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SEP 28 2016

PA Fish & Boat Commission  
Division of Environmental Services



COMMONWEALTH OF PENNSYLVANIA  
PENNSYLVANIA FISH & BOAT COMMISSION  
Application for Permit for Use of Explosives in Commonwealth Waters  
30 PA. C.S. § 2906

1. Purpose: A permit is required from the Fish and Boat Commission for use of explosives in Commonwealth waters for engineering purposes. Applicants: Complete this form in its entirety. Additional instruction and information are on the back of this form. Do not go forward with the project unless and until the Commission issues a permit. Include a check or money order (no cash) in the amount of \$50.00 for each perennial waterway that is proposed to be impacted. Mail your application and remittance (payable to the Pennsylvania Fish and Boat Commission) to Pennsylvania Fish and Boat Commission, Environmental Services Division, 450 Robinson Lane, Bellefonte, PA 16823. Attach additional sheets as necessary. If the permit is denied, the fee will be returned to you.
2. Name of Applicant: ITC Lake Erie Connector LLC; Andrew Jamieson, Counsel
3. Address of Applicant: 27175 Energy Way, Novi, Michigan 48377
4. Phone: 248-946-3000
5. Dates of proposed blasting: See Item 5, attached.
6. Name of project: Lake Erie Connector Project
7. Location of proposed use of explosives: Attach an 8 1/2" x 11" photocopy of a topographic map to show the location of waterway(s) to be impacted. This map can be printed from a site on the internet such as <http://itouchmap.com> or <http://www.topoquest.com> or a photocopy of a 7.5 minute USGS topographical quadrangle. The body of water should be clearly marked with a circle at the location of each project site. See Item 7, attached.
8. Waterway information: attach a table that lists the waterway name(s), county, township, geographic coordinates of the project site, and the Chapter 93 Water Use Protected Classification. Water Use Protection Classification are identified in the Department of Environmental Protection's Chapter 93 regulations, which may be accessed at: See Item 8, attached.  
<http://www.pacode.com/secure/data/025/chapter93/chap93toc.html>
9. Describe the overall project of which the proposed use of explosives is a part: \_\_\_\_\_  
See Item 9, attached.
10. Describe in detail your proposed use of explosives: \_\_\_\_\_  
See Item 10, attached.
11. List all other permits received and the permitting agency: \_\_\_\_\_  
See Item 11, attached.
12. Describe the immediate (short-term) effects you anticipate from the proposed use of explosives. Include a description of the effects on fish and aquatic life in the waters, fish habitat, the stream bed, waterways, waters, and watershed and the effects on boating:  
See Item 12, attached.

The undersigned applicant, under penalty of the law, hereby certifies the above information is true and correct to the best of his/her knowledge and belief:

Date: 9/27/16

Signature of Applicant: \_\_\_\_\_

## Instructions

1. Complete all information requested on the front of this form. Attach additional sheets as necessary. Incomplete applications will be returned without action. Send the complete form together with the fee of **\$50.00 for each perennial waterway** that is proposed to be impacted to the Fish and Boat Commission, Environmental Services Division, 450 Robinson Lane, Bellefonte, PA 16823.
2. Applicants who are granted permits are required by law to make restitution to the Commission for all fish destroyed.
3. The Pennsylvania Fish and Boat Commission staff reviews all aspects of the use of explosives. A permit may be granted by the Executive Director, or his designee, upon a finding by the staff that the activity will have no significant adverse impacts on the fishery resources in, or boating on, the waters where the activity is to take place. The permit is valid for one (1) year following the granted date.
4. If, after review of the application, the staff concludes that there is a substantial likelihood that the proposed activity will have significant adverse impacts on fishery resources and/or boating, the Executive Director, or his designee, will cause a notice of the permit application to be published in the Pennsylvania Bulletin to invite public comments, protests, or intervention responses.
5. Appeal to Commission. Any party, including the applicant, who is aggrieved by a decision of the Executive Director to grant or deny a permit under Section 2906 of the Code, may appeal the decision to the full Pennsylvania Fish and Boat Commission. Appeals must conform to 1 Pa. Code § 35.20. The Executive Director may stay a permit upon filing of an appeal. Appeals shall be disposed of in accordance with the General Rules of Administrative Practice and Procedure, as amended or supplemented by Commission rules.

It is a **misdemeanor** to alter or disturb any stream bed, fish habitat, water or watershed in any manner that might cause damage to, or loss of, fish or other aquatic life without the necessary permits. It is a misdemeanor to place any explosives in any waters within or on the boundaries of Pennsylvania without a permit. It is a misdemeanor to engage in activity for which a permit is required under 30 Pa.C.S. § 2906 without first acquiring the necessary permit. The law provides severe criminal penalties to persons who use explosives in Pennsylvania waters without the required permits.

## ACTION ON APPLICATION

\_\_\_\_\_ (Applicant) is hereby (GRANTED) (DENIED) a permit to use explosives in Commonwealth waters as described on the front of this form. If granted, the permit will be effective until \_\_\_\_\_.

The following additional terms and conditions apply to the permit:

Date: \_\_\_\_\_ Executive Director or Designee: \_\_\_\_\_



RECEIVED

SEP 28 2016

PA Fish & Boat Commission  
Division of Environmental Services

September 27, 2016

Ms. Heather Smiles  
Pennsylvania Fish and Boat Commission  
Environmental Services Division  
450 Robinson Lane  
Bellefonte, PA 16823

**RE: Pennsylvania Fish and Boat Commission: Application for Permit for Use of Explosives in Commonwealth Waters, 30 PA. C.S. § 2906**

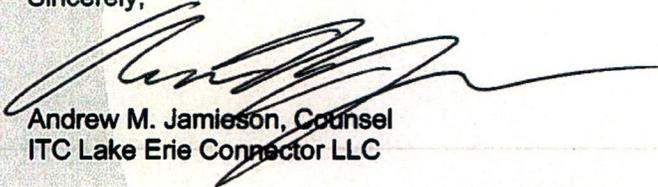
Ms. Smiles:

ITC Lake Erie Connector LLC is requesting your review of the Pennsylvania Fish and Boat Commission (PFBC) Application for Permit for Use of Explosives in Commonwealth Waters, 30 PA. C.S. § 2906 (Blasting Permit).

ITC Lake Erie Connector LLC is proposing to construct and operate the Lake Erie Connector Project, an approximately 72.4 mile (116.5 km) 1,000 megawatt (MW) +/-320 kilovolt (kV) high-voltage direct current (HVDC) bi-directional electric transmission interconnection to transfer electricity between Canada and the United States. Within Lake Erie the interconnection consists of two six-inch diameter submarine cables and a fiber optic cable, all buried in the lakebed. In most areas the cables will be bundled together and buried in the lakebed by a jet plow to protect the cables from damage due to shipping traffic, fishing activity, and ice scour. Typical burial depths in jettable material range from three to 10 ft (one to three m). At the cable landing in Springfield Township in Erie County, Pennsylvania, the lake bottom bedrock is either exposed or very close to the surface, preventing cable burial via jet plow. Due to these geological constraints, underwater confined stemmed blasting in the bedrock (primarily shale) will be conducted along approximately one mile (1.6 km) of the cable route beginning approximately 2,000 ft [609.6 m] from the shoreline to softer lake bed material suitable for jet plow burial. Confined stemmed blasting will also be conducted at the horizontal directional drilling (HDD) exit pits, also located approximately 2,000 ft [609.6 m] from the shoreline.

ITC Lake Erie Connector LLC appreciates your consideration of this permit application. Please feel free to contact Peter Browne with HDR at 207-239-3863 or [Peter.Browne@hdrinc.com](mailto:Peter.Browne@hdrinc.com), or me should you have any questions or require additional information.

Sincerely,



Andrew M. Jamieson, Counsel  
ITC Lake Erie Connector LLC

Ms. Heather Smiles  
September 27, 2016  
Page 2 of 2

Attachments:

Application for Permit for Use of Explosives in Commonwealth Waters, including additional sheets containing requested information

cc: Karl Gross, PADEP  
Nancy Mullen, USACE  
R. Timothy Weston, K&L Gates LLP  
Peter Browne, HDR

**Application for Permit for Use of Explosives in Commonwealth Waters**  
**Attached Information**

*5: Dates of Proposed Blasting*

The cable installation in U.S. waters would occur over a 2.5 year period, and the horizontal directional drill (HDD) and proposed blasting activities would be conducted between May and November of the first and second years (2018 and 2019), based on the current Project development schedule. Assuming blasting shots would occur on consecutive days, blasting work in U.S. waters would require approximately 130 days to complete. Depending on weather and coordination with the Canadian portion of the work, some blasting activities and rock excavation may be delayed into 2019.

*7: Location of Proposed Use of Explosives*

Please see Figure 1 for the location of the overall Project. Blasting would occur within the corridor shown on Figure 2, from 42° 1' 44.5548"N, -80° 24' 33.3606"W to 42° 0' 59.5692"N, -80° 24' 16.9122"W.

*8: Waterway Information*

Blasting would be limited to the nearshore waters of Lake Erie in Springfield Township, Erie County, Pennsylvania, as shown on Figure 2. All sections of Lake Erie in Pennsylvania except Outer Erie Harbor and Presque Isle Bay are designated for Cold Water Fishes (CWF) (25 Pa. Code §93.9). The Pennsylvania portion of Lake Erie is currently listed as impaired for fish consumption due to PCB and mercury contamination (PADEP 2016).

*9: Describe Overall Project of Which the Proposed Explosive is a part of*

The Applicant is proposing to construct and operate the Lake Erie Connector Project, an approximately 72.4-mile (116.5 km), 1,000- MW, +/-320-kilovolt kV, high-voltage direct current (HVDC), bi-directional electric transmission line to transfer electricity between Canada and the U.S. For purposes of permits being issued in the U.S., the Project consists of an approximately 42.5-mile (68.4 km) HVDC transmission line that would be buried in the lakebed of Lake Erie from the U.S. - Canada border and be installed underground in Pennsylvania to a new converter station, called the Erie Converter Station, as well as 2,082 ft (635 m) of underground 345-kV alternating current (AC) cable between the Erie Converter Station and the nearby existing Penelec Erie West Substation. The converter station will include equipment to change the AC of the existing aboveground transmission network to the direct current (DC) transmitted by the proposed Project, and vice versa. HVDC technology is used for the Project because it has many advantages over AC technology for long-distance power transmission. These advantages include the ability to control power flow and lower transmission losses.

The HVDC transmission line consists of two transmission cables, one positively charged and the other negatively charged, along with a fiber optic cable for communications, between the converter stations located in Ontario, Canada, and Erie County, Pennsylvania. The majority of the on-land U.S. cable route uses existing roadway right-of-way (ROWs) to minimize impacts and additional land disturbance. The cable system will be buried on land using conventional open trenching methods, with trenchless techniques used in situations where conventional trenching is less appropriate because of the potential for adverse environmental impacts or other constraints.

The two HVDC transmission cables and the fiber optic cable would transition from the landfall location into Lake Erie via separate borings through bedrock installed by HDD methods. The HDD bores will exit the lake in Pennsylvania approximately 2,000 ft (600 meters) from shore, at a water depth of approximately 18 ft (5.4 meters). It is expected that the distance between bores at the exit will be approximately 33 ft (10 m). Three short trenches will be excavated in the bedrock (primarily shale) from the exit of each of the three HDD bores at approximately kilometer post (KP) 103.4. The three trenches will merge into one trench, which will continue through the bedrock to the softer lakebed material where the sediment overlay is deep enough that burial by jet plow or water jetting can be utilized (approximately KP 102). For the remainder of the cable route to the U.S. - Canada border at approximately KP 47, the cables will be bundled and buried in the lakebed by a jet plow.

*10: Describe in Detail the Proposed Use of Explosives*

Underwater confined stemmed blasting in the primarily shale bedrock will be conducted for approximately one mile (1.6 km) at the HDD exit pits and the bedrock trench areas discussed above. Blasting will be conducted using 4-inch (10-cm) diameter blast holes drilled to a depth of 4 ft (1.2 m) below the planned excavation grade below the lakebed. Blast holes will be spaced 5 to 8 feet apart in an alternating pattern over a trench length of 30 to 40 ft (9 to 12 m) (Figures 3 and 4). The holes will be packed with low-level Hydromite emulsion explosive, stemmed, covered with blasting mats, and detonated (Figure 5). Approximately 20 to 30 stemmed charges will be detonated per shot. The estimated charge weight per hole is 14 pounds (6.35 kg) with a charge delay of 25 msec. One shot would occur per day. This pattern would yield an approximate daily advance rate of 40 to 50 ft per day (12 to 15 m per day).

Additional blasting will use similarly spaced holes and charges at the HDD exit pits, including one pit for each of the two HVDC cables and one pit for the fiber optic cable. Each of the three HDD exit pits will be approximately 20 x 10 x 7 feet (6.1 x 3.1 x 2.1 meters).

The blasted rock will be removed by a barge-mounted excavator and side cast on the lake bottom. As part of that process, two artificial reef structures will be installed using excavated rock as available from the three HDD exit pits, as described at the end of Item 12 and shown in Figure 6.

The trench will be bedded and backfilled with a sand and gravel mixture (originating from an on-land source). Assuming blasting shots would occur on consecutive days, blasting work in U.S. waters would require approximately 130 days to complete. However, as noted above, depending on weather and coordination with the Canadian portion of the work, some blasting activities and rock excavation may be delayed into 2019.

*11: List All Other Permits Received and the Permitting Agency*

Table 1 indicates the permits or approvals that the Applicant expects to be obtained for the U.S. portion of the Project. Please note that these permits are for the Project in its entirety, not just the portions for which blasting will occur.

**Table 1. U.S. Permits and Approvals Required for the Lake Erie Connector Project (Permits or Approvals Received Indicated with Approval/Issuance Date in Parenthesis)**

U.S. Permit or Approval	Applicable Agency or Reviewer
U.S. Rivers and Harbors Act § 10, Federal Clean Water Act § 404 Permit	United States Army Corps of Engineers (USACE)
PA Dam Safety and Encroachment Act, Chapter 105 <i>Submitted via Joint Permit Application Process</i>	Pennsylvania Department of Environmental Protection (PADEP)
Presidential Permit	U.S. Department of Energy
Federal Clean Water Act §401 Water Quality Certification (received 6/13/16)	PADEP
Cultural Resources survey review and approval in accordance with Section 106 of the National Historic Preservation Act	Pennsylvania Historical Museum Commission (PHMC)
PNDI/Natural Resources Review (All reviews completed except for PFBC)	United States Fish and Wildlife Service (USFWS,) Pennsylvania Game Commission (PGC), Pennsylvania Fish and Boat Commission (PFBC), Pennsylvania Department of Conservation and Natural Resources (PA DCNR).
Sewage Facilities Permit for Converter Station	Conneaut Township Sewage Enforcement Officer
Land Development Plan (Preliminary land development plan approved on 5/19/16)	Erie County Planning Department
Road Use Agreement (Springfield – approved 7/5/16)	Girard Township and Springfield Township
Zoning (Approved 5/2/16 and 8/4/16)	Girard Township and Springfield Township
Bluff Recession Setback Variance (Approved 8/4/16)	Springfield Township
Building Permits for Structures	Conneaut Township
Occupancy Permit for Buildings and Structures	Conneaut Township
Residual Waste Form Approval	PADEP
Coastal Zone Management Consistency Determination (Consistency determination – 9/8/16)	PADEP, Coastal Resources Management Program
Submerged Lands License Agreement - (issued 8/18/16)	PADEP
National Pollution Discharge Elimination System (NPDES) Permit for stormwater associated with construction activities	PADEP, Erie County Conservation District
Erosion and Sedimentation Control Plan Approval	Erie County Conservation District
Stormwater Management Plan (approved on 5/5/16)	Conneaut Township
Spill Prevention, Control, and Countermeasures Plan/ Preparedness, Prevention, and	Erie County Conservation District

U.S. Permit or Approval	Applicable Agency or Reviewer
Contingency Plan	
Public Utilities Commission Approval for Railroad Right of Way Crossing	Pennsylvania Public Utilities Commission (PUC)
State Highway Occupancy Permit for Utility Construction	Pennsylvania Department of Transportation (PennDOT)
State Highway Occupancy Permit for Driveway Construction	PennDOT
State Highway Permits for Oversize and Overweight Loads and Vehicles	PennDOT
State Highway Permits to Use Highways Posted Due to Weight, Traffic, or Bridge Condition	PennDOT
State Building Code Building Permit	PA Department of Labor and Industry
Building Energy Conservation Standards	PA Department of Labor and Industry
Local Road Driveway Access Permit	Girard Township, Springfield Township
Local Overweight Vehicle Permits	Conneaut Township, Girard Township, Springfield Township and Erie County
Fire Department/Emergency Management Coordination	Conneaut Township, Girard Township, Springfield Township and Erie County Emergency Management
Storage Tank Registration	PADEP
Other Hazardous Waste Handling Requirements	PADEP
Air Quality Plan Approval or General Permit coverage for emergency generator at converter station	PADEP
Blasting Permit	PFBC
Blasting Activity Permit	PADEP
Incidental Take Permit – for Eastern Sand Darter	PFBC

12: Describe the Immediate (short-term) Effects from Proposed Use of Explosives

The effects from the proposed use of explosives, specifically of blasting on fish and aquatic habitat, were evaluated and included in the Joint Permit Application (JPA)<sup>1</sup> submitted to the Pennsylvania Department of Environmental Protection on January 29, 2016. This evaluation includes a review of existing studies and research, which is not included here, but the analysis of the potential effects is summarized below.

Blasting can cause fish mortality, physical injury, auditory tissue damage, permanent and temporary threshold shifts (TTS), behavioral changes, and decreased egg and larvae viability (Hastings and Popper 2005). The duration of temporary hearing loss varies depending on the

<sup>1</sup> Joint Application for Pennsylvania Water Obstructions and Encroachment Permit and U.S. Army Corps of Engineers, Rivers & Harbors Act §10 and Clean Water Act §404 Permits. The Blasting Analysis was Appendix I of the Environmental Assessment, which was Attachment 3 of the JPA.

nature of the stimulus, but, by definition, there is generally recovery of full hearing over time (Popper and Hastings 2009).

The potential for blasting impacts was assessed by estimating the extent and duration of the sound pressure level and shock wave associated with the proposed blasting, and comparing these estimates to published guidelines and effects thresholds for fish species that have published criteria. Setback distances specify the distance from the explosive source at which overpressure and particle velocity levels fall below thresholds at which detrimental impacts on free swimming fishes (overpressure) or fish eggs (particle velocity) are anticipated to occur (Kolden and Aimone-Martin 2013). An estimate of the setback distance for confined explosives was employed to determine the area of effect using published critical values of both overpressure and peak particle velocity (Table 2).

**Table 2. Confined Explosive Guideline Criterion**

<b>Criteria</b>	
Overpressure	7.3 psi
Peak Particle Velocity	2.0 in / s

Source: Timothy 2013

The resulting setback distance using the proposed charge weights and guidelines outlined in the blasting impact analysis for this Project are shown in Table 3.

**Table 3. Setback distance for guideline criteria.**

<b>Criteria</b>	<b>Setback Distance</b>
Overpressure (fish)	63.3 ft
Peak Particle Velocity (eggs)	53.1 ft

Source: Timothy 2013

Based on the review of existing literature and studies discussed above, the assumptions used to calculate the setback distance for peak particle velocity and pressure for this Project are conservative. Applying this approach to estimating potential impacts on fish takes into consideration the fact that high risk of lethal or permanent injury would be confined to the immediate vicinity of the explosion where compressive forces of the shock wave predominate. Injuries at greater distances are generally caused by negative pressures associated with overshoot of the gas bubble formed by the explosion and reflection of the shock wave from the water's surface (Popper et al. 2014). The 229 to 234 dB re 1 microPascal threshold for mortality recommended by Popper et al. (2014) corresponds to 40 to 70 psi or 276 to 482 kPa. Thus, the overpressure criteria (7.3 psi and 100 kPa) are very conservative. The potential for lethal impacts to fish would be expected to occur in a small footprint (less than 63.3 ft [19.2 m] from the blast location) surrounding an individual blast.

A single blast per 24 hour period would not be expected to induce strong avoidance responses. Following startle responses, which might last only for seconds to minutes, fishes would return to the general vicinity of the blast. Blasting events will not be long in duration with repeated exposures sustained over periods as long as hours to days. Repetitive detonations over relatively short periods of time, which will not occur for this project, would have a greater risk of TTS and behavior responses. However, for this project we do not expect this to be the case and anticipate a lower likelihood of physiological impact or prolonged behavioral response due to the mitigations incorporated into the blasting plan (e.g., stemmed charges, single blasts per day).

Peak pressures and particle velocities decrease with distance from the detonation and therefore potential impacts are reduced as well, especially when considering the stemming methods

proposed and described above. The preferred technique of stemming charges has been demonstrated to reduce pressures and lower aquatic organism mortality than the same explosive charge weight detonated in open water (Hempfen et al. 2007, Nedwell and Thandavamorthy 1992). The reduced impacts of stemmed charge/subterranean explosions versus mid-water explosions were illustrated by Traxler et al. (1992), who reported no mortalities or observable injuries among largemouth bass, bluegills, and channel catfish held in cages placed directly above and at distances between 25 and 300 ft (7.6 and 91.4 m) from shot holes containing 9.9 and 19.8 pounds (4.5 and 9.1 kg) of dynamite. Their experiments were conducted in a freshwater reservoir in Texas.

A number of commercially, recreationally, or ecologically important fish species spawn in shallow Lake Erie habitats in spring and early summer. For example, yellow perch, white bass, walleye, alewives, rainbow smelt and spottail shiner all spawn over sandy, gravel, or rocky substrates in March through April and into May (Daiber 1953, Bodola 1966, Leach and Nepszy 1976, Madenjian et al. 1996, Roseman et al. 1996). In addition, lake sturgeon, which is provided protected status, spawns primarily in tributaries but potentially also over gravel shoals and rocky shorelines in April through early June when water temperatures are between 55 °F and 64°F (GLIMDS 2015, Dick et al. 2006, Scott and Crossman 1998). Other species spawn during warmer months, including brown bullhead, channel catfish, pumpkinseed, and gizzard shad. Eastern sand darters spawn during June and July (Criswell 2013). In a letter dated August 2016, commenting on the JPA, PFBC noted concern about blasting and trenching effects on "... potential fish spawning habitats (generally, waters < 20 feet deep) during spawning timeframes of major Lake Erie gamefishes such as yellow perch, smallmouth bass and walleye (generally, April through July)." Although the required duration of blasting (130 days from May through November) precludes avoiding all potential conflicts with fish spawning seasons, the use of explosives from July through November will avoid the peak spawning periods of a majority of species. In addition, blasting will only occur in depths of 18 feet or deeper with approximately 89 percent of blasting occurring in depths greater than 20 feet; consequently, only a small percentage of the blasting will occur in waters within the depth of concern for spawning fish.

As the effects criteria also apply to fish habitat, there will be direct impacts to benthic habitats at the blast zone. However, following cable installation, that area is expected to recolonize from recruitment from nearby, unaffected areas of the lake. Recovery for benthic communities varies, ranging from several months to several years, depending on the type of community and type of disturbance (U.S. Department of Energy [DOE] 2013). Depth contours will be returned to pre-existing conditions by filling the trench with upland-derived material.

Coarse material excavated from the bedrock trenches will be side-cast, and two artificial reefs will be created from rock excavated from the three HDD exit pits. The two rock reef structures will be located just north of the Lake Erie HDD exit pits. Each rock reef would be approximately 38 ft x 12 ft and 4 ft in height and would serve as new long term aquatic and fish habitat features within the lake bed. Figure 6 shows the Applicant's proposed plan for the location of these reefs within the lake bed. In the long-term, the side cast rock and two artificial reefs will provide relief and habitat structure that could offset any temporary disruption to nearshore habitats.

The proposed blasting plan was developed using confined stemmed charges and use of blasting mats as best management practices (BMPs) to reduce potential impacts to spawning and early life stages of fish species, as well as implementing delays of one day between blasts. The use of a confined stemmed bore hole blasting technique rather than blasting in open water or at the surface effectively reduces blast forces transmitted through the water column horizontally. Implementing delays between the onset of multiple blasts by installing blasting caps was found to mitigate effects as long as the delay duration exceeded 25 msec, and preferably 50 msec

(Baker 2008, Wright and Hopky 1998). In addition, the drill barge and other vessels working in the area may temporarily disperse fishes, such that fish may avoid the work area and fish occurrence close to the daily blast sites may be reduced.

The Project may use additional impact avoidance techniques such as artificial noise generation to repel fish from the area immediately prior to each blast. Noise may be generated using compressed air discharged into the water column or, as the trench alignment occurs in not particularly deep water, could be created mechanically by operating noisy vibratory equipment (e.g., motorized compactor) on the deck of a nearby tending vessel. Alternatively, operation of a small boat over the blast area immediately prior to blasting could temporarily disperse fish from the area. Based on our assessment, use of a bubble curtain is not warranted. Because the present Project will involve blasting in areas where fish occupation will change on a daily and seasonal basis, it is impossible to predict with absolute certainty that no fishes will be impacted detrimentally. However, existing guidelines and studies heavily suggest that potentially detrimental impacts will be limited to within the calculated setback distance of 63.3 ft or less.

Conclusion - The confined and stemmed blasting method was selected to minimize potential impacts. Stemming charges will result in substantially reduced peak pressures and lower aquatic organism mortality rates than comparable open water detonations (Hempfen et al. 2007, Nedwell and Thandavamoorthy 1992). It is expected that the potential for negative impacts on fishes and fish habitat can be minimized during blasting by implementing the proposed existing BMPs (e.g., using confined stem charges, blasting mats, and delays of one day between blasts). Fish are also likely to avoid each daily work area due to localized activities prior to each daily blast. Lastly, only about 11 percent of the blasting will occur in waters 20 ft or less in depth, which minimizes the effects to spawning habitat depths identified by PFBC.

Most impacts from noise would be either temporary or intermittent and it is expected that only a few individuals would be affected relative to the broadly dispersed stocks of any given species in Lake Erie. Of those species in the Project area, many individuals would be expected to react by moving away from noise sources. The amount of explosives used will be limited to the extent possible to avoid noise and vibration impacts on fishes.

It is anticipated that potential impacts to the fish community from blasting during construction will be temporary and do not pose a substantive risk to fish populations within the Project area due to their very limited spatial extent. Side casting of blast rock and the creation of two rock reefs will enhance local aquatic and fish habitat after construction is completed.

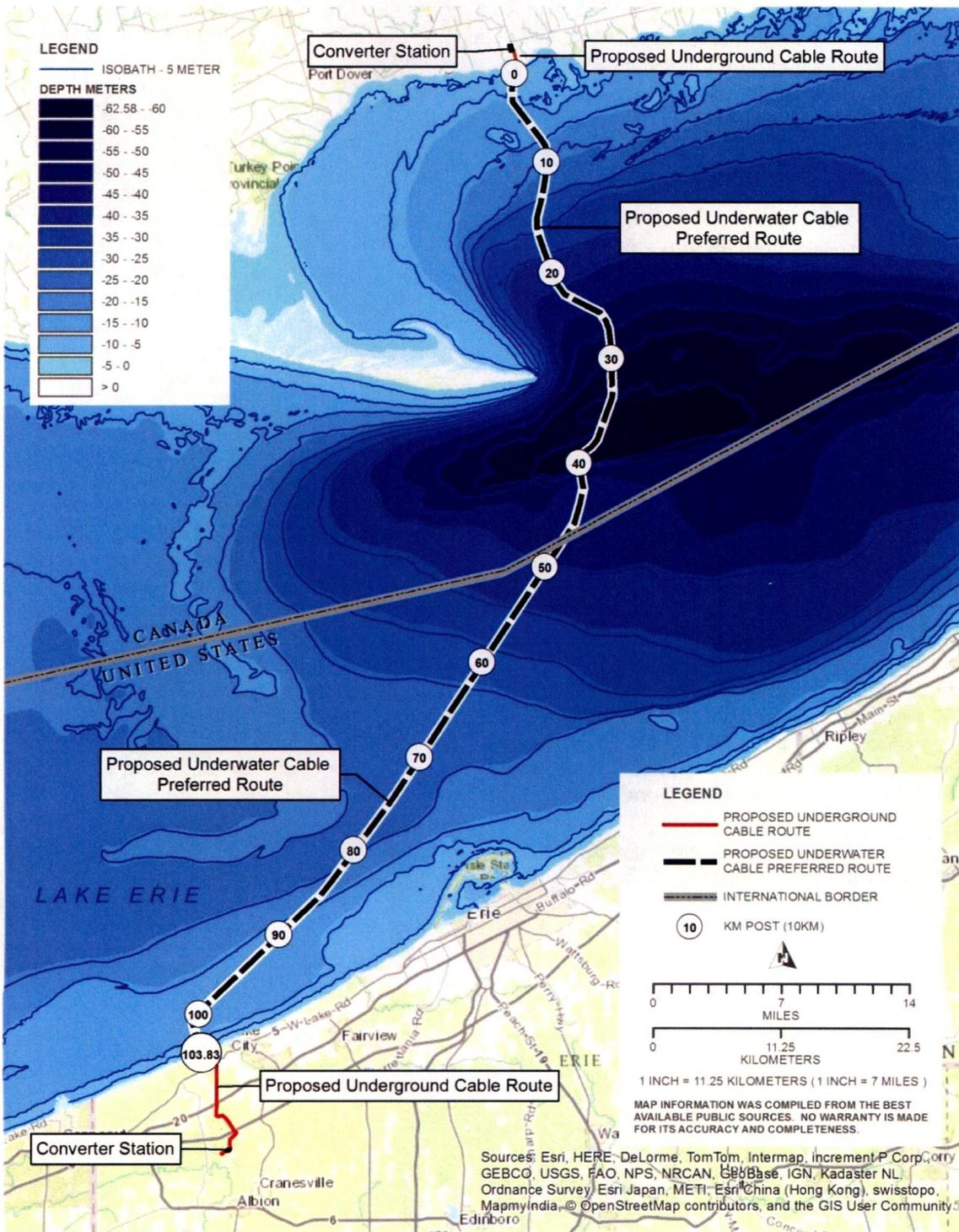


Figure 1. Proposed Project Route, Lake Erie Connector Project.



Figure 2. Location of Proposed Blasting, Lake Erie Connector Project.

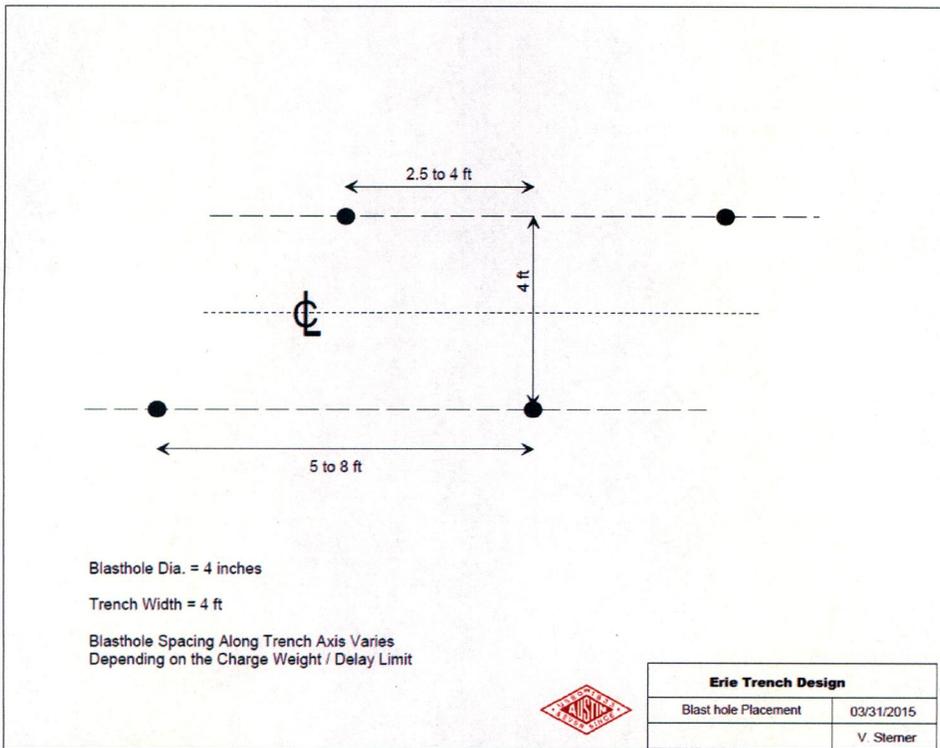
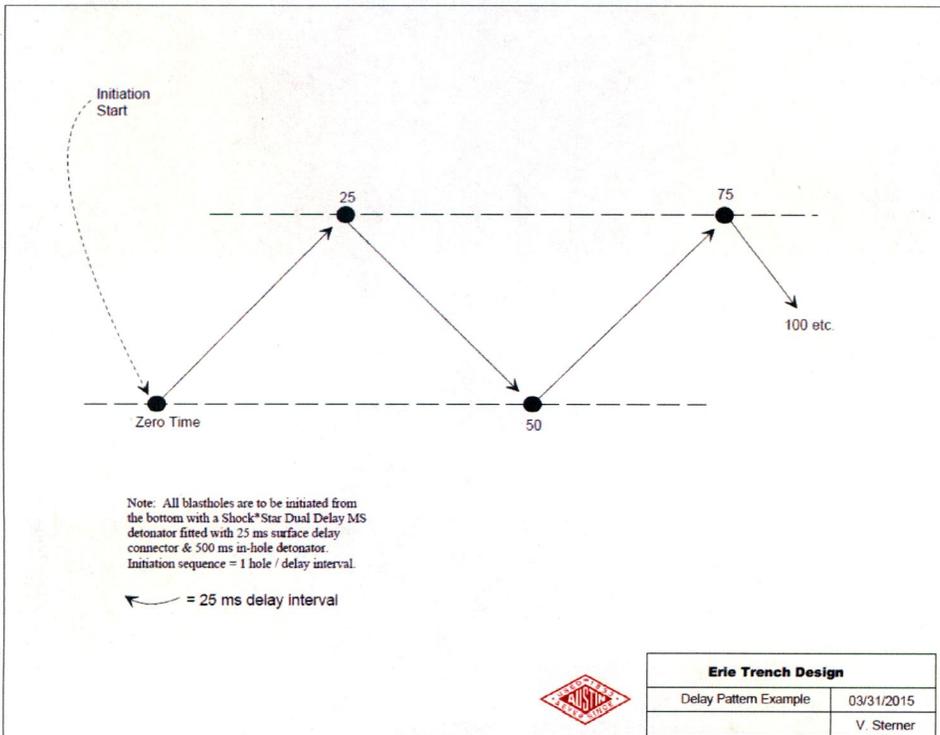


Figure 3. Trench Drill Pattern.



Note: the approximate trench depth will be 6 ft and the width will be approximately 4 ft.

Figure 4. Proposed Blasting Spacing and Delay Pattern.

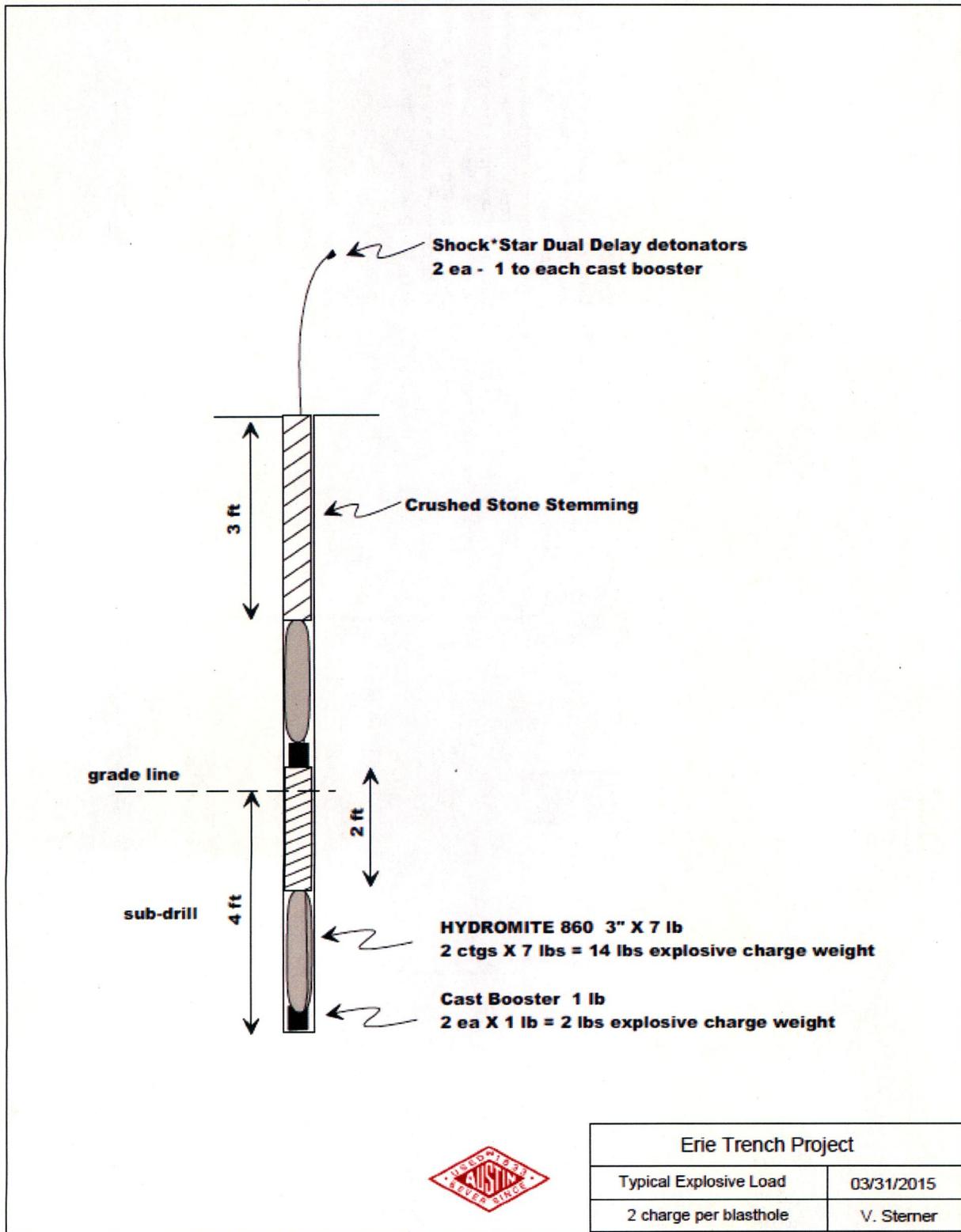


Figure 5. Typical Explosive Load.

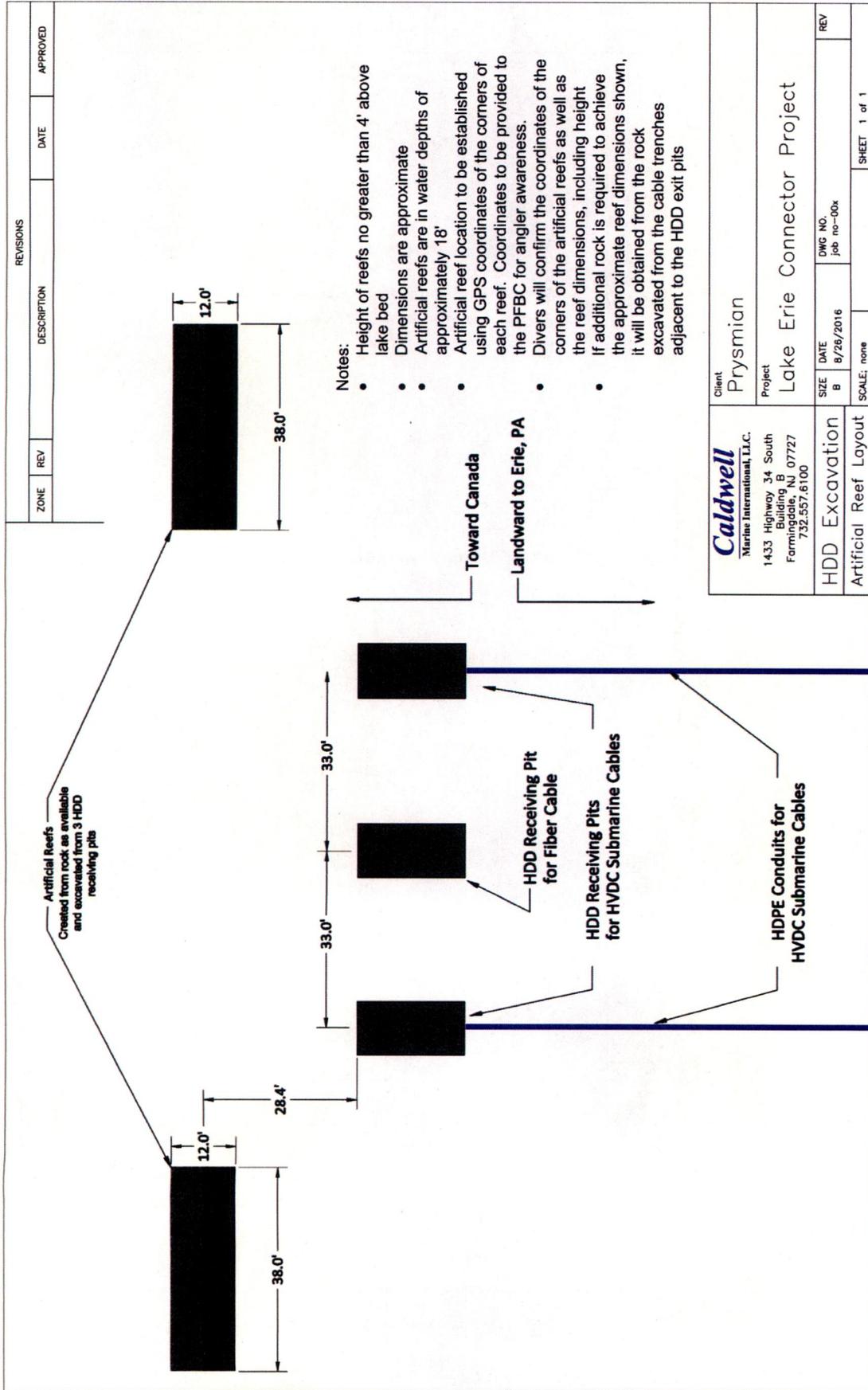


Figure 6. Conceptual Plan for Artificial Reefs.

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