Great Lakes Icebreaking Mission Analysis

August 30, 2016

Fiscal Year 2016 Report to Congress

Homeland Security

U.S. Coast Guard

Foreword

August 30, 2016

I am pleased to present the following report, "Great Lakes Icebreaking Mission Analysis," which has been prepared by the U.S. Coast Guard.

Senate Report 114-68 accompanying the *Fiscal Year 2016 Department of Homeland Security Appropriations Act* (P.L. 114-113) requires the submission of a mission analysis study to determine the assets necessary to carry out effectively its icebreaking requirements on the Great Lakes, including consideration of a second heavy icebreaker for the Great Lakes, consistent with the capabilities of the Coast Guard Cutter Mackinaw.

Pursuant to congressional requirements, this report is being provided to the following Members of Congress:

The Honorable John R. Carter
Chairman, House Appropriations Subcommittee on Homeland Security

The Honorable Lucille Roybal-Allard
Ranking Member, House Appropriations Subcommittee on Homeland Security

The Honorable John Hoeven
Chairman, Senate Appropriations Subcommittee on Homeland Security

The Honorable Jeanne Shaheen
Ranking Member, Senate Appropriations Subcommittee on Homeland Security.

I am happy to answer any further questions you may have. Please do not hesitate to contact me at (202) 372-4411 or the Department's Deputy Under Secretary for Management and Chief Financial Officer, Chip Fulghum, at (202) 447-5751.

Sincerely,

Paul F. Zukunft
Admiral, U. S. Coast Guard
Commandant

Great Lakes Icebreaking Mission Analysis

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I. Legislative Language

This report responds to the language set forth in Senate Report 114-68, which accompanies the *Fiscal Year 2016 Department of Homeland Security Appropriation Act* (P.L. 114-113), as per the following:

Senate Report 114-68 states:

GREAT LAKES ICEBREAKING CAPACITY

> The Coast Guard is required by law to maintain a heavy icebreaking capability on the Great Lakes to assist in keeping channels and harbors open to navigation in response to the reasonable demands of commerce to meet the winter shipping needs of industry. The Committee is concerned that the Coast Guard does not possess adequate capacity to meet its statutorily required icebreaking mission on the Great Lakes, with negative consequences to the regional and national economy as well as to the safety of local communities. While the Committee fully supports the Coast Guard's Service Life Extension Project for its nine-vessel 140-foot icebreaking tugs as part of the In-Service Vessel Sustainment Program, it notes that additional assets may be necessary to successfully operate in the heavy ice conditions often experienced by the Great Lakes. The Committee directs the Coast Guard to undertake an updated mission analysis study to determine the assets necessary to effectively carry out its icebreaking requirements on the Great Lakes, including consideration of a second heavy icebreaker for the Great Lakes, consistent with the capabilities of the Mackinaw. The updated mission analysis should factor in recent historically high levels of ice coverage and the economic costs of reduced Great Lakes shipping associated with maintaining only one heavy icebreaker. The updated mission analysis shall be submitted to the Committee not later than 180 days after the date of enactment of this act.

II. Background

A. Overview

Pursuant to 14 U.S.C. 2, the Coast Guard is authorized to perform icebreaking operations, and domestic icebreaking is mandated by Executive Order (EO) 7521, dated December 21, 1936. EO 7521 directs the Coast Guard to "assist in keeping open to navigation by means of icebreaking operations, in so far as practicable and as the exigencies may require, channels and harbors in accordance with the reasonable demands of commerce." The Coast Guard conducts icebreaking operations on the Great Lakes and along the East Coast, from the Chesapeake Bay northward to Maine, keeping certain shipping routes and ports open during the parts of winter when they otherwise would be impassable by commercial vessels. The Coast Guard also responds to vessel requests for assistance when they are disabled or stranded in ice-covered waters. The Coast Guard, in coordination with the Army Corps of Engineers, also breaks ice to control flooding caused by ice jams during the spring thaw.

Icebreaking in the Great Lakes is conducted by the Ninth Coast Guard District. It facilitates the movement of critical dry and liquid-bulk cargos carried by the Great Lakes commercial fleet during the winter months. During a typical winter, the Great Lakes icebreaking program extends the navigation season for 4 months, ensuring that life-sustaining cargo can be shipped over ice-covered waters. Critical cargos include grain, coal, salt, and fuel oil. Ninth District icebreaking vessels include one heavy icebreaking vessel (240' WLBB), six icebreaking tugs (140' WTGBs), and two buoy tenders (225' WLBs).

B. Customers

Maritime Commerce: Great Lakes: During the Great Lakes winter shipping season (December 15 – April 15), U.S. and Canadian vessels carry millions of tons of cargo – primarily iron ore for steel mills and coal for power plants.

Shoreline Communities: At the request of state and local agencies and the U.S. Army Corps of Engineers, the Coast Guard breaks ice jams to prevent or relieve flooding. This is done primarily along Lake Erie's western shore, the Detroit River, and the St. Clair River.

Island Communities: Upon request, Coast Guard icebreakers may also open ice-covered channels for passenger/cargo ferries to minimize transit delays to island communities. Ferries operate in more than seven locations in the Great Lakes.

C. Winter Ice Season

The Coast Guard defines the "winter ice season" as the period when icebreaking resources need to be available to assist mariners. It is the period when Great Lakes waterways are susceptible to freezing and typically runs from mid-December, when ice is determined to impede navigation, through late March or early April, when ice no longer impedes navigation and temperatures are not expected to return to levels that would facilitate ice formation. The maximum ice extent normally occurs at the end of February or early March. Three specific "winter navigation periods" are defined within the Great Lakes winter ice season:

- Extended Navigation Season (open shipping): Period of time when ice begins to impede navigation until after the Sault Ste. Marie Locks close (January 15) and the bulk of the commercial fleet reaches its winter layup ports (typically no later than January 20).

- Closed Navigation Season (reduced shipping): Period of time from the end of the Extended Navigation Season until the beginning of Spring Break Out.

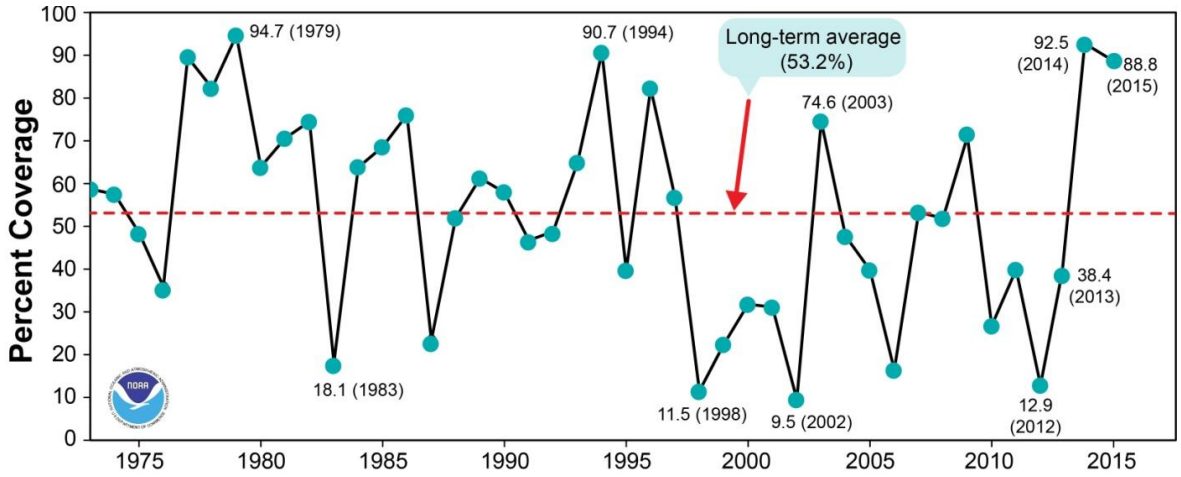
- Spring Break Out (open shipping): Period of time from the end of the Closed Navigation Season until ice no longer impedes navigation. The St. Lawrence Seaway and Welland Canal normally open on or about March 20th and the Sault Ste. Marie Locks on March 25th. Approximately 2 weeks prior to the opening of the locks, the Coast Guard conducts initial fractures in harbors and channels to prepare waterways for open shipping and to enable commercial icebreaking assets to maintain services.

Closed Navigation Season does not mean that all navigation is stopped on the Great Lakes; instead it refers to the closing of the Sault Ste. Marie "Soo" Locks, which prevents traffic flow between Lake Superior and the other Great Lakes through the connecting waters of the St. Mary's River. However, during this period, the traffic does slow down considerably and although the demand for icebreaking still exists, it allows the Coast Guard to conduct any repairs that might be needed on its icebreaker fleet on the Great Lakes.

D. Winter Severity

Icebreaking level of effort and mission performance vary from year to year, and are highly dependent upon the length and severity of winter ice conditions. Over the past 42 years, Great Lakes annual maximum ice coverage has been as little as 9.5 percent and as much as 94.7 percent. Winter severity has a direct correlation to total ice coverage as determined by professional weather and climate entities such as the National Weather Service and the Great Lakes Environmental Research Lab. Graph 1.1 shows the maximum ice coverage and hence winter severity for the last 42 years.

Graph 1.1: Great Lakes Annual Maximum Ice Coverage 1973-2015



E. U.S. Coast Guard Assets

Table 1.1 provides a summary of assets, capabilities, and anticipated lifecycle of Coast Guard icebreakers that service the Great Lakes.

Table 1.1 U.S. Coast Guard Great Lakes Icebreakers

Type	Name	Commissioned	End of Service Life (EOSL)	New SLEP EOSL[1]	Icebreaking Capability[2]: Continuous/ Back & Ram
240' WLBB	MACKINAW	2006	2036	N/A	32"/42"
140' WTGB	KATMAI BAY	1978	2008	2033	22"/36"
	BISCAYNE BAY	1979	2009	2035	
	MOBILE BAY	1979	2009	2034	
	BRISTOL BAY	1979	2009	2032	
	NEAH BAY	1979	2009	2032	
	MORRO BAY	1980	2010	2030	
225' WLB	ALDER	2004	2034	N/A	14"/36"
	HOLLYHOCK	2003	2033	N/A	

F. U.S./Canada Coordination and Memorandum of Understanding

By an exchange of notes on October 28, 1980, and December 5, 1980, the Governments of Canada and the United States formalized an agreement (hereafter "1980 Agreement") to coordinate icebreaking activities of the two governments on the Great Lakes and St. Lawrence Seaway System. The initial agreement was for 10

[1] The Coast Guard has embarked upon a Service Life Extension Program (SLEP) for the 140' WTGBs. This is an acquisition program that will update and extend the service life of the Coast Guard's WTGB fleet by 15 years.
[2] Continuous icebreaking capability is described as the thickness of ice that a cutter can break while steaming ahead at a speed of three knots. Back and ram icebreaking capability refers to the maximum icebreaking potential of a cutter, achieved by backing the vessel away from the ice edge then coming ahead at full throttle to generate momentum and press into the ice.

years, after which it has been renewed (via letters) every 5 years: December 4, 1990; December 5, 1995; December 4, 2000; December 5, 2005; and December 5, 2010. This original agreement expired on December 5, 2015. A new arrangement with the same provisions was signed by the Assistant Commissioner, Central and Arctic Region of the Canadian Coast Guard, and the Director, Marine Transportation Systems of the U.S. Coast Guard, on November 30, 2015. This arrangement remains in place until superseded by a new agreement, or within 90 days of written notification of cancellation by either country.

The aim of these agreements is "that coordination between United States and Canadian Coast Guards will lead to increased efficiency in the utilization of ice operations forces in the Great Lakes and St. Lawrence Seaway System thereby increasing our capability to maintain open routes for maritime commerce to the mutual advantage of both the United States of America and Canada."

The first two Canadian icebreakers in Table 1.2 are home-ported in the Great Lakes and the other three East Coast and St. Lawrence Seaway vessels have been requested and utilized to support icebreaking during severe ice seasons on the Great Lakes as needed.

Table 1.2 Canadian Coast Guard Assets

Vessel Name	Canadian Classification
CCGS SAMUEL RISLEY	Light Icebreaker
CCGS GRIFFON	Light Icebreaker
CCGS MARTHA L. BLACK	Light Icebreaker
CCGS DES GROSEILLIERS	Medium Icebreaker
CCGS PIERRE RADISSON	Medium Icebreaker

The Canadian classification is based on a comparison across its icebreaking fleet to include Arctic icebreakers. Canadian Coast Guard Shop (CCGS) RISLEY is equivalent in capability to the U.S. Coast Guard Cutter (USCGC) MACKINAW. CCGS GRIFFON and MARTHA BLACK are similar in capability to the U.S. Coast Guard 225' WLBs. CCGS DES GROSEILLIERS and PIERRE RADISSON are more capable than USCGC MACKINAW, but less capable than the USCGC HEALY, the Coast Guard's only Medium Polar Icebreaker. The Canadian Coast Guard assets complement the smaller, more maneuverable 140 WTGBs that are excellent for working in confined waterways, but that lack the ability to break heavy ice continuously.

G. Coast Guard Organization – Ice Operations

The United States and Canadian Coast Guards each maintain regional operation centers to monitor waterway conditions and movement of vessels, collect and disseminate marine information, and control and coordinate icebreaking resources.

Icebreaking services are provided throughout the Great Lakes by both the U.S. Coast Guard (Ninth District) in Cleveland, Ohio, and the Canadian Coast Guard (Central and Arctic Regions) in Montreal, Ontario. The Ninth U.S. Coast Guard District commands are organized into two task groups, Operations Taconite and Coal Shovel, that are responsible for the performance of the following assigned icebreaking missions:

- Operation Taconite: Sector Sault Ste. Marie serves as the Operation Taconite Task Group Commander and is responsible for the conduct of icebreaking operations in Lake Superior, the St. Mary's River, the Straits of Mackinac, Northern Lake Huron, and Lake Michigan. The Coast Guard Joint Ice Operations Center and Vessel Traffic Service are located in Sault Ste. Marie, Michigan. The Canadian Coast Guard Marine Communications and Traffic Services (MCTS) Center is located in Thunder Bay, Ontario.

- Operation Coal Shovel: Sector Detroit serves as the Operation Coal Shovel Task Group Commander and is responsible for the conduct of icebreaking operations in all of Lake Erie, the Detroit River, Lake St. Clair, the St. Clair River, and Southern Lake Huron. During joint operations, Regional Operations Center Sarnia coordinates with Operation Coal Shovel and Sarnia MCTS Centre to ensure safe and synchronized efforts.

III. Report

The following analysis recognizes that the U.S. Coast Guard and Canadian Coast Guard icebreakers operate jointly in the Great Lakes and St. Lawrence Seaway; identifies icebreaking requirements for waters of the United States and waters shared with Canada within the Great Lakes; and details the overall performance, capability, and capacity of the United States Great Lakes icebreaking fleet. The analysis does not assess these items for the Canadian domestic icebreaking fleet, nor does it identify the icebreaking requirements for the St. Lawrence Seaway. The analysis does not evaluate alternative approaches for meeting operational capacity such as charging fees or promoting the development of private sector icebreaking services.

A. Supporting Data

Primary data sources to support the qualitative analysis include:

1. Icebreaking end-of-season reports, cutter abstracts of operations, and cutter casualty and maintenance data.

2. Estimates for Great Lakes ice conditions. These rely on previous studies, predictive models, and reported observations found in the 2010 Coast Guard Domestic Icebreaking Mission Analysis Report (MAR).

3. Winter ice coverage. This is used as a measure of winter severity for the Great Lakes. This data is captured and published annually by the North American Ice Service and National Ice Center. The United States Historical Climatology Network maintains a dataset for locations throughout the United States.

4. Performance measurements for the Great Lakes that were reported within Coast Guard Annual Performance Reports and Ninth Coast Guard District Icebreaking End-of-Season Reports.

5. 2010 Domestic Icebreaking MAR. The 2010 MAR remains a relevant document with no recent changes in the facts or assumptions that would impact the analysis, with the exception of two unusual back-to-back severe winters on the Great Lakes.

B. 2010 Domestic Icebreaking MAR Summary

The 2010 MAR examined current and projected mission requirements for domestic icebreaking in the Great Lakes region. The report concluded that the current fleet of domestic icebreakers and ice-capable buoy tenders satisfied most of the icebreaking requirements for the Great Lakes, but identified the following gaps:

1. A 3-week deficit in heavy[3] icebreaking capability (WLBB) during a severe winter ice season, requiring a second icebreaker, when severe ice conditions are experienced simultaneously in the upper and lower Great Lakes;

2. A 6-week deficit in medium icebreaking capability (WTGB) during a severe winter ice season;

3. No current plans to recapitalize or extend the life of the 140' WTGB medium icebreaking tugs that exceeded their designed service life; and

4. An obsolete Coast Guard icebreaking policy that dates back to 1993, which no longer aligns with District policy and lacks elements needed to assess domestic icebreaking mission performance.

C. Actions Taken to Address the 2010 Domestic Icebreaking MAR

The Coast Guard evaluated the solutions presented in the report to determine appropriate actions to sustain adequate icebreaking capabilities on the Great Lakes. Each of the solutions in response to the report's findings is detailed below:

1. The 3-week gap in heavy icebreaker coverage caused during a severe winter will continue to be mitigated through the U.S. and Canadian partnership. The Coast Guard has determined that it is resourced appropriately for a normal winter and that it is not cost-effective to procure a new heavy icebreaker for a 3-week gap that occasionally occurs during severe ice seasons.

2. Coast Guard mitigated the 6-week WTGB deficit by transferring USCGC MORRO BAY, a 140' WTGB cutter homeported in New London, Connecticut, to be homeported in Cleveland, Ohio. This has been a valuable resource to the Great Lakes region and has increased Great Lakes icebreaking capacity to alleviate the gap.

3. The Coast Guard has embarked upon a SLEP for the 140' WTGBs. This is an acquisition program that will update and extend the service life of the Coast Guard's WTGB fleet by 15 years. The program is underway at the Coast Guard Yard in Baltimore, Maryland. USCGC MORRO BAY, the first cutter to commence SLEP, was completed in August 2015 and returned to Cleveland for the 2015-2016 ice season. USCGC BRISTOL BAY is currently at the Yard and completion is scheduled for November 2016 with an expected return to operations in December 2016. The four remaining Ninth Coast Guard District WTGBs will enter SLEP, one per year, for a period of 13 months each.

[3] The designation of "heavy" and "medium" icebreakers in this report refers to the capabilities of the vessels in the context of the Great Lakes icebreaking mission only. For the purposes of this report, the term "heavy" applies to the MACKINAW, and all other USCG Great Lakes icebreakers are considered "medium."

The final Ninth Coast Guard District hull is expected to be complete in May 2020.

4. The Coast Guard has updated its Domestic Icebreaking Operations Policy and has implemented a tiered waterway system to manage service expectations and to better align its service priorities. As per the updated policy, the Coast Guard will conduct icebreaking operations primarily in Tier 1 and Tier 2 waterways to ensure the safe navigation of critical cargos. In Tier 3 and Tier 4 waterways, the Coast Guard will encourage private entities to break ice wherever possible. The tiered system is defined below and Table 1.3 lists the Tier 1 and 2 waterways on the Great Lakes.

    - Tier One: The connecting waterways of the Marine Transportation System or other navigable waterways (as defined in 33 CFR 2.36(a)) deemed highest priority due to geographical location or importance of cargo to public health and safety (e.g., heating oil, power plant fuel, food, etc.).

    - Tier Two: Navigable waterways through which cargo of significant economic importance to a region moves (e.g., supplies to industrial facilities, fishing, large passenger ferries, etc.); or waterways that connect Tier One and Tier Three waterways.

    - Tier Three: Federally maintained waterways within a port or other navigable waterways between Tier Two waterways and commercial facilities or smaller, year-round ports hosting multiple users (as determined by number of vessel transits or economic value to the region).

    - Tier Four: Wholly private or nonfederally maintained waterways, piers, or docks.

Regardless of the tier, Coast Guard will continue to provide icebreaking services to assist vessels in emergency or urgent situations and to assist communities in exigent need.

Table 1.3 Great Lakes Tier 1&2 Waterways

Op Area	Winter Waterways	Tier
Eastern Lake Erie	Eastern Lake Erie	2
Western Lake Erie	Pelee Passage	1
	Maumee Bay	2
Detroit/St. Clair River	Detroit River	1
	Lake St. Clair	1
	St. Clair River	1
Lake Huron	Saginaw Bay	2
	Georgian Bay	2
Straits of Mackinac	Straits of Mackinac	1
	Grand Traverse Bay	2
St. Mary's River	Middle Neebish	1
	West Neebish	1
Eastern Lake Superior	Whitefish Bay	2
	Upper St. Mary's River	1
Western Lake Superior	Western Lake Superior	2
	Thunder Bay	2
Northern Lake Michigan	Upper Green Bay	2
	Lower Green Bay	2
Southern Lake Michigan	Southern Lake Michigan	2
Lake Ontario	Lake Ontario	2
St. Lawrence River	St. Lawrence River	1

D. Performance Measures

Performance is measured as availability of Tier 1 waterways, which are the most critical, and hence best illustrate the ability of marine traffic to navigate the Great Lakes system.

Tier 1 waterway availability is measured by dividing the total actual waterway availability hours from the total potential waterway availability hours during an ice season. A waterway is considered unavailable if an ice-related event or condition prevents vessels from transiting. For example, if the Great Lakes ice season were 96 days long, the total potential waterway availability would equal 2,304 hours (96 days x 24 hours per day). However, if traffic were unable to move due to ice for 48 hours during the season, Tier 1 waterway availability would equal 97.92 percent (2,256 actual hours available/2,304 potential hours available).

Table 1.4 shows percentage of Tier 1 availability since this measure was instituted in 2012. It should be noted that the severe back-to-back ice seasons experienced in 2014 and 2015 are rare occurrences and not necessarily indicative of the Coast Guard's ability to provide icebreaking services.

Table 1.4 Performance Measures 2012-2016

Fiscal Year	Target	Great Lakes Tier One Availability	Severe Season
2012	95%	100%	No
2013	95%	98.00%	No
2014	95%	74.05%	Yes
2015	95%	81.20%	Yes
2016	95%	100%	No

E. Summary

The current mix of heavy and medium icebreakers is capable of managing priorities and requests for icebreaking in Tier 1 and 2 waterways. When a severe ice season stresses Coast Guard asset capabilities, the existing agreement and partnership with Canada fills the capability gap and brings in extra heavy-icebreaking resources to manage the ice. As shown in Graph 1.1 and Table 1.5 below, the 2014 and 2015 ice seasons were a 20-year anomaly, consuming almost twice as many cutter resource hours as in any other year since 2005.

The Coast Guard cannot reliably predict the economic impact of maintaining a single heavy Great Lakes icebreaker. Additionally, given the extreme conditions when ice coverage exceeds 90 percent, it is not clear that shipping delays would be significantly mitigated by an increase in icebreaking capability. Delays can be associated with several factors such as slow transit speeds, availability of pilots, and simultaneous and competing demand signals for icebreaking services across the Great Lakes.

Table 1.5 Great Lakes Icebreaking Hours 2005-2015

Fiscal Year	Great Lakes Cutter Domestic Icebreaking Hours	Severe Season
2005	3,365.60	No
2006	1,550.10	No
2007	2,530.60	No
2008	6,100.00	No
2009	4,311.70	Yes
2010	3,330.80	No
2011	5,506.80	No
2012	2,321.80	No
2013	5,392.60	No
2014	11,717.80	Yes
2015	8,413.80	Yes
2016	1,661.90	No