Appendix R
Navigational Risk Assessment

Navigational Risk Assessment

Icebreaker Wind

Lake Erie, City of Cleveland,

Cuyahoga County, Ohio

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1.0 INTRODUCTION

This Navigational Risk Assessment (Assessment) has been prepared in support of the Icebreaker Wind Project (the Project), a demonstration-scale offshore wind facility in Lake Erie, being proposed by Icebreaker Wind, Incorporated (the Applicant). The design and permitting portions of this Project are being pursued under a grant provided by the U.S. Department of Energy (DOE). Construction of the Project is anticipated to begin in the spring of 2019. For the purpose of this NRA, the term "Project Site" refers to the specific area where the turbines, electric collection cables, and associated infrastructure will be erected. The "Project Area" means generally those portions of the waters of Lake Erie, the Cleveland Harbor, and the Port of Cleveland that may be impacted by the construction or operation of the Project.

The Project will consist of six 3.45 megawatt (MW) wind turbine generators, a buried submarine cable connecting the turbines (inter-array cable), and a buried submarine cable from the turbine closest to shore to the Project Substation located onshore in the City of Cleveland (export cable), totaling approximately 12 miles. The turbines will be in approximately 8 to 10 miles off the coast of Cleveland, Ohio (Figure 1).

The document has been prepared in general accordance with the United States Coast Guard (USCG) guidance for Offshore Renewable Energy Installations (OREIs) contained in the *Navigation and Vessel Inspection Circular No. 02-07* and the *Risk-Based Decision-Making Guidelines for Preliminary Hazard Analysis* from the USCG (USCG 2007, USCG 2010). A change analysis, based on the USCG's *Risk-Based Decision-Making Guidelines*, is used to assess the risk effects and proper management strategies in situations where change is occurring. This Assessment is a qualitative risk assessment, based on a change analysis (Appendix A) that determines the current and future conditions related to navigational safety, evaluates the navigational risk due to the construction and operation of the Project, and where applicable, makes recommendations for mitigation.

The Applicant has consulted with various agencies regarding the Project's potential to pose risks to navigation, including the Cleveland Cuyahoga County Port Authority, USCG, United States Army Corps of Engineers (USACE), National Oceanic and Atmospheric Administration (NOAA), Federal Aviation Administration (FAA), and Ohio Department of Transportation (ODOT). Coordination with these agencies is anticipated to continue throughout construction and operation of the Project. Icebreaker Windpower Inc. has applied and will continue to apply for various permits related to navigation including, but not limited to:

- USCG Permit for Private Aid to Navigation application (Form CG-2554) to identify new navigational aids that will be used;
- USACE Section 408 Permit to Alter or Use a Federal Navigation Project to coordinate activities near the navigation channel and the harbor breakwater;

- USACE Section 10 Permit for work conducted in navigable waters of the United States for installation of cables and turbines in Lake Erie; and
- FAA Notice of Proposed Construction or Alteration with concurrence from ODOT (Form 7460-1) to address aircraft warning lighting (Determination of No Hazard received from the FAA on February 23rd, 2017).

In addition, the Applicant will notify the NOAA Office of Coast Survey prior to and upon completion of construction so that navigational charts may be updated.

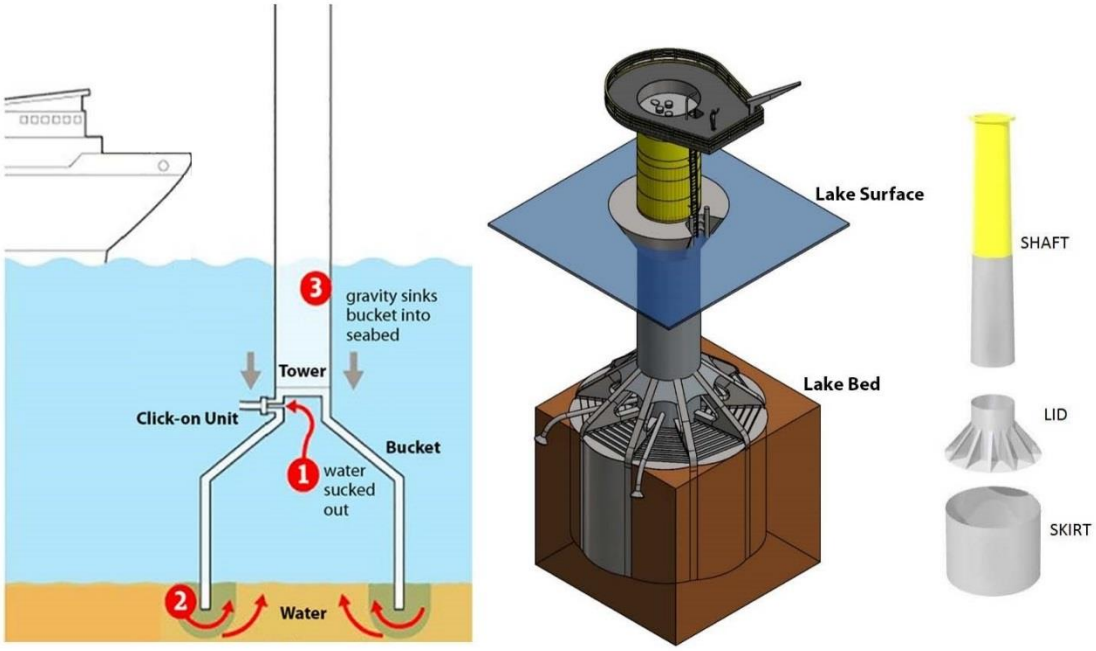
2.0 PROJECT DESCRIPTION

The Project will include six wind turbines, five submerged inter-array cables interconnecting the turbines (with a total length of approximately 2.8 miles), an approximately 9-mile long submerged export cable connecting the turbines to the Project Substation, a new Project Substation located adjacent to the Cleveland Public Power (CPP) Lake Road Substation in Cleveland, Ohio, and approximately 150 feet of new transmission cable installed in an underground concrete duct bank to transmit electricity from the Project Substation to the CPP Substation (Figure 2).

The Project turbines will be Mitsubishi Heavy Industries Vestas Offshore Wind (MVOW) – Vestas 3.45 MW offshore wind turbines, supported by Mono Bucket (MB) foundations. The turbines will be located in Lake Erie, approximately 8 to 10 miles off the coast of Cleveland, Ohio and will be arranged in a single row, generally oriented southeast to northwest, with approximately 756 meters (2,480 feet) between each turbine. Geotechnical surveys were conducted around seven potential turbine sites, and six of those sites will be selected as locations for the turbines. Each turbine will be constructed with an 83-meter hub height (272.3 feet), a rotor diameter of 126 meters (413 feet) and blade length of 62.9 meters (206 feet). The lowest point of the blades will reach 20 meters (66 feet) above the surface of the water and the highest will be 146 meters (479 feet) above the surface of the water (Figure 3). The majority of the turbine, including the blades, will be painted light gray.

The MB foundation combines elements of a gravity base, a monopile, and a suction bucket. It is a suction installed caisson or an “all-in-one” steel foundation system to support offshore wind turbines. The approximate depth of the water at the proposed turbine sites is 19 meters (62 feet). The interface with the lakebed is accomplished by means of an approximately 17.0-meter (55.8 feet) diameter steel skirt that penetrates the lakebed. The skirt is welded to an upper steel lid which then transitions to a shaft, 4.5 meters (14.8 feet) in diameter above the mudline, that resembles the elements of a standard monopile (see Inset 1). The overall height of the foundation will be approximately 36.9 meters (121 feet) and the portion of the foundation above the water line (39 feet [12 meters]) will be painted yellow.

Since the foundation will use suction technology, there will be no lakebed preparation necessary (dredging or drilling) for installation. Additionally, the foundation installation will not require pile driving.



Inset 1. MonoBucket General Design

A combined boat landing/ice cone will be constructed around each turbine to provide access for turbine maintenance crews, to lower the ice loads during the winter, and also potentially to serve as a safe haven for recreational boaters in an emergency (Figure 3). Above the boat landing, there will be a 10 meter (32.8 feet) access ladder to a work platform. The access ladder may be lighted with a small down shielded light, if necessary. Two amber flashing navigation lights will be affixed near the work platform of all six turbines to provide 360º visibility around the turbines. On turbine platforms 2 through 5, the amber lights will have a visibility of 4 nautical miles and a synchronous flash rate of 20 flashes per minute. Synchronously flashing (flash pattern to be determined) amber lights, visible up to 5 nautical miles, will be installed on Turbines 1 and 6 at each end of the turbine string. In addition, Turbines 1 and 6 will have fog horns (and visibility sensors) audible for at least 2 nautical miles.

The proposed inter-array cables and export cable will be 3-conductor, single armored, underwater power cables, with an approximate overall diameter of 4.5 inches and rated at 34.5 kilovolts (kV). The cables will be composed of a 3-core copper conductor with cross-linked polyethylene (XLPE) or ethylene propylene rubber (EPR) insulation. Optical fibers for data transmission will be embedded between the cores, and all of the separate cables will be protected by steel armor and multiple layers of waterproof material. The cables will be buried in the lakebed at a targeted minimum

depth of 1.5 meters (4.9 feet). Geophysical and geotechnical surveys were performed in 2016 along a cable route envelope. The cable route will be finalized upon selection of an installer for the Project.

The export cable will extend from Turbine 1 (ICE1) in a southeasterly direction underneath the Cleveland Harbor Breakwater and under the remaining portion of the Harbor to the Project Substation in Cleveland, Ohio (Figure 4). The proposed cable will be brought ashore entirely under the Harbor and the breakwater through a duct installed using horizontal directional drilling (HDD). The exact location of the cable will be determined by subsurface conditions and installation techniques that have not been finalized at the time of this report. However, the cable will be installed within the envelope surveyed during the geotechnical investigations (Figure 4).

The launch pit for the HDD will be located adjacent to the CPP Lake Road Substation. For this Project, following drilling of the initial pilot hole, the "bottom hole assembly" (the drill bit and the non-magnetic drill pipe encasing the survey instrument at the end of the drill string) will be lifted to the deck of a work barge and removed. At this point, the hole will be "pre-reamed" to approximately 12 inches larger than the outside diameter of the proposed high density polyethylene (HDPE) conduit (i.e., to approximately 28 to 30 inches in diameter). The driller will most likely do this by progressing the reamer (a 30 inch diameter cutter) through the drilled hole from the onshore end towards the offshore "exit." By going in that direction, the majority of the pre-ream cuttings and drilling fluid will be transmitted back to the land surface at the onshore drill site, rather than being emitted at the "exit." The HDPE conduit would be prefabricated in a single string prior to it being pulled back through the drilled and reamed hole. The driller anticipates the HDPE string being towed out to the exit point where, on the deck of the barge, it will be attached to the drill pipe by way of a pull-head at the front of the HDPE pipe, along with a swivel and a reamer. That assembly will be lowered overboard and the onshore drilling rig will then pull the HDPE pipe through the drilled and reamed hole and into the drilling pit onshore. The electric cable would be installed from outside the Breakwater toward the shore through the conduit using the pull-string previously placed in the conduit.

Drilling operations will use drilling fluids to stabilize the bore hole and to lubricate the drilling process. The proposed drilling mud (a clay-based compound such as Bentonite) will be National Sanitary Foundations (NSF) approved for drinking water applications such as water wells. Spent drilling fluids containing solely bentonite clay are considered "earthen material" and may be buried or land applied on-location within the right-of-way of the drilling operation or at a designated property. Drill cuttings resulting from HDD using solely bentonite clay and water are also considered "earthen material" and may be managed similarly. Though precautions will be taken to minimize or avoid a drilling fluid leak, an Inadvertent Return Contingency Plan ("Frac-out" Plan) has been prepared by the Applicant to address the potential risk of an inadvertent release of drilling fluids (Appendix B). The plan describes the procedure the Applicant

and the contractors will implement to avoid, minimize, and remediate potential environmental impacts that could result from an inadvertent release.

The remainder of the export cable will be installed using a deck barge with a cable installation and burial spread mobilized on board. The proposed approach for the export cable is bury-while-lay (simultaneous burial). The cables will be buried by using a jetting tool or a cable plow. A plow is a tool that typically sits on skids (skis) and is pulled by a vessel. The plow's share cuts into the soil forming a trench into which the cable is laid. Alternatively, a jetting tool equipped with high-pressure water jets would accomplish the burial process by fluidizing the sediments within a narrow trench into which the cable is lowered. The installation of the cables would result in short-term localized sediment suspension. Sediments would be disturbed along the approximately 12-mile length of the cable route disturbed by the process. Sediments would subsequently settle back on the lakebed, providing a degree of back-fill. As mentioned above, the exact location of the cable will be determined by subsurface conditions and will be installed within the envelope surveyed during the 2016 geotechnical investigations (Figure 2).

The onshore components of the Project, including the Project Substation, onshore interconnection cable, fiber optic cables, and interconnection facilities will be located in Cleveland, Ohio. Construction activities will be supported by a proposed construction staging area at the lakeshore within the Port of Cleveland (Figure 2). The Great Lakes Towing (GLT) facility on the Old River in Cleveland, Ohio, approximately 1.6 km from the Cleveland outer harbor, is proposed as the location for the Operations and Maintenance (O&M) Center (Figure 2).

3.0 WATERWAY CHARACTERISTICS

Navigational operations in Lake Erie near the Project Area are affected by meteorological conditions, water quality and hydrodynamics, channel size and configuration, obstructions, and aids to navigation (ATONs). Each of these factors is addressed in the following subsections.

3.1 Meteorological Conditions

In general, Cleveland Ohio is characterized by a humid temperate climate with seasonal temperature variations including hot summers and cold winters. Temperatures average in the low 70s in the summer and upper 20s to low 30s in the winter (Table 1). On average, Cleveland experiences 156 days of precipitation per year, with June and July being the wettest months (average of 3.5 inches) and February being the driest month (average of 2.2 inches of precipitation) (NOAA, 2016d). The months with greatest snowfall include December, January, and February, all with average monthly snowfall of at least 12.0 inches (Table 1; NOAA, 2016d). Thunderstorms are responsible for some of the strongest winds on the Lake and typically occur April through September, but are most frequent during the months

of June and July (NOAA, 2016d). Onshore, thunderstorms typically occur 25 to 30 days, a year (NOAA, 2016d). The prevailing wind direction in Cleveland is southwest (NOAA, 2016d). Between 2005 and 2013, overall average wind speed at the Cleveland Crib (at a height of 50 meters) was 7.37 meters/second (16.5 mph) (CWRU, 2014).

Table 1. Average Monthly Air Temperature and Precipitation in Cleveland, Ohio

Month	Temperature (°F)			Precipitation (in)	
	Low	Mean	High	Rain	Snow
January	19.1	26.6	33.5	2.5	13.5
February	20.5	28.5	36.0	2.2	12.2
March	28.5	37.3	45.6	3.0	10.6
April	38.5	48.7	58.4	3.4	2.3
May	48.3	59.1	69.4	3.4	0.1
June	57.7	68.4	78.7	3.5	0.0
July	62.3	72.8	82.7	3.5	0.0
August	61.0	71.2	81.0	3.4	0.0
September	54.2	64.4	74.1	3.1	0.0
October	43.9	53.7	63.0	2.5	0.7
November	34.7	42.5	49.9	3.2	5.3
December	24.6	31.5	37.9	2.9	12.0

Cleveland typically averages 148 days with fog per year. Fog occurs throughout the year with a slight maximum in August (NOAA, 2016d). Over the past year, average monthly visibility at the Cleveland Hopkins International Airport (approximately 9 miles southwest of the Project Site) has ranged from 8.6 miles to 13.7 miles, with a daily minimum of 1.4 miles (Diebel et al., 2016). According to the National Weather Service (NOAA et al., 2015), the City of Cleveland has an average of 66 days per year that are clear (0-30% cloud cover), 97 days that are partly cloudy (40-70% cloud cover), and 202 days that are cloudy (80-100% cloud cover). Thus, clear skies occur approximately 18% of the time, while cloudy/overcast conditions typically occur about 55% of the time.

3.1.1 Lake Erie Water Conditions

The elevation of Lake Erie's surface varies year to year due to changes in lake volume and effects of wind. A strong seasonal pattern is typically seen, with the lowest elevation occurring during the winter and the highest in the summer (NOAA, 2016d). Between 1860 and 2015, Lake Erie's annual average water level ranged from approximately 173 meters (568 feet) above mean sea level (AMSL) to 175 meters (574 feet) AMSL with an average water level of

approximately 174 meters AMSL (NOAA, 2016c). Wind gusts can create sudden changes in water level. Fluctuations as great as 10 feet and lasting as long as 12 hours have been observed; however, along the south shore, fluctuations caused by winds are generally less than 1 foot above or below normal (NOAA, 2016d).

Wave climatology of the lake is closely coupled with wind climatology. An analysis of waves in the Project Area was performed by BMT Argoss. The report provided wave criteria for input into the basis of design. The analyses were based on the Wave Information Studies, a USACE sponsored project that generates consistent, hourly, long-term wave climatology along all U.S. coastlines. Data from WIS station 92070, located approximately 4 miles from the City of Cleveland shoreline, indicated extreme wave criteria for maximum wave height for a one year return period was 6.2 meters (20 feet) and 8.2 meters (27 feet) for a 50 year return period. However, mean significant wave height, defined by the NOAA National Data Buoy Center as the average of the highest one-third of all the wave heights during a 20-minute sampling period, was determined to be 0.5 meters (1.6 feet; BMT Argoss, 2016).

Due to the high surface area to depth ratio and the shallowness of Lake Erie, lake temperatures are much more responsive to seasonal changes in air temperature when compared to the other Great Lakes. Lake Erie is usually at its coldest in January and February (when it can be icebound, or just above freezing), and at its warmest in August, with temperatures generally in the low to mid 70s (NOAA, 1987). Additionally, the difference in temperature between the water surface and the lake bottom can be substantial in the summer months, and varies considerably over the basins (Western, Central, Eastern) (Schertzer et al., 1987). Typical ice formation in Lake Erie begins in the western basin in late December and spreads east across the lake with peak ice coverage typical in February (NOAA, 1987). Historically, there has been a large variation in ice cover in Lake Erie, ranging from less than 25% cover in a mild year to 100% cover during severe winters (Daly, 2016). The Applicant contracted with Eranti Engineering to analyze dynamic ice forces and the significance of ice loads on the fatigue limit design of the turbine foundations. Ice is present at the Project Area an average between zero and 20 weeks per year, with an average of 10 weeks per year.

Ice conditions and winter storms restrict navigation for vessels on Lake Erie. Ice thickness and percent coverage on the lake are important factors determining navigation restrictions. In addition, icing of vessels themselves can add significant weight and instability to the vessel. Although shipping restrictions can occur in the St. Lawrence Seaway from the middle of December to the beginning of April, shipping among the Great Lakes and within Lake Erie can usually continue until January (or even longer) with assistance from USCG icebreakers. The icebreakers can maintain a clear path along main vessel routes.

3.2 Channel Size and Configuration

Within Lake Erie, the Project will be located in the Central Basin, in an area of relatively uniform lakebed topography that slopes downward from southeast to northwest. Water depth increases linearly with increasing distance from shore. In the Project Area, depth of Lake Erie ranges from 0 feet at the Cleveland shoreline to approximately 62 feet (19 meters) at the proposed turbine furthest from shore (Figure 5).

The Cleveland Harbor consists of an outer harbor formed by breakwaters, and an inner harbor made up of the Cuyahoga River and the Old River (Figure 6). The outer harbor is formed by a series of breakwaters that run parallel to the shore and extend about 1 mile west and 4 miles east of the mouth of the Cuyahoga River. The harbor is approximately 1,600 to 2,400 feet wide and approximately 1,300 acres in total size (USACE, 2009). The main entrance to the harbor is a dredged channel opposite the mouth of the Cuyahoga River. Additional entrances to the harbor include one at the east end and one at the west end for small craft. The inner harbor consists of dredged channels that lead upstream into the Cuyahoga River and the Old River. Depths in the outer harbor are 29 feet in the approach of the entrance from deeper water in the lake, 28 feet through the entrance channel to the mouth of the river and in the west basin, 28-27 feet in the east basin, and 25 feet in the airport range. Additional dimensions of the outer harbor channel dimensions are listed in Table 2. The outer harbor is separated into an east and west basin by the Cuyahoga River. In the inner harbor, depths are 27 feet in the Cuyahoga River from the mouth to the junction with Old River, 23 feet in the upstream limit, and 27 feet in Old River (NOAA, 2016d). Federal regulations limit speed in the outer harbor to 10 mph (8.7 knots) and 6 mph (5.2 knots) in the inner harbor. However, the City of Cleveland has adopted a more conservative no wake limit of 4 mph (3.5 knots), in the Cuyahoga and Old Rivers. During periods of fog or when a blue light or flag is shown from any pier, wharf, or bridge, a speed limit of 2 mph (1.7 knots) is enforced (NOAA, 2016d).

There are extensive waterfront facilities in the Cleveland outer harbor and along the banks of the Cuyahoga River and Old River. Facilities in the Cleveland Harbor are listed in U.S. Coastal Pilot.[1] During the closed navigation season, many of the piers, wharves, and docks are available for winter mooring of vessels. The harbormaster, who has control of the waters for the anchorages, generally orders vessels to anchor outside the harbor. Deep-draft vessels normally anchor approximately 2 miles southwest or 3 miles east of Cleveland Waterworks Intake Crib Light. The water depth in this area is approximately 40 to 48 feet, with a clay and gravel bottom. Additionally, vessels are prohibited from anchoring within 2,000 feet west of the main entrance channel (NOAA, 2016d). Within the harbor, general anchorages are located in the northwest part of the west basin and south of the dredged channel in the east part of the east basin. An explosives anchorage (for loading or unloading explosives or munitions away from the port) is located on the

[1] https://www.nauticalcharts.noaa.gov/nsd/coastpilot/files/cp6/CPB6_E46_20170106_1811_WEB.pdf

northwest side of the east breakwater. The west basin anchorage has a sand and mud bottom, and is used only occasionally. The east basin and explosives anchorage have not been used since approximately 1967 (NOAA, 2016d).

The Cleveland-Cuyahoga County Port Authority operates the Port of Cleveland in the Cleveland Harbor. The Port of Cleveland has cargo terminals with 12 docks to the east and west of the Cuyahoga River along the Lake Erie shoreline. Major commodities handled at the port include iron, steel, and aluminum products, limestone, iron ore, sand, stone, salt, and other minerals, petroleum products and other liquid bulk cargo, and general and containerized cargo in the foreign trade (NOAA, 2016b). The port includes 80 acres of owned and leased property including 10 berths, 12 docks, and three warehouses located east of the Cuyahoga River that handle general cargo operations (Port of Cleveland, 2016). The Port of Cleveland also includes the Cleveland Bulk Terminal (CBT), which is approximately 44 acres in size and located west of the river. The CBT primarily handles iron ore and limestone. In 2014, the Port of Cleveland handled over 4.2 million tons of cargo, and 221 vessels (Port of Cleveland, 2016). About 90% of cargo that comes into the Port of Cleveland is imported, with the other 10% coming from within the Great Lakes. The port occasionally handles project cargoes that are produced locally and exported (Port of Cleveland, 2016). The port leases dock facilities to companies for regional distribution of cement and other bulk construction materials (Port of Cleveland, 2011). Terminal operators and tenants include Federal Marine Terminals, Carmeuse Lime & Stone, Essroc, and Kenmore Construction (Port of Cleveland, 2016).

Table 2. Cleveland Harbor Channel Dimensions

Name of Channel	Controlling Depths from Seward (Feet at Great Lakes LWD[2])					Project Dimensions		
	Left Outside Quarter	Left Inside Quarter	Right Inside Quarter	Right Outside Quarter	Date of Survey[1]	Width (feet)	Length (feet)	Depth LWD[2] (feet)
Harbor Entrance	25.8	28.5	27.1	22.8	9,10-2015	600-700	1,150	29
Basins & Cuyahoga River Entrance	23.4	26.9	27.7	24.8	9,10-2015	230-760	1,200	28
West Basin								
Main Section	18.9	22.9	22.2	13.0	9,10-2015	800-1,560	4,400	28
Westerly 400 Feet	14.5	13.2	12.3	10.1	9,10-2015	330-800	400	28
East Basin								
West Section	16.9	23.3	16.6	16.7	9,10-2015	1,560	1,300	28
Middle Section	12.1	20.5	21.2	19.8	9,10-2015	1,270-1560	3,800	27
East Section	18.7	22.0	21.9	13.8	9,10-2015	500	14,600	25
Nicholson Approach	22.4	22.4	22.2	22.0	9,10-2015	400-1,600	1,300	25

[1] Tabulated from surveys by the Corps of Engineers – Report of October 2015 and surveys to October 2015.
[2] LWD = Low Water Datum
Source: NOAA, 201

3.3 Obstructions

NOAA's Automated Wreck and Obstruction Information System (AWOIS) and Electronic Navigation Charts (ENC) were consulted to identify submerged wrecks and obstructions in the Project Area (Figure 7). The obstructions closest to the Project Site (AWOIS 14295 and 14293) are both submerged pilings at a depth of at least 5.8 meters (19 feet) and are located approximately 350 feet to the west of the cable route envelope (Figure 7; NOAA, 2016a). The distance from the cable route envelope and depth of the obstructions (5.8 meters) are anticipated to be sufficient to ensure safe installation of the cable line, as the cable will be installed at a targeted depth of approximately 1.5 meters (5 feet). Construction personnel will be notified of the presence of these obstructions. The NOAA navigational charts (Chart #14839 and #14826) were used to determine additional obstructions including water intakes, dredged disposal areas, shipping lanes, and reefs (Figure 8). All of the structures shown on the charts are located within the Project Area, but outside the Project Site, and are not expected to be impacted by Project construction or operation.

3.4 Current Aids to Navigation

Upon approaching Cleveland Harbor, the most prominent visual markers are the Municipal Stadium (0.7 miles east of the mouth of the Cuyahoga River), the Federal Office Building, Key Tower, and the Erieview Plaza Tower (approximately 1.1 miles east of the mouth), the Terminal Tower (1 mile southeast of the mouth), and the lighted *W* sign (3.3 miles west of the mouth on the lakefront; NOAA, 2016d). Three prominent ATONs are located offshore of the Cleveland Harbor: the Cleveland Waterworks Intake Crib Light, the Cleveland Waterworks East Entrance Light 2, and the Cleveland Harbor Main Entrance Light. The light at the Intake Crib is approximately 55 feet above the water and located 3.3 miles northwest of the harbor entrance. East Entrance Light 2 is located 59 feet above the water on a skeleton tower at the end of the outer harbor breakwater. The Main Entrance light is 63 feet above the water on a white conical tower with attached building on the west side of the main entrance to the Harbor (NOAA, 2016). Additionally, sound signals are at the Intake Crib and Main Entrance lights (NOAA, 2016d). Additional ATONs are included in the U.S. Department of Homeland Security and USCG Light List[2].

4.0 VESSEL CHARACTERISTICS AND TRAFFIC

The waterways in the Project Area experience traffic from a variety of both commercial and recreational vessels, both of which operate in increased numbers during the boating season.

[2] http://www.navcen.uscg.gov/pdf/lightLists/LightList%20V7.pdf

4.1 Commercial Vessels

Commercial vessels in the Great Lakes typically include bulk freighters, self-unloaders, integrated tug barges, chemical carriers, cement carriers, tugs, and barges (Haberly and Stalikas, 2013). The CBT is the main Port of Cleveland facility located to the west of the Cuyahoga River. The facility accommodates around 150 vessel movements per year from self-unloading vessels delivering bulk commodities. Iron ore shipments to the CBT are shipped on Class 7 through 10 vessels and loaded on to Class 5 vessels (USACE, 2009). The inner harbor accommodates around 700 commercial vessels per year. This results in 1,400 vessel transits per season and averages approximately four transits per day during March through December. Commercial vessels in the Cuyahoga River are typically greater than 600 feet in length and are mainly Class 5 vessels.

Annual vessel calls and associated cargo tonnage in the Cleveland Harbor are variable, as summarized in Table 3. From 2005 to 2014, vessel calls ranged from 84 in 2009 to 1,005 in 2006, and tonnage varied from 1,108,239 in 2009 to 31,070,642 in 2010 (Port of Cleveland, 2016).

Table 3. Yearly Total Vessel Calls and Cargo Tonnage at the Port of Cleveland

Year	Vessel Calls	Cargo Tonnage
2005	959	12,847,552
2006	1,005	14,172,792
2007	718	9,659,233
2008	218	2,822,704
2009	84	1,108,239
2010	296	31,070,642
2011	357	3,295,326
2012	411	3,677,751
2013	440	3,638,103
2014	221	4,335,553

Source: ODNR, 2016b

The Ohio Department of Natural Resources (ODNR) manages sport and commercial fisheries in 2.24 million acres of Lake Erie. Ohio commercial fisheries harvested 4.6 million pounds of fish in 2015 with a dockside value of $4.9 million (ODNR, 2016b). Harvest included burbot, freshwater drum, gizzard shad, lake whitefish, buffalo, bullhead, common carp, channel catfish, goldfish, quillback, suckers, white bass, white perch, and yellow perch. Yellow perch, freshwater drum, and white bass were the three primary fish harvested, accounting for 28, 20, and 17% of the total commercial harvest, respectively (ODNR, 2016b). The proposed location of the turbines would be in ODNR management units

that comprised less than 3% of total commercial fishery nets pulled in Lake Erie from 2011 to 2015 (Figure 9). The more heavily fished areas are to the west of the Project.

There are no transportation passenger ferry routes that operate out of the Cleveland Harbor or navigate around the Project Area (ODNR, 2007). However, there are numerous commercial passenger cruises including Nautica Queen Adventures, Majestic, and Goodtime III (Donahue, 2016). Additionally, charter boats can be rented for activities including fishing and diving.

Vessel traffic data, or Automatic Identification System (AIS) data, collected by the USCG, are available for the Great Lakes region. While AIS is not a precise indicator of the entire range of vessel traffic that may traverse the area, it does provide a relative indicator of where vessel traffic is heaviest. AIS data for 2013 vessel density, including cargo vessels, tug and towing vessels, passenger vessels, and pleasure craft and sailing, are available from https://marinecadastre.gov/ for the Project Area (Marine Cadastre, 2016). These data indicate that cargo vessels have the greatest density of all commercial vessels in the Project Area (Figure 10). The vessel traffic is concentrated within the inner and outer Cleveland Harbors, and within the 2 miles leading to the main harbor entrance. As distance from port increases, the cargo traffic density decreases, as vessel traffic spreads out over the shipping channels. Tug and towing vessels follow a similar pattern, with higher concentrations at the main entrance to the harbor, in the inner and outer harbors, and decreasing concentrations as distance from port increases. Tug and towing vessels have traveled in the vicinity of the proposed turbines, but at a low density (Figure 11). Passenger vessels follow five general tracks into the main entrance of the Cleveland Harbor and one track into the east entrance. Density is low throughout the Project Area and while passenger traffic will cross the proposed transmission line, it does not intersect with the turbines (Figure 12). Commercial pleasure craft and sailing vessels, like other vessels, are concentrated within the harbor and near the entrances. However, there is no pattern followed by pleasure craft and sailing vessels outside of the harbor, and vessel density is low around the Project Site (Figure 13). While cargo, tug and towing, passenger, pleasure craft and sailing vessels occur at times in the vicinity of the Project Area, they are only present in low densities around the Project Site (Figures 10 through 13; Marine Cadastre, 2016). Any vessels that have routes that will cross the submerged cables will not be affected by the operation of the Project. The Lake Carriers Association, which represents U.S.-flag operators of the Great Lakes, has not raised any concerns with the Project. There may be some minor disruption to these vessel routes during the Project construction, but such impacts will be temporary.

4.2 Recreational Vessels

The Cleveland Harbor hosts a large number of recreational vessels, including yachts, sailboats, power boats, and private fishing boats. In 2015, over 474,000 boats were registered in Ohio (ODNR, 2016a). Of those registrations, there were a total of 393,385 recreational vessels, 416 commercial vessels, 69,027 alternative registrations, 2,438

documented vessels, and 8,735 livery vessels (USCG & DOT, 2016). The majority of those boats (159,522) were between 16 and 26 feet in length (USCG and DOT, 2016). Recreational craft usage in the inner harbor typically peaks in June, July, and August and tends to be higher on the weekends and when weather conditions are favorable. Marinas in the inner harbor provide access to the Cuyahoga River and Lake Erie for over 800 recreational craft (USACE, 2009). Marinas in the Cleveland Harbor are listed in Table 4, below.

Table 4. Cleveland Harbor Marinas

Name	Owned	# Slips[1]	Slip Material	Vessel Length (ft)	Harbor
Edgewater Yacht Club	Private	378	Steel/Wood	55	Outer
Edgewater Marine	Private	275	Steel/Wood	40	Outer
Whiskey Island Marina	Private	225	Steel/Wood	32	Outer
Lakeside Yacht Club	Private	212	Concrete/Steel/Aluminum	200	Outer
Forest City Yacht Club	Private	130	Steel/Wood	40	Outer
E 55th Street Marina	State	355 seasonal (22 transient)	Wood	40	Outer
Intercity Yacht Club	Private	100	Steel/Aluminum	50	Outer
Olde River Yacht Club	Private	193	N/A	70+	Inner
Channel Park Marina	Private	60	N/A	40	Inner

[1]Slips are representative of in-water slips. Does not include rack and winter storage.
Source: USACE, 2016; Olde River Yacht Club, 2016, Ivancic Marine, 2016.

A recreational boat study was conducted by LimnoTech in 2016 to count and classify power and sail boats in recreational harbors, marinas, and yacht clubs in Lorain, Cuyahoga, and Lake Counties (Appendix C). Aerial imagery from Wednesday, August 3, 2016 was used to inventory a total of 6,057 boat slips across 16 marinas. Weather on August 3rd was warm (81°F), dry, and clear with a visibility of 10 miles (Weather Underground, 2017). Boat type and length were also determined using aerial imagery (Table 5). Estimates of sail boat mast heights were determined based on common sail boat specifications in each sail boat range on http://sailboatdata.com (Table 5). Of the sailboats classified through the LimnoTech study, 99% had a mast height less than the proposed clearance between the lowest point of the turbine blade to the water of 20 meters (66 feet). Signage will also be posted on turbines advising boaters as to the maximum safe clearance and safe distance approach. The Applicant will also recommend for NOAA to indicate the turbine locations on navigational charts.

Table 5. Summary of Boat Lengths and Estimated Mast Heights Above Water

Percentile	Power Boat Length (feet)	Sailboats		
		Length (feet)	# of Boats ≥	Mast Height (feet)
25	23	26	586	41
50	27	29	396	45
75	31	33	191	48
90	36	36	74	50
95	39	38	47	54
97	42	40	20	58
99	48	45	8	65

The ODNR prepared a sport fishery effort map during the creation of their Offshore Wind Turbine Placement Favorability Analysis. In the sport fishery effort map, the 10-minute quadrangle that included the proposed turbine locations was determined to receive 106,000 to 700,00 hours of average hours targeting walleye and yellow perch from 2000 to 2006. This represented the greatest concentration of sport fishery effort. However, in 2016, LimnoTech conducted aerial surveys of the 5-minute quadrangles in the Cleveland area to count boats on 12 different days between May and October. Across all dates, only 2% of the boats counted were in the vicinity of the proposed turbines. These data indicate that recreational boating (including recreational fishing) occurs closer to shore than suggested by the ODNR developed sport fishery effort maps. The ODNR sport fishery effort maps are based on data from 10-minute survey grids, which are likely too coarse to evaluate expected fishing effort in the immediate vicinity of the proposed turbines (LimnoTech, 2016b). Due to the lack of traffic at the Project Site, there will be no anticipated impacts to recreational or sport fisheries as a result of the proposed Project.

4.3 Other

A variety of marine events take place in Lake Erie waters off the coast of Cleveland, including: sailing boat races, festivals, boat shows and exhibitions, and fireworks displays. The most prevalent marine events in the Project Area are sailing regattas. The majority of the regattas in the Project Area are hosted by the Cleveland Sailing Association. Buoys for race courses are marked on Figure 8. There were 13 sailing events conducted by the Cleveland Sailing Association in 2016. Races took place from June 4, 2016 to September 10, 2016 and ranged in participation from four to 23 boats of different sizes. The size and location of race courses are variable, and while some occur in the vicinity of the Project Area, they do not overlap with the Project Site. Yachting organizations including, but not limited to the Lakeside Yacht Club, Edgewater Yacht Club, and Cleveland Yacht Racing Association will be consulted to ensure minimal impacts from the project.

Major boat shows, exhibitions, and festivals in the Cleveland Harbor include the North Coast Harbor Boating and Fishing Fest and the Tall Ships Festival. The North Coast Harbor Boating and Fishing Fest occurs in early June and

includes power and sailboat rides and fishing trips in Lake Erie (North Coast Boating and Fishing Fest, 2016). The Tall Ships Festival is hosted every 3 years in the Great Lakes. While the 2016 festival had to be moved to the Fairport Harbor (in Ohio) due to a conflict, the festival has been held in the Cleveland Harbor since 2001 (Glaser, 2016). The festival includes approximately 10 invited tall ships for tours and demonstrations. Firework displays over Lake Erie include 4th of July festivities and are shot from the Flats at the mouth of the Cuyahoga River (Fireworks in Ohio, 2016). The Applicant will coordinate with event organizers to avoid conflicts to the events due to Project construction. No anticipated impacts to events are anticipated once the Project is operational.

The Cleveland Coast Guard station is located on the south end of the outer harbor near Burke Lakefront Airport. USCG vessels are expected to be present in the Project Area. Additionally, research vessels such as those used by NOAA and the Environmental Protection Agency (EPA) may be present around the Project Area. As the Project moves closer to the construction phase, the USCG will provide a detailed list of events that may impact the construction. Pre-planning will be conducted prior to construction to avoid conflicts with these events to the maximum extent practicable.

5.0 POTENTIAL EFFECTS ON SAFE NAVIGATION AND MITIGATION

The construction and operation of Icebreaker Wind in Lake Erie, 8 to 10 miles off the coast of Cleveland, has the potential to adversely affect navigation in and around the Project Site if not carefully managed. These potential impacts are summarized in the Change Analysis included in Appendix A, and discussed in detail below. Safe navigation relies on vessel operator diligence and advisement from agencies such as the USCG.

5.1 Navigational Rules

The Ports and Waterways Safety Act of 1972, and amendments from the Port and Tanker Safety Act of 1978, deemed increased supervision of vessel and port operations by the USCG necessary to 1) reduce the possibility of vessel or cargo loss, 2) reduce damage to life, property or the marine environment, and 3) ensure that the handling of dangerous articles and substances on the structures in, on, or immediately adjacent to the navigable waters of the United States is conducted in accordance with established standards and requirements (NOAA, 2012). Vessels should operate in accordance with USCG Navigational Rules including, but not limited to:

- 33 Code of Federal Regulations (CFR) 110 anchorage grounds – indicates acceptable anchorage areas;
- 33 CFR 162 inland waterways navigation – designates speed limits within the harbor;
- 33 CFR 165 regulated navigation areas and limited access areas – establishing controlled access and regulated navigation areas and requirements; and
- 33 CFR 166 shipping safety fairways – establish and designate shipping safety fairways and anchorages to provide unobstructed approaches for vessels using U.S. ports (GPO, 2016).

State of Ohio navigational rules and regulations for vessel operators often overlap with federal regulations and should serve to mitigate risk posed to safe navigation by the construction and operation of the Project. Navigational Rules listed in the Ohio Administrative Code (OAC) include, but are not limited to:

- OAC 1501:47-2-05: "Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision;"
- OAC 1501:47-2-06: "Every vessel shall proceed at a safe speed so that it can take proper and effective action to avoid collision and be stopped within a distance appropriate to the prevailing circumstances and conditions;"
- OAC 1501:47-2-07: "Every vessel shall use all available means appropriate to the prevailing circumstances and conditions to determine if risk of collision exists;" and
- OAC 1501:47-2-08: "Any action taken to avoid collision shall be positive and made in ample time and with due regard to good seamanship. Any alteration of course or speed shall be substantial to be readily apparent to another vessel observing visually or by radar. Action taken shall result in passing at a safe distance. If necessary to avoid collision, a vessel shall slacken speed, stop or reverse."

5.2 Construction Phase

Offshore installation of the turbines and submerged cables is anticipated to begin in the spring of 2019 with a targeted completion of fall of 2019. Construction activities are proposed to proceed in the following sequence, though multiple activities may be performed concurrently: HDD conduit installation, substation construction, mobilize floating equipment, transport MB foundations from port to site, installation of MB foundations, installation of export cable, installation of inter-array cables, transport towers, installation of towers, transport nacelles and blades, installation of nacelles and blades, commission of turbines, and commission landside power into grid. Prior to any installation, a full mobilization of all vessels will be conducted, including installation of necessary grillage and sea fastening.

The construction phase will use vessels for the transport and installation of foundations, cables, and turbine components. Typical vessels used in the installation of offshore wind projects normally include tugs, barges, jack-up rigs, supply and crew transport vessels, and cable-laying vessels. Vessels will be operating continually between the port, the turbine siting area, and the Project Substation. During periods of adverse weather conditions, construction activities will be restricted to reduce any unnecessary risks to personnel and vessels. Table 6 lists weather constraint guidelines for different phases of the construction process that will mitigate any unnecessary risks to personnel, vessels, and the environment. Ultimately, it will be up to the individual vessel captains and the project management team to make decisions regarding safe operations during construction.

Table 6. Weather Limitations for Offshore Installation Activities

Operation	Vessel	Wind Limit (m/s)	Wave Limit (m)
Foundation transportation	Feeder Barge	10	1.5 – 2
Turbine component transportation	Feeder Barge	10	2
Transit to site	Feeder Barge	10	1.5 - 2
Nacelle and tower sections installation (lift)	Jack-up Vessel	10	1
Rotor installation	Jack-up Vessel	8	1
Cable installation	Cable Lay Barge	10	1
Transport of personnel	Crew Transport Vessel	10	1.5 - 2
Transfer of personnel to turbine platform during cable installation and commissioning	Crew Transport Vessel	10	1.5

The vessels involved in the construction phase will be properly marked, lighted, and outfitted with sound signals in accordance with applicable navigational rules for the vessel's specific location and activity. Fully trained, licensed vessel operators will be employed for the Project and will adhere to navigational rules and regulations to mitigate any potential safety issues with vessels during the construction phase of the Project. Additionally, a 500 meter safety zone around each foundation will potentially be requested during construction. A temporary exclusion area of up to 500 meters around the vessel installing the inter-array and export cables will also potentially be requested. This will provide clearance of 500 meters from laid cables until burial is confirmed, to prevent any potential interaction with anchors.

The number of vessels to be used for construction of the Project will not be a significant increase over current vessels operating in the Project Area. However, any increase in vessels could increase the risk of vessel collisions, environmental spills due to marine accidents, personnel injury, transit delays, and communication delays due to increased radio traffic. Coordination between construction vessels, the harbormaster, and the USCG will be implemented to ensure safe traffic operations. The USCG will be notified of the construction schedule, location, type and number of vessels, and any private ATONs around the construction area, if needed. Preliminary Notices to Mariners and/or Radio Navigational Warnings will be broadcast prior to and during construction (USDHS & USCG, 2005), and daily notices will be posted on the Project's website. Construction of the Project also has the potential to cause minor disturbance to vessel traffic due to the presence of construction exclusion areas. However, as mentioned above, any exclusion areas that are requested will only be 500-meters in size, and vessel traffic will be restored to normal upon completion of component installation.

5.3 Operational Phase

The portion of the turbine foundations above the water line and the base of the tower, to a height of approximately 39 feet (12 meters) or to at least the height of the ATON, if applicable, will be painted yellow in accordance with the

regulations for OREIs in the Aids to Navigation Manual (USDHS & USCG, 2005). Turbines will be marked with visible unique identification characters, either illuminated by a low intensity light, or more likely, coated in a reflective material. As discussed in Section 2.0 of this Navigational Risk Assessment, lighting and fog horns will be installed on the proposed turbines, consistent with USCG and FAA regulations.

A control center capable of remotely monitoring and controlling the Project will be manned 24 hours a day. The control center will be staffed by trained personnel and contain charts indicating GPS position and identification numbers of all Project components, which will also be provided to the USCG. Icebreaker Windpower Inc. will collaborate with the Ninth USCG District, as well as local and state law enforcement/fire departments, to provide necessary contact information and to facilitate emergency response.

During normal operations, all turbines will be equipped with control mechanisms that will allow the operations center personnel to fix and maintain the position of the blades. Nacelles will be capable of being opened from the outside for rescue and maintenance operations when seaborne approaches are not feasible; however, when the turbines are unmanned, all safety hatches and doors to turbine towers and nacelles will be secured and locked.

The USCG may consider establishing a Limited Access Area around the turbines, which will restrict vessel access. However, upon approval from the U.S. Department of Homeland Security (USDHS) and the USCG, the turbine boat landing could potentially be used as a safe harbor for stranded boaters during emergency situations (USDHS & USCG, 2005). Upon the implementation of the measures noted above, no adverse effects or disruptions to normal maritime traffic in the Project Area are anticipated.

5.3.1 Potential for Impacts from Project Vessels

Once the Project is operational, vessel traffic associated with the Project will be minimal. Maintenance vessels will operate in the Project Area as necessary. As with construction vessels, maintenance vessel operators will be fully trained and licensed, and will be expected to adhere to navigational rules and exercise sound judgment and awareness of potential hazards. These vessels will also be properly marked, lighted, and outfitted with a sound signal in accordance with navigational rules and regulations. As with construction vessels, the number and frequency of maintenance vessels and trips will not represent a significant increase over normal vessel traffic in the Project Area. Impacts to navigational safety from the vessels used in the operational phase of the Project will be negligible.

5.3.2 Potential Obstructed Views from Turbines

The proposed design and spacing of the turbines will result in potentially obstructed views of the coastline, ATONs, and between vessels. However, the small number and the linear array of turbines mitigate potential hindrance in sightlines to the coastline and between vessels. In addition to the linear array, there will be 756 meters (2,480 feet) between each turbine, which will result in large areas with some unobstructed lines of sight between each turbine. The turbines have the potential to block ATONs along the coastline from only very specific locations. Additionally, not all ATONs along the coastline will be blocked by the turbines at once. The small number of turbines, their linear array, and the large distance between each turbine will allow for fairly unobstructed views of the coastline, ATONs, and between vessels. Any vessels that experience blocked views of the coastline or ATONs will be at least 8 miles off the coast and will gain visibility as the vessel passes through the area. Moreover, the navigational lights and fog horns that will be mounted on the turbine platforms (as mentioned in Section 2.0) will serve as ATONs.

5.3.3 Potential Vessel Avoidance of Turbines

Large commercial vessels, which typically use the shipping lanes, will not be affected by the Project as the only part of the Project that intersects shipping lanes will be the buried export cable. However, recreational vessels and smaller commercial vessels are not likely to travel any one particular route. These vessels, including commercial fishing vessels and recreational fishing vessels, commercial charter vessels, and recreational passenger vessels, will be the most likely to access the Project Site. There will also be Project maintenance vessels that access the site. However, there will not be a significant increase in traffic due to maintenance vessels. There will be adequate space around the Project Area for any vessel to avoid the turbines while also maintaining a safe distance from other vessels and commercial shipping lanes. The Project will not result in any channel restrictions caused by the presence of the turbines, and the design and spacing are not expected to limit visibility between vessels. Additionally, AIS will be installed on each turbine. This tracking system will allow ships to "see" turbines on their monitoring equipment, thereby reducing potential impacts. Therefore, impacts from potential vessel avoidance of turbines are not anticipated.

5.3.4 Potential Vessel Collision with Turbines

During the planning phase of the Project, multiple locations were considered and the proposed turbine and cable layout was selected to minimize impacts, including those to maritime activities and navigational safety. However, the presence of the turbines will create a risk of potential vessel collision, as will be the case with the installation of any new structure. As described in Section 5.3.3, large commercial vessels using shipping lanes will not be affected by the Project, as they are not anticipated to pass through the Project Site. However, recreational and smaller commercial vessels could potentially be in the vicinity of the turbines. Recreational vessels may be attracted to the turbines if there is any increase in fish presence, or out of curiosity. A risk assessment for the Horns Rev II wind farm off the coast of

Denmark concluded that the collision frequency (vessels to turbines) in the operational phase of the base case scenario was 0.0043 collisions per year (DONG Energy, 2006). Additionally, at that same windfarm, approximately 48,000 boats pass through a shipping lane 8 kilometers (5 miles) from the wind farm, and it was found to cause only minimal hindrance to commercial traffic (NREL, 2010).

There will be adequate space around the Project Site for smaller vessels to avoid the turbines, while also maintaining a safe distance from shipping lanes and other vessels. Electronic equipment, including GPS units, are widely available and commonly used by commercial and recreational boaters, and would serve to mitigate the potential for a collision with the turbines. Additionally, turbines will be marked and lighted in accordance with navigational rules and agreement with fish and wildlife agencies. During adverse weather including storm events, fog, or high winds, the potential for vessel collision with the turbines is increased. The notice to mariners (NTMs), updates to NOAA navigational charts, and proposed turbine lighting, fog horns, and marking will help to mitigate the potential risk of collisions. Measurements around the Project Site indicated that water at the Project Site does not have a specific current or direction (LimnoTech, 2017). The currents and velocities would not aggravate the potential for a vessel collision with the turbines. In the case of vessel engine failure, a vessel could drift into a turbine, but since currents and water velocities are low in the Project Area, any collision due to drifting is not anticipated to be significant.

The Project foundations will be designed to withstand loads from accidental collisions. The design criteria were set for the normal design case load, in which secondary structural parts of the foundation structure will not lose their function, and the abnormal design load case, in which the secondary structural parts are allowed to become torn off. During final design of the foundation, impacts will be considered at the accidental and ultimate limit states. A preliminary analysis included a vertical extent of the collision zone that was assessed between 3 meters (9.8 feet) above and 5 meters (16.4 feet) below the mean water level (MWL). The foundation design will consider an 18-meter (59-foot) vessel with a maximum vessel displacement of 50 metric tons, drifting at a speed of 0.5 m/s for normal design load cases and 2.0 m/s for abnormal design load case. The design will address energy absorption distribution between the vessel and the structure. Vessel impacts and collision design loads will be in accordance with IEC 61400-3 (IEC, 2009), based on design guidelines of ISO 19902 (ISO, 2013) and DNV-OS-J101 (DNV, 2014).

If a collision between a vessel and a turbine does occur, the Applicant will investigate and verify the structural integrity of the turbine and a report will be filed in accordance with the Marine Casualty Regulations in 46 CFR Part 4. Once the Project is operational, the USCG will consider publishing a Regulated Navigational Area (RNA) limiting access for vessels with air drafts greater than 60 feet and limiting the maximum speed through the Special Local Regulation (SLR). This would leave a 6-foot clearance for vessel air draft (66-foot rotor blade clearance above the water surface) and

increase safety by slowing vessels transiting the area. The anticipated impacts of vessel collision with turbines from the proposed Project are anticipated to be negligible.

5.3.5 Potential Increased Incidence of Lightning

There is some potential for increased lightning strikes at turbine locations, which could increase potential hazards to nearby vessels. Vessels should maintain a safe distance from turbines and exercise sound judgment in accordance with navigational rules, especially in times of adverse weather. The Horns Rev II offshore wind power plant experienced 289 lightning strikes from June 2009 to September 2012. However, due to a lightning protection system, there were no turbine failures, and all turbines remained operational (Siemens, 2012). Lightning protection is mandatory for land-based and offshore wind power generating systems and, as such, will be included for the Project (NREL, 2010). Additionally, vessel traffic is typically lower during periods of adverse weather. Due to the lightning protection system and lack of vessel traffic likely to be 8 to 10 miles offshore during periods of lightning, no significant impacts due to increased potential for lightning strikes are anticipated. As a point of reference the meteorological tower at the Cleveland Water Intake Crib has been struck by lightning numerous times over the last 12 years and still functions as intended.

In addition, all components on the supporting structure will be designed to be protected against potential differences, stray currents, and lightning by providing appropriate grounding. The grounding will meet standards defined in IEC 62305-1 (British Standard, 2006) and IEC 61400-24 (IEC, 2010).

5.3.6 Potential Ice Hazard

Due to the cold winters in Cleveland, and typical freezing conditions of Lake Erie, as described in Section 3.1.1, ice accumulations on and around the turbines will be expected. However, the presence of the proposed turbines will not be expected to significantly mitigate or exacerbate icing. Research and modeling studies were conducted by the USACE Cold Regions Engineering Research Laboratory, Eranti Engineering, Allyn & Croasdale, and DNV GL to determine potential loadings and fatigue of Project turbines from ice cover in Lake Erie. These studies indicated that the proposed turbine foundation design is conservative and will be capable of withstanding forces from ice floes and, more importantly, from ice ridges and keels. Ice forces and associated dynamic responses will be cut by up to an order of magnitude with the help of the downward icebreaking cone that is proposed to be installed on the turbine foundation.

Blade icing also has the potential to create a hazardous condition. Freezing rain may result in ice build-up on the rotor blades and/or sensors, which could lead to ice shedding or ice throw. Ice shedding occurs as air temperature rises and ice on the blades begins to thaw and ice fragments may drop off the rotors and land near the base of the turbine.

Ice could potentially be thrown when ice begins to melt and stationary turbine blades begin to rotate again. There have been no reported injuries caused by ice being thrown from an operating land-based or offshore wind turbine (Garrad Hassan, 2007; Baring-Gould et al., 2012). The distance traveled by ice thrown from a blade depends on a number of factors, including the position of the blade when the ice breaks off, the location of the ice on the blade when it breaks off, the rotational speed of the blade, the shape of the ice, and the prevailing wind speed.

The risk of ice landing at a specific location drops dramatically as the distance from the turbine increases. *Wind Energy Production in Cold Climate* determined that a safe distance between turbine and occupied structures, roads, or public use areas in regards to ice throw will be equal to 1.5 times the sum of the hub height and rotor diameter (Tammelin, et al., 1998). Based on this calculation, a conservative "safe" distance during periods of ice accumulation around the Project turbines will be 313 meters (1,027 feet). The primary risk from ice throw would be related to commercial and recreational uses of Lake Erie. However, there is minimal recreational boating in Lake Erie between December 1st and April 1st. Marinas in the area close between October and November and do not reopen until April or May, so the number of recreational boats on the water when conditions are favorable for ice formation would be minimal (essentially non-existent). Commercial boating is also limited due to ice cover on Lake Erie. As the few commercial vessels on the lake during icing conditions will stay within the shipping lanes (over 2 miles from the turbines), the anticipated ice hazard impact associated with the Project will be negligible.

5.4 Potential Aids to Navigation

All potential Private ATONs for the construction and operation of the Project will be selected in consultation with the USCG, FAA, and ODOT. In addition, NOAA will be notified prior to and following construction so that the nautical charts can be updated accordingly.

Potential Private ATONs during construction include lighting and notices to mariners (NTM) and airmen (NOTAM). Flashing lights will be placed at the top of any tall cranes used for construction, and NTMs and radio navigational warnings (NOTAM) will be issued prior to and during construction. In accordance with 33 CFR 165 (mentioned in Section 5.1), the USCG may prohibit or restrict vessel access around the turbines during construction.

As mentioned previously, potential ATONs on the turbines during operation will include the following (USDHS AND USCG, 2005):

- Aircraft warning lighting: One red flashing light will be mounted on the nacelle of each turbine and the lights on each turbine will flash synchronously.
- Navigation lighting: Amber, synchronous flashing lights will be mounted on the work platform. Turbines 1 and 6 will be the special periphery structures (SPS) and as such will have amber lights visible up to 5 nautical

miles. Turbines 2 through 5 will be the intermediate periphery structure (IPS) and will have amber flashing lights installed on each turbine platform visible to 4 nautical miles. Each SPS and IPS will have 2 flashing lights installed on each platform to allow 360-degree visibility from all directions. Lights on Turbines 2 through 5 will flash at a rate of 20 flashes per minute, while lights on Turbines 1 and 6 will have a quick flash, with the rhythm still to be decided.

- Turbines 1 and 6 will have fog signals and visibility sensors installed that sounded at 670 MHz. The fog signal will sound once every 30 seconds at Turbine 1 and twice every 30 seconds at Turbine 6.
- Signs and markings: each turbine will be marked with its respective turbine number (ICE1 - ICE6) in large black numbering. Markings will be located on each turbine in the vicinity of the work platform and be visible at a distance of at least 150 yards (450 feet) from the turbines.

Marking and lighting of the turbines will be subject to regular inspections by Project maintenance crews. Any light outages will be corrected as soon as possible. As described in Section 5.3.3 AIS transponders will be installed on each turbine. This tracking system will allow ships to "see" turbines on their monitoring equipment, thereby reducing potential impacts. The lighting and marking of the turbines will have no impact on existing ATONs.

6.0 POTENTIAL EFFECTS ON ELECTRONIC NAVIGATION AND COMMUNICATIONS SYSTEMS

6.1 Communications Systems

The USCG recommends that boaters purchase a very high frequency (VHF) marine radio before purchasing anything else for their boats (USCG, 2016). VHF radios are required on vessels greater than 20 meters (65.6 feet) and while not required, are common on smaller vessels as well. VHF radio is the most frequently used radio and has designated channels for commercial ships to confirm passage and communicate actions, mayday distress calls, storm warnings and boat to boat communication. Studies on the Horns Rev wind farm in Denmark and the North Hoyle wind farm in the United Kingdom concluded that there were no significant effects on VHF communication in the vicinity of the wind farms. Those wind farms ranged from 30 to 80 turbines (Elsam, 2004; MCA and QinetiQ, 2004). Additionally, a modeling study by the University of Texas at Austin confirmed that the effect of wind farms on communication systems, including VHF, is anticipated to be low (Ling et al., 2013).

In comparison to the Horns Rev and North Hoyle wind farms, the proposed Project is a much smaller wind farm, with only six turbines. It is anticipated that there will be a similar lack of effects on communication systems from the Project.

6.2 ***Radar***

Radar technology is one of the more important instruments in aiding a vessel operator to navigate safely and avoid collision, particularly when visibility is reduced (USCG, 2009). Wind turbines have the potential to create clutter interference and possibly significant Doppler interference with sensitive radars fielded by the FAA, Department of Defense (DOD), NOAA, and other agencies. Comsearch was contracted to send written notification of the proposed Project to the National Telecommunications and Information Administration (NTIA) of the U.S. Department of Commerce. Upon receipt of notification, the NTIA provides plans for the proposed Project to the federal agencies represented in the Interdepartment Radio Advisory Committee (IRAC), which includes the DOD, the Department of Education, the Department of Justice, and the FAA. The NTIA then identifies any Project-related concerns detected by the IRAC during the review period. The notification letter was sent to NTIA on August 11, 2016 and a response was received on October 13, 2016. Only the DOC identified concerns regarding the Project impacting its radar systems. The DOD's concern was the potential degradation of the detection of lake effect snow. However, DOC proposed a mitigation strategy whereby the Applicant shares near-real time wind turbine meteorological tower data to compensate contaminated radar data with "ground truth" wind and precipitation data. The Applicant has consulted with DOC and received notice that there will be minimal impacts to the radar. There were no concerns from any other IRAC agencies.

The study from the University of Texas at Austin, mentioned above, modeled the effect of offshore wind farms on marine radars typically installed on boats and shipping vessels. It was found that wind farm signal scattering could produce a confusing navigational picture if a boat is inside a wind farm, but there will be minimal interference to tracking of vessels operating outside the wind farm (Ling, et al. 2013). Additionally, the USCG determined that vessels operating around the Cape Wind Energy Project, a 130 turbine wind farm off the coast of Cape Cod, Massachusetts, will be able to navigate safely within and in the vicinity of the proposed wind farm and that the impact of the proposed wind farm on navigation safety would be "moderate" (USCG, 2009). For Icebreaker Wind, a much smaller project with a single line of turbines, the impacts on navigational radar on vessels from the turbines will be minimal. Also, the Applicant has filed a FAA Notice of Alteration or Obstruction form (7460-1), which will trigger the DOD Siting Clearinghouse Review to confirm that military radars will not be adversely impacted. Form 7460-1 was submitted by the Applicant on July 22, 2016, and the application status was updated in December 2016. The FAA issued its Determination of No Hazard to Air Navigation on February 22, 2017 and is included as Appendix D.

6.3 Positioning Systems

Global Positioning Systems (GPS) are becoming more frequently used by commercial and recreational boaters as they are easily available and affordable. GPS provides the fastest and most accurate method for mariners to navigate, measure speed, and determine location, enabling increased levels of safety for vessel operators. GPS is also playing

an increasingly important role in the management of port facilities. GPS technology includes 24 satellites that triangulate a user's position based on line of sight transmitted by multiple satellites (NOAA, 2014). While objects, such as buildings or mountains, can block a satellite's line of sight, it is possible to receive only slightly degraded positions with only three satellites having line of sight (NOAA, 2014). The Project turbines will not obscure all satellites at the same time, given the proposed small diameter of the turbines, large distance between turbines, and single line array. Therefore, the Project's impact on GPS signal reception and accuracy are anticipated to be minimal.

6.4 Electromagnetic Interference

The wind turbines are not anticipated to generate any electromagnetic fields (EMFs), however potential EMFs could be generated by the inter-array cable and export cables. Very little, if any, magnetic field is produced by three-core cables, as interference among the three phases cancel each other out (Sharples, 2011). In addition, any potential EMF effects will be mitigated by the bundling, armor, insulation and targeted burial depth of at least 1.5 meters (4.9 feet). Electromagnetic fields produced by electrical cables tend to be restricted to an area of several meters from the cable. The estimated magnetic field from the Project export cable will be much less than the earth's naturally occurring background levels, and because the cable will be shielded and jacketed with an insulator, electric field impacts will not post an issue to communications (LimnoTech, 2016a). Any impacts from EMF fields are anticipated to be negligible.

6.5 Noise Generation and Sonar Interference

The majority of noise generated by the Project will occur during the construction phase. People who could be aware of noise during construction include recreational boaters on Lake Erie or people on public-use areas along the shoreline. Due to the relatively short duration of construction exposure to construction-based noise to boaters would be short-term and minor. In addition, boaters could choose to avoid the area during periods of elevated construction noise. Therefore, impacts on vessels are not expected. During the operational phase, a slight increase in noise will be expected in the vicinity of the turbines. In the frequency bandwidths used by marine sonar systems, such as commercial and recreational fish finders, the amount of sound energy generated by turbines is orders of magnitude lower than the sonar systems (Lurton, 2002). Modeling studies have determined that, due to the virtual absence of noise exceeding background levels radiated underwater by wind turbines at frequencies above 1 kilohertz (kHz), interference with underwater acoustical systems will be unlikely. Below 1 kHz tones radiated underwater could potentially cause interference when in close proximity to a wind farm (Ling et al., 2013). At these volumes and frequencies, no impacts on typical marine communication systems will be anticipated. Above water the noise from operating turbines is approximately 50 decibels at a distance of 100 meters (328 feet) from the turbine. That level is comparable to ambient noise levels (General Electric, 2014). At ambient noise levels, noise from the turbines over the

water will not cause interference with sound signals from vessels or ATONs near the Project Site, nor pose health concerns to passing vessel crews.

7.0 POTENTIAL IMPACT ON USCG MISSIONS

The Applicant will ensure that all applicable USCG command centers be provided the GPS position and identification number of each wind turbine. Additionally, the contact number of the control center will be provided to USCG command centers. Any distress call received by the USCG Search and Rescue Mission Coordinator will be passed to the Project's control center. A shutdown procedure will be initiated until the Search and Rescue Mission Coordinator notifies the control center that it is safe to restart the turbines.

The USCG provided search and rescue (SAR) and pollution incidents in the Project Area from the Marine Information for Safety and Law Enforcement (MISLE) database. An analysis of the past 10 years of data (2006 through 2016) was performed for this assessment to assess any potential impacts the Project may have on the ability of the USCG to conduct and respond to SAR and pollution incidents. MISLE activities include all USCG activities such as SAR cases, boardings, pollution, and marine casualty investigations. MISLE IIA activities are specific to pollution and marine casualty investigation activities, which require a response and an investigation. In the past 10 years (2006 through 2016) there have been 187 MISLE IIA activities around the Project Area (Figure 14; Table 7). Appendix E contains detailed MISLE IIA activities from the past 10 years in the vicinity of the Project.

In all but one case, the responding unit was the USCG Marine Safety Unit located in the Cleveland Harbor. There were no data available on time of day or weather conditions during these incidents, but the months with the greatest numbers of incidents were May (19 incidents), June (23 incidents), and July (28 incidents) when recreational boating activity is high. The month of October had a high number of incidents (33) due to Super Storm Sandy on October 30, 2012, which resulted in 21 incidents. The majority of cases occurred within the Cleveland Harbor, and no incidents occurred in the direct vicinity of the proposed turbine site for Icebreaker Wind (Figure 14). Specific data regarding commercial salvors and helicopter hoists in response to the incidences were not available.

Table 7. MISLE IIA Activities in the Vicinity of the Project

Activity	Year											Grand Total
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	
Allision	2	5	3	1	3	3	1		1	4	1	**24**
Discharge/Release – Pollution	1	3	4	5	10	13	34	12	3	9	3	**37**

Activity	Year											Grand Total
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	
Fire – Initial					1							**1**
Flooding – Initial				1			1		1			**3**
Flooding – Progressive									1			**1**
Grounding	1											**1**
Loss of Electrical Power			1					2	2			**5**
Loss/Reduction of Vessel Propulsion/Steering			1		4	3	1	2	2	2	1	**16**
Material Failure/Malfunction			1	1	5	1	1	4	5	4		**22**
Personnel Casualty – Injury	2	1		3	1	4						**11**
Sinking			1	2		2						**5**
Vessel Maneuver								1				**1**
Grand Total	**6**	**9**	**11**	**13**	**24**	**26**	**38**	**21**	**15**	**19**	**5**	**187**

Discharge/release of pollution incidents range from significant oil and gas leaks to a sheen on the water from vessels, nearby traffic, and industry at the Cleveland Harbor (Figure 14). There were 37 incidents related directly to the discharge/release of pollutants in the past 10 years.

USCG responders are trained in safe navigation and are prepared to handle all conditions that may be encountered in the environment of the Project Area. As previously described, due to the small number of turbines, their linear array, and the large distance between each turbine, the Project will not significantly affect SAR operations in the vicinity of the Project. Based on the windfarm design including a 20 meter (66 foot) blade tip clearance over the water level, the USCG marine assets should be able to operate in and around the turbines with minimal impact to their operation. While the Project will not cause any delays in response time, the turbines may pose a risk or delay to rescue helicopter missions near the turbine sites until emergency shutdown procedures can be implemented. Once the emergency shutdown is implemented, it will take less than 30 seconds for the turbines to shut down. The turbines will not obstruct cruising helicopters, as the cruising altitude of the helicopters is approximately 1,500 feet above mean sea level, approximately 1,000 feet above the highest point of the turbines (M. Collet, personal communication, 2017). However, the flight for the search pattern will be approximately 300 feet above water level, which is within the rotor area. Pilots should exercise caution when flying near turbines during search patterns.

Visibility of the turbine blades to SAR helicopters will be reduced at nighttime. If pilots cannot make a visual determination on the position of the turbine blades, they should assume that the rotor could be oriented in any direction in a 360 degree circle. This would define a spherical "no fly" zone around each turbine, within which the helicopter should not operate unless he/she can make a visual determination that it is safe to do so. However, for SAR missions, USCG helicopter crews are equipped with night vision goggles and a large external search light on the aircraft known as the "Night Sun" (M. Collet, personal communication, 2017). The technology available to the helicopter crew will provide an increased visibility of the turbine blade position. Additionally, helicopters will not typically be used during periods of low visibility. If visibility is under ¼ statue mile, heavy consideration whether to fly will be taken by the crew, Aircraft Commanders, and Operations Officer prior to flying. If technicians are available in the turbine, the rotor can be pinned in a specific position. If technicians are not available, the parking brake can hold the rotor for a limited amount of time in a random rotational position. The coordinates of the turbines will be available to the helicopter pilots. The largest helicopter that would be used by the USCG for rescue missions in Lake Erie would be the MH60T, with a rotor diameter of 53 feet, 8 inches (M. Collet, personal communication, 2017). The distance between each turbine is approximately 2,480 feet. This distance would provide room for helicopters to safely navigate between turbines. Therefore, helicopter pilots should use caution when approaching turbines and only operate near the turbine when they have made a determination that it is safe to do so. Technology aboard the helicopters will help to increase the visibility of the turbine blades, increasing safety for air crew members.

Additionally, the turbine platforms may be used as a way for stranded boaters to get out of the water, or a mooring for drifting vessels.

As described for SAR incidents above, the Project is not anticipated to result in any additional pollution cases, nor is it anticipated to impede or cause a delay in response to pollution spill incidents. In order to make sure that no discharges of any fluids (oil, hydraulic, cooling, etc.) occur even under abnormal circumstances, the turbine is designed for three levels of containment. Each primary system, i.e. gearbox, is a sealed system with multiple sensors that monitor fluid performance and containment, with each of these inspected at regular maintenance intervals. The secondary system is in the nacelle itself, where fluid containment reservoirs are designed to capture any leaks from a primary system failure. In the event that both primary and secondary containment fails, the bottom of the tower has a reservoir to contain any fluids originating from the nacelle. In the extremely rare incidence of failure of all three containment systems, any fluid that may leak into the environment will be inherently biodegradable. Also, service vessels will be equipped with oil spill handling materials adequate to control or clean up any accidental spill. Additional traffic often heightens the potential for a pollution incident. However, there will not be a significant increase in vessel traffic during construction or operation of the Project. Additionally, the risk of collision between boats and the turbines will be negligible (see section 5.3.3) and no oil or hazardous materials will be stored at the turbines. Vessels involved in the

construction phase of the Project will have a variety of oils or other materials on board that may have a risk of release. The vessels will be navigated by fully trained, licensed vessel operators who will adhere to navigational rules and regulations, to all state laws regarding the safe handling of hazardous materials and reporting and response requirements in the event of a spill.

8.0 ICEBREAKER WIND SHUTDOWN PROCEDURES

A control center capable of remotely monitoring and controlling the Project will be manned 24 hours a day. The control center will be staffed by trained personnel and contain charts indicating GPS position and identification numbers of all Project components, which will also be provided to the USCG. During normal operations, all turbines will be equipped with control mechanisms that will allow the operations center personnel to fix and maintain the position of the blades. Control room personnel will be able to shut down turbine operation in the event of an emergency.

A shutdown procedure will be developed by Icebreaker Windpower Inc. as part of an emergency response plan. This plan will be shared with the local USCG office and first responders. In addition to the response plan, Icebreaker Windpower Inc. will work with the USCG, first responders, and other local authorities to carry out communication and shutdown procedure training in response to emergency situations related to the Project. Any distress call received by the USCG Search and Rescue Mission Coordinator will be passed to the Project's O&M and control center. The shutdown procedure will be initiated until the Search and Rescue Mission Coordinator notifies the control center that it is safe to restart the turbines. The communication and shutdown procedures will be tested by the Applicant at least twice per year.

9.0 MITIGATION STRATEGIES

As described throughout this report, the construction and operation of the Project may increase risk to navigation safety in the area. However, through the use of appropriate mitigation strategies, the risk to navigational safety from the Project is expected to be minimal.

Throughout the construction phase there will be a slight increase in vessel traffic at the turbine and cable route sites, between the Port of Cleveland and these sites, and within the Cleveland Harbor. However, the Project Area (including the Cleveland Harbor and Port of Cleveland) frequently experience high vessel traffic, and the additional traffic generated as a result of Project construction will be negligible. Nonetheless, increased traffic could result in an increased chance of vessel collisions, environmental spills due to marine accidents, personnel injury, transit delays within the port, and communication delays as a result of increased marine radio traffic. Mitigation strategies proposed for the Project include requesting designated safety zones and exclusion areas around the turbine sites and cable

routes, and publishing and broadcasting NTMs and radio navigational warnings. Even though the traffic increase due to Project construction is expected to be minor, these mitigation strategies will help further reduce any risk to navigational safety from Project construction.

During the operational phase, risks to navigational safety could result from the addition of new obstructions (turbines) and some increased turbine maintenance vessel traffic. This could potentially lead to increased risk of collisions with turbines and between vessels, environmental spills or personnel injury due to a marine accident, interference with USCG operations, and confusion to mariners. Due to the small scale of the Project, and large spacing between turbines, these risks are considered to be minimal. However, mitigation strategies to further minimize risk include publishing and broadcasting NTMs and radio navigational warnings, working with NOAA to update navigational charts, markings and lights on turbines and platforms consistent with USCG guidelines, and coordination with the local USCG office and first responders for emergency preparedness. Due to the low level of risk and additional mitigation strategies proposed, the risk to navigational safety is expected to be negligible.

10.0 CONCLUSIONS

A change analysis, based on the USCG's Risk-Based Decision-Making Guidelines, is used to assess the risk effects and proper management strategies in situations where change is occurring. To assess risk to navigational safety, a change analysis was performed for construction and operational phases of Icebreaker Wind. The change analysis is included as Appendix A. This Navigational Risk Assessment includes details on many of the factors that may contribute to elevated risk, including environmental conditions, weather, current vessel traffic patterns, coordination with agencies and local first responders, and an analysis of electronic navigation and communication systems.

The analysis of the construction phase indicated that the construction plans, and vessel routes and traffic, will not adversely affect navigational safety in the Project Area. The establishment of safety zones and/or exclusion areas around the turbine sites and cable route during construction will mitigate any risks associated with construction areas and associated traffic. Vessel traffic increases as a result of construction are expected to be minor in comparison over current traffic use of the Project Area, as the Cleveland Harbor and Port of Cleveland frequently experience high traffic volumes during peak spring and summer seasons.

The change analysis and this Assessment include details on Project design and turbine layout, existing traffic routes, and electronic navigation and communication systems. While there is an elevated risk to navigational safety, especially during low visibility or inclement weather conditions, the mitigation strategies employed by the Applicant, and coordination with local USCG and other relevant authorities, will substantially reduce the risk to navigational safety. Due to the small number of turbines, their linear array, the large amount of space between each turbine, and the 20

meter (66 foot) rotor clearance above the water surface, risk of collisions with turbines due to the new structures are expected to be easily avoided. Updating navigational charts and following lighting and ATON requirements with the USCG will help to mitigate vessel collisions with the turbines. The Project will not significantly affect the USCG's missions.

Additionally, Icebreaker Windpower Inc. is committed to working with the USCG, local emergency responders, and other relevant local authorities throughout the development, construction and operation of the Project to minimize risks to navigational safety.

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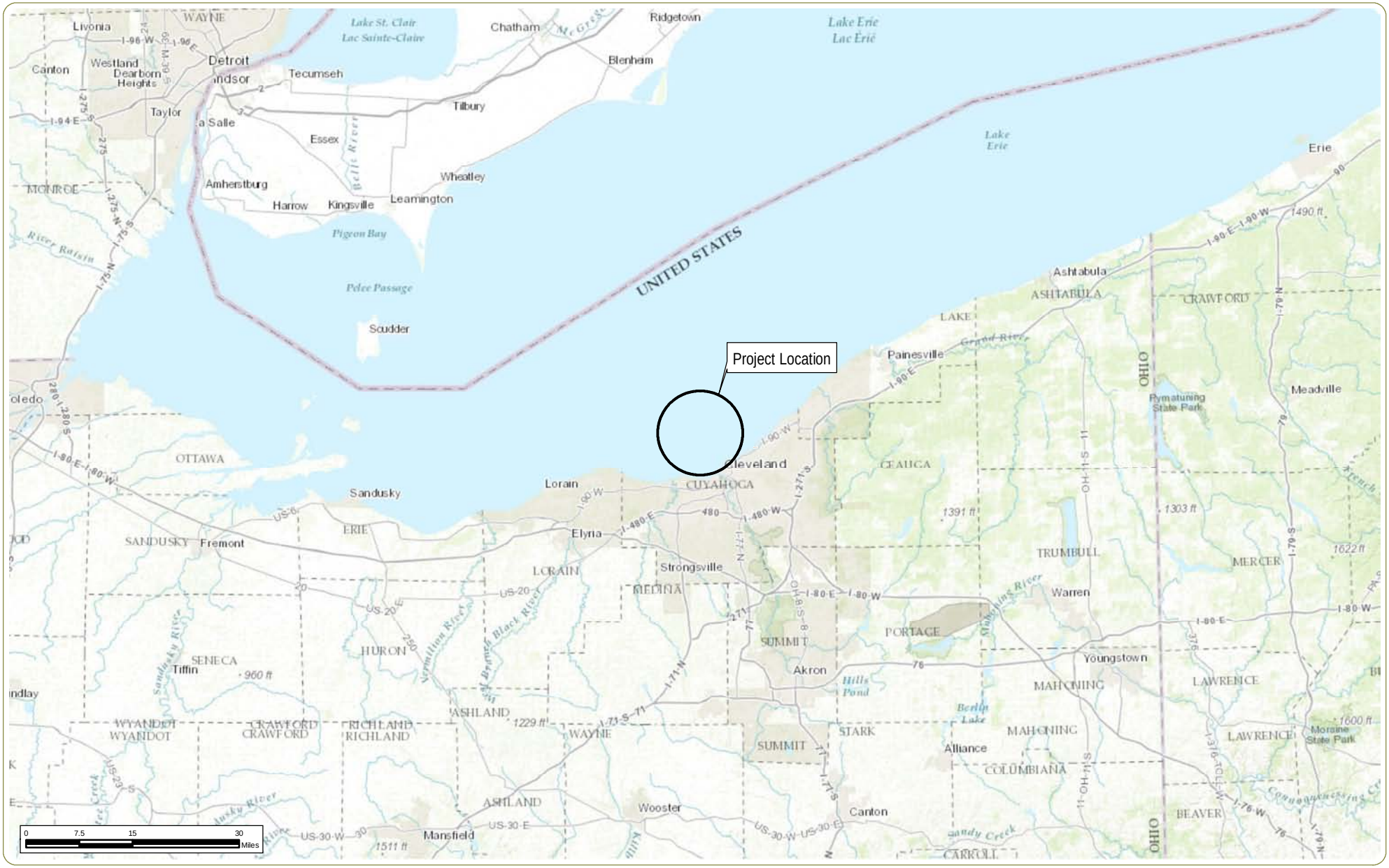
FIGURES



Icebreaker Wind

Lake Erie, City of Cleveland, Cuyahoga County, Ohio

Figure 1: Regional Project Location

Notes: 1. Basemap: ESRI ArcGIS Online "World Topographic Map" map service.
2. This map was generated in ArcMap on March 17, 2017.
3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

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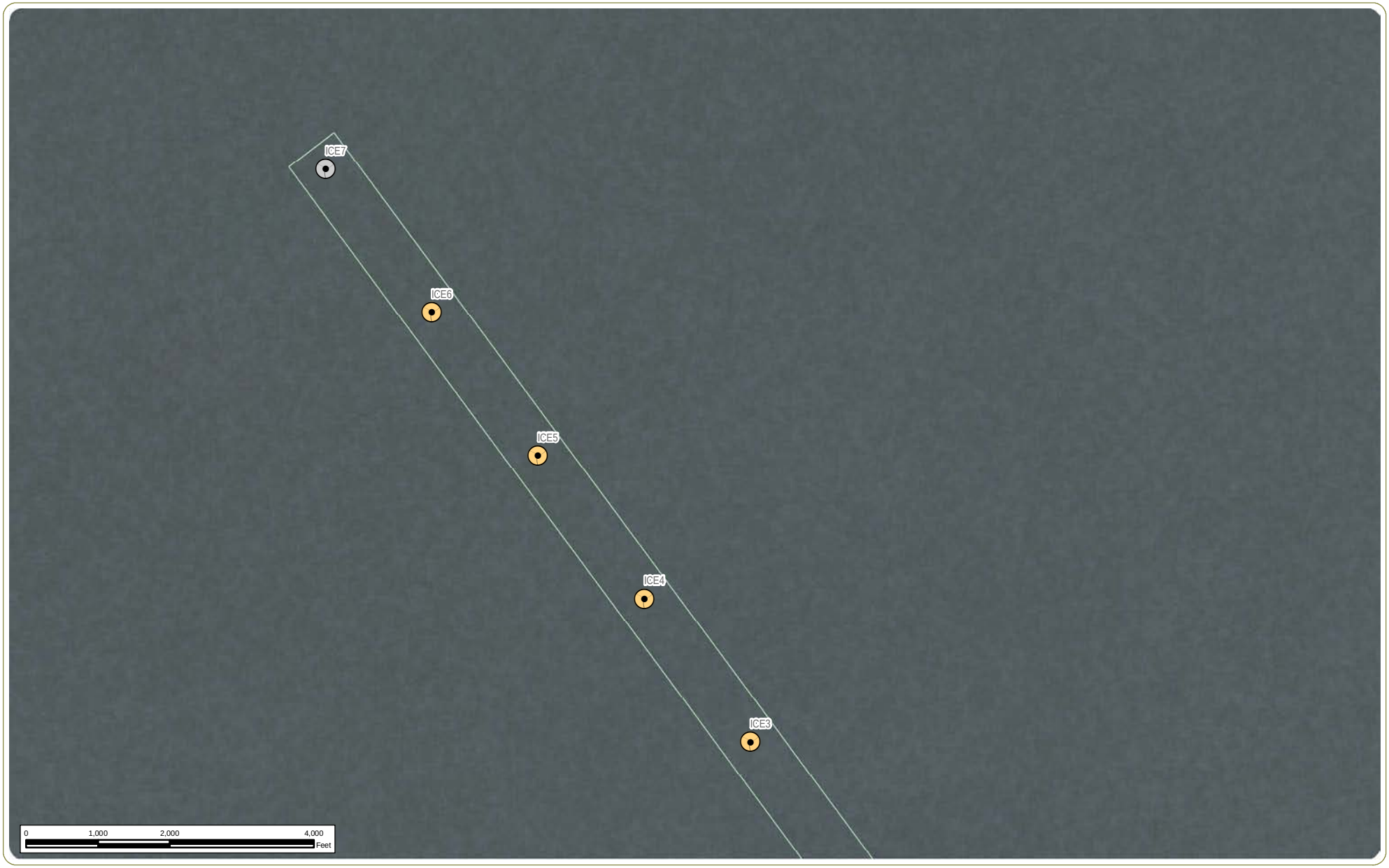

Icebreaker Wind

Lake Erie, City of Cleveland, Cuyahoga County, Ohio

Figure 2. Project Layout

Sheet 1 of 6

Notes: 1. Basemap: ESRI ArcGIS Online "World Imagery" map service.
2. This map was generated in ArcMap on March 17, 2017.
3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

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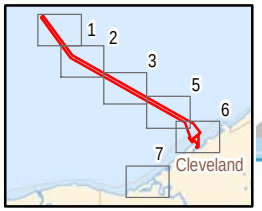
- Alternate Wind Turbine
- Ancillary Features
- Cable Route Envelope



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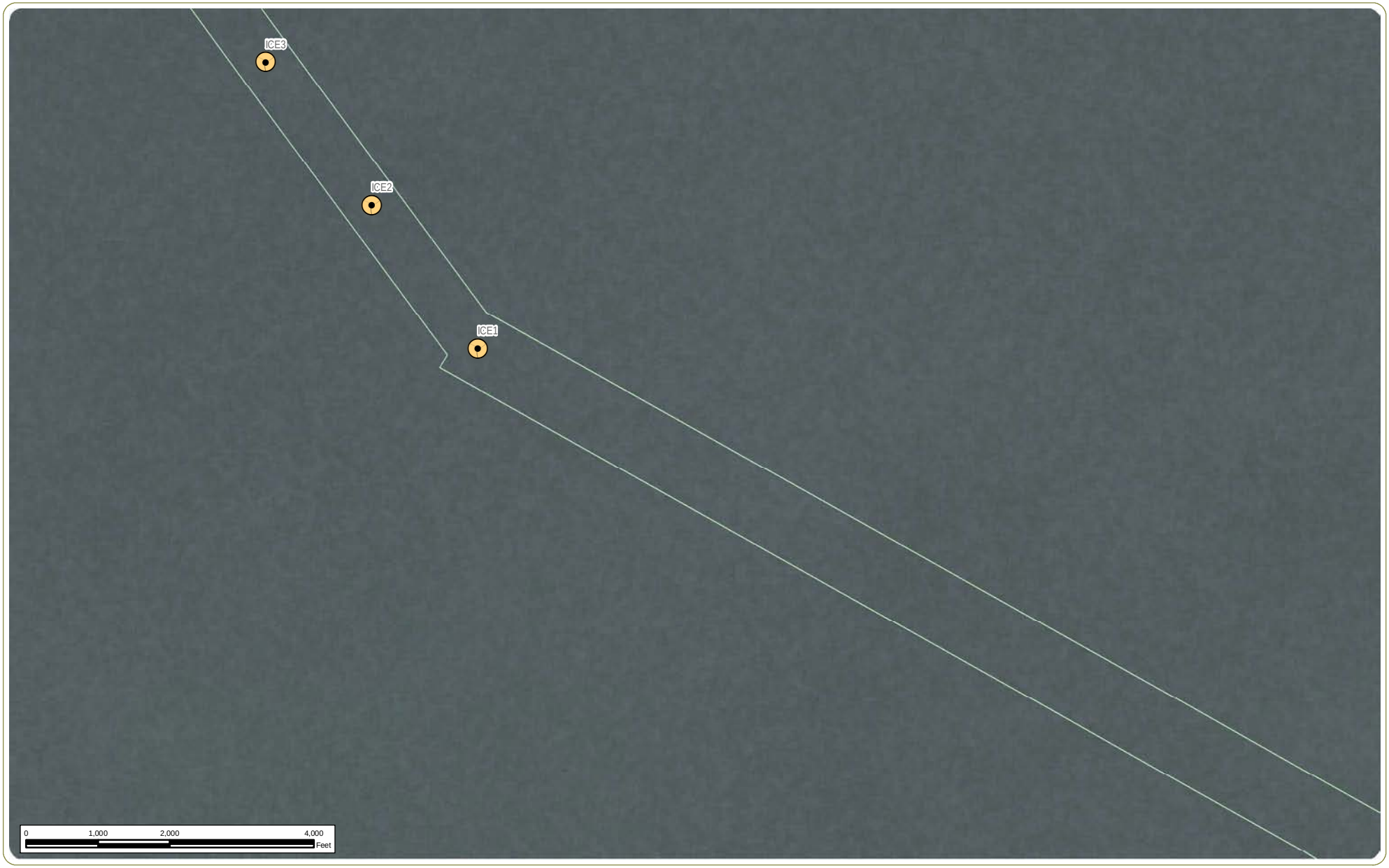

Icebreaker Wind

Lake Erie, City of Cleveland, Cuyahoga County, Ohio

Figure 2. Project Layout

Sheet 2 of 6

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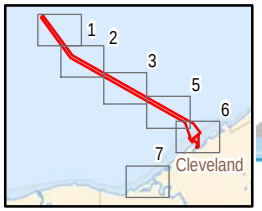

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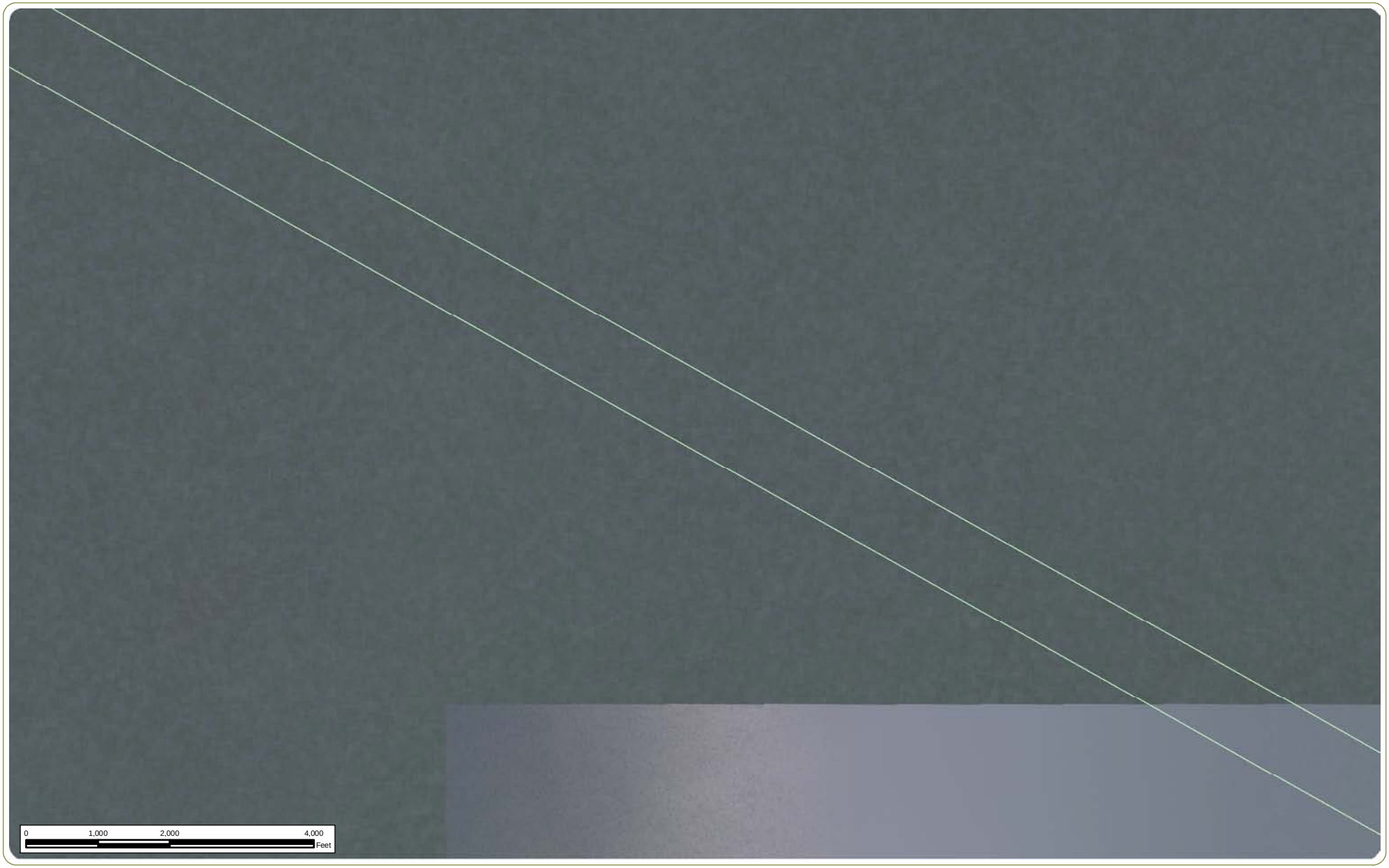


Icebreaker Wind

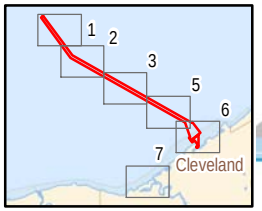
Lake Erie, City of Cleveland, Cuyahoga County, Ohio

Figure 2. Project Layout

Sheet 3 of 6

Notes: 1. Basemap: ESRI ArcGIS Online "World Imagery" map service.
2. This map was generated in ArcMap on March 17, 2017.
3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

- Wind Turbine
- Alternate Wind Turbine
- Ancillary Features
- Cable Route Envelope



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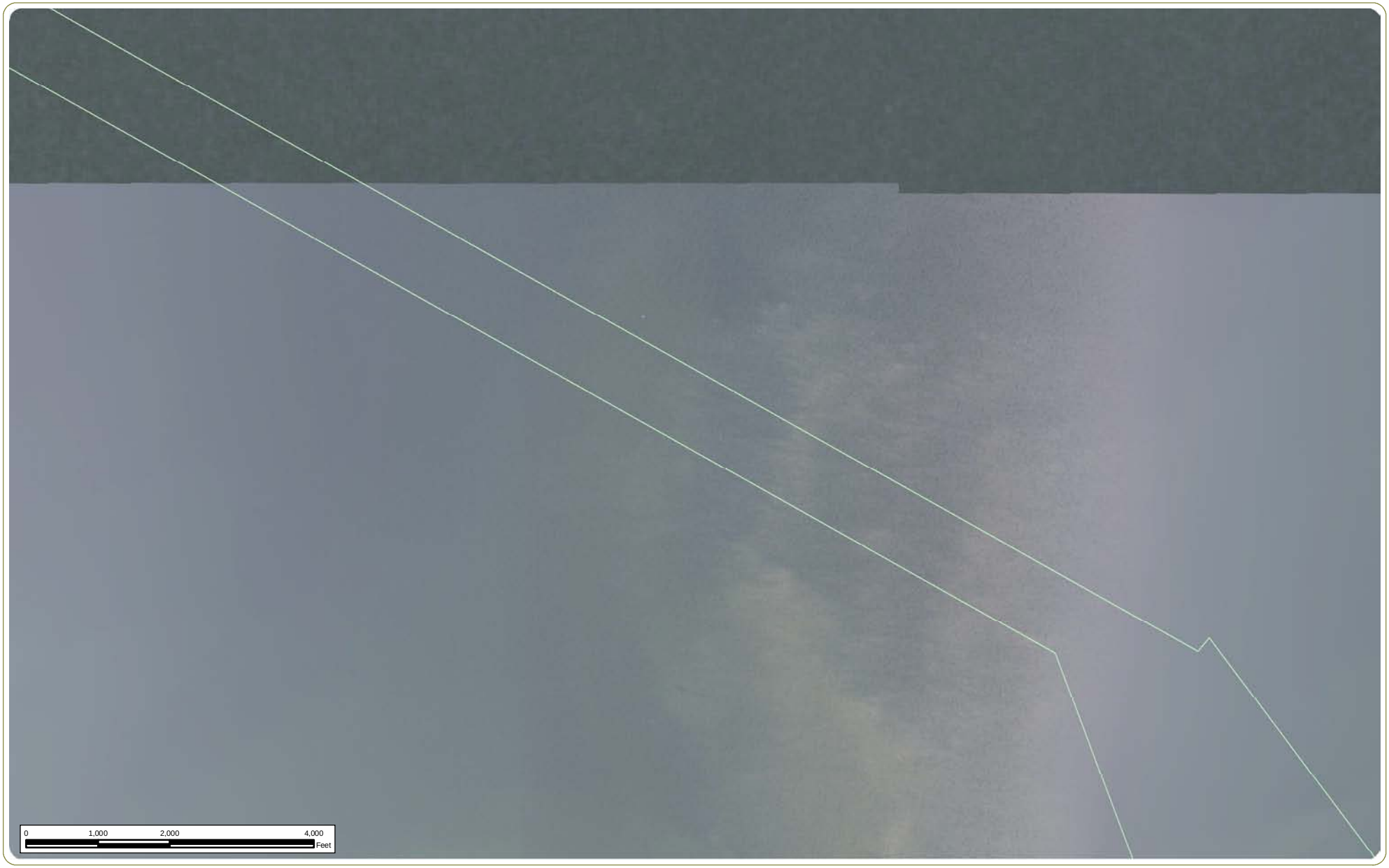

Icebreaker Wind

Lake Erie, City of Cleveland, Cuyahoga County, Ohio

Figure 2. Project Layout

Sheet 4 of 6

Notes: 1. Basemap: ESRI ArcGIS Online "World Imagery" map service.
2. This map was generated in ArcMap on March 17, 2017.
3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

- Wind Turbine
- Alternate Wind Turbine
- Ancillary Features
- Cable Route Envelope

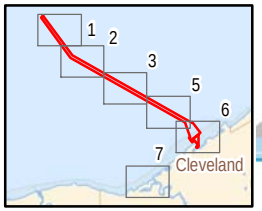

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Figure 2. Project Layout

Sheet 5 of 6

Notes: 1. Basemap: ESRI ArcGIS Online "World Imagery" map service.
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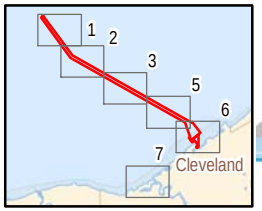
3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

- Wind Turbine
- Alternate Wind Turbine
- Ancillary Features
- Cable Route Envelope



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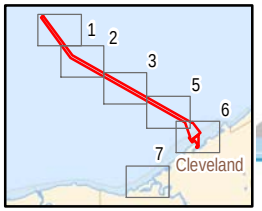
Lake Erie, City of Cleveland, Cuyahoga County, Ohio

Figure 2. Project Layout

Sheet 6 of 6

Notes: 1. Basemap: ESRI ArcGIS Online "World Imagery" map service.
2. This map was generated in ArcMap on March 17, 2017.
3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

- Wind Turbine
- Alternate Wind Turbine
- Ancillary Features
- Cable Route Envelope



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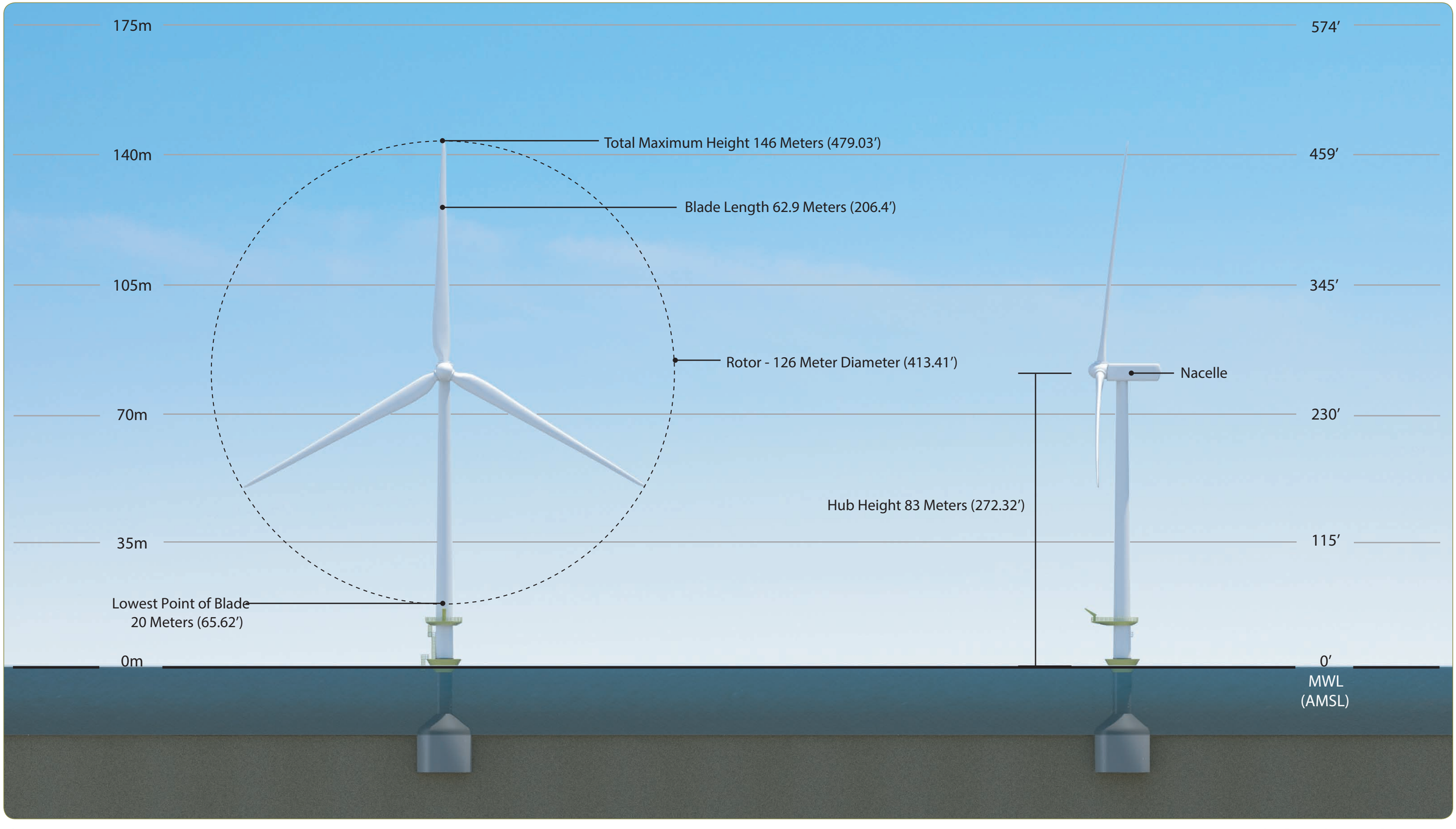

Icebreaker Wind
Lake Erie, City of Cleveland, Cuyahoga County, Ohio

Figure 3: Turbine Design

November 2016

Prepared for:

Prepared by:

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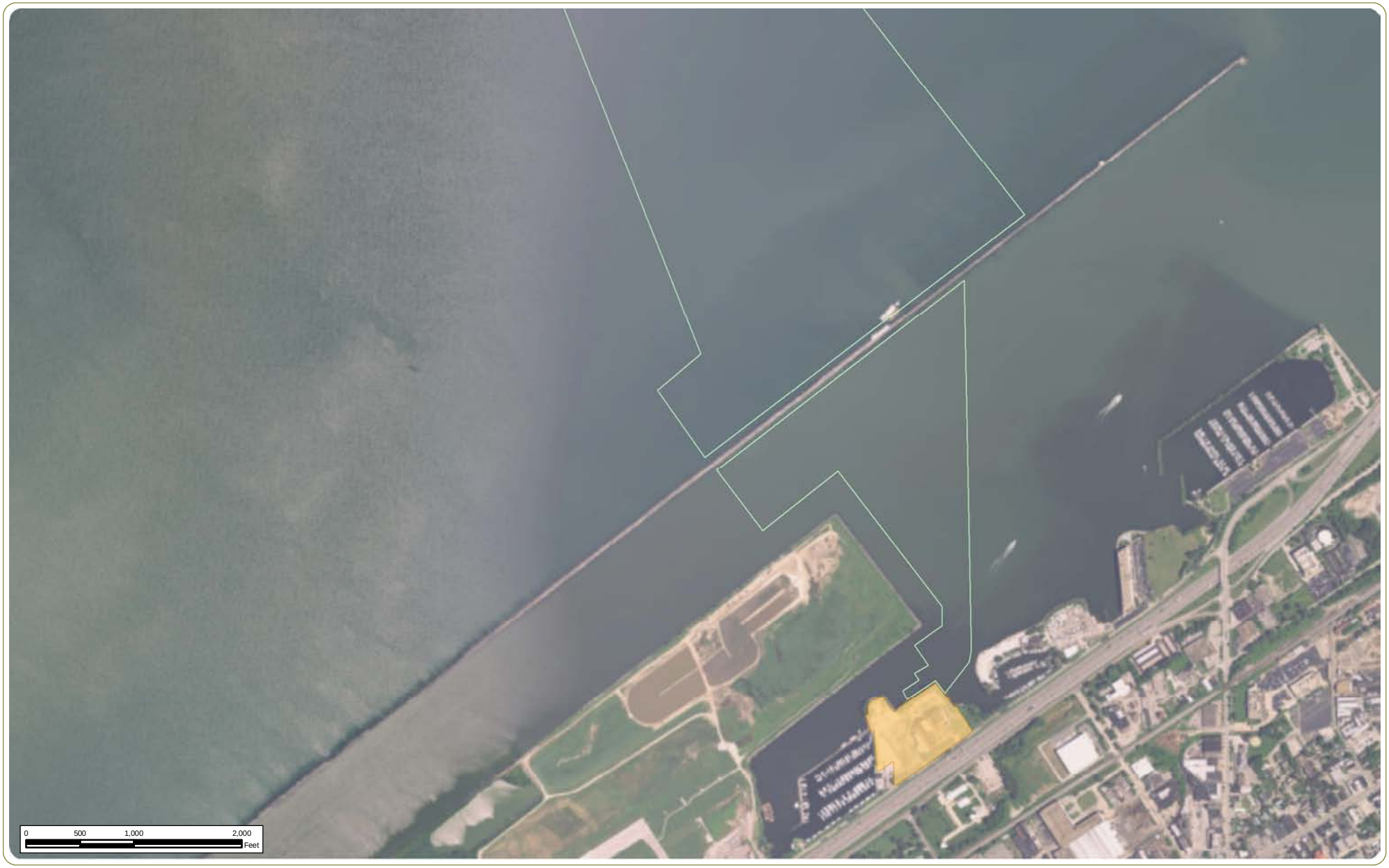

Icebreaker Wind

Lake Erie, City of Cleveland, Cuyahoga County, Ohio

Figure 4. Proposed Nearshore Cable Line

Substation Parcel

Cable Route Envelope

Notes: 1. Basemap: ESRI ArcGIS Online "World Topography" map service.
2. This map was generated in ArcMap on March 17, 2017.
3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

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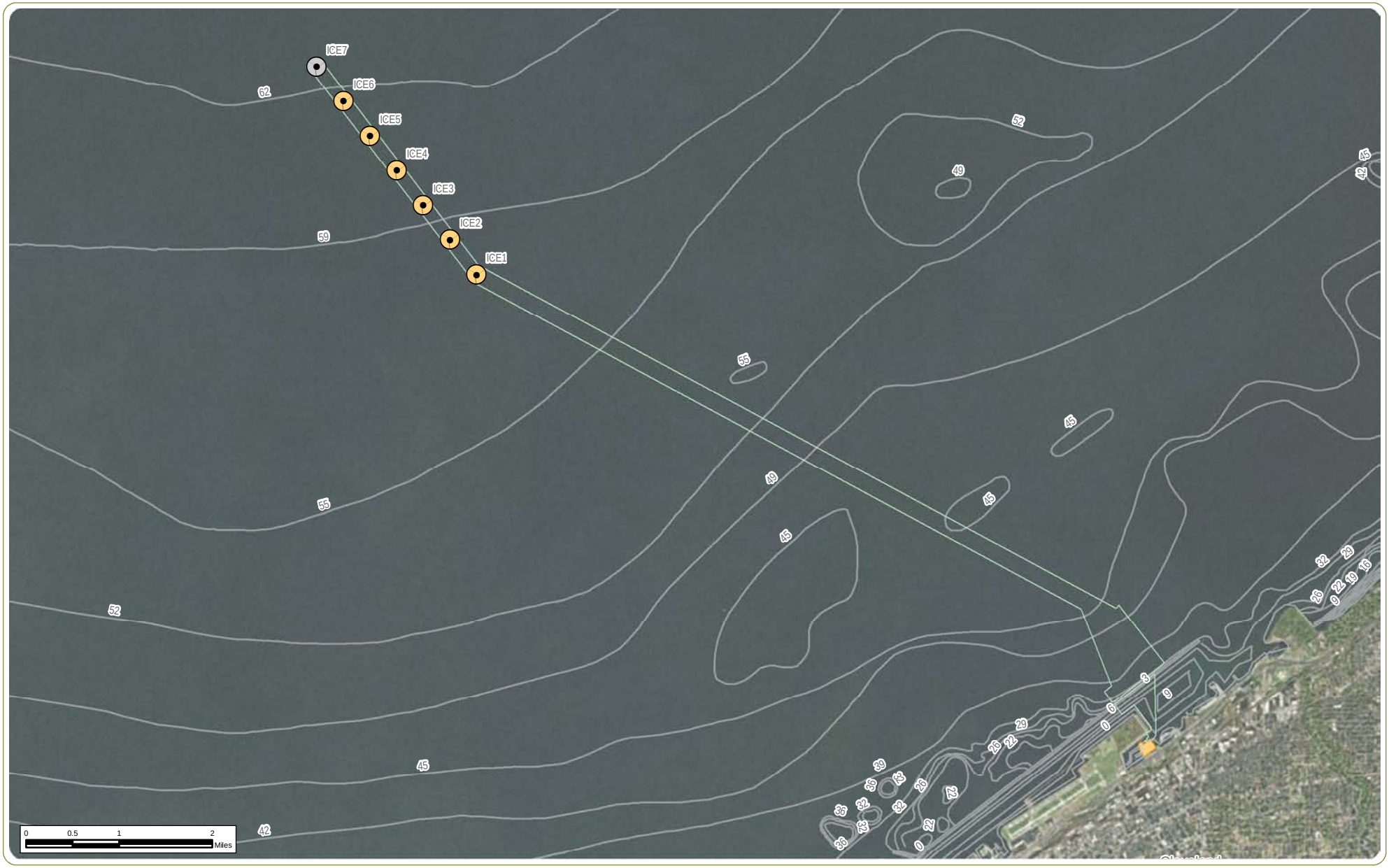

Icebreaker Wind

Lake Erie, City of Cleveland, Cuyahoga County, Ohio

Figure 5. Lake Erie Bathymetry

Notes: 1. Basemap: ESRI ArcGIS Online "World Imagery" map service.
2. This map was generated in ArcMap on March 17, 2017.
3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

- Wind Turbine
- Alternate Wind Turbine
- Bathymetry (ft)
- Substation Parcel
- Cable Route Envelope

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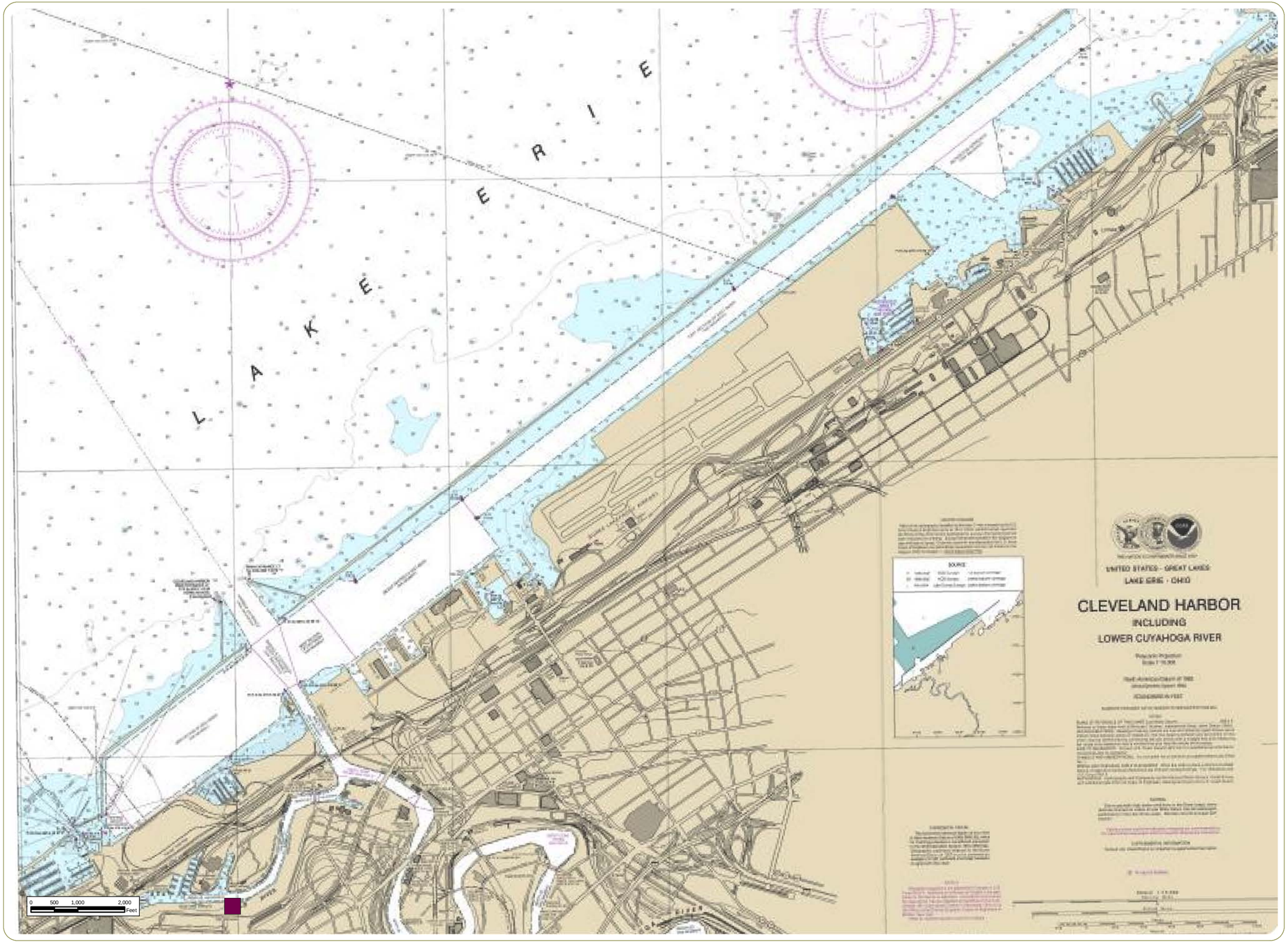

Icebreaker Wind

Lake Erie, City of Cleveland, Cuyahoga County, Ohio

Figure 6. Cleveland Harbor

Notes:
1. Basemap: NOAA Navigational Chart #14839.
2. This map was generated in ArcMap on March 23, 2017.
3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

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Figure 7. NOAA Obstructions

Notes: 1. Basemap: ESRI ArcGIS Online "World Imagery" map serivce.
2. This map was generated in ArcMap on March 23, 2017.
3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

- ENC Wreck
- AWOIS Wreck
- AWOIS Obstruction
- Cleveland Public Power Substation
- Wind Turbine
- Alternate Wind Turbine
- Cable Route Envelope

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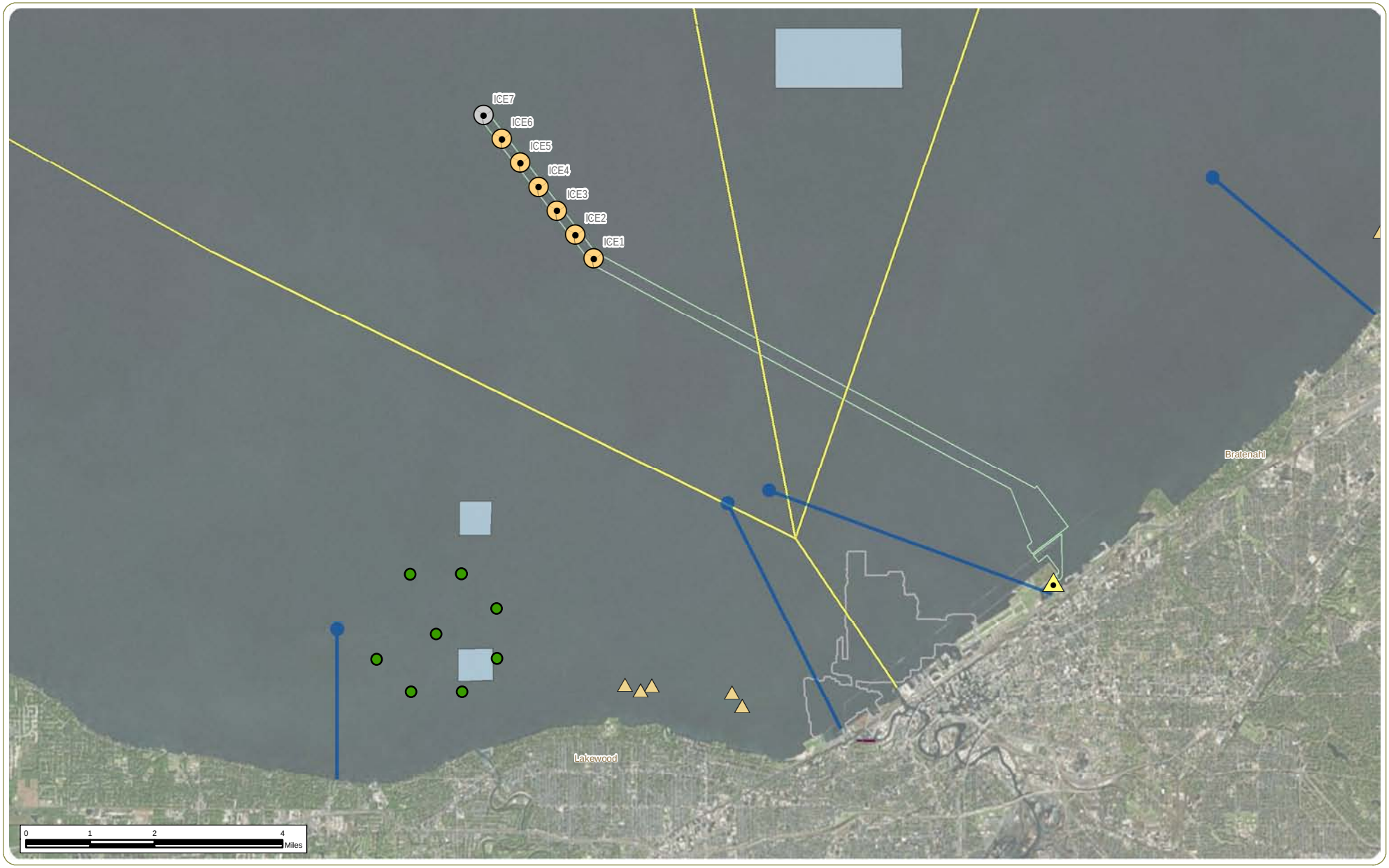

Icebreaker Wind

Lake Erie, City of Cleveland, Cuyahoga County, Ohio

Figure 8. Project Area Existing Uses

Notes: 1. Basemap: ESRI ArcGIS Online "World Imagery" map service.
2. This map was generated in ArcMap on March 23, 2017.
3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

- Yacht Club Buoy
- Reefs and Shoals
- Cleveland Public Power Substation
- Wind Turbine
- Alternate Wind Turbine
- Water Intake
- Shipping Lane
- Cable Route Envelope
- Dredge Disposal Area
- Submerged Salt Mine
- O&M Center Parcel

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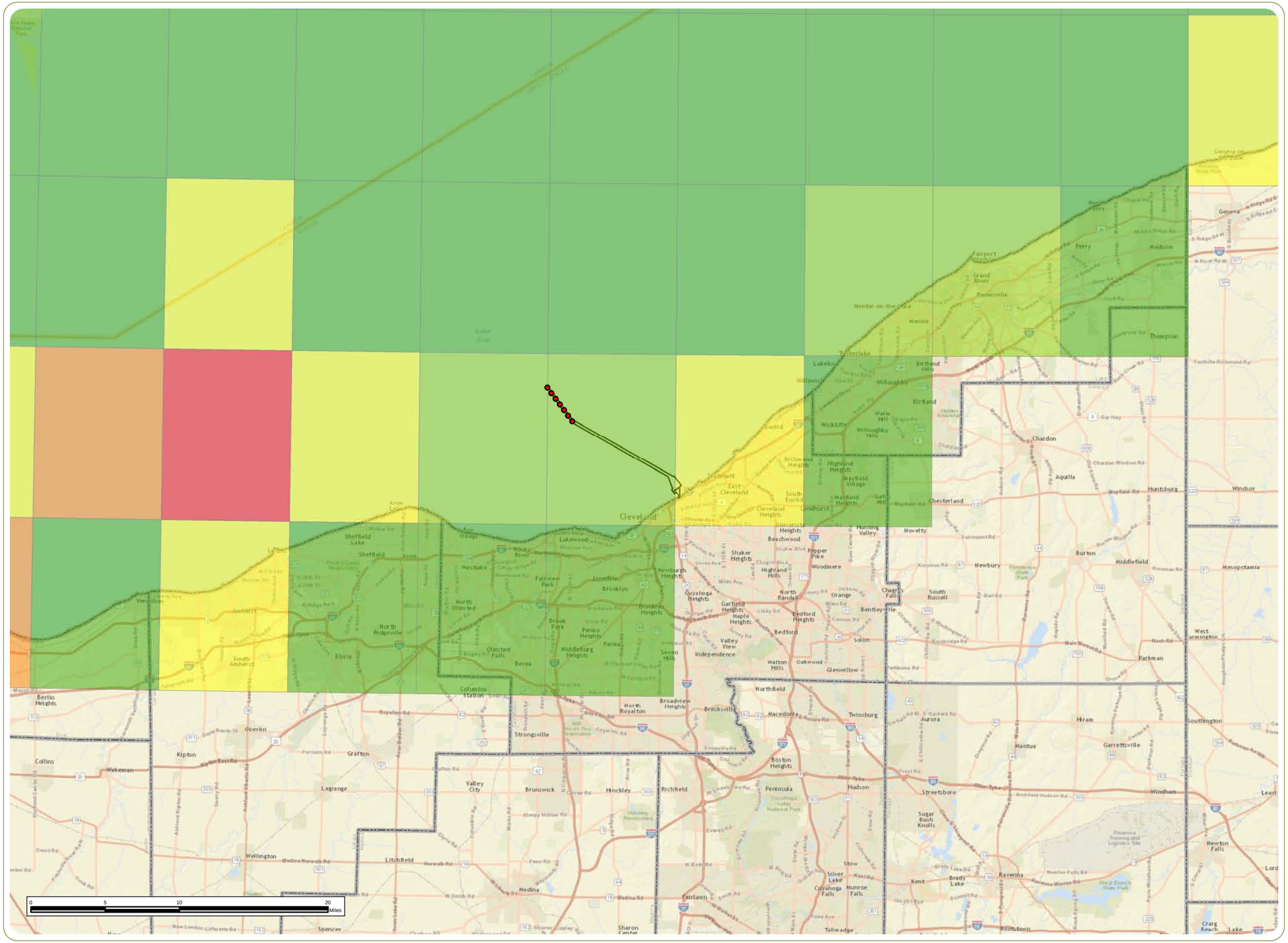
Lake Erie, City of Cleveland, Cuyahoga County, Ohio

Figure 9. Commercial Fisheries in Lake Erie



Wind Turbine

Electric Collection Line Envelope

County Boundary

Commercial Fishery Density

- Less than 1%
- 1.0% to 3.0%
- 3.1% to 6.0%
- 6.1% to 14.4%
- Over 14.5%

Notes:

1. Basemap: ESRI ArcGIS Online "World Street Map" map service.
2. This map was generated in ArcMap on June 13, 2017.
3. Commercial fishery density is from ODNR, represents percentage of total fishing nets pulled from each management unit (2011-2015).
4. This is a color graphic. Reproduction in grayscale may misrepresent the data.

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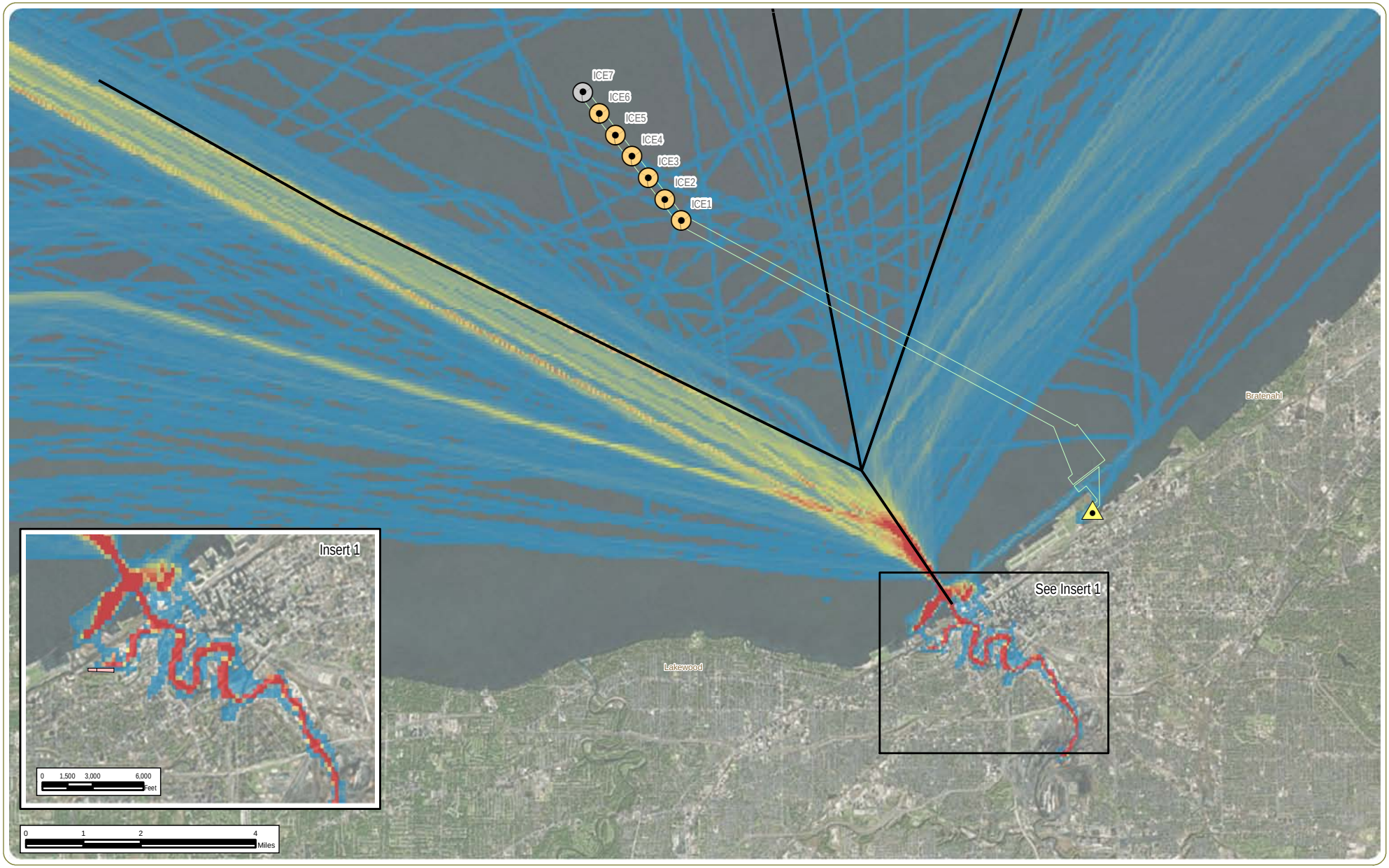

Icebreaker Wind

Lake Erie, City of Cleveland, Cuyahoga County, Ohio

Figure 10. Cargo Vessel Density

Notes: 1. Basemap: ESRI ArcGIS Online "World Imagery" map service.
2. This map was generated in ArcMap on June 13, 2017.
3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

- Wind Turbine
- Alternate Wind Turbine
- Cleveland Public Power Substation
- Shipping Lanes
- Cable Route Envelope
- O&M Center Parcel

Cargo Vessel Density
High
Low

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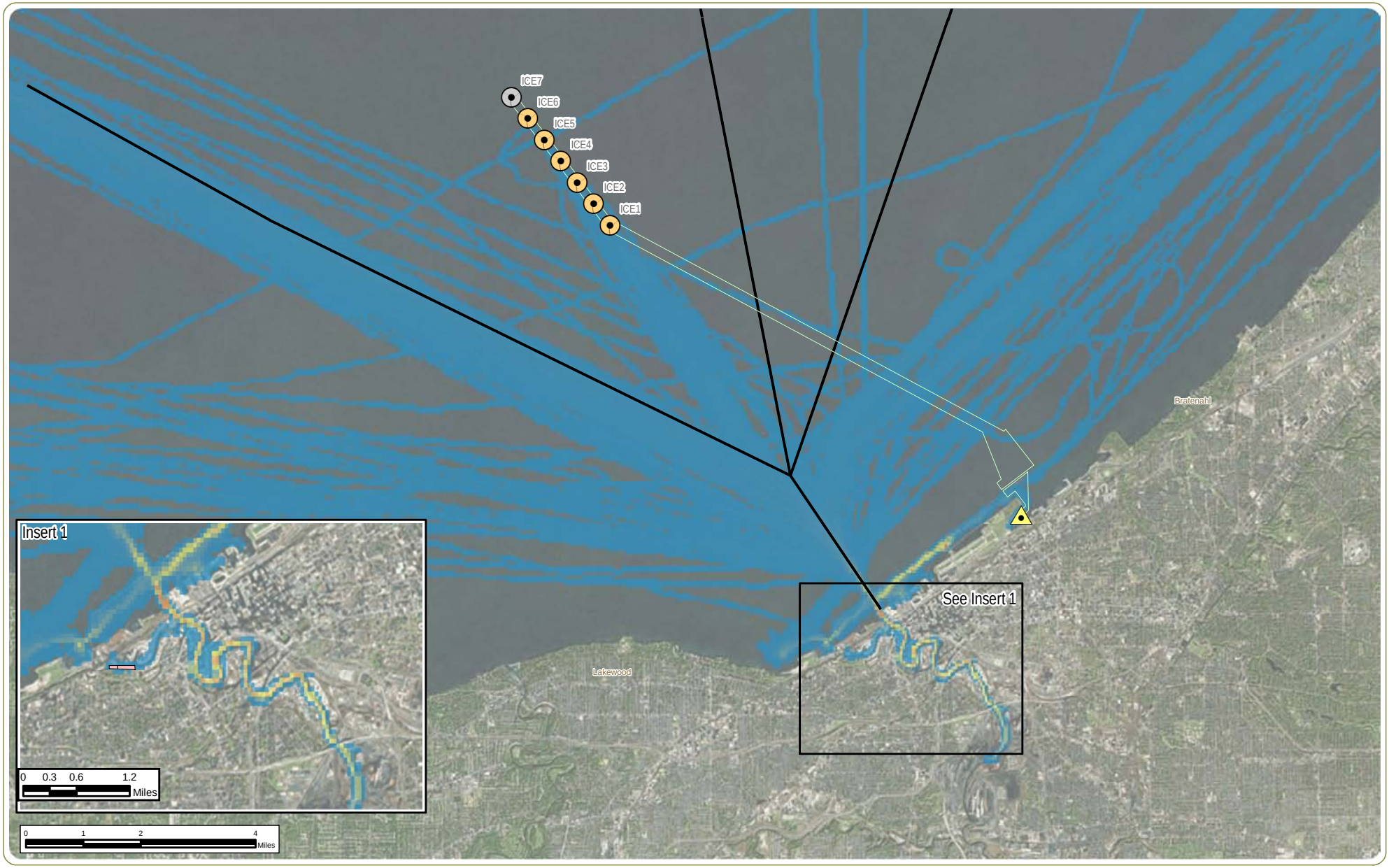

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Lake Erie, City of Cleveland, Cuyahoga County, Ohio

Figure 11. Tug and Towing Vessel Density

Notes: 1. Basemap: ESRI ArcGIS Online "World Imagery" map service.
2. This map was generated in ArcMap on June 13, 2017.
3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

- Wind Turbine
- Alternate Wind Turbine
- Cleveland Public Power Substation
- Shipping Lanes
- Cable Route Envelope
- O&M Center Parcel

2013 Tug and Towing Vessel Density
High
Low

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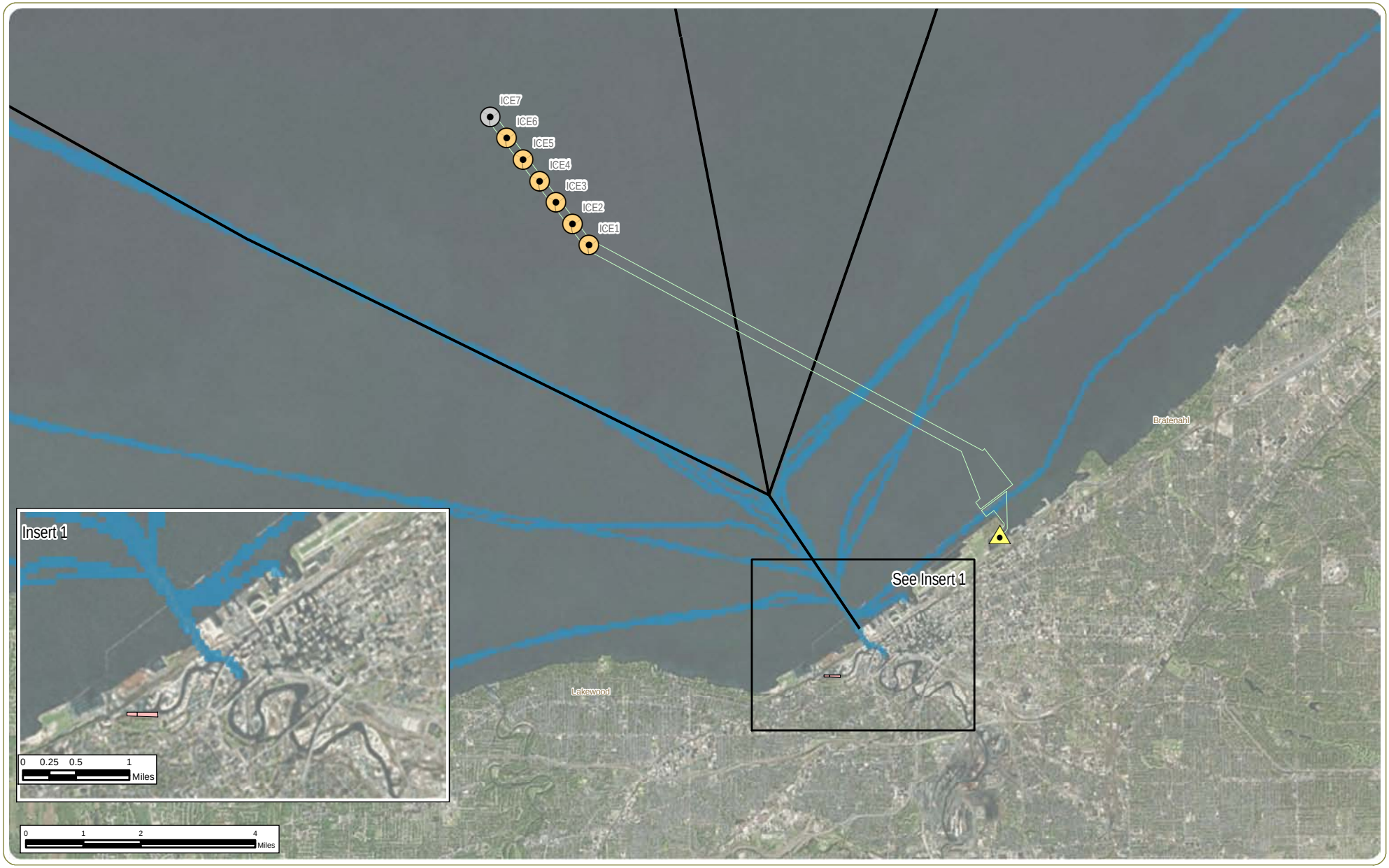

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Lake Erie, City of Cleveland, Cuyahoga County, Ohio

Figure 12: Passenger Vessel Density

Notes: 1. Basemap: ESRI ArcGIS Online "World Imagery" map service.
2. This map was generated in ArcMap on June 13, 2017.
3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

- Wind Turbine
- Alternate Wind Turbine
- Cleveland Public Power Substation
- Shipping Lanes
- Cable Route Envelope
- O&M Center Parcel
- 2013 Passenger Vessel Density
  - High
  - Low

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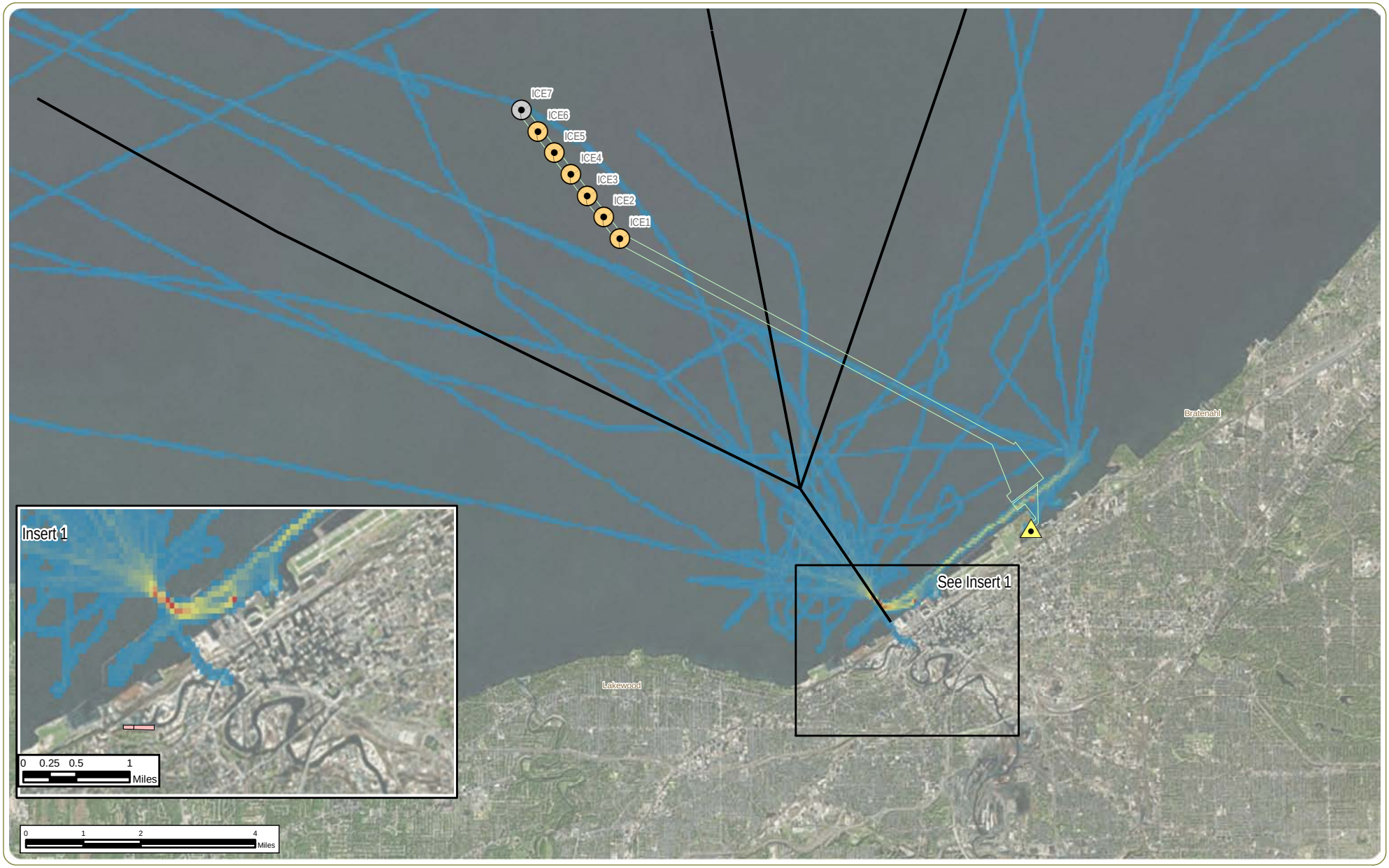

Icebreaker Wind

Lake Erie, City of Cleveland, Cuyahoga County, Ohio

Figure 13: Commercial Pleasure Craft and Sailing Vessel Density

Notes: 1. Basemap: ESRI ArcGIS Online "World Imagery" map service.
2. This map was generated in ArcMap on June 13, 2017.
3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

- Wind Turbine
- Alternate Wind Turbine
- Cleveland Public Power Substation
- Shipping Lanes
- Cable Route Envelope
- O&M Center Parcel

2013 Pleasure Craft and Sailing Vessel Density
- High
- Low

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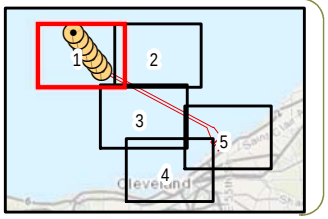
Lake Erie, City of Cleveland, Cuyahoga County, Ohio

Figure 14: U.S. Coast Guard MISLE IIA Activities

Notes: 1. Basemap: ESRI ArcGIS Online "World Imagery" map service.
2. This map was generated in ArcMap on June 13, 2017.
3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

Wind Turbine
Alternate Wind Turbine
Cleveland Public Power Substation
Cable Route Envelope
O&M Center Parcel



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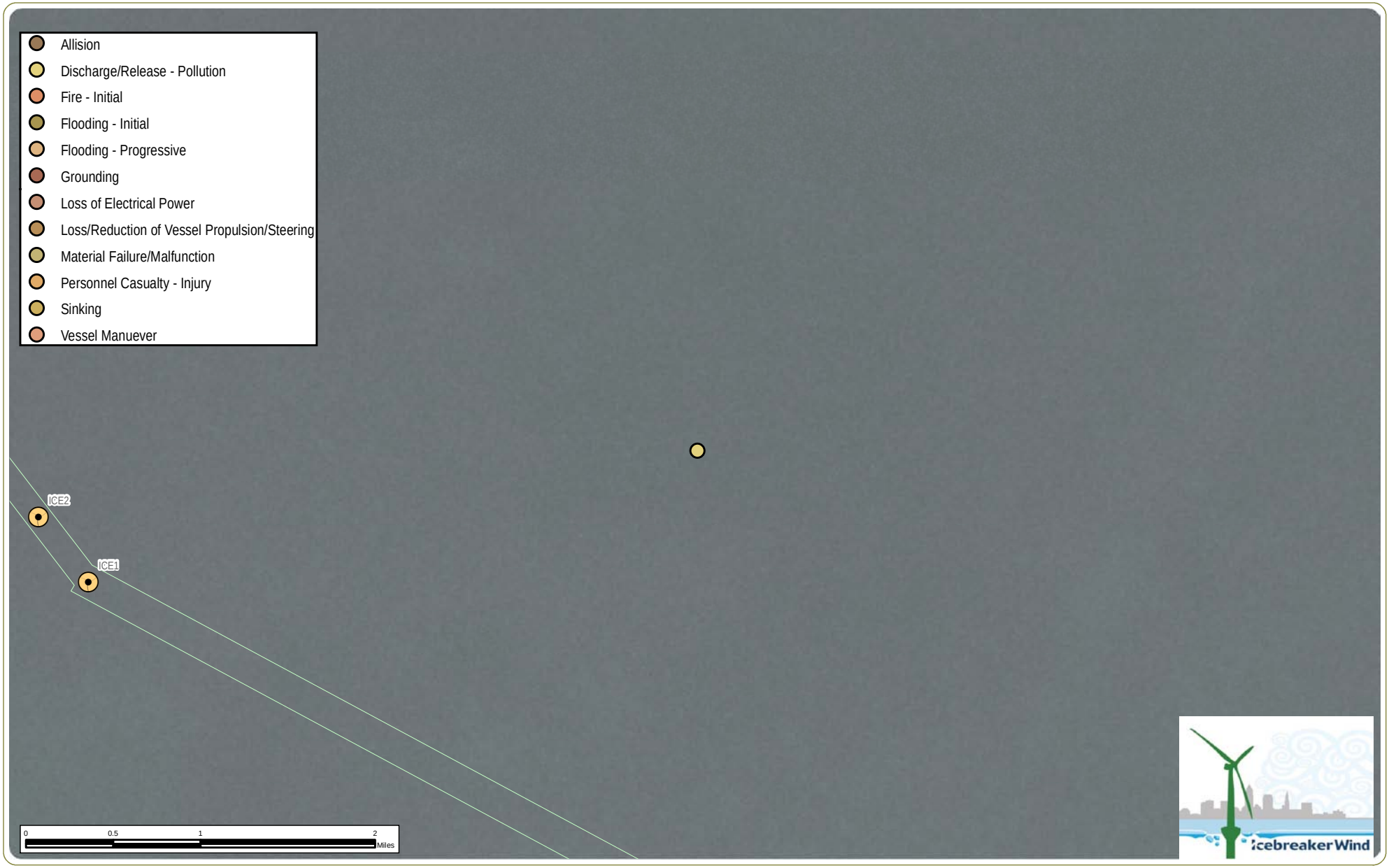


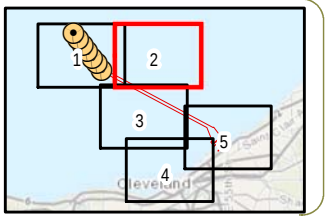
Icebreaker Wind

Lake Erie, City of Cleveland, Cuyahoga County, Ohio

Figure 14: U.S. Coast Guard MISLE IIA Activities

Notes: 1. Basemap: ESRI ArcGIS Online "World Imagery" map service.
2. This map was generated in ArcMap on June 13, 2017.
3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

Wind Turbine
Alternate Wind Turbine
Cleveland Public Power Substation
Cable Route Envelope
O&M Center Parcel



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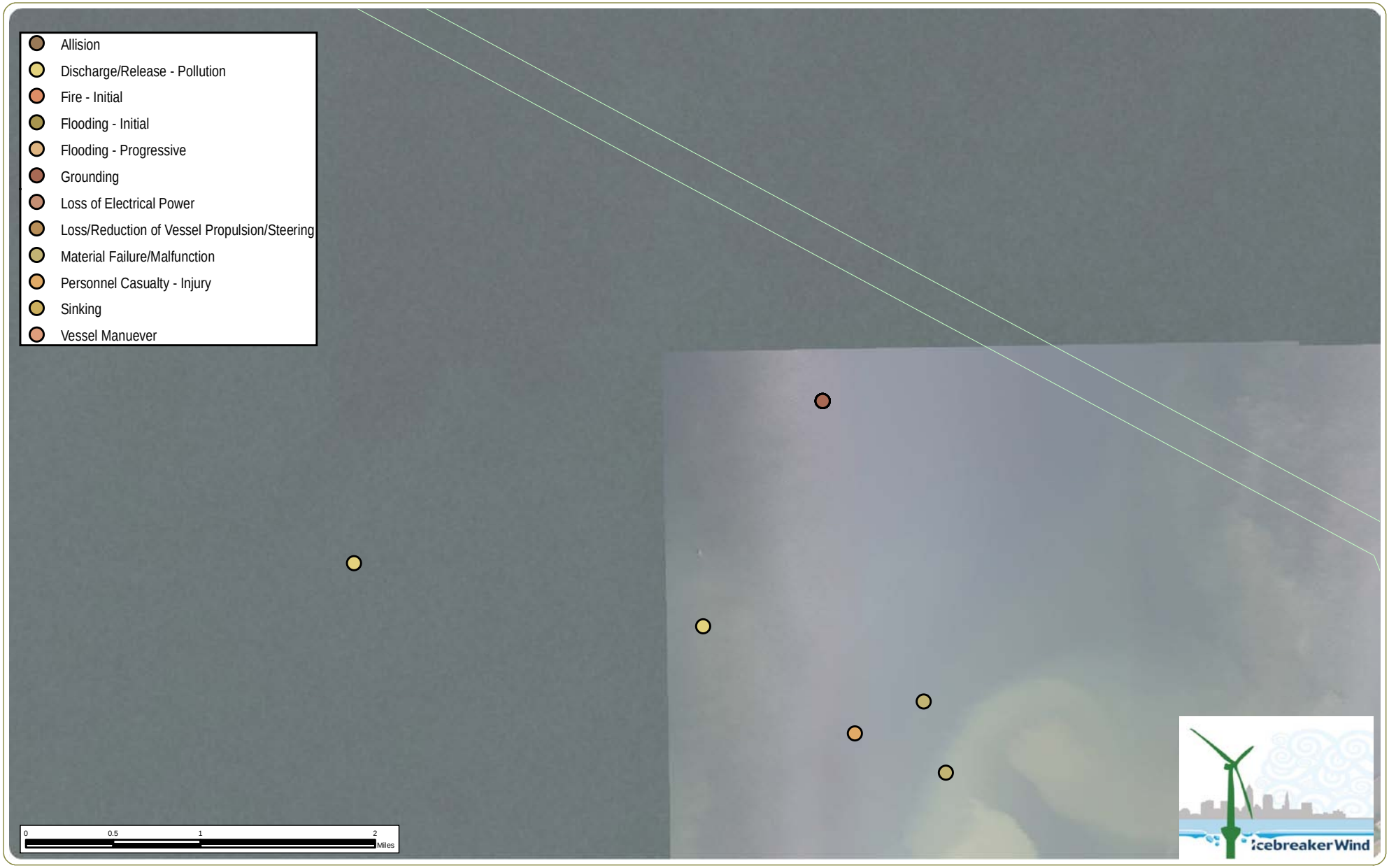


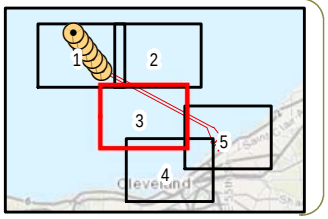
Icebreaker Wind

Lake Erie, City of Cleveland, Cuyahoga County, Ohio

Figure 14: U.S. Coast Guard MISLE IIA Activities

Notes: 1. Basemap: ESRI ArcGIS Online "World Imagery" map service.
2. This map was generated in ArcMap on June 13, 2017.
3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

Wind Turbine
Alternate Wind Turbine
Cleveland Public Power Substation
Cable Route Envelope
O&M Center Parcel



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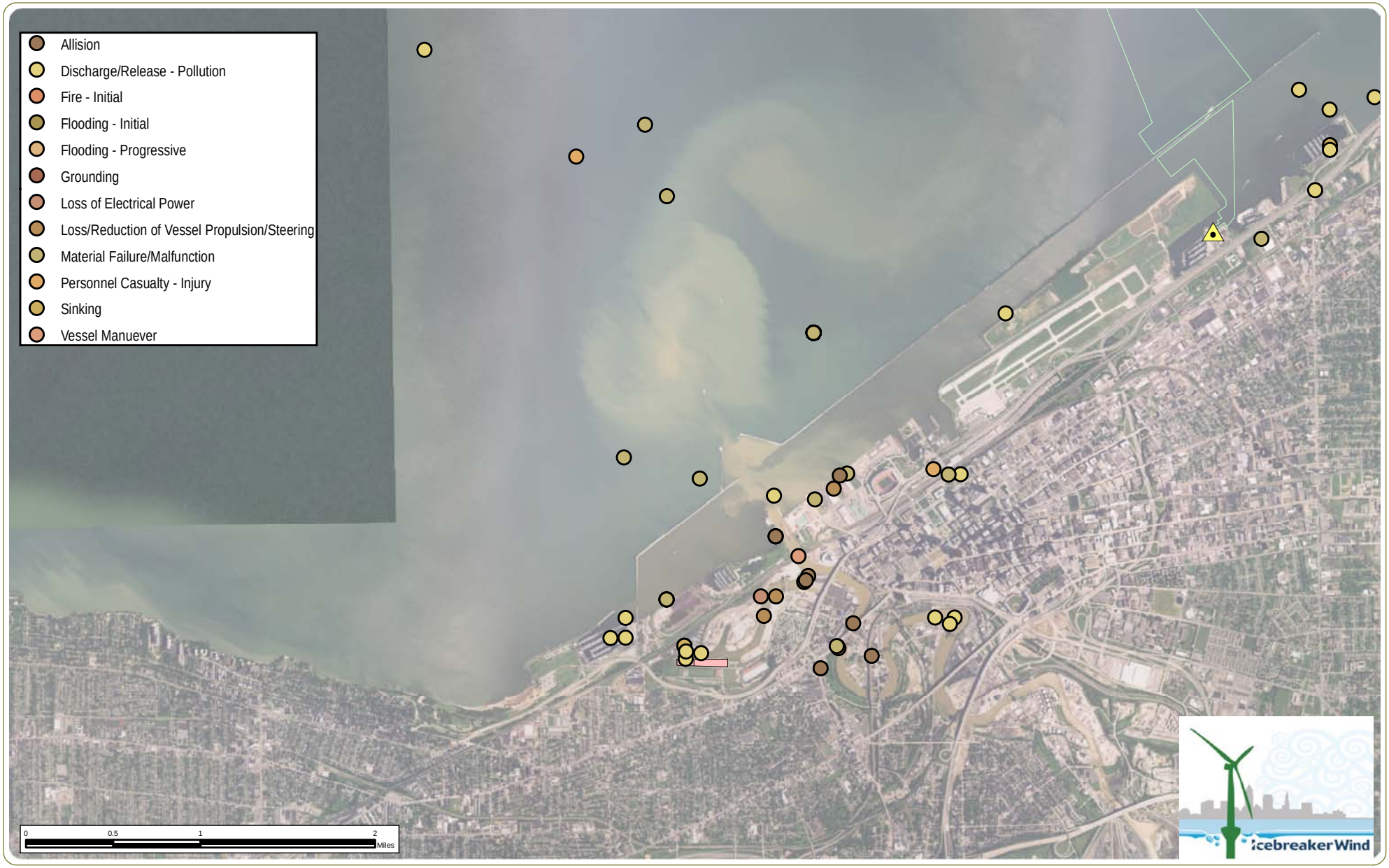


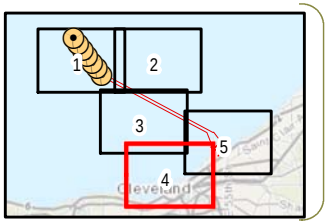
Icebreaker Wind

Lake Erie, City of Cleveland, Cuyahoga County, Ohio

Figure 14: U.S. Coast Guard MISLE IIA Activities

Notes: 1. Basemap: ESRI ArcGIS Online "World Imagery" map service.
2. This map was generated in ArcMap on June 13, 2017.
3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

Wind Turbine
Alternate Wind Turbine
Cleveland Public Power Substation
Cable Route Envelope
O&M Center Parcel



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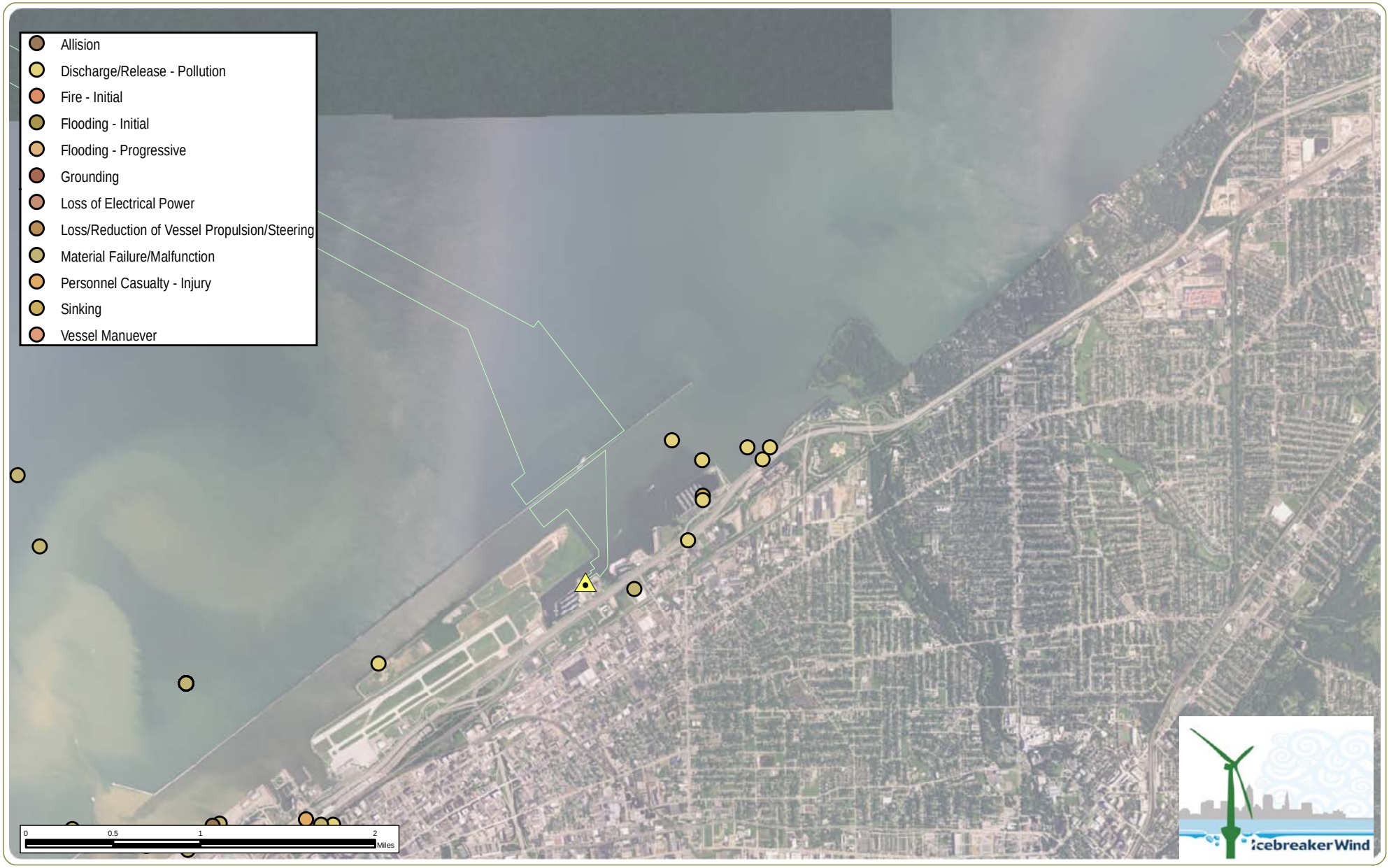


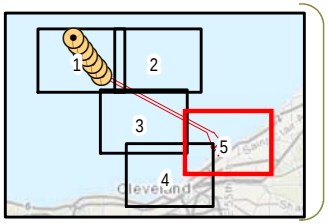
Icebreaker Wind

Lake Erie, City of Cleveland, Cuyahoga County, Ohio

Figure 14: U.S. Coast Guard MISLE IIA Activities

Notes: 1. Basemap: ESRI ArcGIS Online "World Imagery" map service.
2. This map was generated in ArcMap on June 13, 2017.
3. This is a color graphic. Reproduction in grayscale may misrepresent the data.

- Wind Turbine
- Alternate Wind Turbine
- Cleveland Public Power Substation
- Cable Route Envelope
- O&M Center Parcel



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APPENDIX A

Change Analysis of Icebreaker Wind				
Project Phase	**Differences from Normal Activities**	**Potential Effects**	**Recommended Risk Control Strategies**	
			Prevention Requirements	**Surveillance Actions**
Construction	Increased vessel traffic at the Project Site	Increased chance of vessel collisions and allisions Environmental spill (oil release) due to a marine accident Personnel injury from a marine accident	Request a designated Safety Zone and/or exclusion area be established Publish a NTM, broadcast local NTMs, and notify local media Ensure construction vessels have access to adequate spill response assets and resources Establish and coordinate with USCG on emergency response plans Construction vessel operators to use best practices to minimize potential risks	Coordinate with USCG and State officials for assistance in monitoring any construction area interference
Construction	Increased vessel traffic between Cleveland Harbor, Port of Cleveland, and the Project Site	Transit delays that impact port operations Recreational and commercial vessels during boating season may interfere with project vessels	Publish a NTM, broadcast local NTMs, and notify local media	Maintain proper lookouts on construction vessels
Construction	Interference with commercial/recreational traffic during cable installation	Increased risk of collision occurring between project vessels and other vessels Delays that impact port operations	Request temporary exclusion area around installation vessels Publish a NTM, broadcast local NTMs, and notify local media	Enhance lookouts and communications while laying cable, especially across shipping lanes
Construction	Increased marine radio traffic	Communication delays that may affect search and rescue response, mission coordination, recreational boaters, commercial traffic, pilot operations, etc.	Develop a communications plan to include working channels and crisis communications; include USCG and relevant State authorities	Test the communications plan on a frequent basis
Construction	Impact on marine events	Potential for complaints from members of the public	Limit construction activities during major annual special events Develop complaint resolution program Conduct a public relations campaign	Monitor news media to be aware of potential issues Quickly address complaints

Change Analysis of Icebreaker Wind				
Project Phase	**Differences from Normal Activities**	**Potential Effects**	**Recommended Risk Control Strategies**	
			Prevention Requirements	**Surveillance Actions**
Operation	New obstruction could block or hinder view of vessels operating in Project Area	Increased likelihood of vessel collisions and allisions Environmental spill (oil release) due to a marine accident Personnel injury from a marine accident	Publish a NTM, broadcast local NTMs, notify local media Update NOAA navigational charts Ensure maintenance vessels have access to spill response assets and resources Establish and coordinate with USCG on emergency response plans Implement lighting and marking plan	Coordinate with USCG and State officials for assistance in monitoring Project Site interference
Operation	Impact on USCG missions	Turbines could interfere with USCG search and rescue efforts, law enforcement, or other surveillance missions	Coordinate with USCG and local and State authorities Inform USCG and other relevant authorities of shutdown methods and procedures	Implement emergency shutdown procedures when requested by USCG or other relevant authorities
Operation	Increased traffic in the Project Area due to maintenance vessels	Increased risk of collision between project vessels and commercial and/or recreational vessels Potential delays that impact port operations Environmental spill due to a marine accident Personnel injury from a marine accident	Publish a NTM, broadcast local NTMs, notify local media Ensure maintenance vessels have access to spill response assets and resources Establish and coordinate with USCG and local SAR assets on communication and evacuation plans	Coordinate with USCG and State officials for assistance in monitoring Project Site interference
Operation	Structures could interfere with light and sound signal characteristics in certain sectors	Alteration of light and/or sound signals could confuse mariners	Publish a NTM, broadcast local NTMs, broadcast port community information, and notify local media Lighting and marking provides additional aids to navigation	

APPENDIX B

The final Inadvertant Return Contingency Plan can be found in Appendix G-2.

Icebreaker Windpower Inc.
Icebreaker Wind
Preliminary Inadvertent Return Contingency Plan

This Preliminary Inadvertent Return Contingency Plan (Plan) describes the procedures Icebreaker Windpower Inc. and its contractor will implement to avoid, minimize and remediate potential environmental impacts that could result from an inadvertent return of drilling fluids during horizontal directional drilling (HDD) operations associated with the proposed Icebreaker Wind project.

The Plan includes the following components:

(1) Project Description;

(2) Horizontal Directional Drilling Design;

(3) Drilling Fluids;

(4) Monitoring;

(5) Notification Procedures; and

(6) Containment and Remediation.

This preliminary Plan is a template to provide minimum requirements for a site-specific plan to be developed by the HDD contractor once that contractor has been selected. Copies of the final site-specific plan will be provided to interested state and federal regulatory agencies prior to commencement of HDD operations.

Project Description

Construction of the proposed approximately 21 megawatt offshore wind facility consists of:

- Six wind turbines in Lake Erie, approximately 8-10 miles offshore of Cleveland.
- Buried and shielded submarine cables including a fiber optic communications cable interconnecting the turbines (inter-array cables), in total approximately 2.8 miles
- One approximately 9-mile-long buried and shielded submarine cable, including a fiber optic communications cable (export cable) connecting the demonstration project to the new Project Substation located at the existing Cleveland Public Power (CPP) Lake Road Substation in Cleveland, Ohio
- Installation of equipment including a Project Substation at the CPP Lake Road Substation in Cleveland, Ohio to accept power from the Proposed Project
- Approximately 150 feet of new, pole supported, overhead transmission line to transmit electricity from the new Project Substation to the existing CPP Lake Road Substation

The proposed export cable would be brought ashore entirely under the Cleveland Harbor and the breakwater through a duct installed using HDD. Entry/exit points for the HDD would be located at the CPP Lake Road Substation and approximately 3,700 feet offshore. A drawback machine or similar would be used to drill an approximately 30 cm (11.8 inch) diameter bore. The bore would be lined with High-Density Polyethylene conduit or other commonly used lining material.

Horizontal Directional Drilling Design

For a successful HDD and to minimize the potential for an inadvertent return, a site-specific investigation and detailed design of the drill bore is needed.

Subsurface Conditions

Geotechnical investigations have been completed by Icebreaker Windpower Inc. and its contractor to identify subsurface conditions along the proposed HDD path.

Drill Design and Drilling Procedures

Based on the geotechnical investigations, Icebreaker Windpower Inc.'s HDD contractor will develop detailed HDD design plans and procedures identifying the optimal location, depth and methodology for the drill. It is anticipated that these plans will be finalized by the end of 2017.

Drilling Fluids

HDD operations will use drilling fluids to stabilize the bore hole and to lubricate the drilling process. Drilling fluids would be used that are biocompatible with freshwater. The detailed HDD design plan will include the specifications for the chosen drilling fluids. During HDD operations, an inadvertent return of drilling fluids may occur when the drilling fluids follow a path of least resistance through the overburden to the surface (land or water). Some minimal losses of drilling fluids can be expected within the subsurface materials voids or sediments; typically, these losses do not reach the surface.

Additives

Drilling fluids consist of water, bentonite clay and additives. The specific design mix for the drilling fluid depends on site-specific conditions and the drill design (variables may include a water softener, viscosities, filtration control additives, or torque reduction). Since the fluids largely consist of bentonite clay-water mix, they are generally considered non-toxic. Material Safety Data Sheets for fluid additives will be provided in the final site-specific plan.

Disposal

Drilling fluids will be recycled or disposed of at an approved disposal facility according to regulatory requirements. Recovered materials may be collected in containers for temporary storage prior to removal from the site. Qualified disposal facilities will be identified in the final site-specific plan.

Monitoring

Drilling activities will be monitored throughout the HDD operation to determine if an inadvertent release is occurring. Monitoring fluid volumes (circulation), fluid pressures, penetration rates, and fluid viscosity will help minimize the potential for a release and identify releases or potential releases. Specific monitoring protocols based on the HDD design and procedures will be identified in the final site-specific plan.

Visual monitoring will occur on land and in water at set distance intervals along the drilling path. A log will be kept to include the inspector, time of monitoring event and observations. Visual monitoring frequency will be increased if a significant loss of fluids is suspected.

Notification Procedures

The intent of notification procedure is to notify the appropriate agencies when a release occurs according to regulatory requirements. Specific agency personnel, contact information and timeframes will be provided in the final site-specific plan. Agencies to be notified include but are not limited to:

- U.S. Army Corps of Engineers Buffalo District
- U.S. Department of Energy
- Ohio Power Siting Board

- Ohio Environmental Protection Agency
- Ohio Department of Natural Resources

Containment and Remediation

In the event of an inadvertent return, measures will be implemented to control, contain and clean up the release of drilling fluid and the affected area. Site-specific measures will be refined by Icebreaker Windpower Inc.'s HDD contractor as the HDD design is completed and included in the final site-specific plan.

Containment can be achieved by sealing the leak point using loss control materials (LCMs). The use of LCMs is an industry standard for HDD projects to control flow of fluids that may inadvertently escape from the drill bore. LCMs are generally environmentally benign materials that slow or stop the release of fluid from the unintended opening of the HDD bore. The HDD contractor can provide safety data sheets (SDS) for LCMs prior to the start of drilling.

In the event of an unintended compromise of the HDD bore, the contractor would install a gravity cell to contain fluids that may be released into the environment. The gravity cell is a box-like structure that is placed over the location of the release to prevent migration of drilling fluids away from the location. The gravity cell will be constructed of steel and once lowered into place provides a seal at the interface with the sea floor or lake bottom. Once the unintended return has been stabilized, the contractor will send a diver down to the gravity cell with a hose to vacuum out the contained drilling fluids. The captured fluid will be pumped to a holding tank on the work vessel for proper handling and disposal. During the HDD operation, the contractor shall have a barge with a dive team stationed offshore.

Turbidity curtains would not be proposed as they are generally ineffective for confining an inadvertent return of drilling fluids. This is because the drilling fluids are heavier than water and turbidity curtains cannot effectively seal the interface with the sea floor or lake bottom. Released fluids will tend to sink directly to the bottom. The gravity cells described in the preceding paragraph are the industry standard and far more effective at containing fluids that may be released to the environment during an inadvertent return episode.

The following measures provide a minimum guideline to be used by the HDD Contractor in preparing the final site-specific plan.

- Reduce or suspend drilling activities to determine the extent of the release and implement corrective actions;
- Attempt to seal off the release to the surface from the borehole using approved LCMs;
- Pull back the drill string allowing the fluids in the fracture to solidify;
- Determine the cause of the release and implement measures to minimize reoccurrence, such as adjusting fluid viscosity;
- Containment equipment and personnel will be on site during HDD operations;
- Depending on the amount of fluid released on land the area may be swept, shoveled, or mixed with sand and temporarily left in place to dry prior to proper disposal of the material. Appropriate erosion and sediment control measures will be used as needed to prevent drilling fluid from entering the lake or other resources; and,
- The HDD contractor will ensure that appropriate personnel will be available to assist in the containment and cleanup effort that may be necessary within the lake.

The contractor will also use environmentally responsible work practices and methods including the best management practices associated with spill prevention and containment and storm water pollution and prevention.

APPENDIX C

LimnoTech
Water Environment | Scientists Engineers

501 Avis Drive
Ann Arbor, MI 48108
734.332.1200
www.limno.com

Memorandum

From: Ed Verhamme, LimnoTech

Date: April 13, 2017

Project: LEEDCo – Project Icebreaker

To: Lorry Wagner, LEEDCo

CC:

SUBJECT: Recreational Boat Slip Assessment for Cleveland Area Marinas

Introduction

This memorandum was prepared at the request of LEEDCo to assess the extent of recreational boating in the Cleveland area and gather baseline data regarding area marinas and general boat characteristics. Information gathered included identifying the major marinas, counting the number of available boat slips, identifying the type of boat present in the slip, and estimating boat lengths. The study was conducted using high resolution aerial imagery in late summer of 2016. Data from this study will help to inform US Coast Guard Navigational Risk Assessments and other key permit documents.

Overview

A recreational boat study was conducted in 2016 to count and classify power and sail boats in the recreational harbors, marinas, and yacht clubs in Lorain, Cuyahoga, and Lake Counties. Aerial imagery, with an on ground pixel resolution of approximately six inches, was obtained for 16 key harbor areas in the three county area surrounding Cleveland, Ohio on the morning of Wednesday, August 3, 2016. The imagery was captured by Aerial Associates under contract to LimnoTech using a Leica DMC III and post-processed to create a tiled image mosaic. For each of the 16 distinct harbor areas, LimnoTech staff delineated every visible boat slip and marked it as either empty or containing a power or sail boat. For slips containing a boat, a polyline was drawn from its stern to bow to allow for length measurements of each boat. Figure 1 shows an example of how boats were delineated in the marina.

Results

A total of 6,057 boat slips were inventoried across the 16 marina areas. A summary of each of the 16 marina areas is shown in Table 1. A summary of boat lengths for all of marina areas is shown in Table 2. For sail boats, an estimate of the mast height above the water was generated by looking up sail boat specifications common of sailboats in each sailboat range on http://sailboatdata.com. Catalina brand sailboats were used for lengths up to 36 ft and Oceanis brand sailboats were used for sailboats longer than 36 ft. Mast height estimates are meant to be used as a rough guide of sailboat mast heights above the water. Additions to the top of the mast (from whip antennas and wind vanes) can increase the total height of the mast above the water by one or two feet.

Table 1. Summary of boat slips and type by marina area.

Cty.	Marina	Empty	Powerboat	Sailboat	Total
Cuyahoga	Bicentennial Park	46	1	0	47
	East 55th ST	42	260	60	362
	Edgewater	133	235	254	622
	Euclid Creek	46	50	5	101
	Forest City YC	18	75	36	129
	Intercity YC	61	39	0	100
	Lakeside YC	67	127	42	236
	Northeast YC	50	85	17	152
	Olde River YC	82	170	3	255
	Rocky River	84	378	96	558
	Shoreby	50	59	6	115
	Whiskey Island	76	157	27	260
	Sub-Total	**755**	**1636**	**546**	**2937**
Lake	Fairport	270	449	92	811
	Mentor	277	448	52	777
	Sub-Total	**547**	**897**	**144**	**1588**
Lorain	Beaver Park	227	399	7	633
	Lorain	464	320	115	899
	Sub-Total	**691**	**719**	**122**	**1532**
	Total	**1993**	**3252**	**812**	**6057**

Table 2. Summary of boat lengths and estimated mast heights above water.

Percentile of boats counted	Power Boat Length (ft)	Sailboats		
		Length (ft)	# of boats > or =	Mast Height (ft)
25%	23	26	586	41
50%	27	29	396	45
75%	31	33	191	48
90%	36	36	74	50
95%	39	38	47	54
97%	42	40	20	58
99%	48	45	8	65

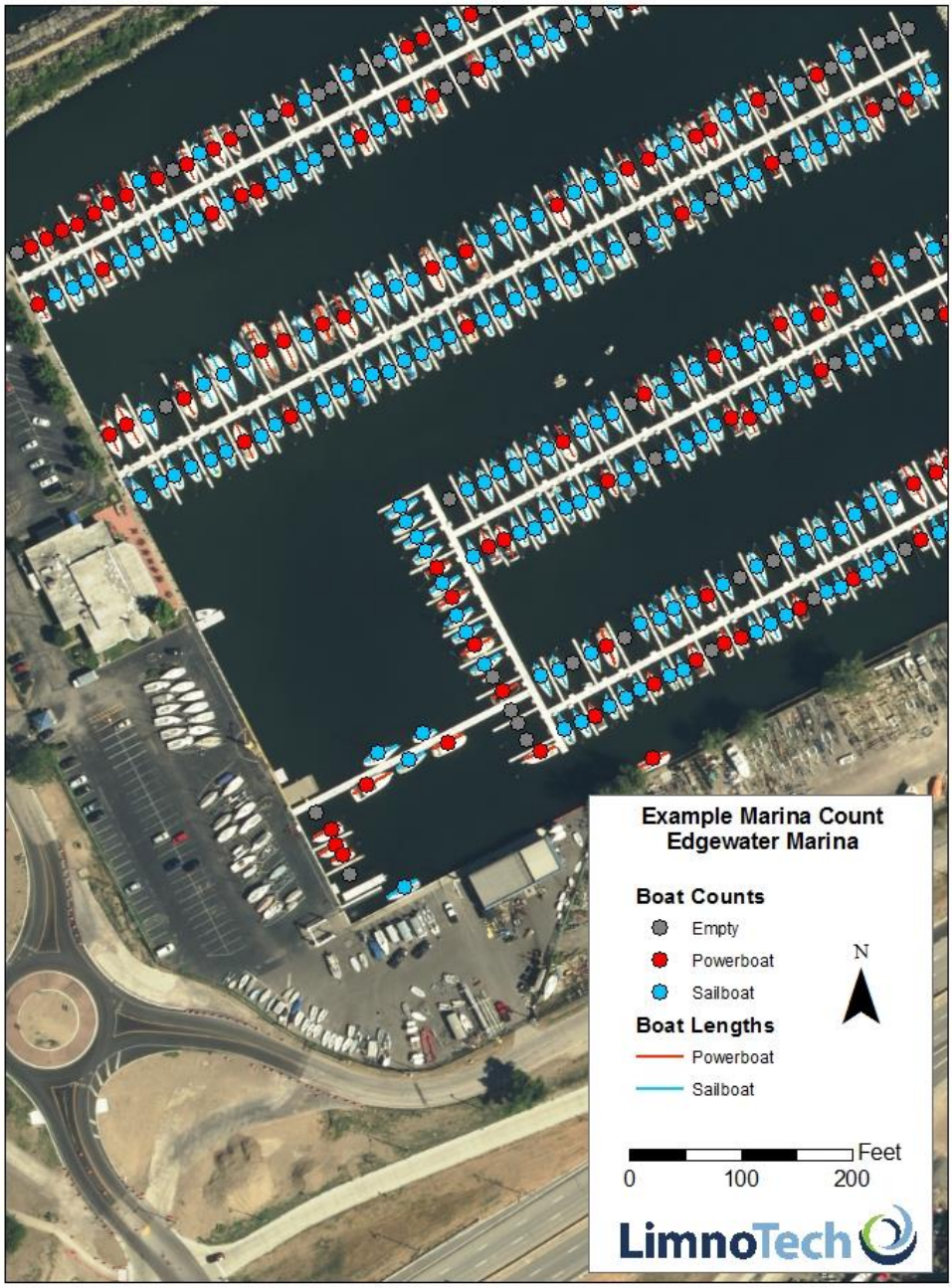

Figure 1. Example marina count from Edgewater Marina.

APPENDIX D

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
10101 Hillwood Parkway
Fort Worth, TX 76177

Aeronautical Study No.
2016-WTE-5048-OE
Prior Study No.
2014-WTE-684-OE

Issued Date: 02/22/2017

Lorry Wagner
LEEDCo
1938 Euclid Avenue
Ste 200
Cleveland, OH 44115

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Wind Turbine Turbine 1
Location:	Cleveland, OH
Latitude:	41-36-02.80N NAD 83
Longitude:	81-48-02.20W
Heights:	569 feet site elevation (SE)
	479 feet above ground level (AGL)
	1048 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure would have no substantial adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or on the operation of air navigation facilities. Therefore, pursuant to the authority delegated to me, it is hereby determined that the structure would not be a hazard to air navigation provided the following condition(s) is(are) met:

As a condition to this Determination, the structure is to be marked/lighted in accordance with FAA Advisory circular 70/7460-1 L Change 1, Obstruction Marking and Lighting, white paint/synchronized red lights - Chapters 4,12&13(Turbines).

Any failure or malfunction that lasts more than thirty (30) minutes and affects a top light or flashing obstruction light, regardless of its position, should be reported immediately to (877) 487-6867 so a Notice to Airmen (NOTAM) can be issued. As soon as the normal operation is restored, notify the same number.

It is required that FAA Form 7460-2, Notice of Actual Construction or Alteration, be e-filed any time the project is abandoned or:

__X__ At least 56 days prior to start of construction (7460-2, Part 1)
__X__ Within 5 days after the construction reaches its greatest height (7460-2, Part 2)

See attachment for additional condition(s) or information.

This determination expires on 08/22/2018 unless:

(a) the construction is started (not necessarily completed) and FAA Form 7460-2, Notice of Actual Construction or Alteration, is received by this office.
(b) extended, revised, or terminated by the issuing office.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

This determination is subject to review if an interested party files a petition that is received by the FAA on or before March 24, 2017. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and be submitted to the Manager, Airspace Policy & Regulation, Federal Aviation Administration, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This determination becomes final on April 03, 2017 unless a petition is timely filed. In which case, this determination will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review. For any questions regarding your petition, please contact Airspace Regulations & ATC Procedures Group via telephone -- 202-267-8783 - or facsimile 202-267-9328.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.

Obstruction marking and lighting recommendations for wind turbine farms are based on the scheme for the entire project. ANY change to the height, location or number of turbines within this project will require a reanalysis of the marking and lighting recommendation for the entire project. In particular, the removal of previously planned or built turbines/turbine locations from the project will often result in a change in the marking/lighting recommendation for other turbines within the project. It is the proponent's responsibility to contact the FAA to discuss the process for developing a revised obstruction marking and lighting plan should this occur.

In order to ensure proper conspicuity of turbines at night during construction, all turbines should be lit with temporary lighting once they reach a height of 200 feet or greater until such time the permanent lighting configuration is turned on. As the height of the structure continues to increase, the temporary lighting should be relocated to the uppermost part of the structure. The temporary lighting may be turned off for periods when they would interfere with construction personnel. If practical, permanent obstruction lights should be installed and operated at each level as construction progresses. An FAA Type L-810 steady red light fixture shall be used to light the structure during the construction phase. If power is not available, turbines shall be lit with self-contained, solar powered LED steady red light fixture that meets the photometric requirements of an FAA Type L-810 lighting system. The lights should be positioned to ensure that a pilot has an unobstructed view of at least one light at each level. The use of a NOTAM (D) to not light turbines within a project until the entire project has been completed is prohibited.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

This aeronautical study considered and analyzed the impact on existing and proposed arrival, departure, and en route procedures for aircraft operating under both visual flight rules and instrument flight rules; the impact on all existing and planned public-use airports, military airports and aeronautical facilities; and the cumulative impact resulting from the studied structure when combined with the impact of other existing or proposed structures. The study disclosed that the described structure would have no substantial adverse effect on air navigation.

An account of the study findings, aeronautical objections received by the FAA during the study (if any), and the basis for the FAA's decision in this matter can be found on the following page(s).

If we can be of further assistance, please contact Paul Holmquist, at (425) 227-2625. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2016-WTE-5048-OE.

Signature Control No: 299560645-322889480 (DNH -WT)
Mike Helvey
Manager, Obstruction Evaluation Group

Attachment(s)
Additional Information
Map(s)

Narrative for ASNs
2016-WTE-5048-OE
2016-WTE-5049-OE
2016-WTE-5050-OE
2016-WTE-5051-OE
2016-WTE-5052-OE
2016-WTE-5053-OE
2016-WTE-5054-OE

Abbreviations

AGL - above ground level	AMSL - above mean sea level	RWY - runway
VFR - visual flight rules	IFR - instrument flight rules	NM - nautical mile
ASN- Aeronautical Study Number	MVA - minimum vectoring altitude	

Part 77 - Title 14 Code of Federal Regulations (CFR) Part 77, Safe, Efficient Use and Preservation of the Navigable Airspace

The proposed project consisting of seven, 479 AGL (1048 AMSL) wind turbines would be located between 7.3 and 9.7 NM northwest of Burke Lakefront Airport, Cleveland, OH. For the sake of efficiency this narrative contains all turbines within this project that have similar impacts. Separate determinations will be issued for each turbine which will be available on the FAA's website at htttp://oeaaa.faa.gov.

The turbine(s) exceed(s) Part 77 standards as described below.

Section 77.17(a)(3): A height that increases a minimum instrument flight altitude within a terminal area (TERPS criteria).

The turbines studied under the ASNs listed below would increase the Sector A Minimum Vectoring Altitude (MVA) from 1800 feet AMSL to 2000 feet AMSL for the Cleveland Ohio Terminal Radar Approach Control (CLE ATCT/TRACON)

2016-WTE-5048-OE
2016-WTE-5049-OE
2016-WTE-5050-OE
2016-WTE-5051-OE
2016-WTE-5052-OE
2016-WTE-5053-OE
2016-WTE-5054-OE

There would be no impact to this standard if the turbines do not exceed 849 feet AMSL (280 AGL).

The study was not circularized for public comment as the impact to Cleveland TRACON's MVA identified above only requires FAA comment. Cleveland Air Traffic Control has responded to this study with no objection to the increase in MVA height.

Aeronautical study disclosed that the proposed structure would have no effect on any existing or proposed arrival, departure, or en route instrument flight rule (IFR) operations or procedures other than the MVA impact identified above.

Study for possible visual flight rules (VFR) effect disclosed that the proposed structure would have no effect on any existing or proposed arrival or departure VFR operations or procedures. It would not conflict with airspace required to conduct normal VFR traffic pattern operations at any known public use or military airport. At 479 feet above ground level the proposed structure would not have a substantial adverse effect on VFR en route flight operations.

The proposed structure would be appropriately obstruction marked and/or lighted to make it more conspicuous to airmen should circumnavigation be necessary.

Therefore, it is determined that the proposed construction would not have a substantial adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or on any air navigation facility and would not be a hazard to air navigation provided the conditions set forth within this determination are met.

Sectional Map for ASN 2016-WTE-5048-OE

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
10101 Hillwood Parkway
Fort Worth, TX 76177

Aeronautical Study No.
2016-WTE-5049-OE
Prior Study No.
2014-WTE-685-OE

Issued Date: 02/22/2017

Lorry Wagner
LEEDCo
1938 Euclid Avenue
Ste 200
Cleveland, OH 44115

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Wind Turbine Turbine 2
Location:	Cleveland, OH
Latitude:	41-36-22.40N NAD 83
Longitude:	81-48-21.60W
Heights:	569 feet site elevation (SE)
	479 feet above ground level (AGL)
	1048 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure would have no substantial adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or on the operation of air navigation facilities. Therefore, pursuant to the authority delegated to me, it is hereby determined that the structure would not be a hazard to air navigation provided the following condition(s) is(are) met:

As a condition to this Determination, the structure is to be marked/lighted in accordance with FAA Advisory circular 70/7460-1 L Change 1, Obstruction Marking and Lighting, white paint/synchronized red lights - Chapters 4,12&13(Turbines).

Any failure or malfunction that lasts more than thirty (30) minutes and affects a top light or flashing obstruction light, regardless of its position, should be reported immediately to (877) 487-6867 so a Notice to Airmen (NOTAM) can be issued. As soon as the normal operation is restored, notify the same number.

It is required that FAA Form 7460-2, Notice of Actual Construction or Alteration, be e-filed any time the project is abandoned or:

__X__ At least 56 days prior to start of construction (7460-2, Part 1)
__X__ Within 5 days after the construction reaches its greatest height (7460-2, Part 2)

See attachment for additional condition(s) or information.

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Mike Helvey
Manager, Obstruction Evaluation Group

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Map(s)

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2016-WTE-5050-OE
2016-WTE-5051-OE
2016-WTE-5052-OE
2016-WTE-5053-OE
2016-WTE-5054-OE

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This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.

Obstruction marking and lighting recommendations for wind turbine farms are based on the scheme for the entire project. ANY change to the height, location or number of turbines within this project will require a reanalysis of the marking and lighting recommendation for the entire project. In particular, the removal of previously planned or built turbines/turbine locations from the project will often result in a change in the marking/lighting recommendation for other turbines within the project. It is the proponent's responsibility to contact the FAA to discuss the process for developing a revised obstruction marking and lighting plan should this occur.

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This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

This aeronautical study considered and analyzed the impact on existing and proposed arrival, departure, and en route procedures for aircraft operating under both visual flight rules and instrument flight rules; the impact on all existing and planned public-use airports, military airports and aeronautical facilities; and the cumulative impact resulting from the studied structure when combined with the impact of other existing or proposed structures. The study disclosed that the described structure would have no substantial adverse effect on air navigation.

An account of the study findings, aeronautical objections received by the FAA during the study (if any), and the basis for the FAA's decision in this matter can be found on the following page(s).

If we can be of further assistance, please contact Paul Holmquist, at (425) 227-2625. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2016-WTE-5050-OE.

Signature Control No: 299560648-322889486 (DNH -WT)
Mike Helvey
Manager, Obstruction Evaluation Group

Attachment(s)
Additional Information
Map(s)

Narrative for ASNs
2016-WTE-5048-OE
2016-WTE-5049-OE
2016-WTE-5050-OE
2016-WTE-5051-OE
2016-WTE-5052-OE
2016-WTE-5053-OE
2016-WTE-5054-OE

Abbreviations

AGL - above ground level	AMSL - above mean sea level	RWY - runway
VFR - visual flight rules	IFR - instrument flight rules	NM - nautical mile
ASN- Aeronautical Study Number	MVA - minimum vectoring altitude	

Part 77 - Title 14 Code of Federal Regulations (CFR) Part 77, Safe, Efficient Use and Preservation of the Navigable Airspace

The proposed project consisting of seven, 479 AGL (1048 AMSL) wind turbines would be located between 7.3 and 9.7 NM northwest of Burke Lakefront Airport, Cleveland, OH. For the sake of efficiency this narrative contains all turbines within this project that have similar impacts. Separate determinations will be issued for each turbine which will be available on the FAA's website at htttp://oeaaa.faa.gov.

The turbine(s) exceed(s) Part 77 standards as described below.

Section 77.17(a)(3): A height that increases a minimum instrument flight altitude within a terminal area (TERPS criteria).

The turbines studied under the ASNs listed below would increase the Sector A Minimum Vectoring Altitude (MVA) from 1800 feet AMSL to 2000 feet AMSL for the Cleveland Ohio Terminal Radar Approach Control (CLE ATCT/TRACON)

2016-WTE-5048-OE
2016-WTE-5049-OE
2016-WTE-5050-OE
2016-WTE-5051-OE
2016-WTE-5052-OE
2016-WTE-5053-OE
2016-WTE-5054-OE

There would be no impact to this standard if the turbines do not exceed 849 feet AMSL (280 AGL).

The study was not circularized for public comment as the impact to Cleveland TRACON's MVA identified above only requires FAA comment. Cleveland Air Traffic Control has responded to this study with no objection to the increase in MVA height.

Aeronautical study disclosed that the proposed structure would have no effect on any existing or proposed arrival, departure, or en route instrument flight rule (IFR) operations or procedures other than the MVA impact identified above.

Study for possible visual flight rules (VFR) effect disclosed that the proposed structure would have no effect on any existing or proposed arrival or departure VFR operations or procedures. It would not conflict with airspace required to conduct normal VFR traffic pattern operations at any known public use or military airport. At 479 feet above ground level the proposed structure would not have a substantial adverse effect on VFR en route flight operations.

The proposed structure would be appropriately obstruction marked and/or lighted to make it more conspicuous to airmen should circumnavigation be necessary.

Therefore, it is determined that the proposed construction would not have a substantial adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or on any air navigation facility and would not be a hazard to air navigation provided the conditions set forth within this determination are met.

Sectional Map for ASN 2016-WTE-5050-OE

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
10101 Hillwood Parkway
Fort Worth, TX 76177

Aeronautical Study No.
2016-WTE-5051-OE
Prior Study No.
2014-WTE-687-OE

Issued Date: 02/22/2017

Lorry Wagner
LEEDCo
1938 Euclid Avenue
Ste 200
Cleveland, OH 44115

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Wind Turbine Turbine 4
Location:	Cleveland, OH
Latitude:	41-37-01.00N NAD 83
Longitude:	81-49-01.10W
Heights:	569 feet site elevation (SE)
	479 feet above ground level (AGL)
	1048 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure would have no substantial adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or on the operation of air navigation facilities. Therefore, pursuant to the authority delegated to me, it is hereby determined that the structure would not be a hazard to air navigation provided the following condition(s) is(are) met:

As a condition to this Determination, the structure is to be marked/lighted in accordance with FAA Advisory circular 70/7460-1 L Change 1, Obstruction Marking and Lighting, white paint/synchronized red lights - Chapters 4,12&13(Turbines).

Any failure or malfunction that lasts more than thirty (30) minutes and affects a top light or flashing obstruction light, regardless of its position, should be reported immediately to (877) 487-6867 so a Notice to Airmen (NOTAM) can be issued. As soon as the normal operation is restored, notify the same number.

It is required that FAA Form 7460-2, Notice of Actual Construction or Alteration, be e-filed any time the project is abandoned or:

__X__ At least 56 days prior to start of construction (7460-2, Part 1)
__X__ Within 5 days after the construction reaches its greatest height (7460-2, Part 2)

See attachment for additional condition(s) or information.

This determination expires on 08/22/2018 unless:

(a) the construction is started (not necessarily completed) and FAA Form 7460-2, Notice of Actual Construction or Alteration, is received by this office.
(b) extended, revised, or terminated by the issuing office.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

This determination is subject to review if an interested party files a petition that is received by the FAA on or before March 24, 2017. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and be submitted to the Manager, Airspace Policy & Regulation, Federal Aviation Administration, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This determination becomes final on April 03, 2017 unless a petition is timely filed. In which case, this determination will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review. For any questions regarding your petition, please contact Airspace Regulations & ATC Procedures Group via telephone -- 202-267-8783 - or facsimile 202-267-9328.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.

Obstruction marking and lighting recommendations for wind turbine farms are based on the scheme for the entire project. ANY change to the height, location or number of turbines within this project will require a reanalysis of the marking and lighting recommendation for the entire project. In particular, the removal of previously planned or built turbines/turbine locations from the project will often result in a change in the marking/lighting recommendation for other turbines within the project. It is the proponent's responsibility to contact the FAA to discuss the process for developing a revised obstruction marking and lighting plan should this occur.

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This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

This aeronautical study considered and analyzed the impact on existing and proposed arrival, departure, and en route procedures for aircraft operating under both visual flight rules and instrument flight rules; the impact on all existing and planned public-use airports, military airports and aeronautical facilities; and the cumulative impact resulting from the studied structure when combined with the impact of other existing or proposed structures. The study disclosed that the described structure would have no substantial adverse effect on air navigation.

An account of the study findings, aeronautical objections received by the FAA during the study (if any), and the basis for the FAA's decision in this matter can be found on the following page(s).

If we can be of further assistance, please contact Paul Holmquist, at (425) 227-2625. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2016-WTE-5051-OE.

Signature Control No: 299560650-322889484 (DNH -WT)
Mike Helvey
Manager, Obstruction Evaluation Group

Attachment(s)
Additional Information
Map(s)

Narrative for ASNs
2016-WTE-5048-OE
2016-WTE-5049-OE
2016-WTE-5050-OE
2016-WTE-5051-OE
2016-WTE-5052-OE
2016-WTE-5053-OE
2016-WTE-5054-OE

Abbreviations

AGL - above ground level	AMSL - above mean sea level	RWY - runway
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ASN- Aeronautical Study Number	MVA - minimum vectoring altitude	

Part 77 - Title 14 Code of Federal Regulations (CFR) Part 77, Safe, Efficient Use and Preservation of the Navigable Airspace

The proposed project consisting of seven, 479 AGL (1048 AMSL) wind turbines would be located between 7.3 and 9.7 NM northwest of Burke Lakefront Airport, Cleveland, OH. For the sake of efficiency this narrative contains all turbines within this project that have similar impacts. Separate determinations will be issued for each turbine which will be available on the FAA's website at htttp://oeaaa.faa.gov.

The turbine(s) exceed(s) Part 77 standards as described below.

Section 77.17(a)(3): A height that increases a minimum instrument flight altitude within a terminal area (TERPS criteria).

The turbines studied under the ASNs listed below would increase the Sector A Minimum Vectoring Altitude (MVA) from 1800 feet AMSL to 2000 feet AMSL for the Cleveland Ohio Terminal Radar Approach Control (CLE ATCT/TRACON)

2016-WTE-5048-OE
2016-WTE-5049-OE
2016-WTE-5050-OE
2016-WTE-5051-OE
2016-WTE-5052-OE
2016-WTE-5053-OE
2016-WTE-5054-OE

There would be no impact to this standard if the turbines do not exceed 849 feet AMSL (280 AGL).

The study was not circularized for public comment as the impact to Cleveland TRACON's MVA identified above only requires FAA comment. Cleveland Air Traffic Control has responded to this study with no objection to the increase in MVA height.

Aeronautical study disclosed that the proposed structure would have no effect on any existing or proposed arrival, departure, or en route instrument flight rule (IFR) operations or procedures other than the MVA impact identified above.

Study for possible visual flight rules (VFR) effect disclosed that the proposed structure would have no effect on any existing or proposed arrival or departure VFR operations or procedures. It would not conflict with airspace required to conduct normal VFR traffic pattern operations at any known public use or military airport. At 479 feet above ground level the proposed structure would not have a substantial adverse effect on VFR en route flight operations.

The proposed structure would be appropriately obstruction marked and/or lighted to make it more conspicuous to airmen should circumnavigation be necessary.

Therefore, it is determined that the proposed construction would not have a substantial adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or on any air navigation facility and would not be a hazard to air navigation provided the conditions set forth within this determination are met.

Sectional Map for ASN 2016-WTE-5051-OE

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
10101 Hillwood Parkway
Fort Worth, TX 76177

Aeronautical Study No.
2016-WTE-5052-OE
Prior Study No.
2014-WTE-688-OE

Issued Date: 02/22/2017

Lorry Wagner
LEEDCo
1938 Euclid Avenue
Ste 200
Cleveland, OH 44115

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Wind Turbine Turbine 5
Location:	Cleveland, OH
Latitude:	41-37-21.00N NAD 83
Longitude:	81-49-21.00W
Heights:	569 feet site elevation (SE)
	479 feet above ground level (AGL)
	1048 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure would have no substantial adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or on the operation of air navigation facilities. Therefore, pursuant to the authority delegated to me, it is hereby determined that the structure would not be a hazard to air navigation provided the following condition(s) is(are) met:

As a condition to this Determination, the structure is to be marked/lighted in accordance with FAA Advisory circular 70/7460-1 L Change 1, Obstruction Marking and Lighting, white paint/synchronized red lights - Chapters 4,12&13(Turbines).

Any failure or malfunction that lasts more than thirty (30) minutes and affects a top light or flashing obstruction light, regardless of its position, should be reported immediately to (877) 487-6867 so a Notice to Airmen (NOTAM) can be issued. As soon as the normal operation is restored, notify the same number.

It is required that FAA Form 7460-2, Notice of Actual Construction or Alteration, be e-filed any time the project is abandoned or:

__X__ At least 56 days prior to start of construction (7460-2, Part 1)
__X__ Within 5 days after the construction reaches its greatest height (7460-2, Part 2)

See attachment for additional condition(s) or information.

This determination expires on 08/22/2018 unless:

(a) the construction is started (not necessarily completed) and FAA Form 7460-2, Notice of Actual Construction or Alteration, is received by this office.
(b) extended, revised, or terminated by the issuing office.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

This determination is subject to review if an interested party files a petition that is received by the FAA on or before March 24, 2017. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and be submitted to the Manager, Airspace Policy & Regulation, Federal Aviation Administration, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This determination becomes final on April 03, 2017 unless a petition is timely filed. In which case, this determination will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review. For any questions regarding your petition, please contact Airspace Regulations & ATC Procedures Group via telephone -- 202-267-8783 - or facsimile 202-267-9328.

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This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

This aeronautical study considered and analyzed the impact on existing and proposed arrival, departure, and en route procedures for aircraft operating under both visual flight rules and instrument flight rules; the impact on all existing and planned public-use airports, military airports and aeronautical facilities; and the cumulative impact resulting from the studied structure when combined with the impact of other existing or proposed structures. The study disclosed that the described structure would have no substantial adverse effect on air navigation.

An account of the study findings, aeronautical objections received by the FAA during the study (if any), and the basis for the FAA's decision in this matter can be found on the following page(s).

If we can be of further assistance, please contact Paul Holmquist, at (425) 227-2625. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2016-WTE-5052-OE.

Signature Control No: 299560651-322889485 (DNH -WT)
Mike Helvey
Manager, Obstruction Evaluation Group

Attachment(s)
Additional Information
Map(s)

Narrative for ASNs
2016-WTE-5048-OE
2016-WTE-5049-OE
2016-WTE-5050-OE
2016-WTE-5051-OE
2016-WTE-5052-OE
2016-WTE-5053-OE
2016-WTE-5054-OE

Abbreviations

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Part 77 - Title 14 Code of Federal Regulations (CFR) Part 77, Safe, Efficient Use and Preservation of the Navigable Airspace

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The turbine(s) exceed(s) Part 77 standards as described below.

Section 77.17(a)(3): A height that increases a minimum instrument flight altitude within a terminal area (TERPS criteria).

The turbines studied under the ASNs listed below would increase the Sector A Minimum Vectoring Altitude (MVA) from 1800 feet AMSL to 2000 feet AMSL for the Cleveland Ohio Terminal Radar Approach Control (CLE ATCT/TRACON)

2016-WTE-5048-OE
2016-WTE-5049-OE
2016-WTE-5050-OE
2016-WTE-5051-OE
2016-WTE-5052-OE
2016-WTE-5053-OE
2016-WTE-5054-OE

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Aeronautical study disclosed that the proposed structure would have no effect on any existing or proposed arrival, departure, or en route instrument flight rule (IFR) operations or procedures other than the MVA impact identified above.

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The proposed structure would be appropriately obstruction marked and/or lighted to make it more conspicuous to airmen should circumnavigation be necessary.

Therefore, it is determined that the proposed construction would not have a substantial adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or on any air navigation facility and would not be a hazard to air navigation provided the conditions set forth within this determination are met.

Sectional Map for ASN 2016-WTE-5052-OE

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Obstruction Evaluation Group
10101 Hillwood Parkway
Fort Worth, TX 76177

Aeronautical Study No.
2016-WTE-5053-OE
Prior Study No.
2014-WTE-689-OE

Issued Date: 02/22/2017

Lorry Wagner
LEEDCo
1938 Euclid Avenue
Ste 200
Cleveland, OH 44115

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Wind Turbine Turbine 6
Location:	Cleveland, OH
Latitude:	41-37-40.60N NAD 83
Longitude:	81-49-40.40W
Heights:	569 feet site elevation (SE)
	479 feet above ground level (AGL)
	1048 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure would have no substantial adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or on the operation of air navigation facilities. Therefore, pursuant to the authority delegated to me, it is hereby determined that the structure would not be a hazard to air navigation provided the following condition(s) is(are) met:

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This aeronautical study considered and analyzed the impact on existing and proposed arrival, departure, and en route procedures for aircraft operating under both visual flight rules and instrument flight rules; the impact on all existing and planned public-use airports, military airports and aeronautical facilities; and the cumulative impact resulting from the studied structure when combined with the impact of other existing or proposed structures. The study disclosed that the described structure would have no substantial adverse effect on air navigation.

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If we can be of further assistance, please contact Paul Holmquist, at (425) 227-2625. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2016-WTE-5053-OE.

Signature Control No: 299560652-322889483 (DNH -WT)
Mike Helvey
Manager, Obstruction Evaluation Group

Attachment(s)
Additional Information
Map(s)

Narrative for ASNs
2016-WTE-5048-OE
2016-WTE-5049-OE
2016-WTE-5050-OE
2016-WTE-5051-OE
2016-WTE-5052-OE
2016-WTE-5053-OE
2016-WTE-5054-OE

Abbreviations

AGL - above ground level	AMSL - above mean sea level	RWY - runway
VFR - visual flight rules	IFR - instrument flight rules	NM - nautical mile
ASN- Aeronautical Study Number	MVA - minimum vectoring altitude	

Part 77 - Title 14 Code of Federal Regulations (CFR) Part 77, Safe, Efficient Use and Preservation of the Navigable Airspace

The proposed project consisting of seven, 479 AGL (1048 AMSL) wind turbines would be located between 7.3 and 9.7 NM northwest of Burke Lakefront Airport, Cleveland, OH. For the sake of efficiency this narrative contains all turbines within this project that have similar impacts. Separate determinations will be issued for each turbine which will be available on the FAA's website at htttp://oeaaa.faa.gov.

The turbine(s) exceed(s) Part 77 standards as described below.

Section 77.17(a)(3): A height that increases a minimum instrument flight altitude within a terminal area (TERPS criteria).

The turbines studied under the ASNs listed below would increase the Sector A Minimum Vectoring Altitude (MVA) from 1800 feet AMSL to 2000 feet AMSL for the Cleveland Ohio Terminal Radar Approach Control (CLE ATCT/TRACON)

2016-WTE-5048-OE
2016-WTE-5049-OE
2016-WTE-5050-OE
2016-WTE-5051-OE
2016-WTE-5052-OE
2016-WTE-5053-OE
2016-WTE-5054-OE

There would be no impact to this standard if the turbines do not exceed 849 feet AMSL (280 AGL).

The study was not circularized for public comment as the impact to Cleveland TRACON's MVA identified above only requires FAA comment. Cleveland Air Traffic Control has responded to this study with no objection to the increase in MVA height.

Aeronautical study disclosed that the proposed structure would have no effect on any existing or proposed arrival, departure, or en route instrument flight rule (IFR) operations or procedures other than the MVA impact identified above.

Study for possible visual flight rules (VFR) effect disclosed that the proposed structure would have no effect on any existing or proposed arrival or departure VFR operations or procedures. It would not conflict with airspace required to conduct normal VFR traffic pattern operations at any known public use or military airport. At 479 feet above ground level the proposed structure would not have a substantial adverse effect on VFR en route flight operations.

The proposed structure would be appropriately obstruction marked and/or lighted to make it more conspicuous to airmen should circumnavigation be necessary.

Therefore, it is determined that the proposed construction would not have a substantial adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or on any air navigation facility and would not be a hazard to air navigation provided the conditions set forth within this determination are met.


Terminal Area Chart for flights at and be
CLEVELAND CLASS B
82°
V5
110
80
40
80
30
See NOTAMs
for Class D/E
243.0
122.2
122.35
255.4
122.1R
CLEVELAND RCO
CLEVELAND
BURKE LAKEFRONT (BKL)
CT - 124.3 ★ C
ATIS 125.25
584 *L 66 122.95
RP 24L, 24R
30
waterworks
intake
1603
(952)
bldgs
1000
(360)
054°
980
NO SVFR
CLEVELAND-HOPKINS INTL (CLE)
CT-120.9 124.5
ATIS 127.85
LEBRN

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
10101 Hillwood Parkway
Fort Worth, TX 76177

Aeronautical Study No.
2016-WTE-5054-OE

Issued Date: 02/22/2017

Lorry Wagner
LEEDCo
1938 Euclid Avenue
Ste 200
Cleveland, OH 44115

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Wind Turbine Turbine 7
Location:	Cleveland, OH
Latitude:	41-37-59.70N NAD 83
Longitude:	81-50-00.00W
Heights:	569 feet site elevation (SE)
	479 feet above ground level (AGL)
	1048 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure would have no substantial adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or on the operation of air navigation facilities. Therefore, pursuant to the authority delegated to me, it is hereby determined that the structure would not be a hazard to air navigation provided the following condition(s) is(are) met:

As a condition to this Determination, the structure is to be marked/lighted in accordance with FAA Advisory circular 70/7460-1 L Change 1, Obstruction Marking and Lighting, white paint/synchronized red lights - Chapters 4,12&13(Turbines).

Any failure or malfunction that lasts more than thirty (30) minutes and affects a top light or flashing obstruction light, regardless of its position, should be reported immediately to (877) 487-6867 so a Notice to Airmen (NOTAM) can be issued. As soon as the normal operation is restored, notify the same number.

It is required that FAA Form 7460-2, Notice of Actual Construction or Alteration, be e-filed any time the project is abandoned or:

__X__ At least 56 days prior to start of construction (7460-2, Part 1)
__X__ Within 5 days after the construction reaches its greatest height (7460-2, Part 2)

See attachment for additional condition(s) or information.

This determination expires on 08/22/2018 unless:

(a) the construction is started (not necessarily completed) and FAA Form 7460-2, Notice of Actual Construction or Alteration, is received by this office.
(b) extended, revised, or terminated by the issuing office.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

This determination is subject to review if an interested party files a petition that is received by the FAA on or before March 24, 2017. In the event a petition for review is filed, it must contain a full statement of the basis upon which it is made and be submitted to the Manager, Airspace Policy & Regulation, Federal Aviation Administration, 800 Independence Ave, SW, Room 423, Washington, DC 20591.

This determination becomes final on April 03, 2017 unless a petition is timely filed. In which case, this determination will not become final pending disposition of the petition. Interested parties will be notified of the grant of any review. For any questions regarding your petition, please contact Airspace Regulations & ATC Procedures Group via telephone -- 202-267-8783 - or facsimile 202-267-9328.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.

Obstruction marking and lighting recommendations for wind turbine farms are based on the scheme for the entire project. ANY change to the height, location or number of turbines within this project will require a reanalysis of the marking and lighting recommendation for the entire project. In particular, the removal of previously planned or built turbines/turbine locations from the project will often result in a change in the marking/lighting recommendation for other turbines within the project. It is the proponent's responsibility to contact the FAA to discuss the process for developing a revised obstruction marking and lighting plan should this occur.

In order to ensure proper conspicuity of turbines at night during construction, all turbines should be lit with temporary lighting once they reach a height of 200 feet or greater until such time the permanent lighting configuration is turned on. As the height of the structure continues to increase, the temporary lighting should be relocated to the uppermost part of the structure. The temporary lighting may be turned off for periods when they would interfere with construction personnel. If practical, permanent obstruction lights should be installed and operated at each level as construction progresses. An FAA Type L-810 steady red light fixture shall be used to light the structure during the construction phase. If power is not available, turbines shall be lit with self-contained, solar powered LED steady red light fixture that meets the photometric requirements of an FAA Type L-810 lighting system. The lights should be positioned to ensure that a pilot has an unobstructed view of at least one light at each level. The use of a NOTAM (D) to not light turbines within a project until the entire project has been completed is prohibited.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

This aeronautical study considered and analyzed the impact on existing and proposed arrival, departure, and en route procedures for aircraft operating under both visual flight rules and instrument flight rules; the impact on all existing and planned public-use airports, military airports and aeronautical facilities; and the cumulative impact resulting from the studied structure when combined with the impact of other existing or proposed structures. The study disclosed that the described structure would have no substantial adverse effect on air navigation.

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Signature Control No: 299560653-322889481 (DNH -WT)
Mike Helvey
Manager, Obstruction Evaluation Group

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The proposed structure would be appropriately obstruction marked and/or lighted to make it more conspicuous to airmen should circumnavigation be necessary.

Therefore, it is determined that the proposed construction would not have a substantial adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or on any air navigation facility and would not be a hazard to air navigation provided the conditions set forth within this determination are met.

Sectional Map for ASN 2016-WTE-5054-OE

APPENDIX E

Case Id	Year	Month	Day	Unit Name	Title	Latitude	Longitude	Event Type
284959	2006	4	19	Marine Safety Unit Cleveland	E.55th St. Sinker	41.51852	-81.70728	Discharge/Release - Pollution
300866	2006	6	22	Marine Safety Unit Cleveland	CANADIAN TRANSFER ALLISION	41.491667	-81.701167	Allision
297392	2006	6	29	Marine Safety Unit Cleveland	M/V CALUMET ELECTROCUTION	41.51852	-81.70728	Personnel Casualty - Injury
368679	2006	9	12	Sector Detroit	ADAM E. CORNELIUS_crew injury	41.496497	-81.723795	Personnel Casualty - Injury
315289	2006	9	13	Marine Safety Unit Cleveland	WOLVERINE ALLISION	41.51852	-81.70728	Allision
329826	2006	12	4	Marine Safety Unit Cleveland	M/V CANADIAN OLYMPIC GROUNDING	41.56096	-81.73659	Grounding
343943	2007	4	4	Marine Safety Unit Cleveland	M/V CUYAHOGA ALLISION	41.51852	-81.70728	Allision
352154	2007	5	26	Marine Safety Unit Cleveland	Channel Park Marina Discharge	41.51852	-81.70728	Discharge/Release - Pollution
352182	2007	5	30	Marine Safety Unit Cleveland	Boat Fire	41.56096	-81.73659	Discharge/Release - Pollution
353485	2007	6	7	Marine Safety Unit Cleveland	CPN 07116 Solvent Release Outfall CSO #080	41.51852	-81.70728	Discharge/Release - Pollution
353872	2007	6	9	Marine Safety Unit Cleveland	M Pollution - Oil (06/09/2007 3:00:00 AM)	41.51852	-81.70728	Allision
360257	2007	7	5	Marine Safety Unit Cleveland	M/V MAUMEE ALLISION	41.51852	-81.70728	Allision
372999	2007	8	28	Marine Safety Unit Cleveland	M/V AMERICAN REPUBLIC: Crew Member INJURY	41.51852	-81.70728	Personnel Casualty - Injury
382708	2007	11	15	Marine Safety Unit Cleveland	M/V CALUMET ALLISION	41.490667	-81.706833	Allision
383927	2007	11	26	Marine Safety Unit Cleveland	M/V MANISTEE ALLISION	41.51852	-81.70728	Allision
392192	2008	1	10	Marine Safety Unit Cleveland	AMERICAN COURAGE EQUIPMENT FAILURE	41.51852	-81.70728	Loss/Reduction of Vessel Propulsion/Steering
399805	2008	4	18	Marine Safety Unit Cleveland	M/V ALGORAIL Allision w/Flats Industrial RR Bridge	41.51852	-81.70728	Allision
400091	2008	4	21	Marine Safety Unit Cleveland	Blue Mystery Drum	41.49245	-81.70495	Discharge/Release - Pollution
400112	2008	4	21	Marine Safety Unit Cleveland	MITAL STEEL discharge	41.51852	-81.70728	Discharge/Release - Pollution

Case Id	Year	Month	Day	Unit Name	Title	Latitude	Longitude	Event Type
401974	2008	5	6	Marine Safety Unit Cleveland	AMERICAN REPUBLIC EQUIPMENT FAILURE	41.501667	-81.711667	Loss of Electrical Power
405832	2008	6	1	Marine Safety Unit Cleveland	M/V CUYAHOGA allision with P/C BEVERLY II	41.51852	-81.70728	Allision
414009	2008	7	12	Marine Safety Unit Cleveland	Transformer Vandalism at Scranton Ave.	41.51852	-81.70728	Discharge/Release - Pollution
414545	2008	7	16	Marine Safety Unit Cleveland	Cuyahoga River Mystery Drum C08112	41.51852	-81.70728	Discharge/Release - Pollution
424371	2008	9	7	Marine Safety Unit Cleveland	Sunken boat at Olde River Yacht Club (08-056)	41.49264	-81.72185	Sinking
428569	2008	9	27	Marine Safety Unit Cleveland	MS Equipment Failure (09/27/2008 8:00:00 PM)	41.506667	-81.6925	Material Failure/Malfunction
431305	2008	10	29	Marine Safety Unit Cleveland	MS Allision (10/29/2008 11:26:00 PM)	41.51852	-81.70728	Allision
439712	2009	1	24	Marine Safety Unit Cleveland	Mercedes crashes on I-90/Oil spill	41.51852	-81.70728	Discharge/Release - Pollution
445971	2009	3	26	Marine Safety Unit Cleveland	MEP Pollution - Hazardous Material	41.51852	-81.70728	Discharge/Release - Pollution
454094	2009	5	25	Marine Safety Unit Cleveland	Maumee / Allision	41.51852	-81.70728	Allision
455369	2009	6	4	Marine Safety Unit Cleveland	Sinking at Old River Yacht Club	41.49264	-81.72185	Sinking
459556	2009	6	20	Marine Safety Unit Cleveland	M/V Holiday / Injury	41.51852	-81.70728	Personnel Casualty - Injury
458538	2009	6	23	Marine Safety Unit Cleveland	DAMAGED GOODS Potential Gasoline Discharge	41.56096	-81.73659	Sinking
462963	2009	7	6	Marine Safety Unit Cleveland	MEP Pollution - Oil (07/06/2009 3:30:00 PM)	41.506667	-81.691167	Discharge/Release - Pollution
461975	2009	7	10	Marine Safety Unit Cleveland	MEP Special Operation (07/11/2009 12:18:00 AM)	41.56096	-81.73659	Personnel Casualty - Injury
463374	2009	7	17	Marine Safety Unit Cleveland	Truck in water; sheen at Wildwood Marina	41.56096	-81.73659	Discharge/Release - Pollution
464157	2009	7	20	Marine Safety Unit Cleveland	Nautica Queen/Mechanical Failure/Allision/Injury	41.501667	-81.711667	Personnel Casualty - Injury
478919	2009	9	13	Marine Safety Unit Cleveland	Express / Flooding	41.56096	-81.73659	Flooding - Initial
480627	2009	11	2	Marine Safety Unit Cleveland	MEP Pollution- Burke Airport 02Nov09	41.51852	-81.70728	Discharge/Release - Pollution

Case Id	Year	Month	Day	Unit Name	Title	Latitude	Longitude	Event Type
484026	2009	12	7	Marine Safety Unit Cleveland	CALUMET / Loss of Propulsion	41.4925	-81.705	Material Failure/Malfunction
486622	2010	1	5	Marine Safety Unit Cleveland	Crank Case Explosion	41.51852	-81.70728	Loss/Reduction of Vessel Propulsion/Steering
487273	2010	1	11	Marine Safety Unit Cleveland	DISCHARGE OF SEWAGE M/V MAUMEE	41.51852	-81.70728	Discharge/Release - Pollution
490904	2010	2	18	Marine Safety Unit Cleveland	MAUMEE OIL DISCHARGE	41.51852	-81.70728	Discharge/Release - Pollution
498274	2010	3	3	Marine Safety Unit Cleveland	SHOOTERS ALLISION	41.51852	-81.70728	Allision
497868	2010	4	9	Marine Safety Unit Cleveland	Oil Discharge from the M/V Maumee	41.51852	-81.70728	Discharge/Release - Pollution
498370	2010	4	23	Marine Safety Unit Cleveland	Nautica Queen/Allision/Machinery Failure	41.51852	-81.70728	Material Failure/Malfunction
499189	2010	5	4	Marine Safety Unit Cleveland	ALGORAIL / Allision & Pollution	41.51852	-81.70728	Allision
499862	2010	5	5	Marine Safety Unit Cleveland	Sam Laud / machinery failure	41.51852	-81.70728	Loss/Reduction of Vessel Propulsion/Steering
501333	2010	5	21	Marine Safety Unit Cleveland	R/V Scooter/Gasoline Discharge/21MAY10	41.51852	-81.70728	Discharge/Release - Pollution
503468	2010	6	3	Marine Safety Unit Cleveland	EQUIPMENT FAILURE/ M/V ST CLAIR	41.535935	-81.725702	Material Failure/Malfunction
505534	2010	6	12	Marine Safety Unit Cleveland	Holiday / Machinery Failure	41.51852	-81.70728	Loss/Reduction of Vessel Propulsion/Steering
505517	2010	6	14	Marine Safety Unit Cleveland	Mentor on the Lake sheen	41.56096	-81.73659	Discharge/Release - Pollution
510448	2010	7	12	Marine Safety Unit Cleveland	Discharge of Oil Whiskey Island Marina/OH5439DZ	41.51852	-81.70728	Discharge/Release - Pollution
512026	2010	7	21	Marine Safety Unit Cleveland	M/V Maumee slop tank oil discharge	41.51852	-81.70728	Discharge/Release - Pollution
515942	2010	8	9	Marine Safety Unit Cleveland	M/V MAUMEE V. TUG IOWA ALLISION/09AUG10	41.51852	-81.70728	Allision
517106	2010	8	12	Marine Safety Unit Cleveland	McKee Sons / Machinery Failure	41.508333	-81.728333	Material Failure/Malfunction
517674	2010	8	18	Marine Safety Unit Cleveland	Nautica Queen / electrical fire	41.51852	-81.70728	Fire - Initial
521157	2010	9	1	Marine Safety Unit Cleveland	MEP Pollution - Oil (09/01/2010 11:41:00 PM)	41.611167	-81.733	Discharge/Release - Pollution

Case Id	Year	Month	Day	Unit Name	Title	Latitude	Longitude	Event Type
524640	2010	9	29	Marine Safety Unit Cleveland	Cleveland Crib/Biodiesel/29SEP10	41.542333	-81.75	Discharge/Release - Pollution
526608	2010	10	8	Marine Safety Unit Cleveland	LINDA MAE / Steering Failure	41.56096	-81.73659	Loss/Reduction of Vessel Propulsion/Steering
525521	2010	10	11	Marine Safety Unit Cleveland	OH9084YK/Gasoline/11OCT2010	41.533333	-81.65	Discharge/Release - Pollution
529613	2010	10	21	Marine Safety Unit Cleveland	MS Loss of Life/Injury (10/21/2010 7:30:00 AM)	41.51852	-81.70728	Personnel Casualty - Injury
529970	2010	11	18	Marine Safety Unit Cleveland	Nautica Queen / Starboard Generator Failure	41.526	-81.657667	Material Failure/Malfunction
532394	2010	12	14	Marine Safety Unit Cleveland	MAUMEE ELECTRICAL FIRE/14DEC10	41.51852	-81.70728	Material Failure/Malfunction
542697	2011	4	4	Marine Safety Unit Cleveland	Personnel Injury on American Integrity	41.533333	-81.733333	Personnel Casualty - Injury
542782	2011	4	4	Marine Safety Unit Cleveland	River Gate Club Gasoline Discharge	41.51852	-81.70728	Discharge/Release - Pollution
544734	2011	4	18	Marine Safety Unit Cleveland	Intercity Yacht Club/ OH 5277 BV/ 02 GAL GAS	41.51852	-81.70728	Discharge/Release - Pollution
551235	2011	4	19	Marine Safety Unit Cleveland	SHEFFIELD LAKE/REPUBLIC SERVICES/DIESEL/19APR11	41.51852	-81.70728	Discharge/Release - Pollution
550718	2011	6	4	Marine Safety Unit Cleveland	EdgeWater Marina R/V SUTTLE SEAS	41.51852	-81.70728	Sinking
552691	2011	6	16	Marine Safety Unit Cleveland	MEP Pollution - Oil (06/16/2011 4:00:00 PM)	41.51852	-81.70728	Discharge/Release - Pollution
553993	2011	6	24	Marine Safety Unit Cleveland	MS/ Loss of Propulsion Goodtime 3	41.496497	-81.723795	Material Failure/Malfunction
556085	2011	7	4	Marine Safety Unit Cleveland	MEP Pollution/Oil/E. 55th Marina	41.5337	-81.64998	Sinking
558302	2011	7	16	Marine Safety Unit Cleveland	Allision / Barge St Mary's Cement	41.51852	-81.70728	Loss/Reduction of Vessel Propulsion/Steering
558869	2011	7	18	Marine Safety Unit Cleveland	MS Allision M/V Calumet vs Shooters Dock	41.492333	-81.704833	Allision
559939	2011	7	23	Marine Safety Unit Cleveland	Discharge of Oil/ OH4572DZ/East 55th Street Marina	41.53	-81.651667	Discharge/Release - Pollution
560152	2011	7	25	Marine Safety Unit Cleveland	M/V H. LEE WHITE/Discharge	41.51852	-81.70728	Discharge/Release - Pollution
560098	2011	7	25	Marine Safety Unit Cleveland	Discharge of Oil/OH4117YT	41.537667	-81.645	Discharge/Release - Pollution

Case Id	Year	Month	Day	Unit Name	Title	Latitude	Longitude	Event Type
560642	2011	7	27	Marine Safety Unit Cleveland	Calumet Allision (07/27/2011 6:00:00 PM)	41.501667	-81.711667	Allision
565787	2011	8	20	Marine Safety Unit Cleveland	Nautica Queen Injury	41.51852	-81.70728	Personnel Casualty - Injury
566490	2011	8	26	Marine Safety Unit Cleveland	CALUMET Equipment Failure	41.56096	-81.73659	Loss/Reduction of Vessel Propulsion/Steering
566717	2011	8	29	Marine Safety Unit Cleveland	MS Allision (08/29/2011 1:30:00 PM)	41.51852	-81.70728	Allision
567300	2011	9	3	Marine Safety Unit Cleveland	036-11 M/V MAUMEE OWS Failure	41.51852	-81.70728	Discharge/Release - Pollution
568337	2011	9	9	Marine Safety Unit Cleveland	037-11 Cuyahoga Valley Scenic Railyard Discharge	41.51852	-81.70728	Discharge/Release - Pollution
571712	2011	9	30	Marine Safety Unit Cleveland	MS Loss of Life/Injury	41.507122	-81.694167	Personnel Casualty - Injury
572833	2011	9	30	Marine Safety Unit Cleveland	OH 2283SB / Discharge of oil / Edgewater Marina	41.493333	-81.728333	Discharge/Release - Pollution
572574	2011	10	7	Marine Safety Unit Cleveland	EXPRESS Engine Overheat	41.56096	-81.73659	Loss/Reduction of Vessel Propulsion/Steering
574130	2011	10	25	Marine Safety Unit Cleveland	054-11 CGC NEAHBAY Oil Discharge	41.51852	-81.70728	Discharge/Release - Pollution
575983	2011	11	11	Marine Safety Unit Cleveland	064-11 Tug OHIO Discharge of Lube Oil	41.51852	-81.70728	Discharge/Release - Pollution
579194	2011	12	14	Marine Safety Unit Cleveland	UCN 076 - 11 Discharge of Oil - M/V ST CLAIR	41.51852	-81.70728	Discharge/Release - Pollution
582500	2011	12	18	Marine Safety Unit Cleveland	Life/Injury	41.51852	-81.70728	Personnel Casualty - Injury
587599	2012	3	21	Marine Safety Unit Cleveland	UCN 029-12 DRUM LAKE ERIE	41.547833	-81.788567	Discharge/Release - Pollution
608647	2012	4	11	Marine Safety Unit Cleveland	Mooring Damage	41.51852	-81.70728	Allision
593293	2012	5	12	Marine Safety Unit Cleveland	051-12 S/V TOCABRE/5 GAL DIESEL DISCHARGE	41.51852	-81.70728	Discharge/Release - Pollution
595248	2012	5	27	Marine Safety Unit Cleveland	UCN 055-12 SUBMERGED VEHICLE/DISCHARGE OF OIL	41.51852	-81.70728	Discharge/Release - Pollution
595904	2012	5	27	Marine Safety Unit Cleveland	UCN 056-12 CAPSIZED VESSEL/DISCHARGE OF GASOLINE	41.51852	-81.70728	Discharge/Release - Pollution

Case Id	Year	Month	Day	Unit Name	Title	Latitude	Longitude	Event Type
596025	2012	5	31	Marine Safety Unit Cleveland	UCN-58-12 SUNKEN VESSEL/POTENTIAL DISCHARGE	41.51852	-81.70728	Discharge/Release - Pollution
596771	2012	6	2	Marine Safety Unit Cleveland	UCN-59-12 GROUNDED VESSEL/POTENTIAL DISCHARGE	41.51852	-81.70728	Discharge/Release - Pollution
597301	2012	6	8	Marine Safety Unit Cleveland	UCN-062 SOUL MATE grounding/ potential discharge	41.52	-81.686	Discharge/Release - Pollution
605687	2012	7	27	Marine Safety Unit Cleveland	Bradshaw McKee Flooding Rec Vessel	41.51852	-81.70728	Flooding - Initial
610298	2012	8	24	Marine Safety Unit Cleveland	M/V BUFFALO Equipment Failure/Loss of Propulsion	41.51852	-81.70728	Loss/Reduction of Vessel Propulsion/Steering
612486	2012	9	8	Marine Safety Unit Cleveland	UCN 090-12 Tractor Trailer Crash Discharge	41.51852	-81.70728	Discharge/Release - Pollution
613473	2012	9	15	Marine Safety Unit Cleveland	UCN 093-12 MV KNOT YET	41.51852	-81.70728	Discharge/Release - Pollution
613622	2012	9	16	Marine Safety Unit Cleveland	UCN 094-12 Discharge of Gasoline/Ivancic Marine	41.51852	-81.70728	Discharge/Release - Pollution
618586	2012	10	26	Marine Safety Unit Cleveland	UCN-105-12/Sunken Vessel/Potential Discharge Oil	41.56096	-81.73659	Discharge/Release - Pollution
619008	2012	10	26	Marine Safety Unit Cleveland	UCN106-12/Sunken Vessel/Lakefront Park/Potential	41.56096	-81.73659	Discharge/Release - Pollution
618954	2012	10	28	Marine Safety Unit Cleveland	UCN108-12/Submerged Dodge/Rocky River/Potential	41.51852	-81.70728	Discharge/Release - Pollution
618909	2012	10	30	Marine Safety Unit Cleveland	UCN119-12/OH1870AV/Sunken/Potential	41.51852	-81.70728	Discharge/Release - Pollution
618914	2012	10	30	Marine Safety Unit Cleveland	UCN115-12/OH1442YT/Potential Discharge	41.51852	-81.70728	Discharge/Release - Pollution
618916	2012	10	30	Marine Safety Unit Cleveland	UCN120-12/OH8317YN/Sunken/Potential	41.51852	-81.70728	Discharge/Release - Pollution
618920	2012	10	30	Marine Safety Unit Cleveland	UCN114-12/OH1229ZB/Sunken/Potential	41.51852	-81.70728	Discharge/Release - Pollution
618942	2012	10	30	Marine Safety Unit Cleveland	UCN117-12/Plum Crazy/Sunken/Potential	41.51852	-81.70728	Discharge/Release - Pollution
619018	2012	10	30	Marine Safety Unit Cleveland	Storm Sandy: UCN112-12/Sunken Vessel/OH9640YF	41.51852	-81.70728	Discharge/Release - Pollution
619045	2012	10	30	Marine Safety Unit Cleveland	UCN 129-12 OH4102WB Sunken Sailboat Whiskey Island	41.492167	-81.721667	Discharge/Release - Pollution

Case Id	Year	Month	Day	Unit Name	Title	Latitude	Longitude	Event Type
619046	2012	10	30	Marine Safety Unit Cleveland	UCN 128-12/S/V DRAGON/WHISKY ISLAND MARINA	41.51852	-81.70728	Discharge/Release - Pollution
619054	2012	10	30	Marine Safety Unit Cleveland	Storm Sandy: UCN 125-12 Sunken s/v Whiskey Island	41.492	-81.72	Discharge/Release - Pollution
619057	2012	10	30	Marine Safety Unit Cleveland	UCN 130-12/OH 4300 UC/EAST 55TH ST MARINA	41.536667	-81.643333	Discharge/Release - Pollution
619171	2012	10	30	Marine Safety Unit Cleveland	Hurricane Sandy Capsized vessel	41.51852	-81.70728	Discharge/Release - Pollution
619172	2012	10	30	Marine Safety Unit Cleveland	Storm Sandy: UCN135-12/OH1659YF/Sunken/Potential	41.51852	-81.70728	Discharge/Release - Pollution
619175	2012	10	30	Marine Safety Unit Cleveland	UCN136-12 22ft Sunken Searay Mouth of Rocky River	41.51852	-81.70728	Discharge/Release - Pollution
619192	2012	10	30	Marine Safety Unit Cleveland	Sandy: UCN140-12/OH9652YU/Potential/Sunk	41.51852	-81.70728	Discharge/Release - Pollution
619193	2012	10	30	Marine Safety Unit Cleveland	SANDY: UCN141-12/OH6366ZB/Sunken/Potential	41.51852	-81.70728	Discharge/Release - Pollution
619274	2012	10	30	Marine Safety Unit Cleveland	UCN 137-12 OH5833ZE Sunken VSL Whiskey Island	41.51852	-81.70728	Discharge/Release - Pollution
619996	2012	10	30	Marine Safety Unit Cleveland	UCN132-12/OH3271BG/Sunken/Potential	41.51852	-81.70728	Discharge/Release - Pollution
620212	2012	10	30	Marine Safety Unit Cleveland	UCN149-12/OH4987DM/Sunken/Potential	41.51852	-81.70728	Discharge/Release - Pollution
620298	2012	10	30	Marine Safety Unit Cleveland	UCN111-12/OH4805DW/Potential	41.51852	-81.70728	Discharge/Release - Pollution
620215	2012	10	30	Marine Safety Unit Cleveland	UCN154-12/Potential/27' Catalina/Sunken	41.51852	-81.70728	Discharge/Release - Pollution
620217	2012	10	30	Marine Safety Unit Cleveland	SANDY: UCN155-12/27' Catalina/Sunken	41.51852	-81.70728	Discharge/Release - Pollution
620344	2012	11	16	Marine Safety Unit Cleveland	M/V MANISTEE loss of propulsion	41.51852	-81.70728	Material Failure/Malfunction
624484	2013	1	9	Marine Safety Unit Cleveland	UCN001-13/Discharge of Oil/UTV California	41.491536	-81.721727	Discharge/Release - Pollution
630808	2013	3	25	Marine Safety Unit Cleveland	UCN-018-13 Discharge of Oil/Universal Oil Inc.	41.51852	-81.70728	Discharge/Release - Pollution
636071	2013	5	14	Marine Safety Unit Cleveland	UCN 030-13 / Great Lakes Towing Company Discharge	41.51852	-81.70728	Discharge/Release - Pollution

Case Id	Year	Month	Day	Unit Name	Title	Latitude	Longitude	Event Type
639501	2013	6	7	Marine Safety Unit Cleveland	UCN039-13 Potential/Tug ATLAS	41.51852	-81.70728	Discharge/Release - Pollution
649090	2013	6	11	Marine Safety Unit Cleveland	UTV ATLAS Loss of Propulsion/Injured Crewmember	41.504683	-81.707267	Material Failure/Malfunction
644476	2013	7	9	Marine Safety Unit Cleveland	M/V MANISTEE Loss of Propulsion	41.496667	-81.711667	Loss/Reduction of Vessel Propulsion/Steering
645642	2013	7	12	Marine Safety Unit Cleveland	UCN 047-13 Lakewood Park Boat Sinking	41.51852	-81.70728	Discharge/Release - Pollution
645973	2013	7	14	Marine Safety Unit Cleveland	UCN 050-13 Arcelor Mittal Outfall Sheen	41.51852	-81.70728	Discharge/Release - Pollution
646215	2013	7	16	Marine Safety Unit Cleveland	M/V AMERICAN COURAGE Bridge Allision	41.51852	-81.70728	Loss of Electrical Power
647047	2013	7	20	Marine Safety Unit Cleveland	UCN 056-13 Potential Discharge	41.56096	-81.73659	Discharge/Release - Pollution
647053	2013	7	20	Marine Safety Unit Cleveland	UCN 057-13 Potential discharge capsized vessel	41.56096	-81.73659	Discharge/Release - Pollution
650182	2013	8	7	Marine Safety Unit Cleveland	UCN063-13 Car Crash Edgewater Yacht Club	41.493333	-81.73	Discharge/Release - Pollution
651223	2013	8	8	Marine Safety Unit Cleveland	T/V ILLINOIS Loss of Steering	41.505576	-81.705204	Loss/Reduction of Vessel Propulsion/Steering
651716	2013	8	12	Marine Safety Unit Cleveland	M/V Holiday Collision with N&S#1	41.5	-81.709167	Vessel Maneuver
654845	2013	8	26	Marine Safety Unit Cleveland	M/V HOOK FOR REEL Loss of Rudder	41.51852	-81.70728	Material Failure/Malfunction
658251	2013	9	23	Marine Safety Unit Cleveland	UTV ILLINOIS Loss of Power	41.496497	-81.723795	Material Failure/Malfunction
658048	2013	9	28	Marine Safety Unit Cleveland	UCN-079-13 East 55th Marina Potential	41.536667	-81.65	Discharge/Release - Pollution
659968	2013	10	10	Marine Safety Unit Cleveland	UCN081-13 Submerged Cadillac/Edgewater Marina	41.495	-81.728333	Discharge/Release - Pollution
661251	2013	10	26	Marine Safety Unit Cleveland	UTV ILLINOIS - Loss of electrical power	41.51852	-81.70728	Loss of Electrical Power
662817	2013	11	9	Marine Safety Unit Cleveland	UCN 090-13 Partially Sunken Rec Vsl E.55th	41.537667	-81.6425	Discharge/Release - Pollution
664400	2013	11	24	Marine Safety Unit Cleveland	M/V MANISTEE Property Damage-Cargo Conveyor Motor	41.51852	-81.70728	Material Failure/Malfunction
669166	2014	1	20	Marine Safety Unit Cleveland	UTV PENNSYLVANIA Flooding	41.51852	-81.70728	Material Failure/Malfunction

Case Id	Year	Month	Day	Unit Name	Title	Latitude	Longitude	Event Type
669165	2014	1	20	Marine Safety Unit Cleveland	UTV DELAWARE Flooding	41.51852	-81.70728	Flooding - Initial
673151	2014	3	3	Marine Safety Unit Cleveland	UTV IOWA Loss of Maneuverability	41.51852	-81.70728	Material Failure/Malfunction
676967	2014	4	9	Marine Safety Unit Cleveland	M/V MANITOWAC Allision with Osborne Stone Dock	41.51852	-81.70728	Loss/Reduction of Vessel Propulsion/Steering
683145	2014	5	29	Marine Safety Unit Cleveland	M/V MANISTEE Loss of Electrical Power	41.496667	-81.713333	Loss of Electrical Power
685523	2014	6	13	Marine Safety Unit Cleveland	Barge GL 170 Flooding	41.496497	-81.723793	Material Failure/Malfunction
687017	2014	6	22	Marine Safety Unit Cleveland	AMERICAN COURAGE - Loss of Bow Thruster	41.51852	-81.70728	Loss of Electrical Power
692471	2014	7	22	Marine Safety Unit Cleveland	UCN 045-14 Conneaut Break Wall Boat Sinking	41.51852	-81.70728	Discharge/Release - Pollution
694578	2014	8	3	Marine Safety Unit Cleveland	P/C CRUZAN Flooding/Sinking	41.5065	-81.72	Material Failure/Malfunction
695610	2014	8	9	Marine Safety Unit Cleveland	M/V GOODTIME III - Allision/Crew Injury	41.506667	-81.7045	Allision
700763	2014	8	29	Marine Safety Unit Cleveland	Fuel Pump; <5 gal gas; E 55th Street Marina	41.56096	-81.73659	Discharge/Release - Pollution
702575	2014	9	23	Marine Safety Unit Cleveland	M/V CALUMET Loss of Bow Thruster in Nav Channel	41.51852	-81.70728	Loss/Reduction of Vessel Propulsion/Steering
703051	2014	9	27	Marine Safety Unit Cleveland	American Bridge Sunken Barge	41.51852	-81.70728	Flooding - Progressive
706820	2014	10	28	Marine Safety Unit Cleveland	Barge LAKES CONTENDER; <1gal hydraulic oil	41.51852	-81.70728	Discharge/Release - Pollution
710148	2014	12	1	Marine Safety Unit Cleveland	M/V BUFFALO Loss of Stern Thruster	41.51852	-81.70728	Material Failure/Malfunction
718879	2015	3	6	Marine Safety Unit Cleveland	Columbus Road Bridge Allision	41.51852	-81.70728	Allision
719630	2015	3	18	Marine Safety Unit Cleveland	UTV DOROTHY ANN Flooding	41.506828	-81.703705	Material Failure/Malfunction
720687	2015	3	28	Marine Safety Unit Cleveland	ARCELOR MITTAL Oil Discharge Cuyahoga River	41.51852	-81.70728	Discharge/Release - Pollution
721345	2015	4	3	Marine Safety Unit Cleveland	Oil Spill at Forest City Yacht Club	41.56096	-81.73659	Discharge/Release - Pollution
722703	2015	4	16	Marine Safety Unit Cleveland	ArcelorMittal 5 Gal Oily Water Into Cuyahoga River	41.51852	-81.70728	Discharge/Release - Pollution

Case Id	Year	Month	Day	Unit Name	Title	Latitude	Longitude	Event Type
723126	2015	4	19	Marine Safety Unit Cleveland	M/V AMERICAN COURAGE Loss of Steering	41.51852	-81.70728	Loss/Reduction of Vessel Propulsion/Steering
724486	2015	5	1	Marine Safety Unit Cleveland	M/V GADWALL Loss of Propulsion	41.51852	-81.70728	Material Failure/Malfunction
726548	2015	5	17	Marine Safety Unit Cleveland	M/V AMERICAN COURAGE Loss of Bow Thruster	41.51852	-81.70728	Loss/Reduction of Vessel Propulsion/Steering
727525	2015	5	25	Marine Safety Unit Cleveland	M/V SAM LAUD Loss of Propulsion	41.51852	-81.70728	Material Failure/Malfunction
727513	2015	5	25	Marine Safety Unit Cleveland	M/V AMERICAN MARINER Loss of Prop Pitch Control	41.53	-81.723333	Material Failure/Malfunction
730767	2015	5	28	Marine Safety Unit Cleveland	RHODE ISLAND; discharge of oil; Lake Erie	41.505033	-81.711817	Discharge/Release - Pollution
730124	2015	6	12	Marine Safety Unit Cleveland	Cleveland Metroparks /Discharge of Diesel / Euclid	41.51852	-81.70728	Discharge/Release - Pollution
732546	2015	6	27	Marine Safety Unit Cleveland	; 15 gal of gasoline; Lake Erie	41.51852	-81.70728	Discharge/Release - Pollution
735149	2015	7	12	Marine Safety Unit Cleveland	/Gasoline Discharge / E. 55th St. Marina	41.538333	-81.653333	Discharge/Release - Pollution
735413	2015	7	13	Marine Safety Unit Cleveland	XYGasoline Discharge/E.55th St. Marina	41.51852	-81.70728	Discharge/Release - Pollution
736621	2015	7	20	Marine Safety Unit Cleveland	19' Sea Ray gasoline discharge; Chagrin River	41.56096	-81.73659	Discharge/Release - Pollution
993491	2015	9	11	Marine Safety Unit Cleveland	M/V HERBERT C JACKSON allision with a bridge	41.49437	-81.703171	Allision
995509	2015	9	26	Marine Safety Unit Cleveland	M/V GREAT REPUBLIC allision with a pier	41.497841	-81.708557	Allision
996156	2015	9	30	Marine Safety Unit Cleveland	M/V MANISTEE allision/loss of maneuverability	41.497977	-81.708355	Allision
1006543	2016	1	3	Marine Safety Unit Cleveland	IMD;Mystery Sheen; Cuyahoga River; UCN 001-16	41.494764	-81.691971	Discharge/Release - Pollution
1018103	2016	3	22	Marine Safety Unit Cleveland	IMD; Gasoline; P/C Live Wire; Cleveland; 018-16	41.494784	-81.694111	Discharge/Release - Pollution
1023638	2016	5	9	Marine Safety Unit Cleveland	Tug ILLINOIS loss of maneuverability	41.495061	-81.713053	Loss/Reduction of Vessel Propulsion/Steering
1027385	2016	6	3	Marine Safety Unit Cleveland	M/V CALUMET allison with pier	41.498333	-81.708086	Allision
1035203	2016	7	18	Marine Safety Unit Cleveland	MSU CLE; Oil; CFD FB Celebrezze; Cleveland; OH	41.494242	-81.692506	Discharge/Release - Pollution