980	14.460	10.880	8.040	fish trap
477	WAA_SSS_400kHz_LWIsland0051	57.7671378	-152.2989055	1.640	8.690	8.440	6.490	fish trap
478	WAA_SSS_400kHz_LWIsland0052	57.7666603	-152.3024978	1.910	4.190	3.640	6.360	unknown
479	WAA_SSS_400kHz_LWIsland0053	57.7656889	-152.3061797	1.050	15.620	2.520	3.530	unknown
480	WAA_SSS_400kHz_LWIsland0054	57.7655998	-152.3066943	1.210	17.800	15.240	3.040	unknown
481	WAA_SSS_400kHz_LWIsland0055	57.7655359	-152.3205704	1.160	11.040	4.790	5.140	unknown
482	WAA_SSS_400kHz_LWIsland0056	57.7645532	-152.3212463	3.050	14.240	7.530	11.040	unknown
483	WAA_SSS_400kHz_LWIsland0057	57.7645402	-152.3020590	1.980	21.350	7.510	8.090	unknown
484	WAA_SSS_400kHz_LWIsland0058	57.7644576	-152.3207818	2.800	7.150	7.130	5.140	fish trap
485	WAA_SSS_400kHz_LWIsland0059	57.7642984	-152.3128207	0.480	6.860	4.210	2.170	mine like object
486	WAA_SSS_400kHz_LWIsland0060	57.7639457	-152.3133933	1.050	5.810	5.430	4.890	mine like object
487	WAA_SSS_400kHz_LWIsland0061	57.7632772	-152.3214317	2.450	9.560	9.560	7.300	fish trap
488	WAA_SSS_400kHz_LWIsland0062	57.7625434	-152.3082031	2.950	6.190	5.060	5.060	unknown
489	WAA_SSS_400kHz_LWIsland0063	57.7624644	-152.3266554	2.650	5.570	5.440	5.320	mine like object
490	WAA_SSS_400kHz_LWIsland0064	57.7622182	-152.3272617	2.120	7.230	7.200	2.880	fish trap
493	WAA_SSS_400kHz_LWIsland0067	57.7614008	-152.3205124	2.910	8.730	7.140	10.010	fish trap
494	WAA_SSS_400kHz_LWIsland0068	57.7613887	-152.3197326	2.730	7.040	5.070	7.670	unknown
495	WAA_SSS_400kHz_LWIsland0069	57.7613280	-152.3157740	3.020	6.090	5.640	7.410	unknown
496	WAA_SSS_400kHz_LWIsland0070	57.7612685	-152.3208730	2.030	4.750	2.670	5.640	unknown
497	WAA_SSS_400kHz_LWIsland0071	57.7609393	-152.3202334	2.370	7.210	6.720	7.840	fish trap
498	WAA_SSS_400kHz_LWIsland0072	57.7609030	-152.3217314	1.590	5.570	4.780	4.950	mine like object
499	WAA_SSS_400kHz_LWIsland0073	57.7605685	-152.3171036	2.770	16.490	6.550	7.770	unknown
502	WAA_SSS_400kHz_LWIsland0076	57.7585642	-152.3177325	2.600	9.340	4.500	5.730	unknown
503	WAA_SSS_400kHz_LWIsland0077	57.7583331	-152.3236918	0.000	6.400	1.600	1.600	mine like object
504	WAA_SSS_400kHz_LWIsland0078	57.7578461	-152.3344285	3.050	5.610	4.940	5.890	fish trap
505	WAA_SSS_400kHz_LWIsland0079	57.7577935	-152.3190377	1.770	11.520	6.420	3.580	unknown
506	WAA_SSS_400kHz_LWIsland0080	57.7563555	-152.3219128	1.520	3.840	3.030	2.570	mine like object
507	WAA_SSS_400kHz_LWIsland0081	57.7557026	-152.3294100	1.040	7.750	2.170	1.490	mine like object
508	WAA_SSS_400kHz_LWIsland0082	57.7556526	-152.3280856	1.720	2.510	2.520	2.190	mine like object

509	WAA_SSS_400kHz_LWIsland0083	57.7555140	-152.3292432	1.180	6.180	2.920	2.060	mine like object
510	WAA_SSS_400kHz_LWIsland0084	57.7554719	-152.3232014	1.280	7.100	2.710	2.240	mine like object
511	WAA_SSS_400kHz_LWIsland0085	57.7552931	-152.3264710	0.000	9.870	1.290	1.720	unknown
512	WAA_SSS_400kHz_LWIsland0086	57.7550458	-152.3300410	1.390	10.270	3.070	1.620	unknown
513	WAA_SSS_400kHz_LWIsland0087	57.7521458	-152.3242039	1.060	6.690	3.340	2.380	unknown
514	WAA_SSS_400kHz_LWIsland0088	57.7521243	-152.3249979	3.030	12.530	9.560	4.660	unknown
515	WAA_SSS_400kHz_LWIsland0089	57.7521153	-152.3242658	1.440	10.900	4.740	3.320	unknown
516	WAA_SSS_400kHz_LWIsland0090	57.7512581	-152.3286494	0.000	0.000	0.000	0.000	
517	WAA_SSS_400kHz_LWIsland0091	57.7505987	-152.3309790	1.400	4.850	1.390	1.760	unknown
518	WAA_SSS_400kHz_LWIsland0092	57.7499280	-152.3343510	4.270	6.400	5.120	4.480	mine like object
519	WAA__SSS_400KHz_MidwayPoint_0001	57.6686256	-152.2544628	1.580	16.960	6.130	2.440	unknown
520	WAA__SSS_400KHz_MidwayPoint_0002	57.6686008	-152.2540883	2.910	9.660	7.130	3.670	unknown
522	WAA__SSS_400KHz_MidwayPoint_0004	57.6661446	-152.2541705	1.670	16.180	2.390	2.990	unknown
523	WAA__SSS_400KHz_MidwayPoint_0005	57.6661010	-152.2562878	3.140	6.760	6.150	4.280	unknown
524	WAA__SSS_400KHz_MidwayPoint_0006	57.6659382	-152.2540491	2.620	10.210	3.190	2.960	unknown
525	WAA__SSS_400KHz_MidwayPoint_0007	57.6654318	-152.2568132	3.950	8.680	3.430	8.500	unknown
527	WAA__SSS_400KHz_MidwayPoint_0009	57.6639811	-152.2595839	4.950	23.030	1.980	11.200	unknown
528	WAA__SSS_400KHz_MidwayPoint_0010	57.6636508	-152.2631785	3.600	35.520	12.670	5.470	unknown
529	WAA__SSS_400KHz_MidwayPoint_0011	57.6631870	-152.2550568	4.300	25.390	17.410	4.970	unknown
530	WAA__SSS_400KHz_MidwayPoint_0012	57.6627582	-152.2618028	1.960	6.160	3.130	4.300	mine like object
531	WAA__SSS_400KHz_MidwayPoint_0013	57.6627429	-152.2594333	4.370	15.910	8.590	5.510	unknown
532	WAA__SSS_400KHz_MidwayPoint_0014	57.6627116	-152.2629974	2.050	37.060	12.990	3.040	unknown
533	WAA__SSS_400KHz_MidwayPoint_0015	57.6622841	-152.2614984	3.240	16.230	6.860	4.350	unknown
534	WAA__SSS_400KHz_MidwayPoint_0016	57.6622775	-152.2586995	4.580	20.620	7.900	9.110	unknown
537	WAA__SSS_400KHz_MidwayPoint_0019	57.6617285	-152.2558813	1.980	13.560	3.080	3.080	unknown
539	WAA__SSS_400KHz_MidwayPoint_0021	57.6610850	-152.2642592	0.940	30.300	12.880	2.680	unknown
540	WAA__SSS_400KHz_MidwayPoint_0022	57.6608694	-152.2598009	3.510	11.480	2.420	7.260	unknown
541	WAA__SSS_400KHz_MidwayPoint_0023	57.6608675	-152.2587917	0.390	21.700	1.380	1.240	unknown
542	WAA__SSS_400KHz_MidwayPoint_0024	57.6608566	-152.2600120	1.700	12.680	13.820	4.600	unknown
543	WAA__SSS_400KHz_MidwayPoint_0025	57.6604692	-152.2646165	1.500	30.760	11.240	2.490	unknown
544	WAA__SSS_400KHz_MidwayPoint_0026	57.6604513	-152.2631376	4.610	10.260	6.960	8.320	unknown
545	WAA__SSS_400KHz_MidwayPoint_0027	57.6604099	-152.2632192	2.320	13.390	11.780	5.390	unknown
546	WAA__SSS_400KHz_MidwayPoint_0028	57.6603512	-152.2639796	1.430	20.200	2.930	2.880	unknown
547	WAA__SSS_400KHz_MidwayPoint_0029	57.6591055	-152.2617261	2.620	12.180	8.080	4.030	unknown
548	WAA__SSS_400KHz_MidwayPoint_0030	57.6588176	-152.2609655	1.980	15.760	3.640	3.040	unknown
549	WAA__SSS_400KHz_MidwayPoint_0031	57.6581733	-152.2598507	3.670	16.260	9.850	6.140	unknown
550	WAA__SSS_400KHz_MidwayPoint_0032	57.6580640	-152.2645227	2.530	49.820	18.430	4.300	unknown
552	WAA__SSS_400KHz_MidwayPoint_0034	57.6572531	-152.2617730	2.380	11.280	8.490	4.840	fish trap
553	WAA__SSS_400KHz_MidwayPoint_0035	57.6569469	-152.2653761	1.820	5.200	5.190	2.520	mine like object
554	WAA__SSS_400KHz_MidwayPoint_0036	57.6568855	-152.2667235	3.510	19.990	15.200	4.580	fish trap
555	WAA__SSS_400KHz_MidwayPoint_0037	57.6568631	-152.2682348	2.180	11.690	7.080	3.540	unknown
556	WAA__SSS_400KHz_MidwayPoint_0038	57.6566267	-152.2622578	4.510	13.430	9.890	6.070	unknown
557	WAA__SSS_400KHz_MidwayPoint_0039	57.6563132	-152.2656800	1.960	12.880	5.890	4.690	unknown
558	WAA__SSS_400KHz_MidwayPoint_0040	57.6562366	-152.2603992	2.730	12.430	3.160	4.330	unknown
559	WAA__SSS_400KHz_MidwayPoint_0041	57.6560265	-152.2648125	3.740	11.880	5.940	5.940	unknown
560	WAA__SSS_400KHz_MidwayPoint_0042	57.6557197	-152.2634876	2.340	15.160	12.760	3.790	unknown
561	WAA__SSS_400KHz_MidwayPoint_0043	57.6555447	-152.2642763	2.860	4.690	3.490	4.650	mine like object
562	WAA__SSS_400KHz_MidwayPoint_0044	57.6490482	-152.2775577	0.880	11.260	2.670	1.050	unknown
563	WAA__SSS_400KHz_MidwayPoint_0045	57.6488614	-152.2739618	2.090	15.230	7.990	2.860	unknown
564	WAA__SSS_400KHz_MidwayPoint_0046	57.6483555	-152.2662241	1.960	14.140	2.420	2.340	unknown
565	WAA__SSS_400KHz_MidwayPoint_0047	57.6475022	-152.2721316	0.000	15.200	1.930	0.000	unknown
566	WAA__SSS_400KHz_MidwayPoint_0048	57.6474105	-152.2759718	1.790	7.720	6.030	3.780	unknown
567	WAA__SSS_400KHz_MidwayPoint_0049	57.6472171	-152.2696446	0.920	12.110	0.900	1.350	unknown
568	WAA__SSS_400KHz_MidwayPoint_0050	57.6471275	-152.2701851	0.590	50.740	1.910	1.210	unknown
569	WAA__SSS_400KHz_MidwayPoint_0051	57.6467571	-152.2695265	2.560	4.750	1.960	3.840	unknown
570	WAA__SSS_400KHz_MidwayPoint_0052	57.6455548	-152.2809741	4.210	11.310	5.200	4.590	unknown
571	WAA__SSS_400KHz_MidwayPoint_0053	57.6455477	-152.2643146	1.630	9.130	5.880	1.810	unknown
572	WAA__SSS_400KHz_MidwayPoint_0054	57.6454877	-152.2623484	1.910	10.820	3.170	3.590	unknown
573	WAA__SSS_400KHz_MidwayPoint_0055	57.6453874	-152.2573044	1.380	5.580	3.260	2.330	unknown
575	WAA__SSS_400KHz_MidwayPoint_0057	57.6452119	-152.2766544	3.030	10.110	3.400	3.360	unknown
576	WAA__SSS_400KHz_MidwayPoint_0058	57.6445908	-152.2594680	2.110	9.300	1.880	5.030	unknown
577	WAA__SSS_400KHz_MidwayPoint_0059	57.6444454	-152.2594668	1.600	14.410	2.740	2.740	unknown
578	WAA__SSS_400KHz_MidwayPoint_0060	57.6444255	-152.2468740	3.030	29.720	2.830	4.660	unknown
583	WAA__SSS_400KHz_MidwayPoint_0065	57.6436868	-152.2607602	3.130	23.950	5.170	6.810	unknown
584	WAA__SSS_400KHz_MidwayPoint_0066	57.6430073	-152.2656049	3.330	10.980	3.030	7.180	unknown
585	WAA__SSS_400KHz_MidwayPoint_0067	57.6406250	-152.2356924	1.490	5.900	4.640	2.450	mine like object
586	WAA_SSS_400kHz_NavyDock2_0001	57.7350085	-152.5088408	1.440	4.700	3.160	13.280	unknown
587	WAA_SSS_400kHz_NavyDock2_0002	57.7346984	-152.5084611	0.920	4.750	2.820	2.510	unknown
588	WAA_SSS_400kHz_NavyDock2_0003	57.7346384	-152.5083499	0.260	3.380	2.650	3.730	unknown
589	WAA_SSS_400kHz_NavyDock2_0004	57.7344497	-152.5093319	0.990	3.060	2.480	3.340	unknown
590	WAA_SSS_400kHz_NavyDock2_0005	57.7338814	-152.5091902	0.900	6.730	3.420	8.580	unknown
591	WAA_SSS_400kHz_NavyDock2_0006	57.7337779	-152.5073756	1.030	4.150	3.400	2.390	mine like object
592	WAA_SSS_400kHz_NavyDock2_0007	57.7337339	-152.5104668	0.470	23.120	13.580	4.430	unknown
593	WAA_SSS_400kHz_NavyDock2_0008	57.7336593	-152.5071213	1.580	3.530	2.030	5.330	unknown
594	WAA_SSS_400kHz_NavyDock2_0009	57.7336209	-152.5069510	1.260	9.550	8.400	7.370	unknown
595	WAA_SSS_400kHz_NavyDock2_0010	57.7336124	-152.5072197	1.310	28.880	1.700	4.380	piling
597	WAA_SSS_400kHz_NavyDock2_0012	57.7335918	-152.5070610	0.820	10.990	10.240	4.250	unknown
598	WAA_SSS_400kHz_NavyDock2_0013	57.7335405	-152.5071078	0.790	7.200	3.330	4.520	unknown
599	WAA_SSS_400kHz_NavyDock2_0014	57.7335258	-152.5067575	0.620	2.850	2.100	5.910	unknown
600	WAA_SSS_400kHz_NavyDock2_0015	57.7335229	-152.5074913	1.780	27.010	5.290	21.360	unknown
601	WAA_SSS_400kHz_NavyDock2_0016	57.7334868	-152.5068476	0.490	27.100	2.740	4.530	piling
602	WAA_SSS_400kHz_NavyDock2_0017	57.7334230	-152.5070893	1.430	7.350	2.260	13.710	unknown
603	WAA_SSS_400kHz_NavyDock2_0018	57.7332606	-152.5095040	1.140	5.250	4.700	5.150	unknown
604	WAA_SSS_400kHz_NavyDock2_0019	57.7332533	-152.5104884	0.170	9.350	1.710	1.080	piling
605	WAA_SSS_400kHz_NavyDock2_0020	57.7330049	-152.5104522	0.380	21.280	4.000	2.880	unknown
606	WAA_SSS_400kHz_NavyDock2_0021	57.7329931	-152.5108556	1.790	3.620	3.460	19.860	unknown
607	WAA_SSS_400kHz_NavyDock2_0022	57.7328093	-152.5089241	0.700	11.400	2.220	6.410	unknown
608	WAA_SSS_400kHz_NavyDock2_0023	57.7326593	-152.5108778	0.280	15.380	2.480	2.260	unknown
609	WAA_SSS_400kHz_NavyDock2_0024	57.7325721	-152.5116399	0.410	4.380	1.390	2.260	unknown
610	WAA_SSS_400kHz_NavyDock2_0025	57.7325151	-152.5095859	0.430	7.160	1.540	2.180	unknown

611	WAA_SSS_400kHz_NavyDock2_0026	57.7324395	-152.5117441	0.280	7.870	1.240	2.050	piling
612	WAA_SSS_400kHz_NavyDock2_0027	57.7321063	-152.5124138	0.900	9.170	2.780	3.630	unknown
613	WAA_SSS_400kHz_NavyDock2_0028	57.7319993	-152.5125904	0.610	5.270	3.210	2.470	unknown
614	WAA_SSS_400kHz_NavyDock2_0029	57.7318637	-152.5118526	0.620	4.920	3.510	2.220	unknown
615	WAA_SSS_400kHz_NavyDock2_0030	57.7318593	-152.5142186	0.580	5.430	2.850	2.850	unknown
616	WAA_SSS_400kHz_NavyDock2_0031	57.7316342	-152.5124431	0.160	3.210	2.430	2.290	unknown
617	WAA_SSS_400kHz_NavyDock2_0032	57.7315756	-152.5132562	4.460	4.620	2.330	12.440	unknown
618	WAA_SSS_400kHz_NavyDock2_0033	57.7313819	-152.5134583	0.990	3.020	3.270	2.940	unknown
619	WAA_SSS_400kHz_NavyDock2_0034	57.7313566	-152.5135161	0.710	3.600	2.800	2.010	unknown
621	WAA_SSS_400kHz_NavyDock2_0036	57.7313007	-152.5131077	0.540	13.850	4.730	2.780	unknown
622	WAA_SSS_400kHz_NavyDock2_0037	57.7310774	-152.5151232	0.660	8.530	5.880	1.980	unknown
623	WAA_SSS_400kHz_NavyDock2_0038	57.7310325	-152.5131228	0.470	21.940	3.730	1.240	unknown
624	WAA_SSS_400kHz_NavyDock2_0039	57.7309021	-152.5138244	0.980	12.100	6.830	4.490	unknown
625	WAA_SSS_400kHz_NavyDock2_0040	57.7308577	-152.5136443	3.510	8.640	9.470	6.440	unknown
626	WAA_SSS_400kHz_NavyDock2_0041	57.7303156	-152.5144220	1.120	29.680	3.900	2.450	piling
627	WAA_SSS_400kHz_NavyDock2_0042	57.7302532	-152.5151629	0.780	18.030	2.480	3.230	piling
628	WAA_SSS_400kHz_NavyDock2_0043	57.7301544	-152.5152491	0.570	2.300	0.000	2.490	unknown
629	WAA_SSS_400kHz_NavyDock2_0044	57.7300440	-152.5153002	1.210	17.860	1.550	5.940	piling
630	WAA_SSS_400kHz_NavyDock2_0045	57.7299367	-152.5146664	1.080	4.470	1.860	3.230	unknown
631	WAA_SSS_400kHz_NavyDock2_0046	57.7298901	-152.5147322	1.030	2.480	2.430	2.620	fish trap
632	WAA_SSS_400kHz_NavyDock2_0047	57.7298661	-152.5146698	0.610	3.780	3.970	0.920	unknown
633	WAA_SSS_400kHz_NavyDock2_0048	57.7297206	-152.5151507	1.370	12.220	2.690	3.750	unknown
634	WAA_SSS_400kHz_NavyDock2_0049	57.7296523	-152.5168650	0.460	10.310	1.140	1.360	piling
635	WAA_SSS_400kHz_NavyDock2_0050	57.7295750	-152.5149310	1.570	4.820	2.380	4.060	unknown
636	WAA_SSS_400kHz_NavyDock2_0051	57.7294583	-152.5158915	0.310	10.210	1.060	1.770	piling
637	WAA_SSS_400kHz_NavyDock2_0052	57.7293985	-152.5157887	0.890	5.560	1.840	3.400	unknown
638	WAA_SSS_400kHz_NavyDock2_0053	57.7293904	-152.5167863	1.540	8.330	3.390	1.940	unknown
640	WAA_SSS_400kHz_NavyDock2_0055	57.7293656	-152.5161301	0.330	5.460	3.290	2.170	unknown
641	WAA_SSS_400kHz_NavyDock2_0056	57.7292695	-152.5153386	0.820	3.470	1.990	3.140	unknown
642	WAA_SSS_400kHz_NavyDock2_0057	57.7292658	-152.5160463	0.460	8.240	5.020	2.040	unknown
643	WAA_SSS_400kHz_NavyDock2_0058	57.7292377	-152.5161625	0.770	5.170	2.230	3.810	unknown
644	WAA_SSS_400kHz_NavyDock2_0059	57.7292331	-152.5164140	0.350	17.130	2.640	2.690	piling
645	WAA_SSS_400kHz_NavyDock2_0060	57.7291000	-152.5167703	0.290	8.400	3.280	2.520	unknown
646	WAA_SSS_400kHz_NavyDock2_0061	57.7280953	-152.5176420	0.440	27.300	1.420	1.220	piling
647	WAA_SSS_400kHz_NavyDock2_0062	57.7280095	-152.5163894	1.110	3.890	2.640	5.350	unknown
648	WAA_SSS_400kHz_NavyDock2_0063	57.7279480	-152.5164242	1.140	4.390	2.300	4.140	unknown
649	WAA_SSS_400kHz_NavyDock2_0064	57.7279108	-152.5168703	0.240	10.180	1.590	1.540	piling
650	WAA_SSS_400kHz_NavyDock2_0065	57.7276311	-152.5188486	1.420	5.660	5.480	6.520	unknown
651	WAA_SSS_400kHz_NavyDock2_0066	57.7272430	-152.5172859	0.550	3.780	2.030	3.290	unknown
652	WAA_SSS_400kHz_NavyDock2_0067	57.7271399	-152.5173535	0.380	19.100	5.870	2.260	unknown
653	WAA_SSS_400kHz_NavyDock2_0068	57.7270656	-152.5169675	1.560	7.950	4.380	5.080	unknown
654	WAA_SSS_400kHz_NavyDock2_0069	57.7270495	-152.5168033	0.720	6.170	1.140	1.420	piling
655	WAA_SSS_400kHz_NavyDock2_0070	57.7270409	-152.5164172	0.660	7.960	1.380	1.090	piling
656	WAA_SSS_400kHz_NavyDock2_0071	57.7269824	-152.5170770	0.590	6.020	2.660	2.520	unknown
657	WAA_SSS_400kHz_NavyDock2_0072	57.7268890	-152.5173210	1.090	4.420	4.340	3.930	unknown
658	WAA_SSS_400kHz_NavyDock2_0073	57.7268723	-152.5174545	1.510	4.260	2.640	4.340	unknown
659	WAA_SSS_400kHz_NavyDock2_0074	57.7268548	-152.5187105	0.820	4.800	1.340	1.910	unknown
660	WAA_SSS_400kHz_NavyDock2_0075	57.7268407	-152.5170828	0.550	19.780	2.500	2.910	piling
661	WAA_SSS_400kHz_NavyDock2_0076	57.7268346	-152.5186261	0.450	4.460	1.410	0.770	unknown
662	WAA_SSS_400kHz_NavyDock2_0077	57.7267986	-152.5175851	0.220	8.700	1.580	0.620	piling
663	WAA_SSS_400kHz_NavyDock2_0078	57.7267979	-152.5177859	1.110	5.440	1.500	2.290	unknown
665	WAA_SSS_400kHz_NavyDock2_0080	57.7267014	-152.5181849	0.940	12.650	1.480	1.640	piling
666	WAA_SSS_400kHz_NavyDock2_0081	57.7265980	-152.5192541	0.750	7.310	1.480	2.150	unknown
667	WAA_SSS_400kHz_NavyDock2_0082	57.7265592	-152.5187462	1.230	4.090	3.290	3.240	unknown
668	WAA_SSS_400kHz_NavyDock2_0083	57.7265146	-152.5186711	1.250	24.790	1.690	2.390	piling
669	WAA_SSS_400kHz_NavyDock2_0084	57.7264916	-152.5194392	0.890	29.050	1.860	2.450	piling
670	WAA_SSS_400kHz_NavyDock2_0085	57.7264672	-152.5176700	0.600	6.410	1.930	0.900	unknown
672	WAA_SSS_400kHz_NavyDock2_0087	57.7264306	-152.5186658	2.800	13.790	2.160	6.980	piling
673	WAA_SSS_400kHz_NavyDock2_0088	57.7264257	-152.5195745	0.530	45.490	1.750	1.400	piling
674	WAA_SSS_400kHz_NavyDock2_0089	57.7263901	-152.5177340	1.700	7.950	2.470	4.220	unknown
675	WAA_SSS_400kHz_NavyDock2_0090	57.7263735	-152.5202734	1.660	4.110	3.690	4.600	unknown
676	WAA_SSS_400kHz_NavyDock2_0091	57.7263242	-152.5198440	1.200	5.020	3.760	4.170	unknown
677	WAA_SSS_400kHz_NavyDock2_0092	57.7263231	-152.5187726	1.110	3.550	2.470	2.770	unknown
679	WAA_SSS_400kHz_NavyDock2_0094	57.7262278	-152.5174864	1.110	2.780	2.820	5.900	unknown
680	WAA_SSS_400kHz_NavyDock2_0095	57.7261487	-152.5175324	1.190	2.130	2.270	7.700	unknown
681	WAA_SSS_400kHz_NavyDock2_0096	57.7261452	-152.5182502	1.790	5.160	2.630	7.880	unknown
682	WAA_SSS_400kHz_NavyDock2_0097	57.7261438	-152.5182210	1.650	5.340	3.160	8.150	unknown
683	WAA_SSS_400kHz_NavyDock2_0098	57.7261235	-152.5183089	1.770	4.500	3.490	7.640	unknown
684	WAA_SSS_400kHz_NavyDock2_0099	57.7261149	-152.5181929	1.180	15.420	3.860	5.860	unknown
685	WAA_SSS_400kHz_NavyDock2_0100	57.7260890	-152.5182988	0.890	17.580	3.980	3.980	unknown
686	WAA_SSS_400kHz_NavyDock2_0101	57.7260837	-152.5183837	1.880	3.950	3.190	7.800	unknown
687	WAA_SSS_400kHz_NavyDock2_0102	57.7260527	-152.5184310	1.680	4.620	3.080	7.080	unknown
689	WAA_SSS_400kHz_NavyDock2_0104	57.7258946	-152.5195704	0.550	14.780	1.440	1.330	piling
690	WAA_SSS_400kHz_NavyDock2_0105	57.7258713	-152.5197356	2.720	4.420	5.200	3.940	mine like object
691	WAA_SSS_400kHz_NavyDock2_0106	57.7258388	-152.5212085	1.620	4.840	4.220	3.930	unknown
692	WAA_SSS_400kHz_NavyDock2_0107	57.7256970	-152.5197446	0.880	3.710	2.400	3.510	unknown
693	WAA_SSS_400kHz_NavyDock2_0108	57.7256951	-152.5198287	1.510	2.610	1.840	3.310	unknown
694	WAA_SSS_400kHz_NavyDock2_0109	57.7251129	-152.5200336	0.240	22.350	6.610	1.690	unknown
695	WAA_SSS_400kHz_NavyDock2_0110	57.7250610	-152.5217204	0.690	23.120	1.440	1.420	piling
697	WAA_SSS_400kHz_NavyDock2_0112	57.7249230	-152.5219142	1.850	3.690	1.570	3.680	unknown
698	WAA_SSS_400kHz_NavyDock2_0113	57.7248775	-152.5197693	0.500	16.150	1.730	2.160	piling
699	WAA_SSS_400kHz_NavyDock2_0114	57.7248041	-152.5204529	1.230	2.860	1.690	1.870	unknown
701	WAA_SSS_400kHz_NavyDock2_0116	57.7246983	-152.5197111	0.500	13.980	1.180	1.210	piling
702	WAA_SSS_400kHz_NavyDock2_0117	57.7246951	-152.5207420	0.550	32.670	1.380	1.660	piling
703	WAA_SSS_400kHz_NavyDock2_0118	57.7246754	-152.5199025	0.740	8.210	4.010	1.850	unknown
704	WAA_SSS_400kHz_NavyDock2_0119	57.7246699	-152.5196434	0.690	13.090	1.820	2.250	unknown
705	WAA_SSS_400kHz_NavyDock2_0120	57.7243605	-152.5218503	1.290	36.270	7.050	2.670	unknown
706	WAA_SSS_400kHz_NavyDock2_0121	57.7241725	-152.5220204	1.140	3.420	2.510	3.200	unknown
707	WAA_SSS_400kHz_NavyDock2_0122	57.7238749	-152.5223711	0.420	6.910	2.860	0.950	unknown
708	WAA_SSS_400kHz_NavyDock2_0123	57.7236287	-152.5225109	0.740	23.550	1.570	1.120	piling

709	WAA_SSS_400kHz_NavyDock2_0124	57.7235784	-152.5228010	1.910	4.590	2.610	4.900	unknown
710	WAA_SSS_400kHz_NavyDock2_0125	57.7234743	-152.5229673	0.900	9.970	4.180	2.210	unknown
711	WAA_SSS_400kHz_NavyDock2_0126	57.7234388	-152.5232692	1.000	5.430	1.720	3.780	unknown
712	WAA_SSS_400kHz_NavyDock2_0127	57.7233382	-152.5229339	1.940	5.140	1.880	2.570	unknown
714	WAA_SSS_400kHz_NavyDock2_0129	57.7233198	-152.5232640	1.240	16.540	1.970	3.350	unknown
715	WAA_SSS_400kHz_NavyDock2_0130	57.7229090	-152.5237177	0.720	13.300	1.530	2.010	unknown
716	WAA_SSS_400kHz_NavyDock2_0131	57.7228155	-152.5239804	1.960	5.220	5.160	5.090	unknown
717	WAA_SSS_400kHz_NavyDock2_0132	57.7226803	-152.5247296	1.530	3.440	1.850	1.800	unknown
718	WAA_SSS_400kHz_NavyDock2_0133	57.7226550	-152.5241793	2.180	8.060	2.540	5.910	unknown
719	WAA_SSS_400kHz_NavyDock2_0134	57.7226339	-152.5248407	2.270	7.780	6.430	9.700	fish trap
720	WAA_SSS_400kHz_NavyDock2_0135	57.7225616	-152.5244556	0.880	5.090	1.350	1.550	unknown
722	WAA_SSS_400kHz_NavyDock2_0137	57.7223046	-152.5253337	0.620	27.100	1.400	2.840	piling
723	WAA_SSS_400kHz_NavyDock2_0138	57.7221577	-152.5255515	1.090	21.110	4.760	5.700	unknown
724	WAA_SSS_400kHz_NavyDock2_0139	57.7221511	-152.5250127	1.040	7.640	3.750	2.600	unknown
725	WAA_SSS_400kHz_NavyDock2_0140	57.7221010	-152.5251943	1.750	9.770	3.420	4.190	unknown
726	WAA_SSS_400kHz_NavyDock2_0141	57.7218556	-152.5255099	0.720	13.850	2.720	2.120	unknown
727	WAA_SSS_400kHz_NavyDock2_0142	57.7218453	-152.5257037	1.170	3.930	1.770	2.910	unknown
728	WAA_SSS_400kHz_NavyDock2_0143	57.7217780	-152.5258835	0.860	5.350	5.400	2.540	unknown
729	WAA_SSS_400kHz_NavyDock2_0144	57.7217736	-152.5260745	1.180	6.230	3.040	2.130	unknown
730	WAA_SSS_400kHz_NavyDock2_0145	57.7213078	-152.5262663	0.490	41.980	3.190	1.590	piling
731	WAA_SSS_400kHz_NavyDock2_0146	57.7211994	-152.5265627	0.540	28.980	2.250	1.570	piling
732	WAA_SSS_400kHz_NavyDock2_0147	57.7211200	-152.5270526	1.800	2.610	2.410	3.660	unknown
733	WAA_SSS_400kHz_NavyDock2_0148	57.7210351	-152.5267618	0.910	5.730	4.080	2.870	unknown
734	WAA_SSS_400kHz_NavyDock2_0149	57.7210307	-152.5268313	1.220	2.820	3.880	3.660	unknown
735	WAA_SSS_400kHz_NavyDock1_Targets0001	57.7373258	-152.5121359	0.430	7.660	2.910	2.780	unknown
736	WAA_SSS_400kHz_NavyDock1_Targets0002	57.7373093	-152.5116085	0.210	7.790	2.660	3.940	unknown
737	WAA_SSS_400kHz_NavyDock1_Targets0003	57.7372910	-152.5115757	0.810	4.460	4.950	13.850	unknown
738	WAA_SSS_400kHz_NavyDock1_Targets0004	57.7372881	-152.5115859	0.630	3.870	2.200	11.790	unknown
739	WAA_SSS_400kHz_NavyDock1_Targets0005	57.7372856	-152.5115499	0.220	8.710	2.530	3.450	unknown
740	WAA_SSS_400kHz_NavyDock1_Targets0006	57.7372400	-152.5122559	0.840	5.540	2.300	6.690	unknown
741	WAA_SSS_400kHz_NavyDock1_Targets0007	57.7372341	-152.5114219	0.330	14.680	3.000	3.750	unknown
742	WAA_SSS_400kHz_NavyDock1_Targets0008	57.7370866	-152.5122087	1.080	4.420	3.010	6.250	unknown
743	WAA_SSS_400kHz_NavyDock1_Targets0009	57.7370517	-152.5122194	1.240	4.410	4.560	17.550	unknown
744	WAA_SSS_400kHz_NavyDock1_Targets0010	57.7370026	-152.5115340	0.090	3.920	2.860	2.750	unknown
745	WAA_SSS_400kHz_NavyDock1_Targets0011	57.7369919	-152.5115040	0.060	4.020	3.140	2.260	unknown
746	WAA_SSS_400kHz_NavyDock1_Targets0012	57.7369740	-152.5127582	0.210	27.120	24.380	2.730	unknown
747	WAA_SSS_400kHz_NavyDock1_Targets0013	57.7369518	-152.5119900	1.400	5.880	2.890	11.190	unknown
748	WAA_SSS_400kHz_NavyDock1_Targets0014	57.7369142	-152.5120852	0.260	2.910	1.600	1.950	unknown
749	WAA_SSS_400kHz_NavyDock1_Targets0015	57.7368610	-152.5120146	0.620	6.450	1.650	3.480	unknown
750	WAA_SSS_400kHz_NavyDock1_Targets0016	57.7368047	-152.5127891	0.570	6.360	6.550	11.140	unknown
751	WAA_SSS_400kHz_NavyDock1_Targets0017	57.7368043	-152.5103502	0.540	29.820	8.050	4.470	unknown
752	WAA_SSS_400kHz_NavyDock1_Targets0018	57.7368024	-152.5128354	0.850	13.280	11.440	8.070	unknown
753	WAA_SSS_400kHz_NavyDock1_Targets0019	57.7367943	-152.5124314	0.630	3.910	5.090	7.270	unknown
754	WAA_SSS_400kHz_NavyDock1_Targets0020	57.7367823	-152.5124513	0.470	8.190	4.920	5.560	unknown
755	WAA_SSS_400kHz_NavyDock1_Targets0021	57.7367461	-152.5124825	0.480	5.900	4.300	5.180	unknown
756	WAA_SSS_400kHz_NavyDock1_Targets0022	57.7367148	-152.5100089	0.780	4.120	1.960	9.300	unknown
757	WAA_SSS_400kHz_NavyDock1_Targets0023	57.7366204	-152.5128659	1.040	5.400	4.770	15.230	unknown
758	WAA_SSS_400kHz_NavyDock1_Targets0024	57.7366155	-152.5101044	0.620	4.260	3.760	3.430	tires
759	WAA_SSS_400kHz_NavyDock1_Targets0025	57.7365473	-152.5128361	0.790	3.340	2.600	8.920	unknown
760	WAA_SSS_400kHz_NavyDock1_Targets0026	57.7364692	-152.5104401	1.140	10.710	3.210	13.310	unknown
761	WAA_SSS_400kHz_NavyDock1_Targets0027	57.7364252	-152.5106586	0.600	4.730	3.950	7.480	unknown
762	WAA_SSS_400kHz_NavyDock1_Targets0028	57.7364237	-152.5106599	0.700	5.880	4.640	9.020	unknown
763	WAA_SSS_400kHz_NavyDock1_Targets0029	57.7364121	-152.5104979	0.470	6.730	5.930	5.030	unknown
764	WAA_SSS_400kHz_NavyDock1_Targets0030	57.7363981	-152.5106985	1.080	6.210	2.960	7.260	unknown
765	WAA_SSS_400kHz_NavyDock1_Targets0031	57.7363958	-152.5113171	0.310	3.240	2.560	1.980	unknown
766	WAA_SSS_400kHz_NavyDock1_Targets0032	57.7363101	-152.5137134	0.230	6.730	4.560	3.550	unknown
767	WAA_SSS_400kHz_NavyDock1_Targets0033	57.7362415	-152.5137240	1.830	22.450	12.020	29.340	wreck
768	WAA_SSS_400kHz_NavyDock1_Targets0034	57.7362324	-152.5137738	2.810	9.260	5.290	20.510	unknown
769	WAA_SSS_400kHz_NavyDock1_Targets0035	57.7361778	-152.5118253	1.120	3.290	2.190	10.420	unknown
770	WAA_SSS_400kHz_NavyDock1_Targets0036	57.7359703	-152.5100305	0.370	4.070	1.590	2.010	unknown
771	WAA_SSS_400kHz_NavyDock1_Targets0037	57.7358628	-152.5149822	0.730	6.300	4.220	7.100	unknown
772	WAA_SSS_400kHz_NavyDock1_Targets0038	57.7358254	-152.5150500	0.300	8.510	4.440	2.560	unknown
773	WAA_SSS_400kHz_NavyDock1_Targets0039	57.7357789	-152.5125968	0.750	5.980	3.760	12.820	unknown
775	WAA_SSS_400kHz_NavyDock1_Targets0041	57.7354878	-152.5160760	0.840	7.130	4.040	4.860	unknown
777	WAA_SSS_400kHz_NavyDock1_Targets0043	57.7354215	-152.5111601	0.620	5.780	3.890	8.480	unknown
778	WAA_SSS_400kHz_NavyDock1_Targets0044	57.7353897	-152.5111309	1.300	5.050	1.630	8.390	unknown
780	WAA_SSS_400kHz_NavyDock1_Targets0046	57.7352220	-152.5139774	0.660	6.570	4.360	6.770	unknown
781	WAA_SSS_400kHz_NavyDock1_Targets0047	57.7350836	-152.5170515	1.340	9.760	5.850	4.540	unknown
782	WAA_SSS_400kHz_NavyDock1_Targets0048	57.7350291	-152.5173580	0.960	15.520	4.830	3.960	unknown
783	WAA_SSS_400kHz_NavyDock1_Targets0049	57.7349811	-152.5174186	1.780	18.020	8.740	6.760	unknown
784	WAA_SSS_400kHz_NavyDock1_Targets0050	57.7349231	-152.5172783	3.290	7.250	3.210	7.610	unknown
785	WAA_SSS_400kHz_NavyDock1_Targets0051	57.7348703	-152.5125669	0.830	6.480	0.490	2.030	piling
786	WAA_SSS_400kHz_NavyDock1_Targets0052	57.7348544	-152.5173456	2.090	8.560	4.870	3.100	unknown
787	WAA_SSS_400kHz_NavyDock1_Targets0053	57.7348438	-152.5177708	1.960	13.500	7.110	6.180	unknown
788	WAA_SSS_400kHz_NavyDock1_Targets0054	57.7348359	-152.5175976	1.760	7.630	3.660	3.930	unknown
789	WAA_SSS_400kHz_NavyDock1_Targets0055	57.7347787	-152.5140823	1.740	4.350	3.400	3.630	unknown
790	WAA_SSS_400kHz_NavyDock1_Targets0056	57.7347351	-152.5176554	2.100	9.600	7.670	2.530	unknown
791	WAA_SSS_400kHz_NavyDock1_Targets0057	57.7346344	-152.5151161	0.410	4.750	4.640	1.690	unknown
792	WAA_SSS_400kHz_NavyDock1_Targets0058	57.7343832	-152.5141218	0.520	23.100	5.740	4.940	unknown
793	WAA_SSS_400kHz_NavyDock1_Targets0059	57.7343472	-152.5138995	1.110	6.540	4.790	6.430	unknown
794	WAA_SSS_400kHz_NavyDock1_Targets0060	57.7343211	-152.5158358	1.980	50.600	3.420	9.740	piling
795	WAA_SSS_400kHz_NavyDock1_Targets0061	57.7343163	-152.5188911	3.330	13.480	8.430	4.330	tires
796	WAA_SSS_400kHz_NavyDock1_Targets0062	57.7343091	-152.5158412	1.370	42.240	3.210	6.860	piling
797	WAA_SSS_400kHz_NavyDock1_Targets0063	57.7342866	-152.5140108	0.690	4.030	3.950	4.140	unknown
798	WAA_SSS_400kHz_NavyDock1_Targets0064	57.7342775	-152.5156148	2.160	3.760	4.150	6.550	unknown
799	WAA_SSS_400kHz_NavyDock1_Targets0065	57.7342759	-152.5143160	1.190	11.390	5.410	12.550	unknown
800	WAA_SSS_400kHz_NavyDock1_Targets0066	57.7342605	-152.5156327	2.220	5.040	5.650	16.340	unknown
801	WAA_SSS_400kHz_NavyDock1_Targets0067	57.7342280	-152.5148059	0.620	4.490	3.370	8.630	unknown
802	WAA_SSS_400kHz_NavyDock1_Targets0068	57.7341908	-152.5149388	0.970	4.080	2.210	2.400	unknown
803	WAA_SSS_400kHz_NavyDock1_Targets0069	57.7340571	-152.5187050	0.350	5.940	5.970	1.980	unknown

804	WAA_SSS_400kHz_NavyDock1_Targets0070	57.7340519	-152.5162080	0.970	5.910	2.460	4.190	unknown
805	WAA_SSS_400kHz_NavyDock1_Targets0071	57.7340478	-152.5162144	0.820	6.030	3.320	4.520	unknown
806	WAA_SSS_400kHz_NavyDock1_Targets0072	57.7340218	-152.5194946	0.830	30.340	1.700	1.520	piling
807	WAA_SSS_400kHz_NavyDock1_Targets0073	57.7340215	-152.5135115	0.350	19.050	2.310	2.660	piling
808	WAA_SSS_400kHz_NavyDock1_Targets0074	57.7340157	-152.5191431	2.700	12.590	5.080	5.670	unknown
809	WAA_SSS_400kHz_NavyDock1_Targets0075	57.7340152	-152.5186218	0.610	5.920	3.110	4.320	unknown
810	WAA_SSS_400kHz_NavyDock1_Targets0076	57.7339877	-152.5145641	0.840	5.980	3.750	4.190	unknown
811	WAA_SSS_400kHz_NavyDock1_Targets0077	57.7339847	-152.5195809	2.390	39.730	33.500	6.640	unknown
812	WAA_SSS_400kHz_NavyDock1_Targets0078	57.7339298	-152.5139562	0.980	4.870	4.090	4.070	unknown
813	WAA_SSS_400kHz_NavyDock1_Targets0079	57.7334456	-152.5165478	1.850	3.680	4.340	3.970	unknown
814	WAA_SSS_400kHz_NavyDock1_Targets0080	57.7334001	-152.5200048	1.180	41.540	5.990	5.130	unknown
815	WAA_SSS_400kHz_NavyDock1_Targets0081	57.7332719	-152.5192161	1.350	6.800	3.130	5.610	unknown
816	WAA_SSS_400kHz_NavyDock1_Targets0082	57.7332639	-152.5201960	0.820	55.130	2.410	3.410	piling
817	WAA_SSS_400kHz_NavyDock1_Targets0083	57.7329925	-152.5194284	1.490	22.650	7.950	3.730	piling
818	WAA_SSS_400kHz_NavyDock1_Targets0084	57.7327844	-152.5203059	1.090	5.550	3.080	4.010	unknown
819	WAA_SSS_400kHz_NavyDock1_Targets0085	57.7325302	-152.5207199	0.000	12.130	2.160	0.000	piling
820	WAA_SSS_400kHz_NavyDock1_Targets0086	57.7325073	-152.5205237	1.660	14.920	6.050	3.190	unknown
821	WAA_SSS_400kHz_NavyDock1_Targets0087	57.7324991	-152.5216346	1.430	10.350	6.960	4.370	unknown
822	WAA_SSS_400kHz_NavyDock1_Targets0088	57.7324591	-152.5210298	0.980	9.590	4.810	3.390	unknown
823	WAA_SSS_400kHz_NavyDock1_Targets0089	57.7324511	-152.5207265	0.840	22.680	2.650	2.160	piling
824	WAA_SSS_400kHz_NavyDock1_Targets0090	57.7323239	-152.5218528	0.440	16.090	7.410	1.310	unknown
826	WAA_SSS_400kHz_NavyDock1_Targets0092	57.7322321	-152.5185270	0.300	3.210	2.570	1.820	unknown
827	WAA_SSS_400kHz_NavyDock1_Targets0093	57.7319173	-152.5176294	0.430	21.430	2.590	1.220	piling
828	WAA_SSS_400kHz_NavyDock1_Targets0094	57.7318824	-152.5174186	3.030	4.320	3.400	14.580	unknown
829	WAA_SSS_400kHz_NavyDock1_Targets0095	57.7318075	-152.5234674	0.710	12.720	1.730	2.300	ladder
830	WAA_SSS_400kHz_NavyDock1_Targets0096	57.7317311	-152.5236565	0.390	13.420	2.330	1.440	piling
831	WAA_SSS_400kHz_NavyDock1_Targets0097	57.7317183	-152.5218913	1.090	20.650	3.470	4.540	piling
832	WAA_SSS_400kHz_NavyDock1_Targets0098	57.7316077	-152.5238818	0.590	25.940	1.150	2.290	piling
833	WAA_SSS_400kHz_NavyDock1_Targets0099	57.7315383	-152.5198424	0.630	6.010	2.190	3.320	unknown
834	WAA_SSS_400kHz_NavyDock1_Targets0100	57.7307347	-152.5233035	2.780	11.300	2.440	3.040	piling
836	WAA_SSS_400kHz_NavyDock1_Targets0102	57.7300411	-152.5254931	0.930	4.180	3.430	2.760	unknown
837	WAA_SSS_400kHz_NavyDock1_Targets0103	57.7300152	-152.5256209	0.380	38.060	7.270	2.020	unknown
838	WAA_SSS_400kHz_NavyDock1_Targets0104	57.7299926	-152.5254464	0.750	23.540	4.080	4.330	unknown
839	WAA_SSS_400kHz_NavyDock1_Targets0105	57.7299020	-152.5255923	0.970	3.470	3.690	2.460	unknown
840	WAA_SSS_400kHz_NavyDock1_Targets0106	57.7296628	-152.5234243	2.280	15.310	6.710	7.370	unknown
841	WAA_SSS_400kHz_NavyDock1_Targets0107	57.7295908	-152.5263480	1.390	4.720	4.070	4.540	unknown
842	WAA_SSS_400kHz_NavyDock1_Targets0108	57.7295719	-152.5264174	3.730	6.310	5.830	18.420	unknown
843	WAA_SSS_400kHz_NavyDock1_Targets0109	57.7294873	-152.5260351	1.240	31.080	2.990	2.130	piling
844	WAA_SSS_400kHz_NavyDock1_Targets0110	57.7294306	-152.5261046	0.800	52.530	3.470	6.640	piling
845	WAA_SSS_400kHz_NavyDock1_Targets0111	57.7292278	-152.5267805	1.890	9.940	7.160	4.590	unknown
846	WAA_SSS_400kHz_NavyDock1_Targets0112	57.7290649	-152.5271054	1.310	5.650	4.530	2.850	fish trap
847	WAA_SSS_400kHz_NavyDock1_Targets0113	57.7286314	-152.5264032	0.970	4.490	4.970	2.020	unknown
848	WAA_SSS_400kHz_NavyDock1_Targets0114	57.7286243	-152.5267031	4.130	5.990	3.550	12.510	unknown
849	WAA_SSS_400kHz_NavyDock1_Targets0115	57.7286088	-152.5268287	3.430	5.270	3.250	11.160	unknown
850	WAA_SSS_400kHz_NavyDock1_Targets0116	57.7278726	-152.5284509	1.630	7.800	5.940	8.350	unknown
851	WAA_SSS_400kHz_NavyDock1_Targets0117	57.7274667	-152.5276680	0.350	17.950	1.740	3.480	piling
852	WAA_SSS_400kHz_NavyDock1_Targets0118	57.7274125	-152.5279329	1.320	41.350	1.910	2.100	piling
853	WAA_SSS_400kHz_NavyDock1_Targets0119	57.7272939	-152.5282475	2.160	45.500	3.380	2.690	piling
854	WAA_SSS_400kHz_NavyDock1_Targets0120	57.7263983	-152.5304028	0.650	4.470	3.630	2.500	unknown
855	WAA_SSS_400kHz_NavyDock1_Targets0121	57.7263831	-152.5323777	2.030	10.840	7.320	6.360	fish trap
856	WAA_SSS_400kHz_NavyDock1_Targets0122	57.7262353	-152.5319466	3.070	11.160	7.960	3.650	unknown
857	WAA_SSS_400kHz_NavyDock1_Targets0123	57.7258351	-152.5341257	2.980	17.280	5.440	8.620	unknown
858	WAA_SSS_400kHz_NavyDock1_Targets0124	57.7247603	-152.5322879	1.340	8.640	4.630	2.390	unknown
859	WAA_SSS_400kHz_NavyDock1_Targets0125	57.7243962	-152.5315948	1.010	3.870	3.220	2.680	unknown
860	WAA_SSS_400kHz_NavyDock1_Targets0126	57.7237493	-152.5375483	0.800	6.020	5.190	2.350	unknown
861	WAA_SSS_400kHz_NavyDock1_Targets0127	57.7230120	-152.5393888	3.020	5.590	4.290	6.680	unknown
862	WAA_SSS_400kHz_NavyDock1_Targets0128	57.7213404	-152.5401941	0.860	38.760	1.260	1.260	piling
864	WAA_SSS_400kHz_PuffinIsland_0002	57.7587173	-152.4363491	1.360	5.940	5.950	1.810	unknown
865	WAA_SSS_400kHz_PuffinIsland_0003	57.7585791	-152.4338773	0.480	10.140	0.950	1.420	piling
866	WAA_SSS_400kHz_PuffinIsland_0004	57.7584116	-152.4370591	2.380	6.790	7.890	3.890	fish trap
867	WAA_SSS_400kHz_PuffinIsland_0005	57.7582677	-152.4338114	0.760	8.090	2.030	1.770	unknown
868	WAA_SSS_400kHz_PuffinIsland_0006	57.7580552	-152.4368284	4.580	4.410	2.870	8.570	unknown
871	WAA_SSS_400kHz_PuffinIsland_0009	57.7575733	-152.4340958	0.310	10.690	1.040	0.780	piling
872	WAA_SSS_400kHz_PuffinIsland_0010	57.7571521	-152.4356360	0.750	22.890	8.610	2.800	unknown
873	WAA_SSS_400kHz_PuffinIsland_0011	57.7570968	-152.4357576	0.630	8.460	3.460	2.290	unknown
874	WAA_SSS_400kHz_PuffinIsland_0012	57.7570903	-152.4360199	1.040	7.200	2.500	4.840	unknown
875	WAA_SSS_400kHz_PuffinIsland_0013	57.7570148	-152.4362585	1.840	8.810	3.390	6.480	unknown
876	WAA_SSS_400kHz_PuffinIsland_0014	57.7569452	-152.4409440	0.740	5.370	3.350	2.550	unknown
877	WAA_SSS_400kHz_PuffinIsland_0015	57.7569258	-152.4334291	2.010	5.950	5.790	5.590	unknown
878	WAA_SSS_400kHz_PuffinIsland_0016	57.7568616	-152.4372107	1.910	8.490	7.170	5.260	unknown
879	WAA_SSS_400kHz_PuffinIsland_0017	57.7567979	-152.4318856	0.890	2.920	2.380	7.170	unknown
880	WAA_SSS_400kHz_PuffinIsland_0018	57.7567979	-152.4318722	0.970	3.370	3.150	7.210	unknown
881	WAA_SSS_400kHz_PuffinIsland_0019	57.7567934	-152.4389290	1.400	16.680	4.310	4.820	unknown
882	WAA_SSS_400kHz_PuffinIsland_0020	57.7567001	-152.4389706	2.170	6.340	4.910	3.210	unknown
883	WAA_SSS_400kHz_PuffinIsland_0021	57.7566405	-152.4368154	0.850	19.000	2.240	3.490	piling
884	WAA_SSS_400kHz_PuffinIsland_0022	57.7566285	-152.4340769	1.040	3.980	2.400	4.790	unknown
885	WAA_SSS_400kHz_PuffinIsland_0023	57.7565693	-152.4347846	0.600	17.440	1.070	1.870	piling
886	WAA_SSS_400kHz_PuffinIsland_0024	57.7565495	-152.4325110	1.220	5.200	3.000	2.230	unknown
887	WAA_SSS_400kHz_PuffinIsland_0025	57.7565373	-152.4403998	0.480	30.960	3.330	1.640	unknown
888	WAA_SSS_400kHz_PuffinIsland_0026	57.7565152	-152.4311904	1.960	7.360	3.090	2.730	unknown
889	WAA_SSS_400kHz_PuffinIsland_0027	57.7564748	-152.4375018	0.450	6.380	5.820	3.420	unknown
890	WAA_SSS_400kHz_PuffinIsland_0028	57.7564743	-152.4332519	1.260	5.850	3.060	9.190	unknown
891	WAA_SSS_400kHz_PuffinIsland_0029	57.7564384	-152.4375994	1.010	5.090	5.180	3.020	fish trap
892	WAA_SSS_400kHz_PuffinIsland_0030	57.7564125	-152.4399527	2.140	9.660	7.720	7.110	unknown
893	WAA_SSS_400kHz_PuffinIsland_0031	57.7564038	-152.4308628	2.530	5.790	3.860	12.270	unknown
894	WAA_SSS_400kHz_PuffinIsland_0032	57.7563927	-152.4311706	1.490	5.200	5.200	4.060	unknown
895	WAA_SSS_400kHz_PuffinIsland_0033	57.7563886	-152.4323491	0.660	13.390	1.560	3.580	piling
896	WAA_SSS_400kHz_PuffinIsland_0034	57.7563708	-152.4371741	1.730	7.970	3.790	6.860	unknown
897	WAA_SSS_400kHz_PuffinIsland_0035	57.7563571	-152.4308200	0.600	5.220	3.640	3.180	unknown
898	WAA_SSS_400kHz_PuffinIsland_0036	57.7563542	-152.4379398	0.740	7.240	6.900	1.320	unknown

899	WAA_SSS_400kHz_PuffinIsland_0037	57.7563417	-152.4372874	0.510	6.750	5.680	6.330	unknown
900	WAA_SSS_400kHz_PuffinIsland_0038	57.7563364	-152.4359356	2.330	5.810	5.970	6.540	fish trap
901	WAA_SSS_400kHz_PuffinIsland_0039	57.7562452	-152.4317937	2.250	6.250	4.350	6.820	unknown
902	WAA_SSS_400kHz_PuffinIsland_0040	57.7562380	-152.4380051	2.140	5.780	6.910	7.360	fish trap
903	WAA_SSS_400kHz_PuffinIsland_0041	57.7562272	-152.4381157	1.360	6.810	5.130	4.320	unknown
904	WAA_SSS_400kHz_PuffinIsland_0042	57.7562206	-152.4378949	0.280	5.340	5.590	3.650	unknown
905	WAA_SSS_400kHz_PuffinIsland_0043	57.7562074	-152.4378958	0.460	10.120	3.990	6.090	unknown
906	WAA_SSS_400kHz_PuffinIsland_0044	57.7562031	-152.4351071	0.170	15.850	1.540	2.200	unknown
907	WAA_SSS_400kHz_PuffinIsland_0045	57.7561946	-152.4379725	0.840	5.410	6.410	10.620	unknown
908	WAA_SSS_400kHz_PuffinIsland_0046	57.7561806	-152.4376633	1.590	4.750	2.600	2.640	unknown
909	WAA_SSS_400kHz_PuffinIsland_0047	57.7561719	-152.4343562	0.570	5.580	2.220	2.160	unknown
910	WAA_SSS_400kHz_PuffinIsland_0048	57.7561716	-152.4343031	1.020	10.080	6.480	5.070	unknown
911	WAA_SSS_400kHz_PuffinIsland_0049	57.7561594	-152.4379202	0.700	3.190	2.450	8.080	unknown
912	WAA_SSS_400kHz_PuffinIsland_0050	57.7560906	-152.4381935	2.290	6.050	4.350	15.650	unknown
913	WAA_SSS_400kHz_PuffinIsland_0051	57.7560408	-152.4361624	0.580	13.240	1.540	1.780	piling
914	WAA_SSS_400kHz_PuffinIsland_0052	57.7559798	-152.4334562	1.110	7.940	3.560	9.390	unknown
915	WAA_SSS_400kHz_PuffinIsland_0053	57.7559562	-152.4336307	2.450	9.750	4.270	22.290	unknown
916	WAA_SSS_400kHz_PuffinIsland_0054	57.7559524	-152.4340778	0.930	5.120	2.830	9.580	unknown
917	WAA_SSS_400kHz_PuffinIsland_0055	57.7559479	-152.4365550	1.650	5.880	2.200	5.480	unknown
918	WAA_SSS_400kHz_PuffinIsland_0056	57.7559459	-152.4364075	1.580	3.910	3.560	4.900	unknown
919	WAA_SSS_400kHz_PuffinIsland_0057	57.7559348	-152.4364849	1.370	5.970	3.260	8.790	unknown
920	WAA_SSS_400kHz_PuffinIsland_0058	57.7557083	-152.4410135	4.280	7.580	3.040	11.610	unknown
921	WAA_SSS_400kHz_PuffinIsland_0059	57.7556395	-152.4379073	1.540	5.710	4.450	11.870	unknown
922	WAA_SSS_400kHz_PuffinIsland_0060	57.7556203	-152.4350770	0.520	17.160	2.130	5.070	unknown
923	WAA_SSS_400kHz_PuffinIsland_0061	57.7556193	-152.4370182	1.950	5.590	3.800	9.750	unknown
924	WAA_SSS_400kHz_PuffinIsland_0062	57.7555992	-152.4372560	0.620	11.070	6.350	2.880	unknown
925	WAA_SSS_400kHz_PuffinIsland_0063	57.7555959	-152.4377646	1.810	6.580	3.460	13.220	unknown
926	WAA_SSS_400kHz_PuffinIsland_0064	57.7555101	-152.4370046	1.350	4.150	2.480	12.600	unknown
927	WAA_SSS_400kHz_PuffinIsland_0065	57.7554355	-152.4365378	0.810	5.730	1.440	11.380	unknown
928	WAA_SSS_400kHz_PuffinIsland_0066	57.7553490	-152.4361652	0.320	5.240	2.780	2.760	unknown
929	WAA_SSS_400kHz_PuffinIsland_0067	57.7553476	-152.4395807	1.620	4.370	4.190	3.080	unknown
930	WAA_SSS_400kHz_PuffinIsland_0068	57.7552984	-152.4365381	0.810	26.200	6.550	9.750	unknown
931	WAA_SSS_400kHz_PuffinIsland_0069	57.7552745	-152.4400729	1.100	7.470	2.970	6.100	unknown
932	WAA_SSS_400kHz_PuffinIsland_0070	57.7552729	-152.4394429	0.690	6.770	6.770	2.370	unknown
933	WAA_SSS_400kHz_PuffinIsland_0071	57.7552719	-152.4362737	1.170	5.850	2.600	15.620	unknown
934	WAA_SSS_400kHz_PuffinIsland_0072	57.7552553	-152.4400981	1.360	4.820	4.370	3.340	unknown
936	WAA_SSS_400kHz_PuffinIsland_0074	57.7544424	-152.4389118	0.880	6.350	6.940	10.050	unknown
937	WAA_SSS_400kHz_PuffinIsland_0075	57.7542152	-152.4398495	1.180	4.910	3.300	10.340	unknown
938	WAA_SSS_400kHz_PuffinIsland_0076	57.7541842	-152.4396373	0.460	21.110	2.540	2.520	piling
940	WAA_SSS_400kHz_PuffinIslandSouth_0002	57.7524251	-152.4380225	0.710	7.250	1.950	2.480	unknown
941	WAA_SSS_400kHz_PuffinIslandSouth_0003	57.7521766	-152.4339834	2.610	13.700	2.550	7.530	unknown
942	WAA_SSS_400kHz_PuffinIslandSouth_0004	57.7521515	-152.4328562	1.400	2.430	2.330	4.790	unknown
943	WAA_SSS_400kHz_PuffinIslandSouth_0005	57.7521349	-152.4363931	0.750	7.300	3.030	1.580	unknown
944	WAA_SSS_400kHz_PuffinIslandSouth_0006	57.7520384	-152.4369855	0.890	8.410	1.640	1.280	piling
945	WAA_SSS_400kHz_PuffinIslandSouth_0007	57.7520382	-152.4371456	0.790	4.470	2.370	4.070	unknown
946	WAA_SSS_400kHz_PuffinIslandSouth_0008	57.7517352	-152.4340792	0.830	8.780	1.750	2.730	unknown
947	WAA_SSS_400kHz_PuffinIslandSouth_0009	57.7517180	-152.4388334	1.010	4.330	1.230	1.920	unknown
948	WAA_SSS_400kHz_PuffinIslandSouth_0010	57.7516958	-152.4345650	1.360	23.750	3.140	3.730	piling
949	WAA_SSS_400kHz_PuffinIslandSouth_0011	57.7516626	-152.4368256	2.430	11.460	2.600	2.920	unknown
950	WAA_SSS_400kHz_PuffinIslandSouth_0012	57.7516027	-152.4375879	0.980	6.020	2.150	2.390	unknown
951	WAA_SSS_400kHz_PuffinIslandSouth_0013	57.7515138	-152.4370325	1.160	7.710	6.740	6.450	unknown
952	WAA_SSS_400kHz_PuffinIslandSouth_0014	57.7515075	-152.4374790	0.890	16.820	1.450	3.450	piling
953	WAA_SSS_400kHz_PuffinIslandSouth_0015	57.7514541	-152.4373080	0.800	6.590	1.670	2.540	unknown
954	WAA_SSS_400kHz_PuffinIslandSouth_0016	57.7513507	-152.4382164	1.560	3.810	1.810	4.430	unknown
955	WAA_SSS_400kHz_PuffinIslandSouth_0017	57.7513346	-152.4375434	0.960	4.850	1.200	1.370	unknown
956	WAA_SSS_400kHz_PuffinIslandSouth_0018	57.7512517	-152.4355960	3.020	44.090	13.960	5.960	unknown
957	WAA_SSS_400kHz_PuffinIslandSouth_0019	57.7512140	-152.4362726	1.190	6.060	1.620	2.820	unknown
958	WAA_SSS_400kHz_PuffinIslandSouth_0020	57.7511037	-152.4364379	2.300	12.470	5.230	4.500	unknown
959	WAA_SSS_400kHz_PuffinIslandSouth_0021	57.7510121	-152.4369473	1.240	4.830	2.100	1.440	unknown
960	WAA_SSS_400kHz_PuffinIslandSouth_0022	57.7510090	-152.4363525	0.850	3.840	1.650	1.790	unknown
961	WAA_SSS_400kHz_PuffinIslandSouth_0023	57.7510062	-152.4371578	1.330	8.770	2.410	2.110	unknown
962	WAA_SSS_400kHz_PuffinIslandSouth_0024	57.7509162	-152.4333534	1.160	6.410	1.700	2.060	unknown
963	WAA_SSS_400kHz_PuffinIslandSouth_0025	57.7509125	-152.4332171	2.570	7.560	0.000	5.820	unknown
964	WAA_SSS_400kHz_PuffinIslandSouth_0026	57.7494510	-152.4380052	2.280	6.430	5.440	2.960	fish trap
965	WAA_SSS_400kHz_PuffinIslandSouth_0027	57.7486585	-152.4347338	1.390	4.320	3.430	1.630	unknown
966	WAA_SSS_400kHz_PuffinIslandSouth_0028	57.7483382	-152.4399216	0.900	6.550	3.440	1.760	unknown
967	WAA_SSS_400kHz_PuffinIslandSouth_0029	57.7483196	-152.4380178	0.580	9.110	0.760	0.850	piling
968	WAA_SSS_400kHz_PuffinIslandSouth_0030	57.7482170	-152.4400130	0.670	2.850	2.730	1.730	unknown
969	WAA_SSS_400kHz_PuffinIslandSouth_0031	57.7481315	-152.4399463	0.320	4.420	1.250	0.930	unknown
970	WAA_SSS_400kHz_PuffinIslandSouth_0032	57.7477172	-152.4403962	1.460	3.440	2.600	4.380	unknown
971	WAA_SSS_400kHz_PuffinIslandSouth_0033	57.7476016	-152.4402636	1.240	5.130	1.970	3.430	unknown
972	WAA_SSS_400kHz_PuffinIslandSouth_0034	57.7475571	-152.4401511	1.240	4.300	2.650	3.110	unknown
973	WAA_SSS_400kHz_PuffinIslandSouth_0035	57.7472356	-152.4361857	0.840	1.800	1.850	1.310	unknown
974	WAA_SSS_400kHz_StPaulArmyDock_0001	57.7842198	-152.4227733	0.730	37.870	2.530	2.230	piling
975	WAA_SSS_400kHz_StPaulArmyDock_0002	57.7841576	-152.4226345	1.240	4.390	2.980	3.410	unknown
976	WAA_SSS_400kHz_StPaulArmyDock_0003	57.7841555	-152.4236336	1.310	20.450	2.430	3.110	piling
977	WAA_SSS_400kHz_StPaulArmyDock_0004	57.7840952	-152.4225532	1.110	3.790	3.370	2.670	unknown
978	WAA_SSS_400kHz_StPaulArmyDock_0005	57.7840744	-152.4232114	0.820	45.040	2.290	1.610	piling
979	WAA_SSS_400kHz_StPaulArmyDock_0006	57.7840714	-152.4231334	2.330	48.680	3.530	4.740	piling
980	WAA_SSS_400kHz_StPaulArmyDock_0007	57.7836487	-152.4271702	2.520	7.050	5.480	5.850	unknown
981	WAA_SSS_400kHz_StPaulArmyDock_0008	57.7836443	-152.4251197	3.870	7.870	4.190	5.870	unknown
983	WAA_SSS_400kHz_StPaulArmyDock_0010	57.7836254	-152.4278696	2.370	8.780	7.590	5.780	fish trap
984	WAA_SSS_400kHz_StPaulArmyDock_0011	57.7836211	-152.4275908	2.160	18.470	10.870	6.130	unknown
985	WAA_SSS_400kHz_StPaulArmyDock_0012	57.7835456	-152.4266757	0.900	22.260	4.390	3.650	unknown
986	WAA_SSS_400kHz_StPaulArmyDock_0013	57.7835361	-152.4273316	2.860	23.410	6.560	4.840	unknown
987	WAA_SSS_400kHz_StPaulArmyDock_0014	57.7835241	-152.4275037	2.270	6.370	5.310	3.650	fish trap
988	WAA_SSS_400kHz_StPaulArmyDock_0015	57.7835223	-152.4269798	2.230	21.640	5.970	10.000	unknown
989	WAA_SSS_400kHz_StPaulArmyDock_0016	57.7834771	-152.4286851	2.170	5.820	4.450	5.340	fish trap
990	WAA_SSS_400kHz_StPaulArmyDock_0017	57.7834421	-152.4291838	2.030	6.130	5.030	5.500	fish trap
991	WAA_SSS_400kHz_StPaulArmyDock_0018	57.7834134	-152.4211023	1.610	4.390	2.650	3.570	unknown

992	WAA_SSS_400kHz_StPaulArmyDock_0019	57.7832791	-152.4227431	3.750	16.830	6.410	13.600	unknown
993	WAA_SSS_400kHz_StPaulArmyDock_0020	57.7832712	-152.4258200	0.470	19.850	4.920	1.560	unknown
994	WAA_SSS_400kHz_StPaulArmyDock_0021	57.7832351	-152.4213057	3.100	4.960	2.650	4.380	unknown
995	WAA_SSS_400kHz_StPaulArmyDock_0022	57.7831957	-152.4270616	1.460	28.700	2.330	4.780	piling
996	WAA_SSS_400kHz_StPaulArmyDock_0023	57.7831129	-152.4254345	2.800	20.450	2.820	3.990	piling
997	WAA_SSS_400kHz_StPaulArmyDock_0024	57.7829089	-152.4277155	1.950	11.620	8.950	7.400	unknown
998	WAA_SSS_400kHz_StPaulArmyDock_0025	57.7827349	-152.4280290	0.830	4.360	3.510	2.860	unknown
999	WAA_SSS_400kHz_StPaulArmyDock_0026	57.7826988	-152.4270968	1.110	5.410	4.220	3.400	unknown
1000	WAA_SSS_400kHz_StPaulArmyDock_0027	57.7826826	-152.4273790	2.250	7.850	3.980	9.490	unknown
1001	WAA_SSS_400kHz_StPaulArmyDock_0028	57.7823724	-152.4302668	0.900	6.310	3.310	1.230	unknown
1002	WAA_SSS_400kHz_StPaulArmyDock_0029	57.7822118	-152.4306886	2.360	9.920	2.730	3.170	unknown
1003	WAA_SSS_400kHz_StPaulArmyDock_0030	57.7821605	-152.4334852	0.880	9.160	1.700	2.560	unknown
1004	WAA_SSS_400kHz_StPaulArmyDock_0031	57.7820670	-152.4312696	2.450	10.970	6.270	2.700	unknown
1005	WAA_SSS_400kHz_StPaulArmyDock_0032	57.7817483	-152.4293965	2.110	29.760	3.840	3.720	piling
1006	WAA_SSS_400kHz_StPaulArmyDock_0033	57.7814879	-152.4347687	0.940	5.620	2.870	1.410	unknown
1008	WAA_SSS_400kHz_StPaulArmyDock_0035	57.7813367	-152.4327221	0.470	7.560	3.910	1.500	unknown
1009	WAA_SSS_400kHz_StPaulArmyDock_0036	57.7811499	-152.4351724	2.370	8.460	2.900	3.270	unknown
1010	WAA_SSS_400kHz_StPaulArmyDock_0037	57.7811048	-152.4301890	2.990	8.490	9.060	7.760	unknown
1011	WAA_SSS_400kHz_StPaulArmyDock_0038	57.7810669	-152.4304190	2.430	10.330	8.540	5.530	unknown
1012	WAA_SSS_400kHz_StPaulArmyDock_0039	57.7809516	-152.4350513	0.930	15.960	1.680	3.370	piling
1013	WAA_SSS_400kHz_StPaulArmyDock_0040	57.7809376	-152.4318768	3.420	13.390	7.340	3.660	unknown
1014	WAA_SSS_400kHz_StPaulArmyDock_0041	57.7809065	-152.4367652	1.040	13.560	3.410	3.370	unknown
1015	WAA_SSS_400kHz_StPaulArmyDock_0042	57.7807860	-152.4365251	0.920	9.670	2.820	1.940	unknown
1016	WAA_SSS_400kHz_StPaulArmyDock_0043	57.7807523	-152.4361951	1.050	10.210	1.330	1.860	piling
1017	WAA_SSS_400kHz_StPaulArmyDock_0044	57.7805679	-152.4353955	1.150	13.500	3.670	5.910	unknown
1018	WAA_SSS_400kHz_StPaulArmyDock_0045	57.7804193	-152.4353598	1.130	8.520	2.690	3.330	unknown
1019	WAA_SSS_400kHz_StPaulArmyDock_0046	57.7803331	-152.4361480	0.960	5.780	3.680	5.210	unknown
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1021	WAA_SSS_400kHz_StPaulArmyDock_0048	57.7801664	-152.4355788	2.360	10.620	7.890	9.420	unknown
1022	WAA_SSS_400kHz_StPaulArmyDock_0049	57.7798785	-152.4346185	0.930	29.190	4.610	2.990	piling
1023	WAA_SSS_400kHz_StPaulArmyDock_0050	57.7797383	-152.4376341	1.550	32.370	6.600	11.970	unknown
1025	WAA_SSS_400kHz_StPaulArmyDock_0052	57.7786990	-152.4393087	3.030	32.410	7.250	14.100	unknown
1026	WAA_SSS_400kHz_StPaulArmyDock_0053	57.7782419	-152.4363194	0.460	5.940	3.880	1.700	unknown
1027	WAA_SSS_400kHz_StPaulArmyDock_0054	57.7782092	-152.4390029	0.540	10.620	3.070	1.610	unknown
1028	WAA_SSS_400kHz_StPaulArmyDock_0055	57.7782001	-152.4368000	0.850	6.570	4.080	2.370	unknown
1029	WAA_SSS_400kHz_StPaulArmyDock_0056	57.7779042	-152.4407990	1.140	9.830	1.010	1.680	piling
1030	WAA_SSS_400kHz_StPaulArmyDock_0057	57.7778958	-152.4426014	1.170	186.310	2.030	3.350	cable
1031	WAA_SSS_400kHz_StPaulArmyDock_0058	57.7776198	-152.4374479	1.360	6.520	4.630	6.150	unknown
1032	WAA_SSS_400kHz_StPaulArmyDock_0059	57.7775111	-152.4408564	0.640	19.350	2.300	2.060	piling
1033	WAA_SSS_400kHz_StPaulArmyDock_0060	57.7775105	-152.4380767	1.550	5.400	4.500	5.640	unknown
1034	WAA_SSS_400kHz_StPaulArmyDock_0061	57.7774151	-152.4415852	1.710	28.050	2.730	2.370	piling
1035	WAA_SSS_400kHz_StPaulArmyDock_0062	57.7773915	-152.4413336	0.790	19.180	2.460	1.710	piling
1036	WAA_SSS_400kHz_StPaulArmyDock_0063	57.7773791	-152.4408489	0.460	23.000	1.850	1.720	piling
1037	WAA_SSS_400kHz_StPaulArmyDock_0064	57.7773771	-152.4426748	2.770	28.220	2.690	4.030	piling
1038	WAA_SSS_400kHz_StPaulArmyDock_0065	57.7773593	-152.4411944	0.740	16.630	1.080	2.050	piling
1039	WAA_SSS_400kHz_StPaulArmyDock_0066	57.7773011	-152.4309818	1.430	7.950	4.820	3.960	unknown
1041	WAA_SSS_400kHz_StPaulArmyDock_0068	57.7772448	-152.4286071	0.980	10.360	7.130	2.680	unknown
1042	WAA_SSS_400kHz_StPaulArmyDock_0069	57.7772310	-152.4407219	0.420	15.060	1.530	2.050	piling
1043	WAA_SSS_400kHz_StPaulArmyDock_0070	57.7771004	-152.4309106	2.320	6.600	3.980	3.990	unknown
1044	WAA_SSS_400kHz_StPaulArmyDock_0071	57.7769551	-152.4317171	2.030	8.760	7.000	5.930	fish trap
1045	WAA_SSS_400kHz_StPaulArmyDock_0072	57.7768532	-152.4419050	1.230	9.410	5.390	5.960	unknown
1047	WAA_SSS_400kHz_StPaulArmyDock_0074	57.7759001	-152.4326196	1.860	21.450	13.950	4.350	mine like object
1048	WAA_SSS_400kHz_WoodyIslandArmyDock_0001	57.7841080	-152.3606745	0.970	16.340	6.190	3.400	unknown
1049	WAA_SSS_400kHz_WoodyIslandArmyDock_0002	57.7840585	-152.3607797	1.420	9.510	4.370	5.080	unknown
1050	WAA_SSS_400kHz_WoodyIslandArmyDock_0003	57.7839341	-152.3609163	1.470	20.510	3.180	4.840	unknown
1052	WAA_SSS_400kHz_WoodyIslandArmyDock_0005	57.7837840	-152.3565182	1.470	17.640	4.860	9.010	unknown
1053	WAA_SSS_400kHz_WoodyIslandArmyDock_0006	57.7837136	-152.3564016	1.320	17.990	3.810	9.360	unknown
1054	WAA_SSS_400kHz_WoodyIslandArmyDock_0007	57.7836767	-152.3577038	0.430	7.610	1.710	2.020	unknown
1055	WAA_SSS_400kHz_WoodyIslandArmyDock_0008	57.7836224	-152.3576472	1.120	3.630	1.560	4.190	unknown
1056	WAA_SSS_400kHz_WoodyIslandArmyDock_0009	57.7834878	-152.3617536	0.900	6.560	2.580	2.920	unknown
1057	WAA_SSS_400kHz_WoodyIslandArmyDock_0010	57.7833554	-152.3632137	1.340	8.920	4.780	3.290	unknown
1058	WAA_SSS_400kHz_WoodyIslandArmyDock_0011	57.7832747	-152.3620565	1.090	12.550	3.000	3.390	unknown
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1061	WAA_SSS_400kHz_WoodyIslandArmyDock_0014	57.7829787	-152.3585410	0.860	5.230	4.430	12.170	unknown
1062	WAA_SSS_400kHz_WoodyIslandArmyDock_0015	57.7828728	-152.3595480	1.930	4.870	2.250	2.620	unknown
1063	WAA_SSS_400kHz_WoodyIslandArmyDock_0016	57.7827282	-152.3585668	1.040	4.730	2.870	4.880	unknown
1064	WAA_SSS_400kHz_WoodyIslandArmyDock_0017	57.7827208	-152.3586909	1.520	5.180	3.000	3.550	unknown
1065	WAA_SSS_400kHz_WoodyIslandArmyDock_0018	57.7827118	-152.3587899	1.300	2.000	0.940	6.470	unknown
1066	WAA_SSS_400kHz_WoodyIslandArmyDock_0019	57.7826292	-152.3587975	1.410	4.410	1.860	4.700	unknown
1067	WAA_SSS_400kHz_WoodyIslandArmyDock_0020	57.7826106	-152.3585846	1.540	3.090	1.920	3.240	unknown
1068	WAA_SSS_400kHz_WoodyIslandArmyDock_0021	57.7826104	-152.3596885	0.230	9.970	3.530	1.610	unknown
1069	WAA_SSS_400kHz_WoodyIslandArmyDock_0022	57.7825824	-152.3583269	2.810	2.660	1.680	4.140	unknown
1070	WAA_SSS_400kHz_WoodyIslandArmyDock_0023	57.7825693	-152.3584685	1.220	6.430	3.400	4.350	unknown
1071	WAA_SSS_400kHz_WoodyIslandArmyDock_0024	57.7825424	-152.3586902	1.030	4.200	3.090	1.470	unknown
1072	WAA_SSS_400kHz_WoodyIslandArmyDock_0025	57.7825039	-152.3587821	1.770	4.830	3.820	2.490	unknown
1073	WAA_SSS_400kHz_WoodyIslandArmyDock_0026	57.7824829	-152.3596050	0.600	2.760	0.000	2.920	unknown
1074	WAA_SSS_400kHz_WoodyIslandArmyDock_0027	57.7823094	-152.3585681	0.980	5.470	2.230	3.660	unknown
1075	WAA_SSS_400kHz_WoodyIslandArmyDock_0028	57.7821990	-152.3600016	0.630	3.400	1.090	2.850	unknown
1076	WAA_SSS_400kHz_WoodyIslandArmyDock_0029	57.7821581	-152.3598600	0.950	4.100	0.820	2.170	unknown
1077	WAA_SSS_400kHz_WoodyIslandArmyDock_0030	57.7821574	-152.3591646	3.580	13.050	4.510	13.490	unknown
1078	WAA_SSS_400kHz_WoodyIslandArmyDock_0031	57.7821545	-152.3590695	4.080	3.460	1.380	13.940	unknown
1079	WAA_SSS_400kHz_WoodyIslandArmyDock_0032	57.7820363	-152.3591479	2.430	16.450	2.040	10.590	unknown
1080	WAA_SSS_400kHz_WoodyIslandArmyDock_0033	57.7820326	-152.3590594	3.280	3.900	2.660	16.080	unknown
1081	WAA_SSS_400kHz_WoodyIslandArmyDock_0034	57.7820142	-152.3612833	0.400	4.750	1.310	0.930	unknown
1082	WAA_SSS_400kHz_WoodyIslandArmyDock_0035	57.7820064	-152.3602191	1.880	3.550	2.890	6.760	unknown
1083	WAA_SSS_400kHz_WoodyIslandArmyDock_0036	57.7819971	-152.3601797	0.980	8.180	5.910	2.920	unknown
1084	WAA_SSS_400kHz_WoodyIslandArmyDock_0037	57.7819869	-152.3603146	0.610	4.780	1.850	1.990	unknown
1085	WAA_SSS_400kHz_WoodyIslandArmyDock_0038	57.7819718	-152.3601008	1.430	6.180	4.090	2.890	unknown
1087	WAA_SSS_400kHz_WoodyIslandArmyDock_0040	57.7819156	-152.3604226	0.600	13.510	2.330	1.460	piling

1088	WAA_SSS_400kHz_WoodyIslandArmyDock_0041	57.7818969	-152.3603302	4.440	4.720	3.190	9.910	unknown
1089	WAA_SSS_400kHz_WoodyIslandArmyDock_0042	57.7817420	-152.3639673	3.370	10.390	3.100	3.930	unknown
1090	WAA_SSS_400kHz_WoodyIslandArmyDock_0043	57.7817127	-152.3620178	0.500	8.680	2.410	1.890	unknown
1091	WAA_SSS_400kHz_WoodyIslandArmyDock_0044	57.7816402	-152.3612514	0.640	2.330	1.990	2.820	unknown
1092	WAA_SSS_400kHz_WoodyIslandArmyDock_0045	57.7816122	-152.3615108	0.390	4.480	1.010	2.490	unknown
1093	WAA_SSS_400kHz_WoodyIslandArmyDock_0046	57.7815765	-152.3614087	0.580	3.660	1.330	2.990	unknown
1094	WAA_SSS_400kHz_WoodyIslandArmyDock_0047	57.7815629	-152.3607169	0.990	3.980	3.540	2.320	unknown
1095	WAA_SSS_400kHz_WoodyIslandArmyDock_0048	57.7813483	-152.3660172	2.730	16.380	3.850	4.700	unknown
1096	WAA_SSS_400kHz_WoodyIslandArmyDock_0049	57.7812364	-152.3616918	1.160	3.610	2.570	2.190	unknown
1097	WAA_SSS_400kHz_WoodyIslandArmyDock_0050	57.7811273	-152.3639089	3.570	3.340	3.350	7.790	unknown
1098	WAA_SSS_400kHz_WoodyIslandArmyDock_0051	57.7809370	-152.3622302	1.080	5.640	1.250	1.730	unknown
1099	WAA_SSS_400kHz_WoodyIslandArmyDock_0052	57.7805869	-152.3631718	0.320	5.590	4.620	2.430	unknown

APPENDIX D

Geophysical Subcontractor Report

Site Investigation

Kodiak Island Naval Sea Defense Area

Marine Geophysical Survey Report

Prepared for:

URS Group / AECOM

Prepared by:

Gravity Consulting LLC

SeaVision Underwater Solutions Inc

FINAL

April 14th , 2016

Executive Summary

During a 15-day operational period from May 1, 2015 to May 15, 2015, Gravity Consulting LLC and SeaVision Underwater Solutions Inc. (hereafter referred to as the Survey Team) completed marine geophysical survey activities in the Kodiak Island Naval Defense Sea Area (NDSA) in support of U.S. Navy Contract N44255-09-D-4001, Delivery Order 80, for URS Group, Inc / AECOM and the Naval Facilities Engineering Command Northwest (NAVFAC Northwest).

Per the Final Work Plan issued on November 21, 2014, the principle objective of this Site Investigation (SI) was to investigate the presence of munitions and explosives of concern (MEC) from U.S. forces on the sea floor at known in-water ranges and bombing targets, over-water ordnance handling sites, and in-water MEC disposal areas within the Kodiak NDSA. During a previously executed preliminary assessment (PA) of this NDSA, eighteen (18) discrete survey areas had been identified and prioritized for further investigation based on risks for human exposure to MEC based on reported discoveries, proximity to known human activities, and known frequency of historic MEC release.

Of these 18 areas, the survey team performed a partial and/or complete **Wide Area Assessment (WAA) of fifteen (15) discrete survey areas using sidescan sonar surveys and interferometric sidescan sonar surveys.** Wide swath sidescan sonar and interferometric sidescan sonar surveying from two vessels (a 69' catamaran and a 15' survey launch) had been determined by the Survey Team to be the most effective approach to maximizing seafloor survey coverage during the fixed field survey period. During this field period, **the Survey Team covered 5600 acres of seafloor** using these survey methods.

In-field processing and interpretation of the WAA sonar data led to Reacquisition and Verification (RV) efforts in seven (7) survey areas to reacquire **45 total targets** with a remotely-operated vehicle (ROV) and collect video and still image confirmation of target identification. Further processing and interpretation of the WAA sonar data yielded a total of **1099 potential targets**, some of which are readily identified in the imagery as various types of debris or fishing gear.

The total number of targets that has been identified through comprehensive post-processing after the field survey period is a testament to the challenges associated with SI activities in fixed field operations windows because field personnel must rapidly review, interpret, classify, prioritize, and select targets of interest for further RV activites, in an attempt to select the best targets for further investigation while ignoring hundreds of other targets. Additionally, RV activities must be prioritized and scheduled to make the best use of the field period and to accommodate weather and sea-state conditions so that remotely operated vehicle operations can successfully yield detailed target investigations. Therefore, RV activities represent investigation of a small percentage (5% or less) of all detected targets during WAA survey operations.

RV activities led to reacquisition of 45 targets, most of which proved to be various types of fishing traps, mooring anchor blocks, rocks, and debris. However, one target (0009) investigated in Women's Bay Explosive Anchorage 2 appeared to be a timber crate that could be a munitions storage crate and may warrant further investigation in future activities.

The results of this WAA survey should not be construed to indicate that the surveyed areas are clear of MEC or that RV activities are not necessary. Rather, it is more appropriate to conclude that at the time of this WAA survey, these survey methodologies may not indicate the presence of MEC exposed on the seafloor. Sediment transport dynamics in the survey areas may expose MEC in the future.

Exhaustive RV operations may not be prudent for reacquiring all unknown or suspicious WAA targets that have been identified in this survey effort. However, some areas, notably the **Humpback Rock Glide and Dive Bombing Target Range, Explosive Anchorage 1, and Explosive Anchorage 2, may require future RV or Remedial Investigation (RI) activities** because weather conditions precluded RV operations at Humpback Rock during this field period, and the identification of several targets of interest in the Explosive Anchorages warrant further investigation. Past operational use of the Humpback Rock site indicates a high probability of MEC presence. Additionally, the difficulties posed by the underwater geologic features that "mask" discrete target identification via WAA survey methodologies at a site like Humpback Rock may require further, more onerous investigation activities such as ROV video transects.

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1 WAA Survey Program

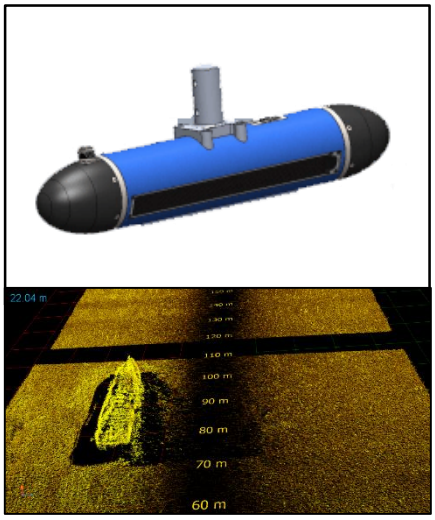
1.1 Equipment

1.1.1 Edgetech 4125 Sidescan Sonar with Hemisphere GPS R320 GNSS Receiver

The Survey Team embarked onboard R/V Thunder, a 69-foot aluminum catamaran survey boat, to conduct survey operations in the Kodiak NDSA. To survey large areas in the Kodiak NDSA, the Survey Team deployed an Edgetech 4125 Dual Frequency 400 kHz / 900 kHz CHIRP sidescan sonar with a depressor wing. The Survey Team paired the Edgetech sidescan sonar with a sub-meter accurate HemisphereGPS R320 GNSS Receiver. The HemisphereGPS R320 supplied WGS-84 latitude and longitude positioning at a rate of 20 Hz, with the positioning data distributed simultaneously to the Edgetech 4125 acquisiton system and a hydrographic survey software package for monitoring real-time navigation relative to pre-planned survey lines during all survey operations.

1.1.2 PingDSP 3DSS 460 Interferometric Sonar with SBG Inertial Navigation System

In order to survey smaller survey areas (whose geometries required tighter turning radii or approaches to shallow water less than 5-meters depth), the Survey Team mobilized a 15-foot plastic survey skiff outfitted with aPingDSP 3DSS 460 Interferometric sonar and an SBG Systems Ekinox-D Inertial Navigation System. The PingDSP sonar is a high-resolution sidescan sonar operating at 460 kHz that collects simultaneous sidescan sonar imagery and bathymetry data. The SBG Inertial Navigation System couples a dual-antenna Trimble GPS receiver with a tactical grade inertial measurement unit to generate decimeter-level accurate positioning at a rate of 50 Hz. The PingDSP sonar, rigidly mounted to a pole on the port beam of the survey skiff, integrates all of the positioning and orientation data in real-time to generate high-resolution sidescan sonar imagery, 3D rendered sonar imagery, and high-resolution bathymetry.



1.2 Survey Geometry

Survey operations with both the Edgetech 4125 sidescan sonar and the PingDSP interferometric sonar required similar survey geometries in the respected survey areas, with some variations according to water depth and overall survey area shape. In general, the Survey Team utilized the following guidelines for planned survey lines:

a. Parallel survey lines throughout survey area.
b. Planned turns should be minimized so that the turns are gently sweeping maneuvers.
c. Lines that follow the shoreline should be utilized in nearshore survey areas.
d. Line spacing for the survey lines would be set at the range setting for the sonar.
e. Sonar range for the Edgetech would be set at 50 to 70 meters. Sonar range for the PingDSP would not exceed 50 meters.

Setting the line spacing equivalent to the sonar range (the range of a single channel) may appear on the surface to be somewhat inefficient, because both the Edgetech and the PingDSP sonars generate a swath width that is double the set range. However, the advantage to setting the line spacing equal to (or slightly less than) the sonar range is that coverage gaps due to the nadir gap below the sonars are minimized if not rendered completely inconsequential, and individual targets are likely illuminated in successive passes of the sonar thus providing additional opportunities to identify, measure, and characterize targets.

1.3 Acquisition

Survey data acquisition with the Edgetech 4125 sidescan sonar required deployment of the sonar from the stern a-frame of the vessel to a pre-set cable pay-out. During all survey operations, the survey team manually recorded the amount of sonar towfish tow cable paid out to the a-frame turning block so that post-processing can accurately correct the location of the towfish for cable payout, layback geometry, and distance between the turning block and the HemisphereGPS R320 antenna.

All data with the Edgetech 4125 has been collected with the Edgetech Discover software and recorded to the proprietary JSF file format that records sonar data with geographic positioning information from the HemisphereGPS R320 receiver. During survey operations, track line positioning, towfish positioning, and survey vessel positioning were monitored simultaneously in Hypack 2015 (a hydrographic survey software package) by the Survey Team and the vessel operator with cloned computer displays in the pilothouse and in the vessel salon.This allowed both the Survey Team and the vessel operator to monitor survey progress relative to planned line files.

Survey data acquisition with the PingDSP sonar utilized the Hypack 2015 hydrographic survey software to integrate and record the PingDSP data with the SBG Ekinox-D inertial navigation data, monitor vessel positioning and track line positioning, and monitor completed survey coverage. Device offsets between the PingDSP and the SBG inertial navigation system required only one measurement and entry into survey configuration files prior to all survey operations. For all survey operations, Hypack generated the HSX file format for each discrete survey line that integrated sidescan sonar, bathymetry, positioning, and orientation information.

1.4 Processing

The Survey Team completed all data processing (both in the field, and in office-based post-processing) using Chesapeake Technologies' SonarWiz 6. SonarWiz is an industry-leading sidescan sonar processing software that allows review and post processing of a variety of data from commercially available sidescan sonars. The Survey Team organized all data according to survey area and treated each survey area separately for purposes of processing.

The Survey Team utilized the following general workflow for processing data from each survey area:

a. Import JSF or HSX data with proper geodesy and initial signal gain settings.
b. Enter and confirm device and vessel geometry to account for GPS location, turning block location, a cable layout so as to properly calculate towfish layback for all sidescan sonar imagery.
c. Review all data and track bottom in all survey lines. Slant-range correct all survey data once bottom tracking is complete.
d. Review data and impose automatic gain control and/or time-varied gain signal processing techniques to improve image quality and maximize image detail.
e. Review all files individually to select targets.
f. Reconcile targets that have been selected multiple times in multiple survey files.
g. Measure and characterize targets.
h. Manipulate files to generate sidescan sonar image mosaics of entire survey area.
i. Generate deliverable files for each survey area, relative to the project horizontal datum.

The project horizontal datum is the North American Datum of 1983, Alaska (Zone 10) State Plane Feet.

Note, however, that the Survey Team rapidly executed steps a through g above when reviewing data in the field in order to select targets for further Reacquisition and Verification efforts in each survey area. Rapid targeting identified several unique targets in each Survey Area that could be investigated later in the field period, while comprehensive office-based post-processing after the field period yielded dramatically increased numbers of targets in each survey area, some of which were clearly not MEC targets.

2 WAA Survey Production

2.1 WAA Survey Areas Completed

In the Kodiak NDSA, the Survey Team completed survey operations in fifteen (15) discrete survey areas for a total of 5600 acres surveyed. The survey areas are summarized in Table 2.1, below.

Survey Area	Date Surveyed	System	Area (Acres)
Explosive Anchorage 1	5/8/2015	Edgetech 4125	219
Explosive Anchorage 2	5/5/2015	PingDSP 3DSS 460	110
Explosive Anchorage 3	5/8/2015	PingDSP 3DSS 460	163
Ft Greely Range	5/3/2015	Edgetech 4125	954
Humpback Rock	5/4/2015	Edgetech 4125	864
Long Island – Army Dock	5/13/2015	PingDSP 3DSS 460	20
Long Island – Chiniak Bay	5/2/2015	Edgetech 4125	879
Long Island – Woody Island	5/5/2015	Edgetech 4125	1197
Midway Point	5/7/2015	Edgetech 4125	635
Navy Dock 1	5/7/2015	PingDSP 3DSS 460	157
Navy Dock 2	5/8/2015 – 5/9/2015	PingDSP 3DSS 460	107
Puffin Island	5/12/2015	PingDSP 3DSS 460	55
Puffin Island South	5/12/2015	PingDSP 3DSS 460	62
St. Paul's Army Dock	5/9/2015	Edgetech 4125	131
Woody Island Army Dock	5/12/2015	PingDSP 3DSS 460	47

Table 2.1 Summary of WAA Sidescan Sonar Survey Areas in Kodiak NDSA

2.2 WAA Survey Data Deliverables

Wide Area Assessment (WAA) Sidescan Sonar Survey deliverables consisted of the following items and file formats:

1. Sidescan Sonar Image Mosaic: GeoTiff and Google Earth KMZ
2. Sidescan Sonar Coverage Map: ESRI Shapefile of polygon coverage maps of survey areas.
3. Sidescan Sonar Targets: ESRI Shapefile and ASCII Text comma-separate values file with target locations, target identification, and interpretation information.
4. Sidescan Sonar Target Report: Adobe Acrobat PDF document with target image and interpretation information.

File formats and file naming conventions have been established in the Site Investigation Work Plan dated November 21, 2014.

3 WAA Survey Targets

3.1 WAA Target Summaries

Post-processing of the sidescan sonar survey data from the Kodiak NDSA resulted in identification of 1,099 potential targets. The tabulation of these targets according to each survey area can be found below in Table 3.1

Survey Area	Date Surveyed	System	Targets
Explosive Anchorage 1	5/8/2015	Edgetech 4125	54
Explosive Anchorage 2	5/5/2015	PingDSP 3DSS 460	29
Explosive Anchorage 3	5/8/2015	PingDSP 3DSS 460	23
Ft Greely Range	5/3/2015	Edgetech 4125	100
Humpback Rock	5/4/2015	Edgetech 4125	92
Long Island – Army Dock	5/13/2015	PingDSP 3DSS 460	23
Long Island – Chiniak Bay	5/2/2015	Edgetech 4125	105
Long Island – Woody Island	5/5/2015	Edgetech 4125	92
Midway Point	5/7/2015	Edgetech 4125	67
Navy Dock 1	5/7/2015	PingDSP 3DSS 460	128
Navy Dock 2	5/8/2015 – 5/9/2015	PingDSP 3DSS 460	149
Puffin Island	5/12/2015	PingDSP 3DSS 460	76
Puffin Island South	5/12/2015	PingDSP 3DSS 460	35
St. Paul's Army Dock	5/9/2015	Edgetech 4125	74
Woody Island Army Dock	5/12/2015	PingDSP 3DSS 460	52

Table 3.1 Summary of WAA Sidescan Sonar Survey Targets in Kodiak NDSA

3.2 Field Targets Versus Post-Processed Targets

Office-based post-processing, performed after the field activities of May 1 through May 15, 2015, is a much more comprehensive and time-consuming effort that results in a dramatic overall increase in targets in each survey area. Due to the limitations inherent in a fixed field activity period, and the need to maximize WAA survey production while also protecting the efficiency of Reacquisition and Verification efforts on high-value targets in each survey area, field-based post-processing is driven by the Survey Team to quickly yield targets of interest that can be readily investigated within the contract survey period.

4 Reacquisition/Verification (RV) Surveying – Magnetometer

Marine magnetometer surveying can, under certain circumstances, be an effective technique when surveying for underwater MEC. Magnetometer surveys can be valuable risk management tools that should be kept in a specific context when brought to bear in any type of survey, whether they are for MEC location and identification or for dredging and construction projects. Marine magnetic field observations are driven by both the mass of the object (as a proxy for what is, effectively, the magnetic permeability of the target object), and the distance of that object from the sensor. In the case of a marine magnetometer, the sensor has no directional component and therefore we must consider the magnetic anomaly problem as "poorly constrained" because there are two variables (mass and distance) and one observable (field strength).Additionally, the anomaly created by an object is inversely proportional to the cube of the distance between the target object and the sensor. For these reasons, marine magnetometer surveying has not been used as a wide area assessment (WAA) technique on this project, and it was only used sparingly as a reacquisition and verification (RV) technique in the Kodiak NDSA.

4.1 Equipment

For the magnetometer surveys, the Survey Team paired a Marine Magnetics SeaSpy magnetometer with a sub-meter accurate HemisphereGPS R320 GNSS Receiver. The HemisphereGPS R320 supplied WGS-84 latitutde and longitude positioning at a rate of 20 Hz, with the positioning data delivered to the Hypack 2015 hydrographic survey software package that was configured for monitoring real-time navigation relative to pre-planned survey lines, magnetometer layback and position, and magnetometer observations during all survey operations.

4.2 Survey Geometry

Survey operations with the Marine Magnetics SeaSpy required pre-planned survey lines in two directions (orthogonal to each other). All lines were spaced 30-meters apart.

4.3 Acquisition

Survey data acquisition with the Marine Magnetics SeaSpy utilized the Hypack 2015 hydrographic survey software to integrate and record the magnetometer data with the HemisphereGPS R320 positioning data, monitor vessel positioning and track line positioning, and calculate magnetometer towfish layback relative to the survey vessel. Device offsets between the A-frame turning block and the GPS antenna, and attention to cable payout, were recorded into survey configuration files prior to all survey operations. For all survey operations, Hypack generated the RAW file format for each discrete survey line that integrated magnetometer data with time, positioning, and layback information.

4.4 Processing

The survey team completed in-field processing of the magnetometer survey data by utilizing the Hypack 2015 hydrographic survey software package to generate a text XYZ file of each survey area where X represents easting values and Y represents northing values relative to the project horizontal datum of the North American Datum of 1983, Alaska (Zone 10) State Plane Feet. However, the Z values represent the total magnetic field observation collected by the magnetometer in nanoTeslas (nT).

After generating XYZ files, the field survey team generated color-shaded relief imagery after triangulated irregular network (TIN) surface generations to interpolate between points in the survey area and thus display anomalies against the background magnetic field for this area. The color-shaded relief imagery, in turn, produced GeoTiff geographically referenced TIFF images for use as basemaps to compare with sidescan sonar target shapefiles, thus providing the Survey Team with rough indications as to the presence of ferrous/metallic objects amongst the interpreted targets that sidescan sonar surveys produced.

Further processing of the magnetometer data utilizes the time stamp of the magnetometer data and uses a time-domain processing technique where the change in the magnetic field observation (“delta”) is calculated between subsequent observations and a data matrix that records the X,Y, and delta value. This is a slightly different approach to processing and rendering than the field approach because it focuses on the differential anomaly that any ferrous objects may create in the local magnetic field. This processing approach also helps

to suppress noise or abnormal behavior in the magnetometer. Further rendering and display of the matrix files in GeoTiff geographically referenced TIFF images, as illustrated in the figures in Section 5, has been performed in order to highlight the signal of magnetic anomalies.

Point shapefile coverages from the Wide Area Assessment (WAA) sidescan sonar surveys in Explosive Anchorages 1 and 2 have been overlaid on each magnetic anomaly contour map. Additionally, targets have been selected from each WAA sidescan sonar target shapefile to create dedicated RV magnetometer target shapefiles for targets that correlate with magnetic anomlies. Quality assurance shapes (a 50-MM shell casing, a 25-LB shell casing, and a 100-LB shell casing) were seeded in Explosive Anchorage 1 during the magnetometer survey and their locations have also been overlaid on the magnetic anomaly map to demonstrate the efficacy (or lack thereof) of the magnetometer survey data acquisition effort for various target types. Results of QA testing are discussed in Section 8.

5 Reacquisition/Verification (RV) Surveying – Magnetometer

5.1 RV Magnetometer Survey Areas Completed

In the Kodiak NDSA, magnetometer surveys have been completed in Explosive Anchorage 1 and Explosive Anchorage 2. The field survey team surveyed approximately 160 acres in Explosive Anchorage 1 and 132 acres in Explosive Anchorage 2.

5.2 RV Magnetometer Survey Data Deliverables

Magnetometer survey data deliverables include:

a. ASCII Text XYZ Files that provide the magnetic field observations as the Z value.
b. ASCII Text XYZ Files where Z is the magnetic field observation and T is the time of observation
c. GeoTiff Color Shaded Relief Imagery of the magnetic anomalies
d. ESRI Shapefiles that provided WAA sidescan sonar surveying targets that correlate with magnetic anomalies.

Figures 5.1 through 5.4 illustrate the results of the magnetometer surveys in Explosive Anchorages 1 and 2.

5.3 RV Magnetometer Findings – Discussion

After acquiring and processing the magnetometer data in accordance with the methods described Section 4, the results of the magnetometer surveying in Explosive Anchorages 1 and 2 have been overlaid on a NOAA raster navigation chart (RNC). The target shapefiles from the Wide Area Assessment (WAA) sidescan sonar surveys for each Anchorage have been overlaid on the magnetometer survey data in Figures 5.1 and 5.2. Sidescan sonar targets that coincide with magnetic anomalies have also been identified and displayed in Figures 5.3 and 5.4.

Magnetometer surveys do not yield discrete targets; rather, they highlight anomalies whose size and resolution are directly related to the track line spacing of the data collection effort. Therefore, single magnetic anomalies may be related to one or more sidescan sonar targets depending on the magnetic permeability of the objects, the relative location of the targets near each other, and how aggregates of targets may combine to yield magnetic anomalies.

In Explosive Anchorage 1, there are at least ten (10) WAA sidescan sonar targets that appear to correspond with magnetic anomalies in the Anchorage, of which four (4) targets have been investigated with the remotely operated vehicle (ROV) as described in Section 6.

RI_ROV_ExplosiveAnchorage1_Target_0003:	Concrete anchor block
RI_ROV_ExplosiveAnchorage1_Target_0006	Crab trap
RI_ROV_ExplosiveAnchorage1_Target_0014	Timber crate or timber debris
RI_ROV_ExplosiveAnchorage1_Target_0015	Unknown target

Additionally, **there are at least six (6) other magnetic anomalies in Explosive Anchorage 1** that neither correspond with apparent sidescan sonar targets, nor have they been investigated with an ROV.

In Explosive Anchorage 2, there are at least twelve (12) WAA sidescan sonar targets that appear to correspond with magnetic anomalies in the Anchorage, of which ten (10) targets have been investigated with the remotely operated vehicle (ROV) as described in Section 6.

RI_ROV_ExplosiveAnchorage2_Target_0009:	Possible ammunition crate
RI_ROV_ExplosiveAnchorage2_Target_0010:	Unknown block
RI_ROV_ExplosiveAnchorage2_Target_0011:	Unknown block
RI_ROV_ExplosiveAnchorage2_Target_0013:	Possible ammunition crate
RI_ROV_ExplosiveAnchorage2_Target_0014:	Possible ammunition crate
RI_ROV_ExplosiveAnchorage2_Target_0015:	Empty drum or expended shell casing
RI_ROV_ExplosiveAnchorage2_Target_0016:	Unknown debris
RI_ROV_ExplosiveAnchorage2_Target_0023:	Crab pot
RI_ROV_ExplosiveAnchorage2_Target_0024:	Crab pot
RI_ROV_ExplosiveAnchorage2_Target_0025:	Crab pot

Additionally, **there are at least seven (7) other magnetic anomalies in Explosive Anchorage 2** that neither correspond with apparent sidescan sonar targets, nor have they been investigated with an ROV.

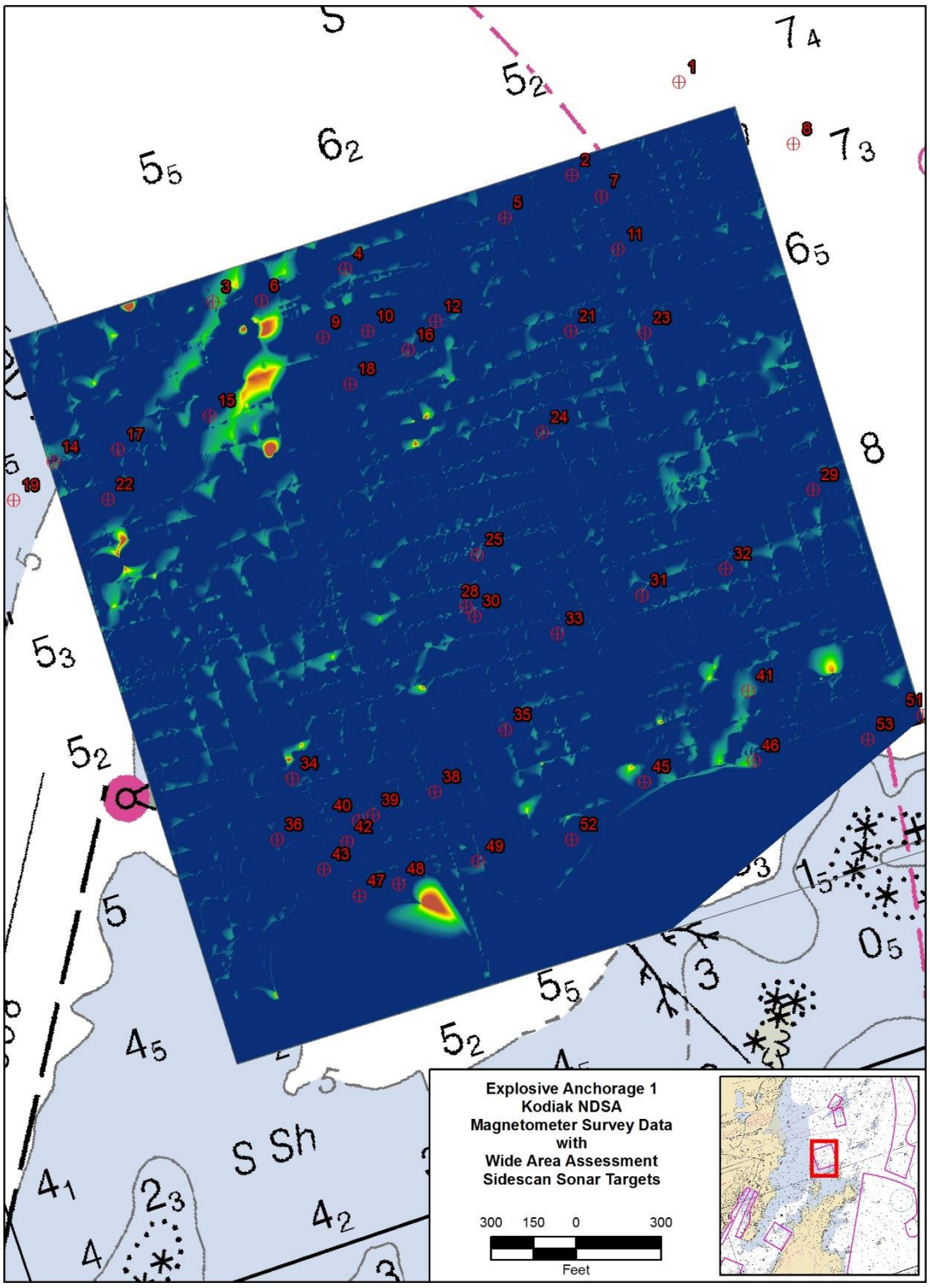


Figure 5.1: Magnetometer Survey Data for Explosive Anchorage 1, with WAA Sidescan Sonar Targets Overlay

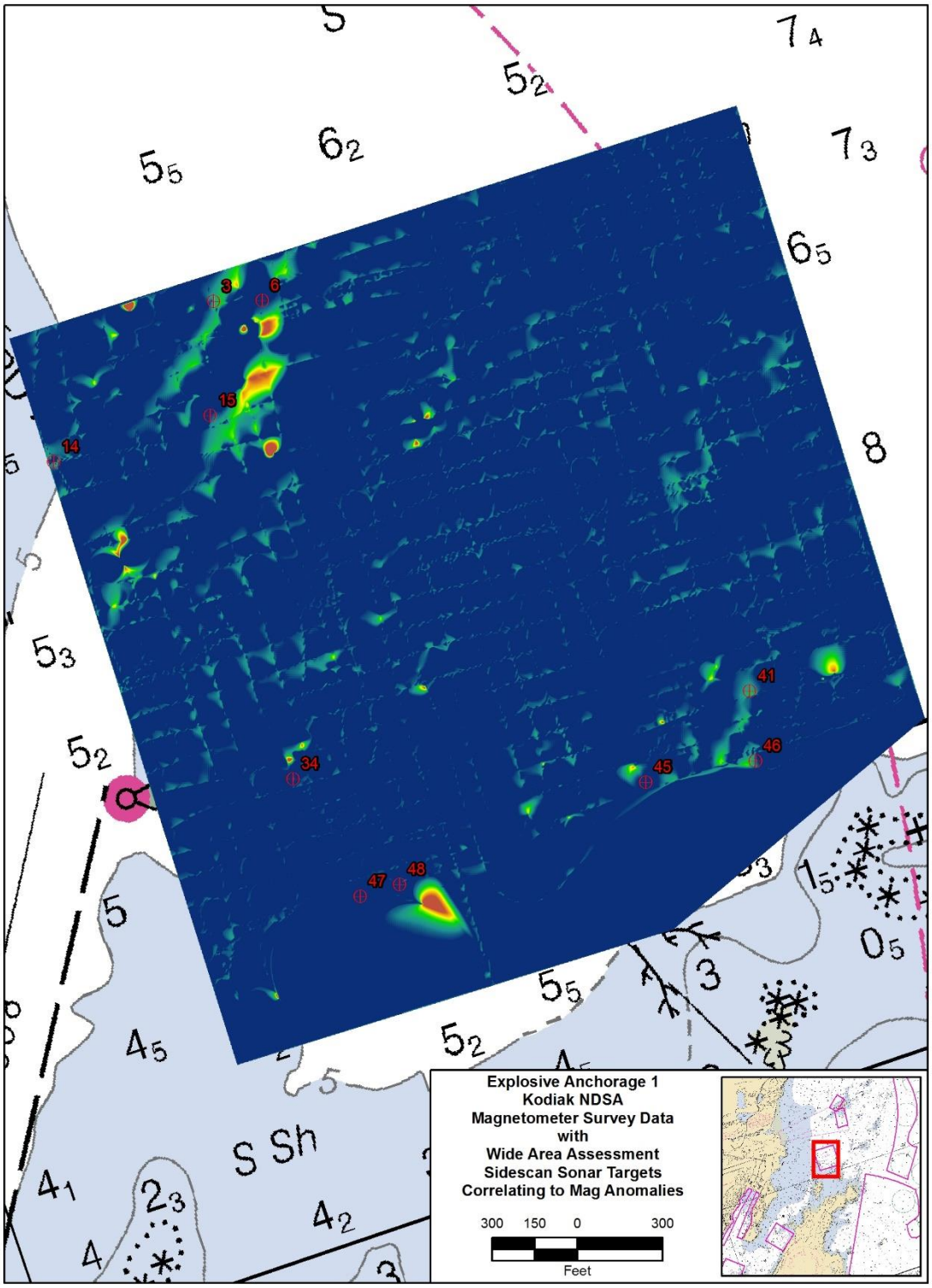


Figure 5.2: Magnetometer Survey Data for Explosive Anchorage 1, with WAA Sidescan Sonar Targets Overlay. WAA Targets that correlate with Magnetic Anomalies have been selected for display.

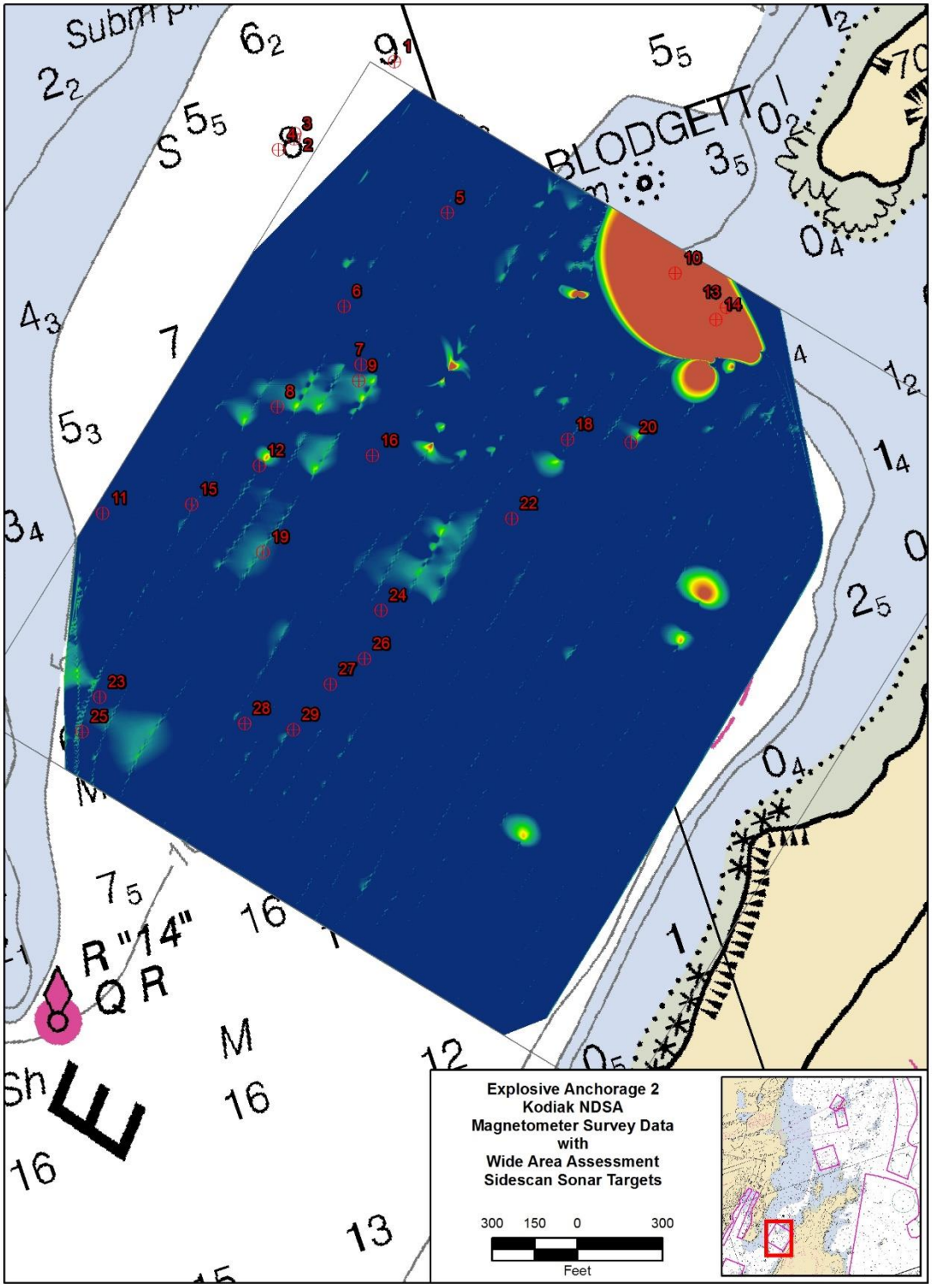


Figure 5.3: Magnetometer Survey Data for Explosive Anchorage 2, with WAA Sidescan Sonar Targets Overlay

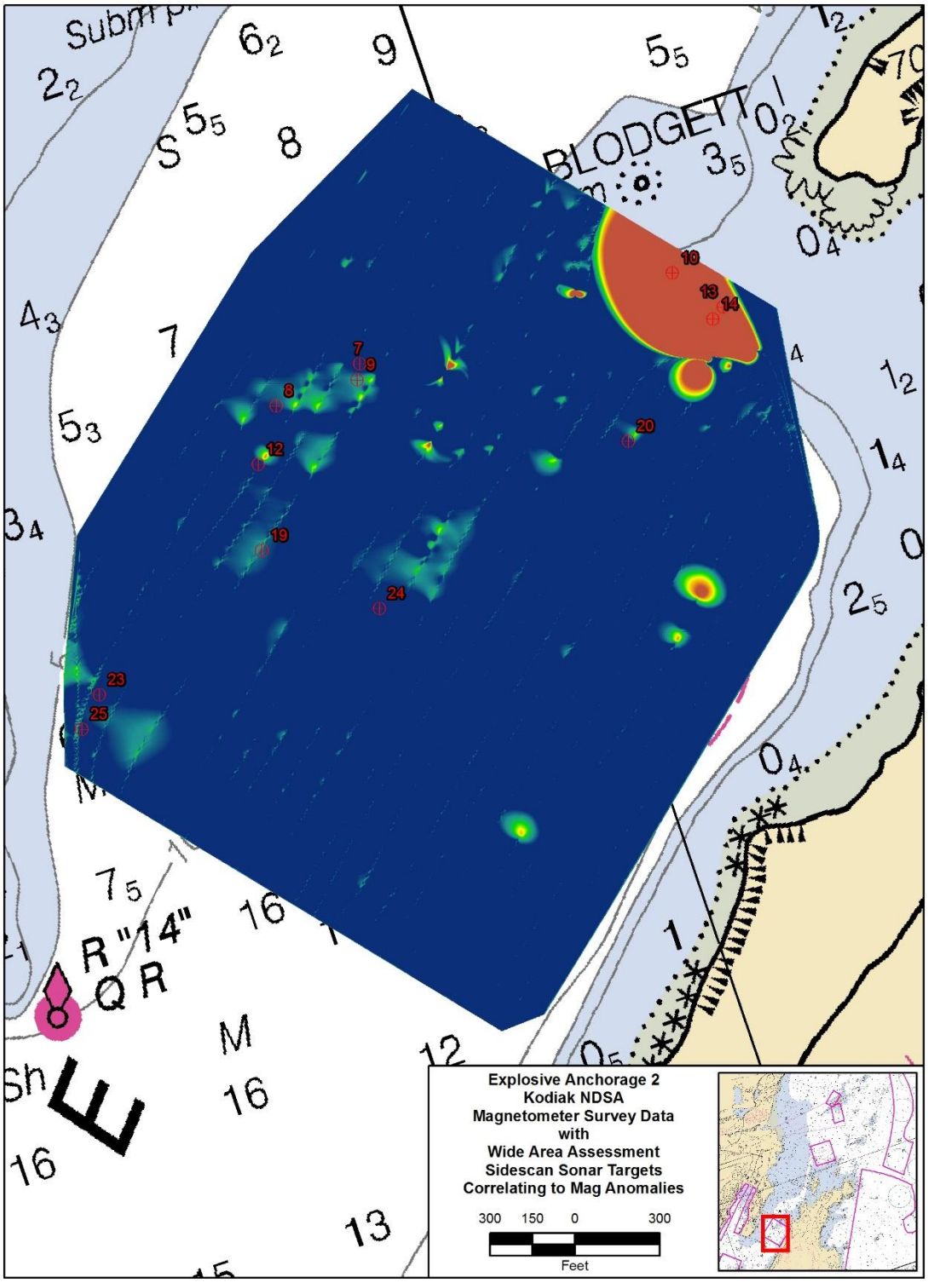


Figure 5.4: Magnetometer Survey Data for Explosive Anchorage 2, with WAA Sidescan Sonar Targets Overlay. WAA Targets that correlate with Magnetic Anomalies have been selected for display.

6 Reacquisition/Verification – ROV Operations

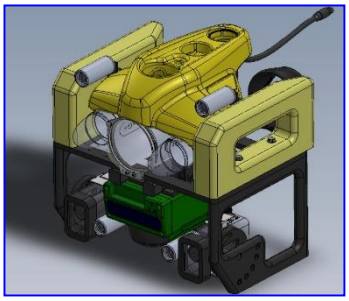
After completing WAA sidescan sonar surveys in the various project survey areas, the Survey Team performed a rapid review, processing, and interpretation of the data in an attempt to identify potential MEC targets of concern. Field determination of potential targets for reacquisition and verification was based on several characteristic features in sidescan sonar imagery:

e. Size: Less than 1.5 meters by 1.5 meters. Some large targets may be of interest.
f. Shape: Cylindrical (for bombs/artillery shells), or Rectangular (for crates)
g. Strength of Acoustic Signal Return

After identifying and prioritizing potential targets for RV surveys, the Survey Team directed the vessel to anchor in the vicinity of each target. At each anchorage, an remotely-operated vehicle (ROV) was deployed to collect video, still image, and sonar imagery of each target and allow team members to classify the targets based on observations.

6.1 Equipment

The ROV system that the Survey Team deployed for the RV surveys in the Kodiak NDSA and the Unalaska NDSA consisted of the following inventory of equipment:



1. VideoRay Pro4 Mini-ROV
   a. Electrically-Powered Mini-ROV with Three DC-Brushless Thrusters for Horizontal and Vertical Vehicle Control.
   b. LED Lighting
   c. 570-Line Resolution Video Camera
   d. Auto-Depth and Auto-Heading Capability
   e. Spare External LED Lighting

2. Over 500’ feet of control umbilical

3. Topside control unit with integrated control box featuring:
   a. Windows-based Graphic User Interface
   b. Head-Up Display of ROV Heading, Depth, Water Temperature
   c. Real-Time Video Display
   d. Real-Time Digital Video Recording to Windows Media (WMV) or AVI formats
   e. Real-Time Digital Video Still Capture Capability
   f. Multi-Function Hand Controller

4. Tritech Gemini, Forward Looking Multibeam Imaging Sonar

The Survey Team’s model of the VideoRay Pro4 is actually a custom modified system that we have developed to install additional lighting and self-contained camera equipment on the vehicle, thus providing additional sensors and points of data collection from such a small platform.

The ROV was deployed by hand from the vessel and flown to the seafloor where the vehicle was flown by an operator to reacquire each target. While video was assumed to be the primary RV survey tool, the ROV was also outfitted with a Tritech Gemini high-resolution forward-looking imaging sonar that provided longer-range (greater than 100-feet) plan-view imagery in real-time to aid the operator with understanding the underwater surroundings beyond what may be readily visible with the ROV onboard camera. The ROV provided real-time video, heading, and depth information as well as time and date stamps and user-definable text title fields that provided the operator with the ability to maintain situational awareness during underwater survey operations and to maintain a proper video record of all survey activities.

6.2 Acquisition

Upon anchoring at each target location, the Survey Team marked the location of the survey vessel relative to the target, and determined the bearing and range from the ROV launch location to each intended target. The ROV was hand-launched from the stern of the survey vessel and operated so as to descend directly down from the stern of the vessel. Upon reaching the bottom, the operator used the onboard ROV sensors (specifically the compass) to bring the ROV to bear on the intended target, and utilize the forward looking

Tritech Gemini sonar to reacquire the target on sonar. Then the operator flew the ROV to the target until the target could be detected visually with the ROV's onboard digital video camera.

Video files and still images have been collected of each target. Onboard scaling lasers, spaced at 3.25 inches apart, provide scale in the imagery to aid with characterizing target size. In some cases, multiple dives have been made on targets in order to re-deploy the ROV with an onboard high-resolution still camera and high-definition camera in order to collect higher quality video and still photo imagery of specific targets of interest. All data has been organized and named in accordance with the conventions have established in the Site Investigation Work Plan dated November 21, 2014.

7 RV Survey Targets

In the Kodiak NDSA, the Survey Team performed Reacquisition and Verification (RV) surveys in seven (7) of the fifteen (15) areas subject to Wide Area Assessment (WAA) surveys. This resulted in the investigation of forty-five (45) discrete targets. Weather precluded RV activities in several survey areas, notably Humpback Rock (which has a well documented history of use as a glide and dive bombing range).

7.1 RV Target Summaries

Survey Area	Date Surveyed (WAA)	Targets
Explosive Anchorage 1	5/10/15, 5/12/15	12
Explosive Anchorage 2	5/10/15 -5/14/15	14
Explosive Anchorage 3	5/13/2015	7
Ft Greely Range	na	3
Humpback Rock	na	0
Long Island – Army Dock	na	0
Long Island – Chiniak Bay	na	0
Long Island – Woody Island	5/10/2015	3
Midway Point	na	0
Navy Dock 1	5/14/15	0
Navy Dock 2	na	6
Puffin Island	na	0
Puffin Island South	na	0
St. Paul's Army Dock	na	0
Woody Island Army Dock	na	0

Table 7.1 Summary of Reacquisition/Verification Targets in the Kodiak NDSA

7.2 RV Target Identification – Findings of Interest

NDSA	Survey Area	RV Target ID	WAA Target ID	Easting	Northing	Height	Length	Width	Classification
Kodiak	Explosive Anchorage 1	RI_ROV_ExplosiveAnchorage1_Target_0003	WAA_SSS_400kHz_ExplosiveAnchorage1_0003	7815691.2	3213419.8	1.5	4.2	2.2	Concrete anchor block
Kodiak	Explosive Anchorage 1	RI_ROV_ExplosiveAnchorage1_Target_0006	WAA_SSS_400kHz_ExplosiveAnchorage1_0006	7815861.2	3213424.0	1.9	3.4	2.7	Crab pot
Kodiak	Explosive Anchorage 1	RI_ROV_ExplosiveAnchorage1_Target_0014	WAA_SSS_400kHz_ExplosiveAnchorage1_0014	7815127.3	3212854.7	1.7	4.4	3.9	Timber crate or timber debris
Kodiak	Explosive Anchorage 1	RI_ROV_ExplosiveAnchorage1_Target_0015	WAA_SSS_400kHz_ExplosiveAnchorage1_0015	7815678.3	3213019.0	1.4	4.2	2.4	Unknown
Kodiak	Explosive Anchorage 1	RI_ROV_ExplosiveAnchorage1_Target_0017	WAA_SSS_400kHz_ExplosiveAnchorage1_0017	7815355.3	3212898.4	1.6	2.6	2.4	Unknown
Kodiak	Explosive Anchorage 1	RI_ROV_ExplosiveAnchorage1_Target_0022	WAA_SSS_400kHz_ExplosiveAnchorage1_0022	7815319.1	3212723.6	1.5	8.0	1.8	Concrete plank
Kodiak	Explosive Anchorage 1	RI_ROV_ExplosiveAnchorage1_Target_0031	WAA_SSS_400kHz_ExplosiveAnchorage1_0031	7817203.1	3212385.8	1.3	2.8	1.1	Crab pot
Kodiak	Explosive Anchorage 1	RI_ROV_ExplosiveAnchorage1_Target_0033	WAA_SSS_400kHz_ExplosiveAnchorage1_0033	7816904.7	3212249.3	1.1	2.5	1.7	Possible ammunition crate.
Kodiak	Explosive Anchorage 1	RI_ROV_ExplosiveAnchorage1_Target_0044	WAA_SSS_400kHz_ExplosiveAnchorage1_0044	7818311.4	3212153.2	1.8	2.1	1.5	Rock
Kodiak	Explosive Anchorage 1	RI_ROV_ExplosiveAnchorage1_Target_0050	WAA_SSS_400kHz_ExplosiveAnchorage1_0050	7818277.9	3211997.5	1.0	5.7	2.8	Rock
Kodiak	Explosive Anchorage 1	RI_ROV_ExplosiveAnchorage1_Target_0051	WAA_SSS_400kHz_ExplosiveAnchorage1_0051	7818194.0	3211961.0	0.8	2.5	2.3	Rock
Kodiak	Explosive Anchorage 1	RI_ROV_ExplosiveAnchorage1_Target_0054	WAA_SSS_400kHz_ExplosiveAnchorage1_0054	7818403.2	3211990.6	0.7	10.2	5.0	Rock
Kodiak	Explosive Anchorage 2	RI_ROV_ExplosiveAnchorage2_Target_0002	WAA_SSS_400kHz_ExplosiveAnchorage2_0002	7809776.5	3203573.1	5.7	32.0	17.2	Timber pilings up to 6' above mudline
Kodiak	Explosive Anchorage 2	RI_ROV_ExplosiveAnchorage2_Target_0003	WAA_SSS_400kHz_ExplosiveAnchorage2_0003	7809773.4	3203555.0	10.7	41.8	25.0	Timber pilings up to 6' above mudline
Kodiak	Explosive Anchorage 2	RI_ROV_ExplosiveAnchorage2_Target_0004	WAA_SSS_400kHz_ExplosiveAnchorage2_0004	7809719.7	3203516.3	1.4	4.7	3.5	Conical Fish Pot
Kodiak	Explosive Anchorage 2	RI_ROV_ExplosiveAnchorage2_Target_0008	WAA_SSS_400kHz_ExplosiveAnchorage2_0008	7809714.1	3202611.8	2.2	5.2	2.5	Rock
Kodiak	Explosive Anchorage 2	RI_ROV_ExplosiveAnchorage2_Target_0009	WAA_SSS_400kHz_ExplosiveAnchorage2_0009	7810002.8	3202703.3	3.0	5.6	3.8	Possible ammunition crate.
Kodiak	Explosive Anchorage 2	RI_ROV_ExplosiveAnchorage2_Target_0010	WAA_SSS_400kHz_ExplosiveAnchorage2_0010	7811116.2	3203080.7	0.7	7.6	2.9	Unknown block.
Kodiak	Explosive Anchorage 2	RI_ROV_ExplosiveAnchorage2_Target_0011	WAA_SSS_400kHz_ExplosiveAnchorage2_0011	7809099.2	3202236.2	1.1	3.0	2.5	Unknown block.
Kodiak	Explosive Anchorage 2	RI_ROV_ExplosiveAnchorage2_Target_0013	WAA_SSS_400kHz_ExplosiveAnchorage2_0013	7811296.0	3202961.5	2.3	19.6	6.5	Possible ammunition crate.
Kodiak	Explosive Anchorage 2	RI_ROV_ExplosiveAnchorage2_Target_0014	WAA_SSS_400kHz_ExplosiveAnchorage2_0014	7811258.5	3202918.4	2.2	2.1	3.0	Possible ammunition crate.
Kodiak	Explosive Anchorage 2	RI_ROV_ExplosiveAnchorage2_Target_0015	WAA_SSS_400kHz_ExplosiveAnchorage2_0015	7809412.2	3202268.5	0.6	11.4	1.0	Empty drum or expended shell
Kodiak	Explosive Anchorage 2	RI_ROV_ExplosiveAnchorage2_Target_0016	WAA_SSS_400kHz_ExplosiveAnchorage2_0016	7810049.4	3202439.5	2.2	4.8	4.6	Unknown debris
Kodiak	Explosive Anchorage 2	RI_ROV_ExplosiveAnchorage2_Target_0023	WAA_SSS_400kHz_ExplosiveAnchorage2_0023	7809089.6	3201590.0	0.4	21.0	0.7	Crab pot
Kodiak	Explosive Anchorage 2	RI_ROV_ExplosiveAnchorage2_Target_0024	WAA_SSS_400kHz_ExplosiveAnchorage2_0024	7810079.0	3201894.5	1.1	28.7	2.4	Crab pot
Kodiak	Explosive Anchorage 2	RI_ROV_ExplosiveAnchorage2_Target_0025	WAA_SSS_400kHz_ExplosiveAnchorage2_0025	7809027.1	3201468.0	2.2	5.9	1.7	Crab pot
Kodiak	Explosive Anchorage 3	RI_ROV_ExplosiveAnchorage3_Target_0009	WAA_SSS_400kHz_ExplosiveAnchorage3_0009	7802468.7	3197248.2	0.9	4.9	3.9	Fish trap
Kodiak	Explosive Anchorage 3	RI_ROV_ExplosiveAnchorage3_Target_0010	WAA_SSS_400kHz_ExplosiveAnchorage3_0010	7802439.3	3197231.6	1.9	34.6	6.7	Corroded drum
Kodiak	Explosive Anchorage 3	RI_ROV_ExplosiveAnchorage3_Target_0013	WAA_SSS_400kHz_ExplosiveAnchorage3_0013	7804142.8	3197470.3	1.3	2.9	2.9	15K Navy Anchor
Kodiak	Explosive Anchorage 3	RI_ROV_ExplosiveAnchorage3_Target_0015	WAA_SSS_400kHz_ExplosiveAnchorage3_0015	7804920.1	3197316.8	1.8	9.5	4.1	Fish trap
Kodiak	Explosive Anchorage 3	RI_ROV_ExplosiveAnchorage3_Target_0016	WAA_SSS_400kHz_ExplosiveAnchorage3_0016	7804623.6	3197186.7	2.0	5.0	2.5	Fish trap
Kodiak	Explosive Anchorage 3	RI_ROV_ExplosiveAnchorage3_Target_0017	WAA_SSS_400kHz_ExplosiveAnchorage3_0017	7803244.3	3196516.6	1.8	15.3	3.2	Fish trap
Kodiak	Explosive Anchorage 3	RI_ROV_ExplosiveAnchorage3_Target_0021	WAA_SSS_400kHz_ExplosiveAnchorage3_0021	7804702.1	3196063.0	0.9	7.4	2.3	Deteroriated timber frame
Kodiak	Ft Greely	RI_ROV_FtGreely_Target_0020	WAA_SSS_400kHz_FtGreely_0020	7825034.2	3225128.5	2.1	20.9	11.4	Unknown
Kodiak	Ft Greely	RI_ROV_FtGreely_Target_0037	WAA_SSS_400kHz_FtGreely_0037	7825040.9	3221985.2	1.1	6.7	0.8	Tire
Kodiak	Ft Greely	RI_ROV_FtGreely_Target_0052	WAA_SSS_400kHz_FtGreely_0052	7825339.0	3215404.0	0.9	12.4	2.6	Fishing net
Kodiak	Long Island - Woody Island	RI_ROV_LWIsland_Target_0027	WAA_SSS_400kHz_LWIsland0027	7841810.5	3234443.3	2.3	15.4	8.3	Unknown
Kodiak	Long Island - Woody Island	RI_ROV_LWIsland_Target_0028	WAA_SSS_400kHz_LWIsland0028	7841810.5	3234422.3	2.3	8.1	7.2	Unknown
Kodiak	Long Island - Woody Island	RI_ROV_LWIsland_Target_0049	WAA_SSS_400kHz_LWIsland0049	7839931.0	3231475.6	2.3	4.4	3.2	Cable from fishing gear
Kodiak	Navy Dock 2	RI_ROV_NavyDock2_Target_0051	WAA_SSS_400kHz_NavyDock2_0051	7806432.6	3205295.0	0.3	10.2	1.1	Large capacity battery.
Kodiak	Navy Dock 2	RI_ROV_NavyDock2_Target_0052	WAA_SSS_400kHz_NavyDock2_0052	7806458.7	3205280.7	0.9	5.6	1.8	Ladder
Kodiak	Navy Dock 2	RI_ROV_NavyDock2_Target_0054	WAA_SSS_400kHz_NavyDock2_0054	7806435.0	3205260.1	3.2	26.4	4.0	Gangway from ship
Kodiak	Navy Dock 2	RI_ROV_NavyDock2_Target_0058	WAA_SSS_400kHz_NavyDock2_0058	7806408.2	3205201.3	0.8	5.2	2.2	5-gallon bucket
Kodiak	Navy Dock 2	RI_ROV_NavyDock2_Target_0059	WAA_SSS_400kHz_NavyDock2_0059	7806362.0	3205183.8	0.4	17.1	2.6	Fish trap
Kodiak	Navy Dock 2	RI_ROV_NavyDock2_Target_0060	WAA_SSS_400kHz_NavyDock2_0060	7806311.5	3205115.2	0.3	8.4	3.3	Tire and metal debris

Table 7.2 Reacquisition/Verification Targets in the Kodiak NDSA

Table 7.2 details the forty-five (45) targets surveyed by the Survey Team using the remotely operated vehicle (ROV). Critical targets of interest have been highlighted, and still photos of the targets are provided on the following pages with brief descriptions of the principal findings during each ROV mission.

RI_ROV_ExplosiveAnchorage1_Target_0033: Possible crate.Partially buried in bottom

RI_ROV_ExplosiveAnchorage2_Target_0009: Appears to be a timber crate, possibly an ammunition crate. The target is located near the anchor block for the green navigation buoy that marks the channel next to this explosive anchorage.

RI_ROV_ExplosiveAnchorage2_Target_0009: Appears to be a timber crate, possibly an ammunition crate. The target is located near the anchor block for the green navigation buoy that marks the channel next to this explosive anchorage.

RI_ROV_ExplosiveAnchorage2_Target_0013: Possible crate.

RI_ROV_ExplosiveAnchorage2_Target_0013: Possible crate.

RI_ROV_ExplosiveAnchorage2_Target_0014: Possible crate.

8 Survey QA/QC

8.1 Survey Data QA/QC

For the marine geophysical survey techniques utilized in this Task Order, quality assurance/quality control required the following checks for component system performance:

1. Positioning Integrity / GPS Receiver Performance

    a. Internal filters on receiver were set to require Wide Area Augmentation System (WAAS) or better differential GPS positioning solutions.

    b. Internal filters on receiver were set to require position dilution of precision (PDOP) of 2.1 or better.

    c. Internal filters on receiver were set to require minimum numbers of space vehicles (SV) and minimum mask angles such that high-quality solutions are protected.

2. Measurement of GPS Antenna Offsets Relative to Sensors

    a. On the oceanographic survey vessel, measurement distance between the GPS receiver antenna and the tow cable block/sheave. Additionally, height above water for the tow cable block/sheave, and known, repeatable payout distances between the tow block and the instrument (sidescan sonar or the magnetometer) were maintained during all survey operations. All offsets have been recorded for all survey operations.

    b. On the small survey vessel, measurement of the distance (horizontal forward, horizontal athwartships, and vertical) between the inertial measurement unit and the PingDSP sonar were recorded and maintained throughout the survey operations. Offsets have been incorporated into data acquisition and data processing software configuration files.

3. Patch test calibration of fixed Inertial Measurement Units / Inertial Navigation Systems: For the small survey vessel operating the PingDSP, patch test calibration test lines have been collected at the beginning of each survey day in order to identify angular offsets between the PingDSP sonar and the SBG Systems Ekinox-D inertial navigation system.

4. Sound Velocity Profiles: Sound velocity profiles were collected/checked prior to survey operations to confirm the speed of sound in seawater in Kodiak and Alaska.

5. Empirical Observations: During all survey operations, the field Survey Team could observe navigation system performance relative to the pre-planned survey lines, electronic navigation charts and raster navigation charts, nearby landforms and features in order to monitor overall navigation performance.

8.2 Instrument performance testing with test shapes

In addition to monitoring component systems for adherence to standard technical performance specifications, the field Survey Team understood that overall system performance can, and should be assessed as part of this Task Order. By pre-seeding the vicinity of a sample survey area with representative target objects, it was possible to assess the efficacy of the combined sonar and navigation system (or magnetometer and navigation system) for the survey objectives in the conditions encountered in the Kodiak NDSA.

This testing approach consisted of deployment of an inert 25-pound mortar shape, and an inert 100-pound bomb shape, adjacent to Explosive Anchorage 1 for testing of the EdgeTech 4125 towed sidescan sonar system, and within Explosive Anchorage 1 for testing of the Marine Magnetics SeaSpy towed magnetometer. After deploying each inert test shape at a pre-planned location and recording the position, a series of survey passes with the instruments were performed on May 8, 2015 and May 10, 2015 in order to test detection and position accuracy. (**NOTE: It is important to remember that position accuracy has been demonstrated throughout this project, in practice, by virtue of the successful identification of targets in the WAA sidescan sonar surveys and reacquisition and verification of targets with the ROV. In other words, the positioning accuracy has been demonstrated sufficient to reacquire and verify targets using similar ROV equipment.)**

1. SeaSpy Marine Magnetometer Survey QA/QC Results: The results from the magnetometer survey in Explosive Anchorage 1 have been overlaid with a point coverage shapefile that identifies the locations of the three test shapes placed in the anchorage prior to the survey. Figure 8.1, on the next page, illustrates these results. The results of the testing indicate that the magnetometer as deployed is likely to have detected the 100-pound bomb test shape, but detection of the 25-pound mortar shell and the 50-caliber round were inconclusive. As discussed in Section 5, magnetometer surveys suffer from the inverse proportionality between the detected strength of an anomaly generated by an object, and the cube of the distance between the object and sensor. For MEC and UXO surveys, consistently placing the magnetometer at a fixed altitude near to the seafloor is necessary for effective detection of small ferrous objects and is very difficult to do with towed survey instruments. The poor detection of the 25-pound mortar shell and the 50-caliber round is likely due to the magnetic permeability of the targets coupled with the tow altitude of the magnetometer during the survey of Explosive Anchorage 3.

2. Edgetech 4125 Sidescan Sonar Survey QA/QC Results: The results of the QA/QC testing of the EdgeTech 4125 sidescan sonar against the 25-pound mortar and the 100-pound bomb test shapes have been attached in Figures 8.2 and 8.3. In the case of the 25-pound mortar shell, neither the 400 kHz nor the 900 kHz frequencies on the towfish offered conclusive results that indicated positive detection of the test shape. However, both the 400 kHz and 900 kHz frequencies appeared to indicate the ability to detect the 100-pound test shape. It is important to note, however, that the 100-pound bomb test shape does not necessarily look like a bomb; rather, it could easily be mistaken for a rock, or a fuel tank or other storage tank.

   The approximate distance between the dropped location of the test shape and the detected location of the test shape is roughly 30-feet. The error can be attributed to several sources of error during the deployment of the test shapes and sources of error inherent in the survey technique. As stated above in Section 8.1, however, positioning efficacy has been demonstrated in practice via successful detection and reacquisition of targets in both the Kodiak and Unalaska NDSAs.

   As expected, though both the 400 kHz and 900 kHz frequencies detected the 100-pound bomb target, the 900 kHz frequency appeared to provide better resolution and detail. Measurements of the target with the 400 kHz and the 900 kHz frequency on multiple passes indicated an object approximately 2.0 feet in length, 1.0 feet in diameter, and approximately 7-to-8 inches above the seabed (comparable to the test shape).

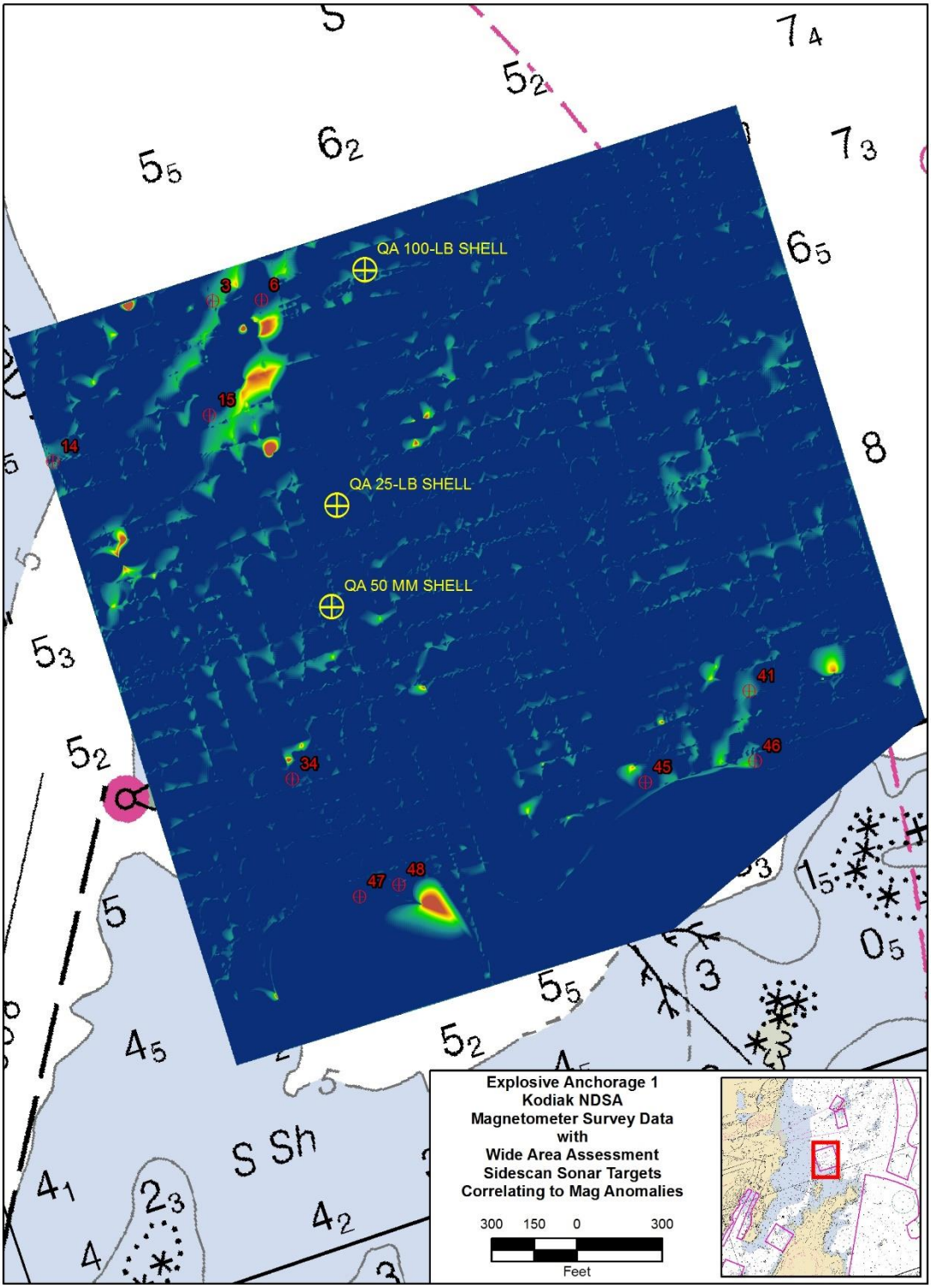


Figure 8.1: Magnetometer Survey Data for Explosive Anchorage 1, with WAA Sidescan Sonar Targets Overlay. WAA Targets that correlate with Magnetic Anomalies have been selected for display. QA/QC seed targets are displayed.

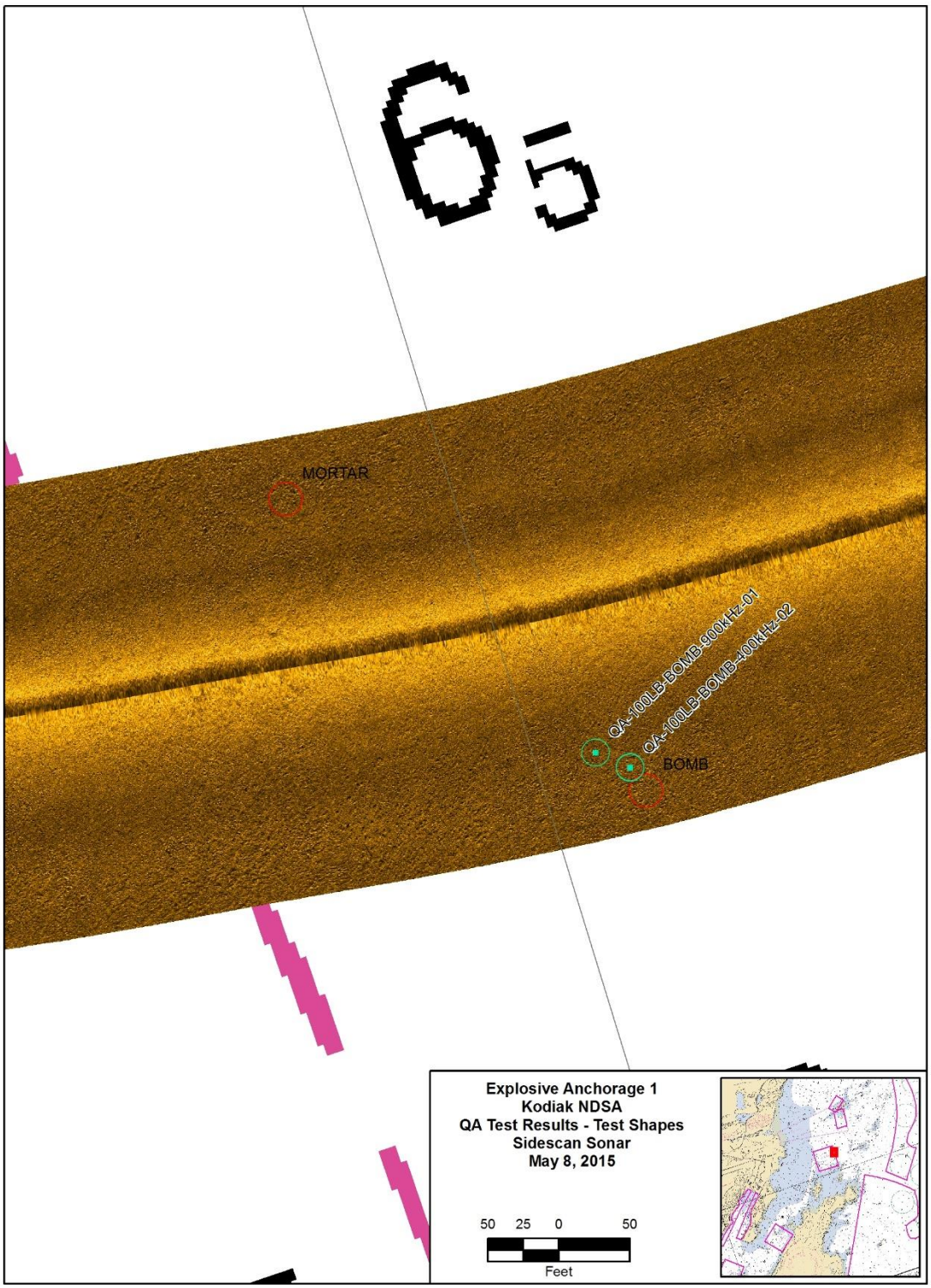


Figure 8.2: Sample QA/QC Sidescan Sonar Survey pass in the vicinity of Explosive Anchorage 1, at 900 kHz. The dropped locations of the test shapes are indicated with the red circles, while the interpreted locations of the 100-pound bomb (from multiple passes) are indicated with the cyan circles.

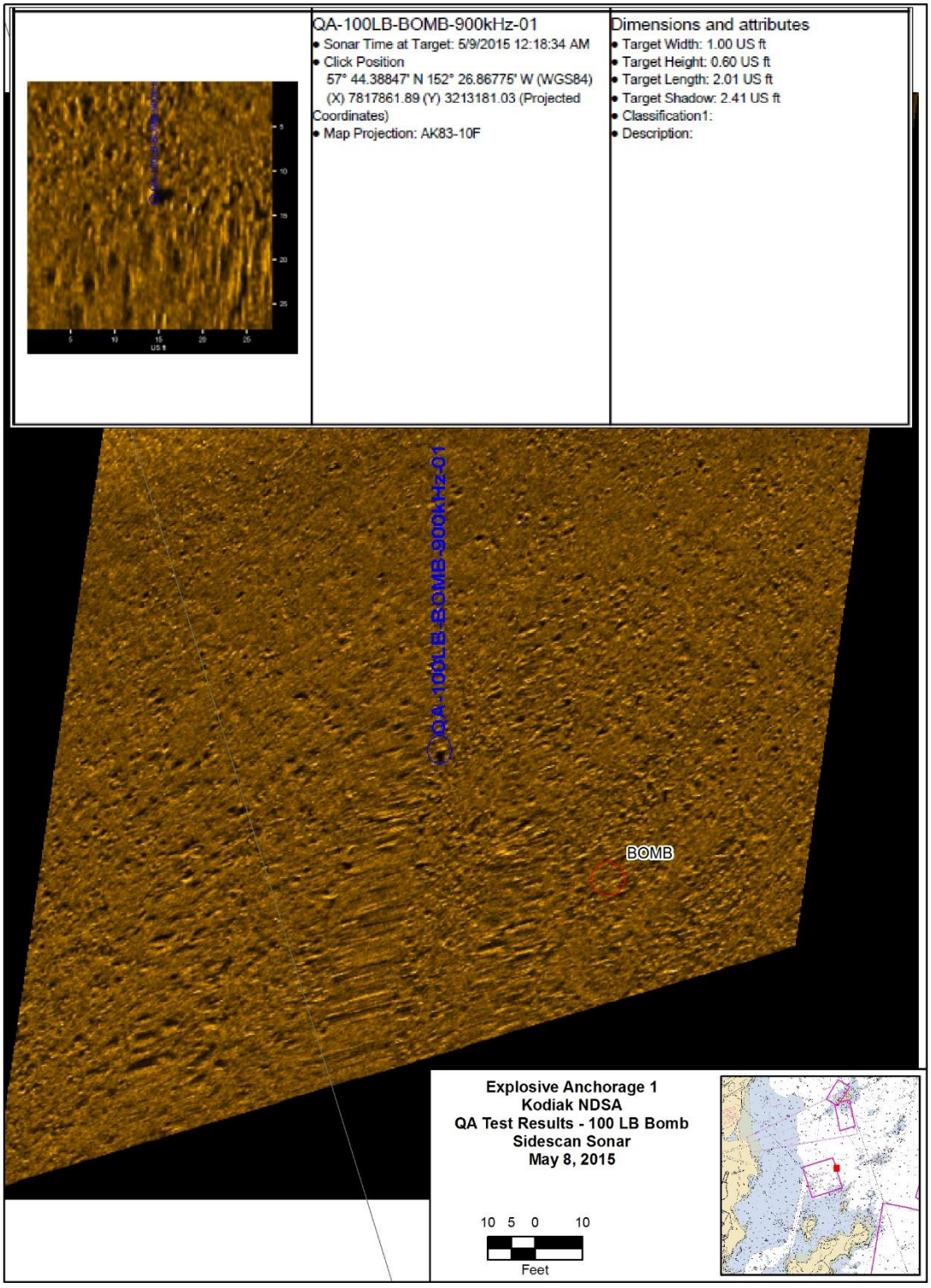


Figure 8.3: Sample QA/QC Sidescan Sonar Survey pass in the vicinity of Explosive Anchorage 1, at 900 kHz. The dropped locations of the bomb test is indicated with the red circle, while the interpreted location of the bomb is indicated with the blue circle. The target information from the processing software is at the top of the figure.

9 Final Conclusions

During a fixed performance period, the Gravity/SeaVision Survey Team performed a wide area assessment (WAA) of fifteen (15) survey areas in the Unalaska Naval Defense Sea Area (NDSA) using high-frequency sidescan sonar 1,099 targets.

Of these targets, the Survey Team subjected forty-five (45) discrete targets to Reacquisition/Verification Surveys by using an observation-class remotely-operated vehicle (ROV) to visually identify and characterize the targets. Most of these targets appeared to be debris and fishing gear, however four (4) targets in Explosive Anchorages 1 and 2 may be potential submerged MEC (potential ammunition crates). Additionally, the Survey Team was unable to perform any ROV operations at the Humpback Rock survey area, which may pose a continued risk for MEC that should be investigated in future survey and/or investigation efforts.

Based on our activities during this survey period, we can offer the following recommendations and conclusions regarding data collection:

1. **Future survey activities, including survey areas Explosive Anchorage 1, Explosive Anchorage 2, Humpback Rock, and former Anti-Ship Mines Area between Long and Woody Islands would benefit from the incorporation of a geophysical survey program that utilizes high resolution acoustic survey methods and electromagnetic survey methods.** The scope of survey areas for this Task Order required particular focus on WAA survey production to cover large areas. This rendered high frequency sidescan sonar surveys (900 kHz or higher) and electromagnetic survey methods with marine magnetometers or metal detectors as poor choices for instrumentation because they are not well-suited to large survey area production. However, with the survey areas more constrained, high-frequency acoustic surveys, densely spaced magnetometer surveys, and carefully conducted towed metal detector surveys may be well-suited to the RI activities at these three sites.

   For clarification of the proposed survey methods, refer to the following definitions:

   - "Electromagnetic (EM) survey methods" is used as a catch-all description for a group of geophysical survey methods to include magnetometer surveys, multiple magnetometer surveys, and metal detector surveys (using pulse-induction methods).

   - "Magnetometer Surveys" refer to surveys that utilize proton precession or overhauser effect magnetometers to measure the earth's magnetic field and thus detect fluctuations in that field due to magnetic anomalies. These would incorporate Marine Magnetics SeaSpy Magnetometers or 3-Axis Gradiometers, or Geometrics G-882M Magnetometers towed behind a survey vessel.

   - "Towed Metal Detector Surveys" refer to surveys that utilize pulse-induction techniques to detect metallic objects. By creating momentary local magnetic fields in search coils and measuring decay rates in the local fields, it is possible to detect metallic objects in the vicinity of the search coils. These techniques would incorporate Geonics EM-61 pulse-induction detectors.

   Additionally, multiple magnetometer arrays, such as the SeaSpy 3-Axis Gradiometer or the "Marine Mag towed multiple magnetometer" system might be prescribed for focused WAA surveys or RI surveys where the survey footprints are much smaller, and there are known targets of concern.

2. **Future WAA activities in the Kodiak and Unalaska NDSA may benefit from AUV deployment.** Prior to mobilization for this project, the uncertainty about the task area geometry and the underwater conditions in the Kodiak NDSA and the Unalaska NDSA precluded deployment of an autonomous underwater vehicle (AUV). However, a properly configured AUV may be very effective for collecting useful sidescan sonar imagery and magnetometer data in specific survey areas in Kodiak and Unalaska.

3. **GIS Data for abandoned fishing gear should be shared with Alaska DNR.** Our survey teams identified dozens, if not hundreds, of ghost fishing pots during this survey effort. Abandoned fishing gear poses a threat to juvenile Alaskan king crab, specifically in the Kodiak area (where efforts are underway to revitalized the fishery). Alaska DNR may find this data useful as they plan ghost pot recovery programs.

APPENDIX E

Interactive Map of Survey Areas

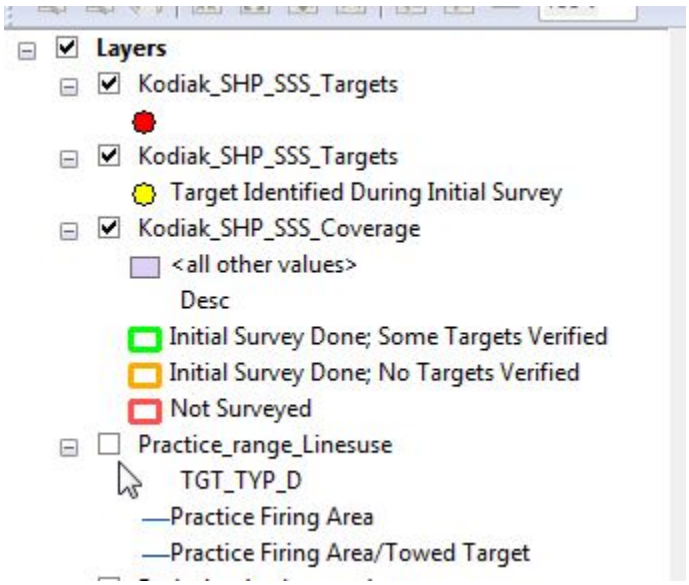
Appendix E - Brief Instructions about How to Use the Interactive GIS Map

Step 1 – Download ArcReader for free at http://www.esri.com/software/arcgis/arcreader/download by following the instructions at the ESRI (author of ArcReader) website.

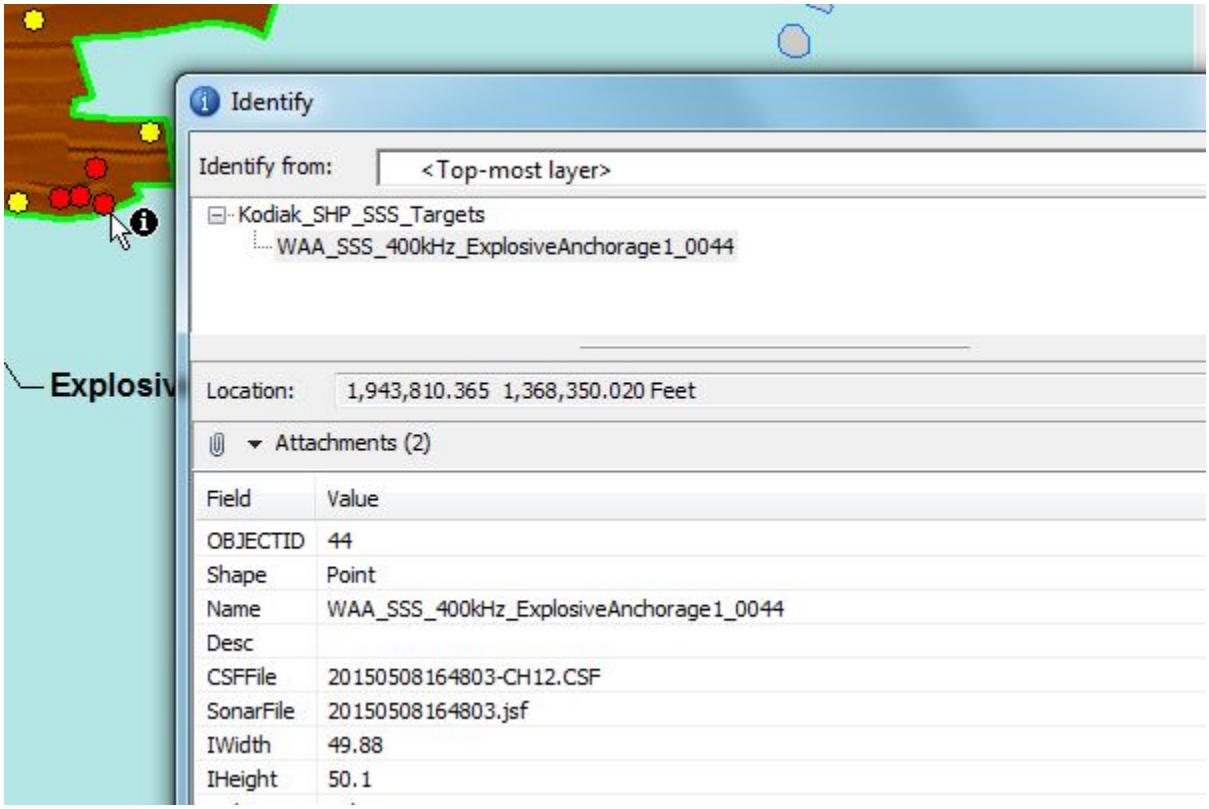
Step 2 – Open ArcReader. Click on menu File on the top left corner of the screen, select Open; then navigate to the .pmf file under the pmf folder on the DVD.

Step 3 – Some basics for operating ArcReader

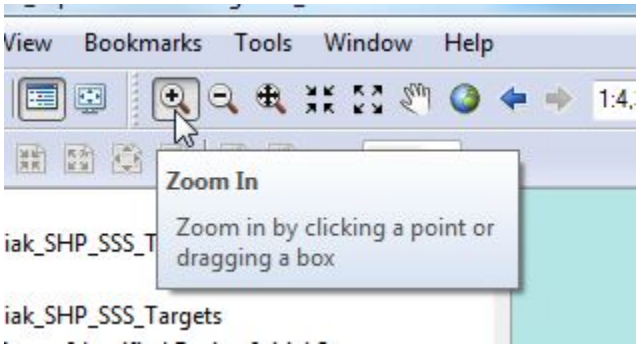
- To turn on/off GIS layers, left click the available check boxes for the various layers listed at the left of the screen. Some layers will be turned on when the file opens and some layers will be turned off.



- To view target information for any target (red or yellow point), left click on the Identify tool on the toolbar located at the top center of the screen, then left click on the target. Left click again on the symbol to exit out of the information mode.



- To enlarge an area, use magnifier symbol located at the toolbar, click on the symbol or draw a rectangle box over the intended area on the screen.

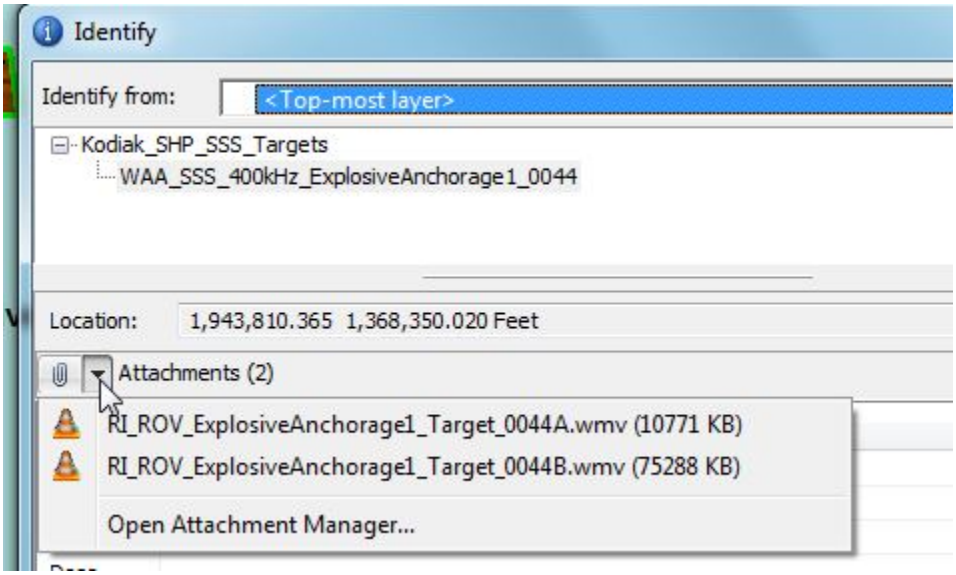


- To see the video of the reacquired targets (red points), follow three steps.

  1) Click on the Identify tool and click on target in red

  2) Click the Open Attachment Manager button – the paperclip icon just above the grid of attribute values. The number of files attached to the features is shown in parentheses.

  3) Click the attachment in the list to open it, or open the attachment from the list of files in Open Attachment Manager window.



Appendix E - Content of DVDs

DVD1 includes sidescan sonar results and links to videos of reacquired targets in:

- Explosive Anchorage No. 1
- Fort Greely Gun Batteries Impact Area (larger of two areas)
- Former Anti-Ship Mines Area between Long and Woody Islands

DVD2 includes sidescan sonar results and links to videos of reacquired targets in:

- Explosive Anchorage No. 2
- Explosive Anchorage No. 3
- Navy Dock Locations in Womens Bay (southeastern portion)

DVD3 includes sidescan sonar results for other areas in Womens Bay, St. Paul Harbor, and northwestern and northeastern Chiniak Bay including:

- Navy Dock Locations in Womens Bay (northwestern portion)
- Army Dock Locations in Saint Paul Harbor
- Former Army Dock at Puffin Island
- Former Navy Dock at Woody Island
- Fort Greely Gun Batteries Impact Area (smaller of two areas, referred to as Puffin Island south in database)
- Long Island Dock
- Former Anti-Ship Mines Areas East of Long Island

DVD4 includes sidescan sonar results for areas in southeastern Chiniak Bay including:

- Humpback Rock Glide and Dive Bombing Target
- Former Anti-Ship Mines Area (two areas)