Dispersal Barrier Efficacy Study

INTERIM IIIA – Fish Dispersal Deterrents, Illinois & Chicago Area Waterways Risk Reduction Study and Integrated Environmental Assessment

April 2010

US Army Corps
of Engineers ®
Chicago District

Executive Summary

The U.S. Army Corps of Engineers (USACE) was directed in the Water Resources Development Act 2007, Section 3061(b)(1)(D), to conduct a study of a range of options or technologies for reducing impacts of hazards that may reduce the efficacy of the Electrical Dispersal Barriers located on the Chicago Sanitary and Ship Canal (CSSC), hereafter referred to as the Efficacy Study. The Electrical Dispersal Barriers were designed to reduce the risk of inter-basin transfer of fish from the Mississippi River and Great Lakes drainage basins via the CSSC. It consists of three electrical barriers, Barrier I, IIA and IIB that comprise the Electrical Dispersal Barrier Project. Barriers I and IIA are constructed and in operation. Construction of Barrier IIB is scheduled to be completed in 2010.

As Asian carp have migrated steadily northward up the Illinois River, the threat of these species gaining access to Lake Michigan and the rest of the Great Lakes has become generally recognized by many in the environmental community and among numerous federal, state and local government agencies as having potentially significant ecological and economic consequences, although many uncertainties remain about the ability of Asian carp to establish in the Chicago Area Waterways (CAWS) and Great Lakes. These issues have been the topic of a number of recent Congressional hearings and the subject of a Supreme Court action.

USACE and its multi-agency partners are not waiting to develop one comprehensive approach for near-term solutions. Rather, in order to address the increasing sense of concern surrounding the migration of Asian carp close to Lake Michigan, and consistent with the Asian Carp Control Strategy Framework released by the inter-agency Asian Carp Regional Control Committee, the Efficacy Study is being conducted in a series of interim studies as USACE identifies potentially implementable technologies and actions to deploy in support of this multi-agency effort.

(1) *Interim I*, *Dispersal Barrier Bypass Risk Reduction Study and Integrated Environmental Assessment* – This interim report was approved by the Assistant Secretary of the Army for Civil Works (ASA (CW)) on 12 January 2010 to construct measures to prevent Asian carp from bypassing the electrical barrier system during flood events on the Des Plaines River and through culverts in the Illinois and Michigan (I&M) Canal. The USACE awarded a construction contract on 21 April 2010 for the construction of the bypass barrier. Construction of the bypass barrier is expected to be completed by 28 October 2010.

(2) Interim II, *Electrical Barrier Optimum Operating Parameters* - The USACE is currently operating the existing Electrical Dispersal Barrier System at the optimal parameters based on prior test results. Under Interim II, the USACE is conducting further testing to confirm these optimal parameters, and this testing is scheduled to be completed by 30 September 2010.

(3)Interim III, *Modified Structural Operations, Chicago Area Waterways Risk Reduction Study and Integrated Environmental Assessment* – This interim report is an on-going study to evaluate the potential for risk reduction that might be achieved through potential changes in the operation of the CAWS structures, such as locks, sluice gates, and pumping stations ,in consultation with the multi-agency working group. The report may include an assessment of operational changes that could be implemented to facilitate fish management efforts such as electro-fishing, spot piscicide application or intensive commercial fishing efforts under the

direction of the U.S. Fish and Wildlife (USFWS) and the Illinois Department of Natural Resources (IDNR). This report is scheduled to be finalized in June 2010.

(4) Interim IIIA, *Fish Deterrent Barriers, Illinois and Chicago Area Waterways Risk Reduction Study and Integrated Environmental Assessment* – This interim report is presented in this document.

(5) *Final Efficacy Report* - This report will provide a summary of all interim reports and recommend a multi-agency comprehensive strategy for improving the efficacy of the dispersal barriers and reducing the population effects of Asian carp within the area waterways. The report will evaluate additional risk reduction measures to specifically address the open pathways to Lake Michigan: the Grand Calumet River which outlets at the Indiana Harbor and Canal; and the Little Calumet River, which outlets at Burns Ditch. Near term efforts at population reduction of Asian carp will be carried out in cooperation with other agencies and concerned stakeholders. In all cases, permanent solutions to the inter-basin transfer of aquatic nuisance species will be evaluated in the longer term Great Lakes and Mississippi River Inter-Basin Study, (GLMRIS) which is underway.

Due to the perceived nature of the threat, USACE used an Interim Risk Reduction analysis, following an existing USACE process, to rapidly evaluate potential interim measures that could be used to mitigate unacceptable risks (USACE EC 1110-2-6064, Interim Risk Reduction Measures (IRRMs) for Dam Safety). While this expedited process was designed to evaluate dam structures, its concepts are applicable to other circumstances that require expedited development of solutions to reduce risk. The analysis identified four potential failure modes and then an analysis of alternatives was conducted to address ways to reduce risk and/or consequences associated with the failure modes.

At the outset of this process, USACE identified several existing technologies, used in other contexts that seemed to show promise for quick implementation at a relatively low cost. These technologies are acoustic deterrents, light deterrents, and bubble deterrents. USACE decided to evaluate whether and how these technologies might be used to enhance the efficacy of the electric barrier and to reduce the threat that a sustainable population of Asian carp could become established in the CAWS or in Lake Michigan. In the course of this evaluation, USACE determined that these technologies are more expensive and more time consuming to install and operate at appropriate parameters than first thought. While these technologies do show promise for use in the CAWS, they are not an immediate or inexpensive solution.

As discussed in this report, a measure combining an acoustic deterrent with an air bubble curtain and strobe lights (**ABS fish deterrent)** was judged to be the best available IRRM that has the potential to reduce the risk related to Asian carp migration in the CAWS when fully functional. The next stage of the analysis was an evaluation of potential locations for application of this demonstration technology as well as sites that would be appropriate to address the potential risk of Asian carp migration, through outlets from the CAWS to Lake Michigan. Eight locations were chosen as good candidate sites for placement of the recommended ABS fish deterrent measure. Three of these sites were downstream of the Electrical Dispersal Barrier and five were upstream of the current barrier in the CAWS and closer to Lake Michigan. These sites were as follows:

- Chicago Lock
- Chicago River at Throop Street
- Calumet River at TJ O'Brien Lock and Dam
- Little Calumet River at Calumet Sag Channel
- CSSC at Lockport Lock and Dam
- Des Plaines River at Brandon Road Lock and Dam
- Calumet Sag Channel at I&M Canal
- Dresden Island Lock and Dam

The Preferred IRRM consists of a demonstration ABS fish deterrent measure at the Des Plaines River at Brandon Road Lock and Dam. The ABS, demonstration fish deterrent measures has the potential to provide risk reduction when fully functional. Additional details on site selection and evaluation criteria are contained in Section 3.5.

The estimated cost for implementation of a demonstration ABS fish deterrent measure at the Des Plaines River at Brandon Road Lock and Dam is approximately $[redacted]. The cost estimate includes construction costs, lands, design, construction management, engineering during construction, and monitoring and sampling for the first 2 years of the demonstration project. The cost estimate includes a [redacted]% contingence, which is based upon an analysis of associated risks.

In addition to funding, the eight months currently estimated to complete the recommended plan once approved will require the construction authority provided by Section 126 of P.L. 111-85 to be extended beyond its October 28, 2010 expiration date, or the recommended plan to be otherwise authorized for construction.

This report includes an Environmental Assessment (EA) in compliance with the National Environmental Policy Act (NEPA) that assists with the planning and decision making. The EA provides environmental information and possible beneficial and adverse impacts of the proposed action available to the public and decision makers. The EA supports a Finding of No Significant Impact which concludes that an environmental impact statement is not required for this action.

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Acronyms

ABS – Acoustic-bubble-strobe light

ANS - Aquatic nuisance species

ASA(CW) - Assistant Secretary of the Army for Civil Works

ACRCC - Asian Carp Regional Coordinating Committee

CAWS - Chicago Area Waterways

CEQ - White House Council on Environmental Quality

CERCLIS – Comprehensive Environmental Response Liability Information System

CRCW - Chicago River Controlling Works

CSO - Combined Sewer Overflow

CSSC - Chicago Sanitary and Ship Canal

EA - Environmental Assessment

I&M Canal - Illinois and Michigan Canal

IDNR - Illinois Department of Natural Resources

IWW - Illinois Waterway

EA – Environmental Assessment

FPDCC - Forest Preserve District of Cook County

GLFC - Great Lakes Fishery Commission

GLMRIS - Great Lakes and Mississippi River Inter-Basin Study

IRRM - Interim Risk Reduction Measure

MGP - Manufactured Gas Plant

MNDNR - Minnesota Department of Natural Resources

MRRWG - Monitoring and Rapid Response Work Group

MOU - Memorandum of Understanding

MWRDGC - Metropolitan Water Reclamation District of Greater Chicago

NEPA - National Environmental Policy Act

PDT - Project Development Team

PED - Planning, Engineering and Design

TARP - Tunnel and Reservoir Project

USACE - U.S. Army Corps of Engineers

USCG - United States Coast Guard

USEPA - United States Environmental Protection Agency

USFWS - U.S. Fish and Wildlife

USGS - United States Geological Survey

WWTP – Waste Water Treatment Plant

CHAPTER 1 – Introduction

1.1 – Dispersal Barrier Efficacy Study Purpose

The U.S. Army Corps of Engineers (USACE) was directed in Section 3061(b)(1)(D) of the Water Resources Development Act of 2007 (WRDA 2007), to conduct a study (the Efficacy Study) of a range of options or technologies for reducing impacts of hazards that may reduce the efficacy of the Electrical Dispersal Barrier located on the Chicago Sanitary and Ship Canal (CSSC). , The Electrical Dispersal Barrier was designed to reduce the risk of inter-basin transfer of fish from the Mississippi River and Great Lakes drainage basins via the CSSC, and it has been partially completed.

The first dispersal barrier was authorized as a demonstration project under Section 1202(i)(3) of the Aquatic Nuisance Prevention and Control Act P.L. 101-646. , and Barrier I has been in operation since April 2002. The second dispersal barrier, Barrier II, was initially authorized by Section 1135, WRDA 1986 P.L. 99-662, as modified by Section 345 of the District of Columbia Appropriations Act of 2005 P.L. 108-335. Barrier II is a set of two barriers, Barrier IIA and Barrier IIB. Barrier IIA has been in operation since April 2009 and Barrier IIB is under construction and is scheduled for completion in 2010. The combination of these three barriers is designed to reduce the risk of inter-basin transfer of fish from the Mississippi River and Great Lakes drainage basins. Any additional Interim Risk Reduction Measures (IRRMs) implemented as a result of this study will potentially complement the electrical dispersal barriers and these additional measures will be operated collectively as a system when fully functional.

Although the electric dispersal barrier system is designed to prevent the movement of any fish species through the CSSC, the current species of greatest concern are two species of Asian carp (Cypriniformes: Cyprinidae). Asian carp have the potential to damage the Great Lakes and confluent large riverine ecosystems. Two species of Asian carp, bighead carp (*Hypophthalmichthys nobilis*) and silver carp (*H. molitrix)*, have become well established in the Mississippi and Illinois Rivers exhibiting exponential population growth in recent years. Certain life history traits have enabled bighead and silver carp to achieve large population numbers soon after establishing a reproducing presence in an area.

The USACE is implementing a four-pronged strategy to address the propagule pressure these two target species of Asian carp may be placing on the Electrical Dispersal Barrier. Propagule pressure is defined by the number and quality of invading organisms. Because propagule pressure is considered to be directly proportional to the success of invasions, “Minimizing the number of invading individuals is key to preventing the successful establishment of a species” (Chapman, 2010). The purpose of this Interim report is to evaluate whether modifying the operation of locks, gates, pumping stations and other structures within the Chicago Area Waterways (CAWS) and the Illinois Waterway (IWW) could be effectively applied to minimize the risk of Asian carp dispersal into Lake Michigan. The strategy is consistent with the February 2010 *Draft Asian Carp Control Strategy Framework*, developed by the Asian Carp Workgroup, which includes the United States Environmental Protection Agency (USEPA), the United States Fish and Wildlife Service (USFWS), the United States Coast Guard (USCG), the Illinois Department of Natural Resources (IDNR), the City of Chicago, the Metropolitan Water Reclamation District of Greater Chicago (MWRD), the White House Council on Environmental Quality (CEQ), the United States Geological Survey (USGS), the Great Lakes Fishery Commission

(GLFC) and the USACE. Operating within this framework, USACE is executing a four-pronged strategy consisting of:

(1) operation, maintenance, and improvement of the Electrical Dispersal Barrier;
(2) monitoring for the potential presence of Asian carp;
(3) using the Efficacy Study process to recommend additional measures to reduce the risk that Asian carp could establish a sustainable population that threatens Lake Michigan; and,
(4) using the Great Lakes and Mississippi River Inter-Basin Study to develop long term solutions.

The Efficacy Study is being conducted and documented in a series of interim studies and associated reports:

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Indiana Harbor and Canal; and the Little Calumet River, which outlets at Burns Ditch. Near term efforts at population reduction of Asian carp will be carried out in cooperation with other agencies and concerned stakeholders. In all cases, permanent solutions to the inter-basin transfer of aquatic nuisance species will be evaluated in the longer term Great Lakes and Mississippi River Inter-Basin Study, (GLMRIS) which is underway.

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In collaboration with Federal, State and local agencies as well as nongovernmental entities USACE is conducting a Feasibility Study of the long-term options and technologies that could be applied to prevent or reduce the risk of aquatic nuisance species (ANS) transfer between the Great Lakes and Mississippi River basins through aquatic pathways, where aquatic pathways are defined as natural and manmade hydraulic connections between the Great Lakes and Mississippi River basins. The Great Lakes and Mississippi River Interbasin Study (GLMRIS) Feasibility Study will provide a thorough and comprehensive analysis of these Aquatic Nuisance Species (ANS) controls. Additionally, GLMRIS will analyze the affects each alternative plan would have on the current uses of the CAWS, including the CSSC, and other identified aquatic pathways between the GL and MR basins. Interim I of GLRMIS will specifically address the CAWS. The report will include evaluations of all current uses of the waterway and Lake Michigan including: commercial and recreational fishing, commercial navigation, small boat navigation, flood risk management, municipal and industrial water supplies, hydropower, and water quality diversion. The study shall also address the need to mitigate or provide alternative facilities or measures for current uses that may be affected by study recommendations.

This report presents the results of the Interim IIIA study. The report consists of seven (7) parts including a main report and six appendices with figures and tables. The report is structured as follows:

- Main Report and Integrated Environmental Assessment and Plates
- Appendix A – Civil Design
- Appendix B – HTRW Assessment
- Appendix C – Cost Engineering
- Appendix D – Planning Information
- Appendix E – Coordination
- Appendix F – Real Estate

1.2 – Study & Implementation Authorities

Two statutory authorities are relevant to the measures considered in this report. The first is Section 3061(b)(1)(D) of the Water Resources Development Act of 2007 (P.L. 110-114) which is a study authority only. This authority does not authorize implementation of any Efficacy Study

recommendations. The second authority is from Section 126 of the Energy and Water Appropriations Act of 2010 (P.L. 111-85) which provides authority to implement recommendations from the Interim Efficacy Reports. The Section 126 authority expires on October 28, 2010. These two authorities are quoted below.

WRDA 2007 SEC. 3061. CHICAGO SANITARY AND SHIP CANAL DISPERSAL BARRIERS PROJECT, ILLINOIS.

(a) TREATMENT AS SINGLE PROJECT.—The Chicago Sanitary and Ship Canal Dispersal Barrier Project (in this section referred to as ''Barrier I''), as in existence on the date of enactment of this Act and constructed as a demonstration project under section 1202(i)(3) of the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (16 U.S.C. 4722(i)(3)), and the project relating to the Chicago Sanitary and Ship Canal Dispersal Barrier, authorized by section 345 of the District of Columbia Appropriations Act, 2005 (Public Law 108–335; 118 Stat. 1352) (in this section referred to as ''Barrier II'') shall be considered to constitute a single project.

(b) AUTHORIZATION.—

(1) IN GENERAL.—The Secretary, at Federal expense, shall—

(A) upgrade and make permanent Barrier I;

(B) construct Barrier II, notwithstanding the project cooperation agreement with the State of Illinois dated June14, 2005;

(C) operate and maintain Barrier I and Barrier II as a system to optimize effectiveness;

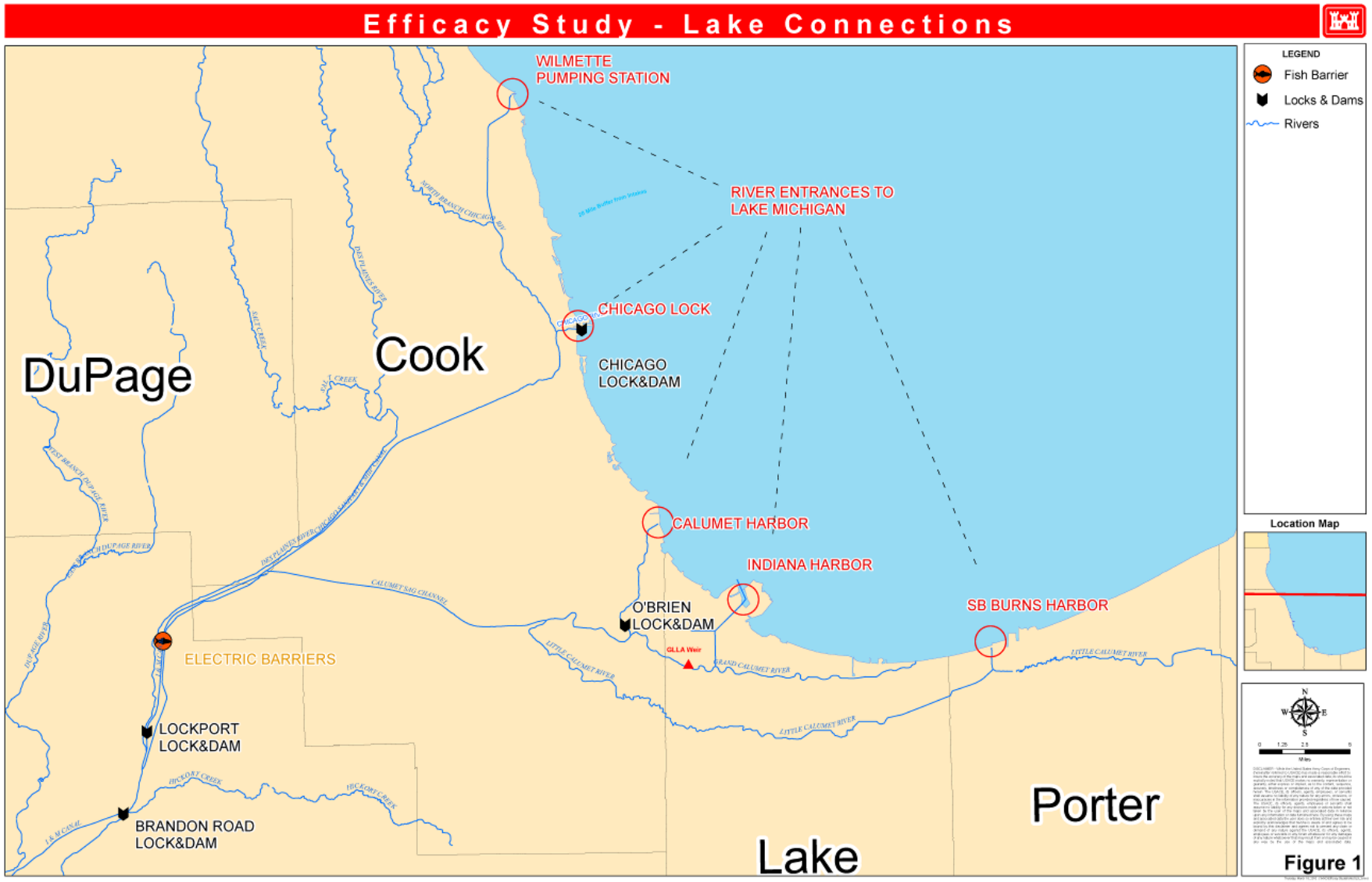
(D) conduct, in consultation with appropriate Federal, State, local, and nongovernmental entities, a study of a range of options and technologies for reducing impacts of hazards that may reduce the efficacy of the Barriers; and

(E) provide to each State a credit in an amount equal to the amount of funds contributed by the State toward Barrier II.

Energy and Water Development and Related Agencies Appropriation Act 2010. SEC. 126

During the 1-year period beginning on the date of enactment of this Act, the Secretary of the Army shall implement measures recommended in the efficacy study, or provided in interim reports, authorized under section 3061 of the Water Resources Development Act of 2007 [121 Stat. 1121] with such modifications or emergency measures as the Secretary of the Army determines to be appropriate, to prevent aquatic nuisance species from bypassing the Chicago Sanitary and Ship Canal Dispersal Barrier Project referred to in that section and to prevent aquatic nuisance species from dispersing into the Great Lakes.

Figure 1 - Map of the IWW and CAWS with Key Points of Interest

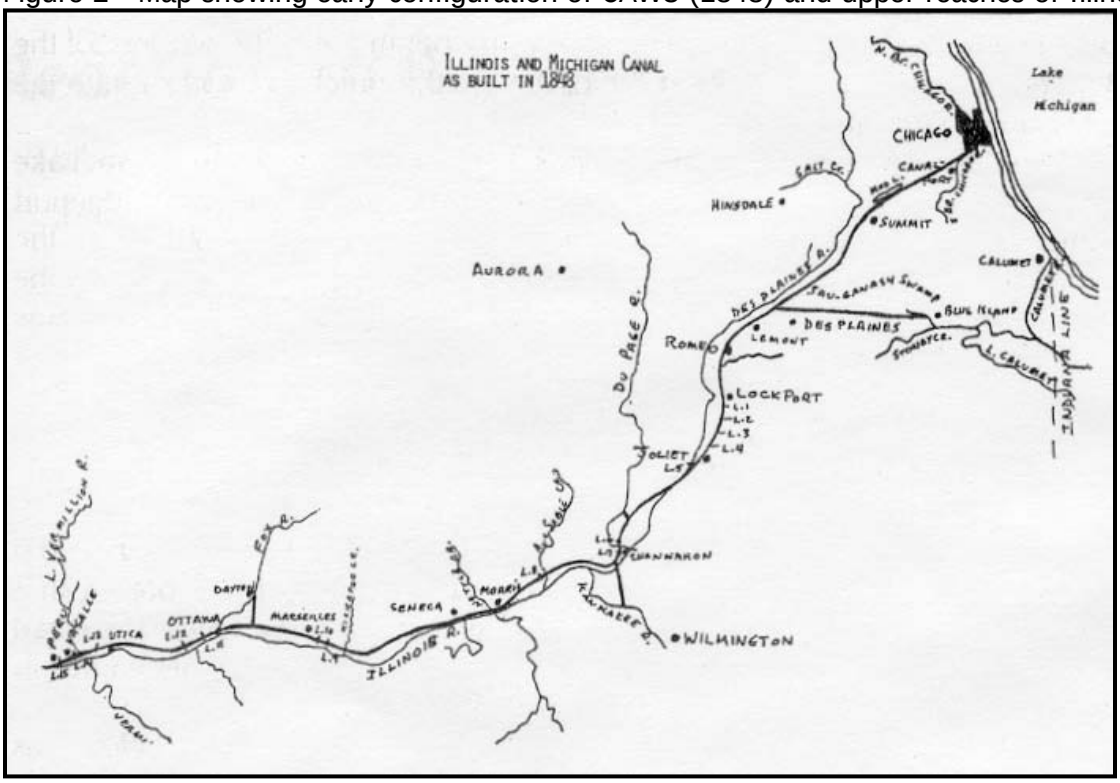


1.3 – Study Background

Prior to anthropogenic intervention, the Chicago and Calumet Rivers were essentially wetland complexes that sluggishly flowed east into Lake Michigan. The Des Plaines River naturally flowed west into the Mississippi River drainage. There were periods of high flow when the Des Plaines River changed its course and flowed into the Chicago and Calumet Rivers due to the relatively flat topography of the region. Two critical locations existed, referred to as hydraulic divides, and known as Mud Lake and Saganashkee Slough. Sporadically, during spring floods, Mud Lake and the Saganashkee Slough would overflow into the West Fork of the South Branch of the Chicago River near Kedzie Avenue and the Little Calumet River near Blue Island. This flow reversal provided a temporary connection between the respective drainage basins. The following description of the development of the CAWS illustrates the significant investments in the growth of the City of Chicago over the past 150 years to convert these natural waterways toward multiple human purposes associated with navigation and commerce, sanitary waste water management and recreation.

The economic opportunity provided by this natural occurrence was seized in 1848 with the completion of the Illinois and Michigan (I&M) Canal (Figure 2). The dimensions of the original I&M Canal were 60-feet wide at the surface, 36-foot wide at the base, and 6-feet deep. Immediately after, in the spring of 1849, the Little Calumet River was connected to the Illinois and Michigan Canal via a 40-foot wide and 4-foot deep Calumet Feeder Canal, which ditched through the Saganashkee Slough. The I&M Canal gave way to a much larger Sanitary and Ship Canal started in 1892 that connected Lake Michigan with the Illinois Waterway. The permanent connection between the Lake Michigan and the Mississippi drainage was finalized with the completion of the Sanitary and Ship Canal in 1900. On the Calumet River, the Corps of Engineers removed sandbars and built piers at the mouth during 1870-1882; between 1888-1896 the river between Lake Michigan and Lake Calumet was straightened; between 1899 and 1916 the Calumet River was dredged to a depth of 16 feet; between 1911-1922 the Calumet Feeder Canal was obliterated by the construction of the Cal-Sag Channel, which was incised through a vast and unique dolomite prairie, formerly the Saganashkee marshland. With the completion of joining the Cal-Sag Channel with the Calumet River, the Calumet Region's drainage was reversed; and in 1961 the Calumet River was completely reversed by the construction of the O'Brien lock and dam near the original confluence with Lake Michigan. The I&M Canal is no longer in operation.

Figure 2 - Map showing early configuration of CAWS (1848) and upper reaches of Illinois River.



Since the creation of the canal system, poorly treated wastewater, low dissolved oxygen concentrations, high ammonia concentrations and other contaminants formed an effective "barrier" not only to colonization of the canal by native pioneer species, but to introduced species as well. Significant improvements in water quality over the last two decades have allowed the aquatic conditions in the canal to become suitable for native and introduced species of the tolerant sort, which both share pioneering attributes.

There was inter-basin transfer of aquatic species between the Mississippi River and the Great Lakes naturally in the past after various glaciation and major flood events, which naturally drives speciation and biogeography; however the man-made connection in conjunction with non-native species introduction (both accidentally and purposefully) poses a great threat to these processes. This was first realized for fish in the early 1990s when the introduced eastern European *Neogobius melanostomus* round goby and the Atlantic slope *Morone americana* white perch were found in southern Lake Michigan. In an effort to contain their range expansion, the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 P.L. 101-646 as amended by the National Invasive Species Act of 1996 P.L. 104-332, authorized the Assistant Secretary of the Army for Civil Works (ASA(CW)) to examine potential methods to create an aquatic nuisance species dispersal barrier in the CSSC. In November 1997, Congress appropriated $500,000 to begin work on the project. In April 2002, the electrical barrier was turned on in an attempt to prevent fishes from dispersing to and from the Great Lakes and Mississippi River basins after nearly 140 years of unnatural nexus. This dispersal barrier complex located at river mile 296.25 in the CSSC was to be the first stop gap measure to prevent the spread of aquatic nuisance species (ANS) species. Unfortunately, the round goby and white perch dispersed faster than anticipated and were well past the dispersal barrier site by the time construction was able

to commence. The decision to construct the barriers was prudent since a new threat was imminent from the Mississippi River system – the silver and bighead carps.

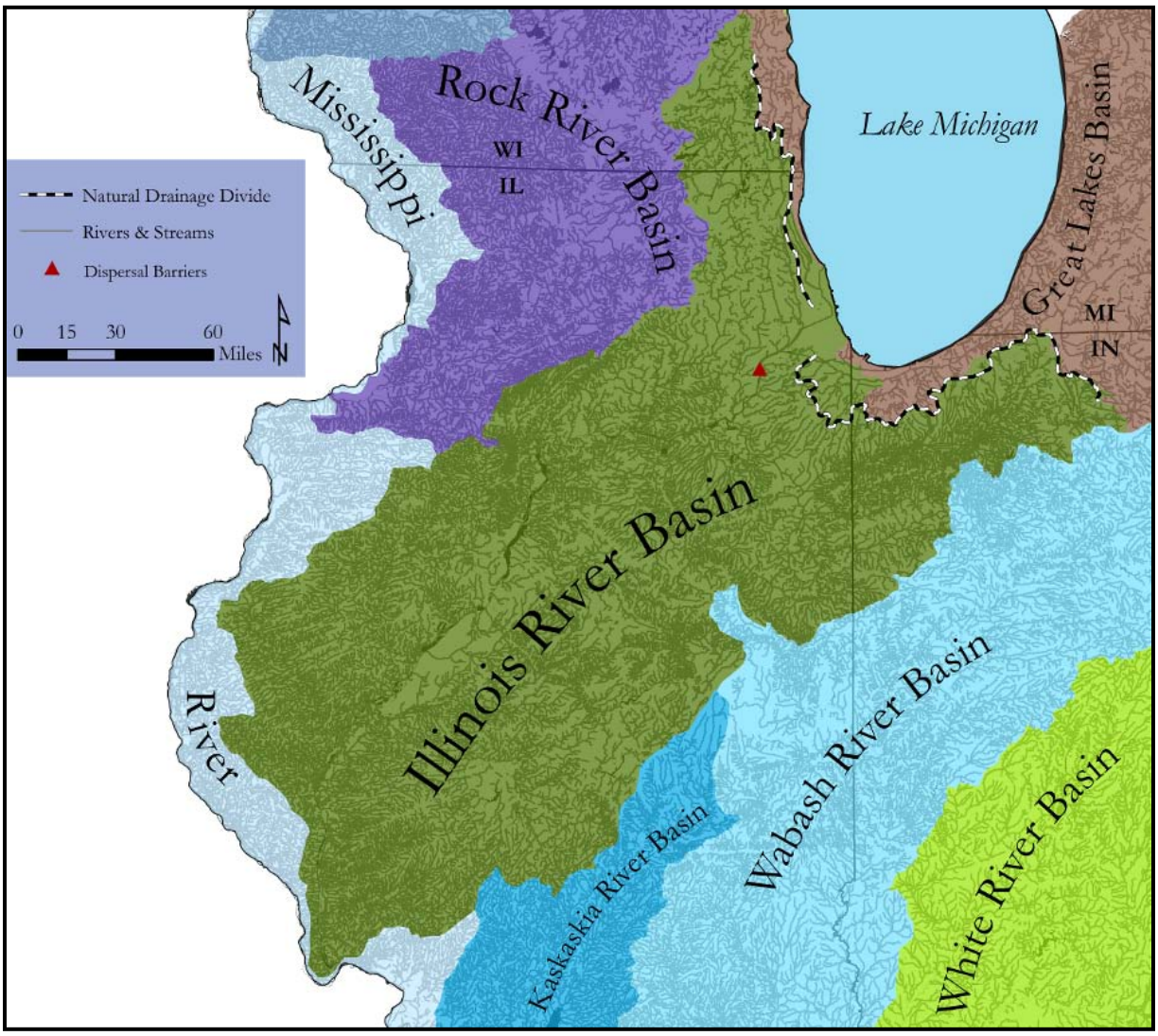
A number of government and non-governmental organizations led by the USFWS contributed to the report, *Management and Control Plan for Bighead, Black, Grass, and Silver Carps in the United States*, dated October 2007. Due to heightened concern about the target species in the Great Lakes, the Asian Carp Workgroup comprised of Federal and State agencies is working collaboratively to bring their particular authorities and knowledge together to reduce the threat of Asian carp establishment in the Great Lakes. The group prepared the Draft Asian Carp Control Strategy Framework (referred to hereafter as the Framework) to document actions already undertaken and to identify potential courses of action to be implemented in both the near and short term. The actions outlined in the Framework, such as ongoing electro-fishing and netting and potential rotenone applications by our multi-agency partners, provides the context for the analysis in this report. The actions in the Framework have been divided into three categories, and there is a workgroup established for each. The categories are: (1) Invasion Control, (2) Monitoring and Rapid Response, (3) Communication and Outreach.

The Framework is designed to establish a plan for action to prevent Asian carp from becoming established in the Great Lakes; to integrate and unify the impending actions of the participating agencies; and to facilitate cooperation by additional agencies. It also serves to identify lead agencies for particular actions.

1.4 – General Study Area

The regional study area for the fish dispersal system includes the Mississippi River and Great Lakes Basins, the IWW and the CAWS (See Figures 1 and 3). The general vicinity of the study area includes reaches of the CSSC, lower Des Plaines River, I&M Canal, Calumet Sag Channel, Calumet River, Little Calumet River, Grand Calumet River, Chicago River, South Branch Chicago River, North Branch Chicago River and North Shore Channel. The study area is in all or part of Cook, Du Page, Lake and Will Counties in the metropolitan Chicago area in Illinois, and in Lake County, Indiana. The electric Dispersal Barriers Project is located at river mile 296.25, roughly 0.2 miles or 1300-feet upstream of the 135th Street Bridge in Romeoville, IL (Figure 3 & Plate 01). The electric Dispersal Barriers Project site lies in the southeast ¼ of the southwest ¼ of section 35, T37N R10E, Lockport Township, in Will County.

Figure 3 - Efficacy Report Study Area and adjacent watersheds.



1.5 – Existing Projects

Illinois Waterways

The Illinois Waterways, including the CAWS, provide a hydraulic connection between Lake Michigan and the Mississippi River. Natural flow regimes were modified through a series of engineered projects to establish the existing configuration of the waterways. Modifications occurred over the past 100+ years to accommodate the needs of regional and local interests. Modifications included channel construction, lock and dam construction, and operation and maintenance activities. Presently, navigation is affected by maintenance of sufficient water levels in pools behind the dams, operation of locks to pass boat and barge traffic at the lock and dam sites, dredging in certain areas to maintain channel depth, and clearing and snagging to keep the channel clean. The formal authorization for the USACE to perform operation and

maintenance activities on the Illinois Waterway was given in the Rivers and Harbors Act of 1927, 1930, and 1935, (P.L. 69-560, 71-520, and 74-409).

The Illinois Waterways include the Chicago, Des Plaines, and Illinois Rivers, plus numerous canals, in particular the Calumet Sag Channel and the navigable portions of the Little Calumet and Calumet Rivers. The completion of the I&M Canal linking Lake Michigan to the Illinois River was completed in 1848. In 1900, the upper end of the I&M Canal was replaced as far south as Lockport by the CSSC which, in addition to providing sanitation, was available for navigation. In 1922, the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) completed the construction of the Calumet Sag Channel for the purpose of preventing pollution of Lake Michigan by reversing the flow of the Calumet River. Today the Illinois Waterway is completely navigable with a minimum depth of nine feet over its stretch of 350-miles for commercial navigation to near Alton, IL. The physical components of the navigation system are the eight sets of locks, seven with accompanying dam structures, and the navigation channel.

The CAWS consists of 78 miles of canals and modified streams located within Cook and surrounding counties. The CAWS consists of the Chicago River, its two main branches (North Branch and South Branch), as well as the Calumet Sag Channel, the Chicago Sanitary and Ship Canal, and the tributaries in an area extending from the metropolitan Chicago area to the Lockport vicinity. It also includes Lake Calumet.

The diversion of water from Lake Michigan is closely regulated. Water is diverted for numerous purposes including water supply, navigation makeup and water quality. Currently, the Lake Michigan diversion accountable to the state of Illinois is limited to 3,200 cfs over a forty- year averaging period. The measurement of the quantity of Lake Michigan diversion water and the method for accounting are specified in the U.S. Supreme Court Decree and in a 1996 Memorandum of Understanding (MOU) between the U.S. Department of Justice and eight states bordering the Great Lakes. The Illinois Department of Natural Resources (IDNR) controls and regulates Lake Michigan diversion water. The USACE is responsible for computing the annual Illinois Lake Michigan diversion and preparing an annual diversion report for IDNR.

Chicago Lock – The Chicago Lock, also known as the Chicago Harbor Lock is situated at the mouth of the Chicago River (Plate 02). This lock is the primary controlling mechanism of the Illinois Waterway separating Lake Michigan from the Chicago River. The current lock was designed and built by the Sanitary District of Chicago (now the Metropolitan Water Reclamation District of Greater Chicago). An unusual aspect of the Chicago Lock is its use of sector gates, a gate type normally used in tidal reaches of rivers and canals.

The Chicago Lock complex is comprised of a lock chamber, concrete guide walls, and a lock control house. The lock chamber measures 600-feet long, 80-feet wide, and 22.4-feet deep and is equipped with two sets of rotating double-leaf sector gates (one set at each end). Sector gates resemble traditional miter gates, except each gate is shaped like a pie-sliced sector of a cylinder oriented to rotate about a vertical axis. This form of lock system does not utilize valves, sluices or culverts.

Also located at the Chicago Lock is the Chicago River Controlling Works (CRCW). The CRCW consists of two sets of four sluice gates. Each gate has a 10' x 10' opening.

The Chicago Lock/CRCW has three primary functions. First it serves as a hydraulic gateway between the Chicago River and Lake Michigan. Used by more than 40,000 commercial and recreation vessels a year, this is the second-busiest navigational lock in the United States. The lock and CRCW also plays a role in reducing pollution, by letting controlled quantities of lake water into the Chicago River for water quality purposes. Lastly, the lock and CRCW functions as flood control releasing excess water from the Chicago River into the lake during periods of extreme high water.

TJ O'Brien Lock and Dam – The Thomas J. (T.J.) O'Brien Lock and Dam is 326.0 miles above the confluence of the Illinois River with the Mississippi river at Grafton, Illinois (Plate 04). It is approximately 35 miles upstream of the Lockport Lock and Dam, in the southeastern portion of Chicago. T.J. O'Brien is located seven miles southwest from the entrance to Lake Michigan along the Calumet River. . The facility is a unit of the Inland Waterway Navigation System and is one of eight such facilities between Chicago and Versailles, IL. It is composed of a navigational lock, fixed dam, and controlling works.

O'Brien is a low-lift sector gate lock. It provides a maximum lift of five feet for traffic passing from Lake Michigan to the Calumet River. The lock chamber is 1,000-feet long by 110-feet wide. The dam is 296.75 feet long. The controlling works consist of four large vertical slide gates (10 feet square) located near the center of the dam to regulate water flow. There are also two sets of sector gates weighing 216 tons each at both the river and lake ends. These are unique on the Illinois Waterway and; consequently, there is no need for tunnels in the lock walls. T.J. O'Brien Lock and Dam and controlling works control the movement of water between Lake Michigan and the Calumet River while maintaining navigation. The controlling works are used for flood control and water quality diversion.

Lockport Lock and Dam –The Lockport Lock and Dam is 291.0 miles above the confluence of the Illinois River with the Mississippi River at Grafton, IL (Plate 06). The complex is two miles southwest of the city of Lockport, Illinois. The lock opened in 1933. The lock is 110 feet wide by 600 feet long. Maximum vertical lift is 42.0 feet; the average lift is 39 feet. It averages 22.5 minutes to fill the lock chamber; 15 minutes to empty.

Lockport Lock was one of five designed and partially constructed by the state of Illinois over a period from 1923 to 1930. The complex was about 97 percent complete when construction was turned over to the federal government due to state financial difficulties. The USACE controls the lock at Lockport. The Lockport Dam consists of the MWRDGC lock, powerhouse and associated controlling works. The USACE has no ownership of the controlling works; however, it has the responsibility to maintain the foundation, piers, dolphins and all the concrete at the Lockport Controlling Works and the gravity structure at the dam. This dam serves the multiple purposes of power generation, flood control, and navigation. The role of the controlling works is primarily to control flooding due to large rainfall events. North of Lockport the CSSC lies between high retaining walls backed by earth embankments with the level of the canal being above the level of the surrounding terrain. The dam is a 260 foot long dam, which contains 15 gate openings. Eight of the gate openings have never been used and are sealed with concrete bulkheads. The seven remaining gates are equipped with 30 foot wide by 20 foot high vertical lift sluice gates. The gates are operated with a 3HP Electrical drive mechanism and counterweight.

Brandon Road Lock and Dam – Brandon Road Lock and Dam is 286 miles above the confluence of the Illinois River with the Mississippi river at Grafton, Illinois (Plate 07). The complex is located 27 miles southwest of Chicago; 2 miles southwest of Joliet, Illinois, near Rockdale. Brandon Road Dam, located on the Des Plaines River just below the city of Joliet, Illinois, is a fixed concrete structure, 1,569 feet long. The height of the pool and discharge past the dam are controlled by twenty-one 50-foot tainter-type crest gates which hold the normal pool 27 inches above the crest of the masonry. Six openings through the dam, previously controlled by sluice gates, have been sealed and are no longer used. A 320-foot section of head gates which was designed for future addition of a powerhouse contains eight operating head gates used for passing water. An ice chute and two sections of earth embankment complete the dam. The major portion of the short pool is the city of Joliet and is in part contained between flood walls varying in height to a maximum of 35 feet.

The lock is 600 feet long, 110 feet wide. Nominal lift is 34 feet with an average 19-minute lock chamber fill time; 15-minute emptying time. The dam is 2,391 feet long (exclusive of fixed embankment and river wall). It contains 21 operational Tainter gates (50 feet wide by 2 feet, 3-1/2 inches high), six sluice gates (7 feet, 9 inches wide x 8 feet, five inches high, bulkheaded closed), and 16 pairs of 16 feet high by 15 feet wide headgates (eight operational, eight bulkheaded closed). The lock opened in 1933 and was one of five designed and partially constructed by the state of Illinois over a period from 1927 to 1930. The complex was about 70 percent complete when construction was turned over to the federal government due to state financial difficulties.

Dresden Island Lock and Dam –Dresden Island Lock and Dam is 271.5 miles above the confluence of the Illinois River with the Mississippi river at Grafton, Illinois (Plate 09). The complex is 1-1/2 miles downstream from the mouth of the Kankakee River and about 15 miles southwest of Joliet, Illinois. The Lock and Dam consist of a gated concrete gravity dam. The total length of the lock and dam between abutments is about 1,320 feet. Lock dimensions are 110 feet wide by 600 feet long with a maximum lift of 22 feet. Average filling time of the lock chamber is 14 minutes; 12 minutes emptying time. The dam consists of an arch dam section, a fixed spillway section, nine Tainter gates (60 feet wide by 17 feet high), 18 plugged headgates, and a 500-foot-long earthfill section with steel sheet pile cut-off wall connecting the headgate section to I & M Canal embankment.

The lock opened in 1933. Dresden Island Lock and Dam was one of five designed and partially constructed by the state of Illinois over a period from 1928 to 1930. Excavation and masonry work began in December 1928. The complex was about 35 percent complete when construction was turned over to the federal government due to state financial difficulties.

Wilmette Pumping Station – The Wilmette Pumping Station is located on the North Shore Channel, approximately 1500 feet from the open waters of Lake Michigan. The pump house forms a part of the structure of the Sheridan Road Bridge over the North Shore Channel in the City of Wilmette. The purpose of the pumping station is to control the movement of water between Lake Michigan and the North Shore Channel. The pumping station is also used for flood control and water quality diversions.

The Wilmette Pumping Station consists of a pump house and a large sluice gate. The sluice gate is located on the channel side south of the pump station is used to control the diversion of

water from Lake Michigan. The sluice gate is 32 feet wide by 16 feet high. The pump house consists of four pumps housed in individual bays fronted by trash racks, with flap gates at the downstream end of each bay to prevent backflow.

Other Structures and Outfalls: – The remainder of the Illinois Waterway has 4 additional navigation structures known as Marseilles Dam (RM 246), Starved Rock Dam (RM 230) Peoria Dam (RM 158), and LaGrange Dam (RM 80)

There are two major types of outfalls into the CAWS: WWTP /industrial discharge outfalls and Combined Sewer Overflow (CSO) outfalls. There are four Waste Water Treatment Plants (WWTPs) that discharge into the CAWS. The four plants are Stickney, North Side, Calumet and Lemont. Normal long term (firm) capacity and short-term (peaking) capacity for each of the four plants is as follows: Stickney 1200 mgd and 1400 mgd; North Side 333 mgd and 450 mgd Calumet 354 mgd and 430 mgd; and, Lemont 2.3 mgd and 4 mgd. The permitted industrial discharge outfalls return the non-contact cooling, treated process water, and wastewater back to the waterway. The CSO outfalls relieve overload of the sewer network and the waste water treatment plants primarily during major storm events. There are more than three hundred CSO outfalls owned by the City of Chicago, MWRDGC, and local municipalities in the northeastern Illinois. Not all outfalls into the CAWS are permitted.

Chicago Sanitary & Ship Canal, Dispersal Barrier I

The CSSC's first dispersal barrier (Barrier I) was implemented as a demonstration project under authority granted by the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, P.L. 101-646, as amended by Section 2309 of the Emergency Supplemental Appropriations Act for Defense, the Global War on Terrorism and Hurricane Recovery, 2006, P.L. 109-234. Barrier I consists of an array of DC electrodes which were installed on the channel bottom of the CSSC. When power is provided, an electrical field is created within the water that repels fish in order to prevent or reduce the dispersal of fish between the Great Lakes and the Mississippi River drainage basins. Barrier I is located approximately at river mile 296.25 about 1,000 feet from Barrier II. Barrier I was turned on in April 2002.

Chicago Sanitary & Ship Canal, Dispersal Barrier II

The second dispersal barrier (Barrier II) on the CSSC was initially implemented by the Corps under the Section 1135 program of the Water Resources Development Act of 1986, P.L. 99-662, as further authorized in Section 345 of the District of Columbia Appropriations Act, 2005, P.L. 108-335 and Section 3061(b)(1)(B) of WRDA 2007, P.L. 110-114. This second permanent dispersal barrier was determined to be necessary to provide continued protection against fish. Barrier II is also an Electrical field barrier, but includes design improvements identified during monitoring and testing of the demonstration barrier. Barrier II is being constructed in two phases, IIA and IIB. The first phase consists of construction of two underwater electrode arrays and one control house. This control house is able to operate one of the two arrays. Barrier IIA has been constructed and was placed in operation in 2009. The second phase consists of construction of a second control house that will allow both arrays to be operated as a system. Barrier II is located at approximately river mile 296.25, about 1000 feet from Barrier I. Barrier IIA was turned on in April 2009 and Barrier IIB is under construction and is scheduled to be

completed in 2010. No bighead or silver carp have been documented to be challenging the Electrical Dispersal Barrier as of yet.

1.6 –Assessing Asian Carp Migration

As Asian carp have migrated steadily northward up the Illinois River, the threat of these species gaining access to Lake Michigan and the rest of the Great Lakes is of concern to many in the environmental community as well as to numerous federal, state and local government agencies. There is a potential for significant ecological and economic consequences, although many uncertainties about the ability of Asian carp to establish a sustainable population in the CAWS and Great Lakes remain. These issues have been the subject of recent Congressional hearings and a Supreme Court action. The following is a brief summary of the current circumstances, which are more fully explained in the draft Framework and in the various declarations submitted by various agencies to the Supreme Court. (Chapter 6, References, for link to USACE, USGS, FWS, IDNR Supreme Court declarations).

As part of a comprehensive review in the fall of 2008, USACE assessed the full suite of methods available to locate and monitor Asian carp as they migrated up the Illinois River. These fish sampling tools were evaluated for their ability to deliver a high level of confidence that USACE could locate the leading front of the migrating fish. USACE concluded that the available tools, principally all forms of netting (seine, gill, pound, etc.) and electro-fishing conducted primarily by partner agencies, could effectively locate Asian carp when the populations are high, but they were not necessarily effective in locating the fish when population numbers were low. Because the migratory front of fish is comprised of a few rapidly moving individuals, traditional sampling methods do not provide a good indication of their presence, and consequently additional technologies were investigated.

A technique developed by researchers at the University of Notre Dame referred to as environmental DNA (eDNA) analysis is presently the most sensitive technology available to detect the possible presence of the silver and bighead carp in the aquatic environment. In August 2009, identification of Asian carp eDNA in the Brandon Road pool, which is just over 6 miles downstream of the Dispersal Barriers, triggered the Corps' decision to increase the electrical output of Barrier IIA, although live bighead and silver carp had not yet been visually identified in that location. On November 17, 2009 Asian carp eDNA was detected in the Cal-Sag Channel and Calumet River near the O'Brien Lock, in three areas ranging from 10 to 30 miles upstream of the Electrical Dispersal Barriers. An intensive fishing effort followed and although over 1,000 fish were caught near the O'Brien Lock, none of them were the target species. Detection of Asian carp eDNA have been reported north of the fish barrier near the Wilmette Pumping Station and lakeward of the O'Brien Lock. Given that eDNA is an emerging technology being applied in a field setting for the first time, USACE cannot conclude that water samples testing positive for eDNA evidence confirms the presence of Asian carp. Until other methods for positive and confirmatory Asian carp detection become available and affordable, the ACRCC and USACE intend to use eDNA as a basis for precautionary and prudent actions.

Numerous questions remain regarding the ability of reproducing populations of Asian carp to become established in the CAWS, Lake Michigan and in the Great Lakes. Experts tend to agree that because of the variety of habitats available, environmental conditions in the Great Lakes

and adjacent tributaries are suitable to support the survival of Asian carp but it is unknown if these species can establish reproducing populations. Although there are uncertainties, the federal and state partners are taking action now to reduce the risk that a sustainable population of Asian carp could threaten the Great Lakes.

1.7 – Deterrent Site Preliminary Screening Process

Based on the types of measures that could be employed in the CAWS and Illinois Waterways the Project Development Team (PDT) reviewed potential locations. The sites were located within the waterways, both above (upstream) and below (downstream) of the electric dispersal barrier. Sites located far enough downstream to serve as impediments to carp movement through all of the known connections to the Great Lakes were considered as well as sites closer to the known outlets to Lake Michigan. Other criteria were included in the process to identify potential locations for fish deterrents. These criteria included physical site characteristics, real estate requirements, construction access, availability of utilities, the presence of an upstream pool or adjacent diversion area for fish, as well as proximity to outlets into Lake Michigan. The PDT utilized aerial mapping to locate potential sites, and then followed up with site visits to further evaluate the acceptability of the sites

Descriptions of the sites are contained in Section 2.1. Evaluation of the sites to develop the recommended configuration is contained in Section 3.5.

CHAPTER 2 – Affected Environment

This chapter includes a description of the affected environment in the study area as well as specific discussion about the sites that were selected in the preliminary screening process described in Section 1.7.

2.1 – Site Descriptions

Eight (8) sites were considered for the location of potential interim measures that could relatively quickly be implemented to reduce the risk of Asian carp dispersing into Lake Michigan. The following are brief site descriptions of each considered site.

Chicago Lock – This proposed deterrent site consists of the interior entrance to the Chicago Lock in downtown Chicago (Plate 02). The feature would be placed between the concrete walls at the interior lock gates to minimize the feature's width. The feature would be about 70-feet wide. There exists no terrestrial habitat within the riparian zone. Aquatic habitat is minimal consisting of open lake water with a uniform clay/sand bottom surrounded by concrete bulkheads. The real estate needed for the interim measure is currently owned by the USACE for operational purposes of the Chicago Lock works.

Chicago River at Throop Street – This proposed deterrent site consists of a cross section in the Chicago River South Branch at Throop Street (Plate 03). The feature would be placed between the sheet pile wall to the south and a riprap revetment to the north. Its placement would direct dispersing fish into the slip to the north. The feature would be about 70-feet wide. There exists no terrestrial habitat within the riparian zone, only industrial lots and pavement. Aquatic habitat is minimal consisting of an unnatural canal lined with sheet pile, concrete and riprap. The real estate needed to be acquired for the interim measure is currently owned by Commonwealth Edison.

Calumet River at TJ O'Brien Lock and Dam - This proposed deterrent site consists of a cross section in the Calumet River at the mouth of the O'Brien Lock (Plate 04). The feature would be placed between the concrete lock walls. Its placement would direct dispersing fish into the dam. The feature would be approximately 130-feet wide. Minimal terrestrial habitat exists within the riparian zone in the form of scrub-shrub abandoned plots infested with non-native plant species. The majority of the surrounding land is for industrial use. Aquatic habitat is minimal consisting of an unnatural canal lined with sheet pile, concrete and riprap. The sandy bars and substrates present provide some habitat for lake species such as emerald shiners (*Notropis atherinoides*) and white sucker (*Catostomus commersonii*). The real estate needed to be acquired for the interim measure is currently owned by the MWRDGC.

Little Calumet River at Calumet Sag Channel – This proposed deterrent site is located at the junction of the Little Calumet River at the Calumet Sag Channel (Plate 05). The feature would be placed at an angle across the mouth of the Little Calumet River. The feature would be about 500-feet wide. Adjacent properties include a Forest Preserve District of Cook County (FPDCC) Joe Lewis Golf Course. Aquatic habitat is minimal consisting of a navigation channel and disturbed habitat. The real estate needed to be acquired for the interim measure is currently owned by MWRD and the FPDCC.

CSSC at Lockport Lock and Dam – This proposed deterrent site consists of a cross section in the Calumet Sag Cannel at the downstream entrance to the Lockport Lock (Plate 06). The feature would be placed between two cement headwalls. Its placement would direct dispersing fish to the dam spillway area to the northwest, which is impassable to fish. The feature would be 130-feet wide. Terrestrial habitat exists within the riparian zone consisting of successional woodlands including non-native plant species. The majority of the surrounding land is for industrial and park use. Aquatic habitat is minimal consisting of an unnatural canal lined with concrete walls and riprap revetment. The primary fish species that occur here are common carp (*Cyprinus carpio*), gizzard shad (*Dorosoma cepedianum*) and yellow bullhead (*Ameiurus natalis*). The real estate needed to be acquired for the interim measure is currently owned by the MWRDGC and Will County.

Des Plaines River at Brandon Road Lock and Dam – This proposed deterrent site consists of a cross section in the Des Plaines River at the downstream entrance to the Brandon Road Lock (Plate 07). The feature would be placed between riprap revetments on each wall of the lock entrance channel. Its placement would direct dispersing fish to the dam spillway area to the northeast where Hickory Creek flows into the Des Plaines River. The feature width would be approximately 400-feet. Terrestrial habitat exists within the riparian zone consisting of successional woodlands including non-native plant species. The majority of the surrounding land is for industrial and park use. Aquatic habitat is minimal consisting of an unnatural canal lined with concrete walls and riprap revetment. The primary fish species that occur here are common carp (*Cyprinus carpio*), gizzard shad (*Dorosoma cepedianum*) and yellow bullhead (*Ameiurus natalis*). The real estate needed to be acquired for the interim measure is currently owned by Midwest Generation.

Calumet Sag Channel at I&M Canal – This proposed deterrent site consists of a cross section in the Calumet Sag Cannel at the confluence of I&M Canal (Plate 08). The feature would be placed between the riprap revetment on the south bank and the concrete bulkhead to the north. Its placement would direct dispersing fish into the I&M Canal, which is impassable to fish because the channel turns into a pipe several hundred feet upstream. The feature width would be 325-feet wide. Terrestrial habitat exists within the riparian zone consisting of successional woodlands including non-native plant species. The majority of the surrounding land is for industrial and park use. Aquatic habitat is minimal consisting of an unnatural canal lined with concrete walls and riprap revetment. The primary fish species that occur here are common carp (*Cyprinus carpio*), gizzard shad (*Dorosoma cepedianum*) and yellow bullhead (*Ameiurus natalis*). The real estate needed to be acquired for the interim measure is currently owned by Village of Lemont, IDNR, and Hannah Marine.

Illinois River at Dresden Island Lock and Dam – This proposed deterrent site consists of a cross section in the Illinois River at the downstream entrance to the Dresden Island Dam. The feature would be placed between riprap revetments on each wall of the lock entrance channel. The feature width would be approximately 500 feet. Terrestrial habitat exists within the riparian zone consisting of successional woodlands including non-native plant species. The majority of the surrounding land is for industrial and park use. Aquatic habitat consists of a natural canal lined, flooded but with some good flow and habitat conditions. Eighty-five species of fish have been identified in the Dresden pool. The primary fish species include rare as well as endangered species: Brown bullhead (*Ameiurus nebulosus*) – rare; Bluntnose darter

(*Etheostoma chlorosomum*) – rare; Goldeye (*Hiodon alosoides*) – rare; Mooneye (*Hiodon tergisus*) – rare; Pallid shiner (*Hybopsis amnis*) endangered; Shortnose gar (*Lepisosteus platostomus*) – rare; Speckled chub (*Macrhybopsis aestivalis*) –rare; River redhorse (*Moxostoma carinatum*) – endangered; Greater redhorse (*Moxostoma valenciennesi*) – endangered; Ghost shiner (*Notropis buchanani*) – rare; Ironcolor shiner (*Notropis chalybaeus*) –endangered; Slenderhead darter (*Percina phoxocephala*) - rare; and, Trout perch (*Percopsis omiscomaycus*) rare. Real estate ownership has not been established for this site.

2.2 – Physical Resources

Climate

The climate of the project area is typical of northeast Illinois and may be classified as humid continental, characterized by warm summers, cold winters, and daily, monthly, and yearly fluctuations in temperature and precipitation. National Weather Service data collected from the area around Chicago report average temperatures of 24.9° F in winter and 71° F in summer. Coldest average monthly temperatures range from daily lows and highs of 14° F and 30° F respectively, in January. July is the warmest month with an average daily low of 63°F and an average high of 84° F. Mean annual precipitation is 36.57 inches with the majority of the precipitation occurring April through October. Accumulated snowfall averages 46.2 inches for the study area. Wind speed averages 11 to 12 miles per hour. Early spring floods may occur when snow accumulations extend into a period of increasing temperature that results in melting. If this occurs when soils are already saturated, and given the amount of impervious surfaces within the study area, runoff increases dramatically. The start of the growing season as defined for agricultural purposes usually occurs from late April to early May, but in natural areas there may be blooming plants in ground water discharge zones as early as the last week in January, although most native organisms start their annual growth after cultivated and non-native species. The first frost typically occurs between late September and mid-October, with the frost free season ranging from 158 to 178 days.

Air Quality

The Chicago Metropolitan area, including the study area, is a non-attainment area for both ozone (and ozone precursors) and particulates (with a diameter less than 2.5 microns). Existing air quality data are available for Cook, DuPage, Lake and Will counties from the USEPA Air Data database. Although the trends show overall improvement over the last 10 years, individual measurements and monitoring stations still have measurements that exceed the national standards. The existing air quality should be considered marginal, but improving over time.

Geology

Bedrock located within the project area is primarily composed of dolomite and limestone with small amounts of shale present. The bedrock is covered by up to 300 feet of an unconsolidated formation comprised of clay, silt, sand, and gravel. Much of the material was directly deposited as glacial till and outwash from melting glaciers. The very young glacial geology of the region plays a significant role in the hydrology that drives the local ecosystems.

The project area lies entirely within the Central Lowland Province. Comprising the Province is the Great Lake Section and the Till Plains Section. The Great Lake Section is composed of the Wheaton Morainal Country and the Chicago Lake Plain. The Wheaton Morainal Country is characterized by broad flat expanses spotted with steeply sloping Wisconsinan-age moraines and till plains that are approximately parallel to the Lake Michigan shoreline. The Chicago Lake Plain is approximately the area that is now metropolitan Chicago. It is relatively flat, glacio-lacustrine deposit formed by the slow moving waters of glacial Lake Chicago. Elevation ranges from 400 to 900 feet above sea level. The Till Plains Section is composed of the Bloomington Ridged Plain, with land surface elevation ranges from 585 to 855 feet above sea level.

Soils

The US Department of Agriculture Soil Surveys of Cook, DuPage, and Will Counties, Illinois describe 28 soil series found on the study area; twelve of the soil classes are hydric. Muskego and Houghton Mucks, which is a group of nearly level depressional areas composed primarily of herbaceous organic material over coprogenous deposits, is the only soil association. The 28 soil series encompass four soil orders: Alfisols, Entisol, Histosol, and Mollisols. Alfisols form in semiarid to humid areas and are typically found under hardwood forest cover. They have a clay-enriched subsoil and relatively high native fertility. The soil series included under Alfisols are Blount, Fox, Ozarkee, and Wauconda. The Entisol soil order is characterized by having no diagnostic soil horizons. Most of the soils within this order are unaltered from their parent material. The only soil series included under the Entisol order is Orthents. Soil comprised primarily of organic materials characterizes the Histosol soil order. For Histosol soils to be present, aquic conditions or artificial drainage must exist. The Muskego and Houghton soils are the only series included under the Histosol soil order. Finally, the largest order is the Mollisols including the Ashkum, Barrington, Channahon, Drummer, Faxon, Grundelein, Harpster, Joliet, Kane, Kankakee, Mundelein, Rockton, Romeo, and Sawmill soil series. The Mollisols form typically under grassland cover in semi-arid to semi-humid areas. These soils are characterized by a deep, high organic matter, nutrient-enriched surface soil. Prime farmlands do not occur along or on the project footprint.

Land Use

Pre-settlement land cover of the study area was primarily prairie, with pockets of rare dolomite prairie and wetland depressions. Along the riparian zones of the Des Plaines River and confluent streams, hardwood forest most likely occurred. The riparian zones of the Chicago and Calumet Rivers were much different than the Des Plaines River. These two river systems flowed through vast marshes and more often than not, had an undefined channel. Land use within the CAWS basin is generally urban with extensive industrial development. Basin stakeholders include the City of Chicago and 31 suburban municipalities. Flow in the CAWS is dominated by treated wastewater from 5 million residents and an additional industrial load of approximately 4.5 million population equivalents. Land use has been converted from these natural types to industrialized and residential grounds with intermittent pockets of highly disturbed forest and wetland. Most of the land adjacent to the rivers and canals is owned by the MWRDGC; certain parcels are leased to the Cook County and Du Page Forest Preserves and are used for recreational purposes.

General Hydrology

The CAWS consists of 78 miles of canals and modified streams. The CAWS consists of the Chicago River, its two main branches (North Branch and South Branch), as well as the Calumet Sag Channel, the CSSC, and the tributaries in an area extending from the metropolitan Chicago area to the Lockport vicinity. It also includes Lake Calumet. To facilitate a reversal of the flow of the Chicago River to divert water from Lake Michigan to the CAWS, the Chicago Sanitary and Ship Canal, the Calumet Sag Channel and the North Shore Channel were constructed over 100 years ago. The diversion and the artificial waterways facilitated navigation and protected the drinking water intakes in Lake Michigan from Chicago wastes. The Little Calumet River North Leg, the Chicago River, the South Branch of the Chicago River and North Branch of the Chicago River downstream from its confluence with the North Shore Channel are natural rivers that have been modified through channelization and widened and deepened.

Chicago's wastewater system was developed with a combined sewer system that accepted both stormwater and sanitary waste. After rainstorms, the capacity of the sewer system became overwhelmed on a regular basis and combined sewer overflows (CSO) occurred. These CSOs are discharged into the CAWS and frequently from the river into Lake Michigan. To address this problem, the MWRDGC developed the Tunnel and Reservoir Project (TARP), which included the construction of the Deep Tunnel project. The Deep Tunnel is a series of tunnels that lie 250 to 300 feet below the Chicago River and are located parallel to it. The first phase of the TARP project or "Deep Tunnel" project has been completed. During periods of heavy rainfall, the TARP project directs combined sanitary waste and infiltrating rainwater into massive tunnels and collection reservoirs where it can be withdrawn for treatment after the rain subsides.

Water Quality

The North Shore Channel, North Branch Chicago River, Chicago River, South Branch Chicago River (including the South Fork), Chicago Sanitary and Ship Canal (CSSC), Des Plaines River, Cal-Sag Channel, Grand Calumet River, and Little Calumet River are all currently on the 2008 Final Draft Illinois 303(d) list of impaired waters. These waters include both natural and man-made waterways which serve as receiving waters for the tributary streams and water reclamation plant effluents, combined sewer overflows, and stormwater runoff, and are therefore of marginal quality, and unlikely to improve.

Within Illinois, the Chicago River, the North Shore Channel from the North Side Sewage Treatment Works to Lake Michigan, the Des Plaines River downstream of its confluence with the CSSC, and the Little Calumet River from the State Line to the Cal-Sag Channel are classified by the Illinois Pollution Control Board as "General Use Waters". General Use waters are protected for aquatic life, wildlife, agricultural use, primary contact (e.g. swimming, water skiing), secondary contact (e.g. boating, fishing), and most industrial uses. These General Use Waters are all currently listed as impaired for supporting aquatic life and primary contact recreation, and the Chicago River, North Shore Channel, and Des Plaines River are impaired for fish consumption as well. All other waters mentioned above are classified by the Illinois Pollution Control Board as "Secondary Contact and Indigenous Aquatic Life Use Waterways", which indicates a highly modified waterway, not suited for General Use activities (e.g. swimming, water skiing). These waters are capable of supporting indigenous aquatic life but are limited by the physical configuration of the body of water, characteristics, and origin of the water and the

presence of contaminants. These Secondary Contact waters are all currently listed as impaired for supporting indigenous aquatic life and/or fish consumption. See Appendix D, Table 1 for further details.

2.3 – Biological Resources

Riverine Habitat

Chicago River Sites – The riverine habitat at the Chicago Lock and the Chicago River atThroop Street sites consist of a manmade canal, with no natural riverine function. The shoreline is retained by concrete, sheet pile or riprap revetment. Physical habitat structure consists of slumping riprap banks, sunken logs and man- made debris.

Calumet River at O'Brien Lock and Dam – The riverine habitat at the site downstream from the O'Brien Lock consist of a manmade canal, with no natural riverine function. The shoreline is retained by concrete, sheet pile or riprap revetment. Physical habitat structure consists of slumping riprap banks, sunken logs, sand bars and man-made debris.

Calumet Sag Channel at I&M Canal and /CSSC Canal at Lockport Lock and Dam - The canals (CSSC and Calumet Sag) in these two areas contain similar habitat. The canals were incised through the native dolomite limestone. Accordingly, aquatic habitat in the vicinity of the proposed sites is fairly homogeneous, consisting of vertical limestone walls that extend 24 – 26 feet down to the bottom. These nearly perpendicular walls of the canal offer little or no littoral zone for aquatic species. The walls have crumbled down enough at various locations along the reach that may provide limited littoral habitat for present species. The bottom of the canal is essentially flat with virtually no fine substrates; however, rock or flagstone is present on the bottom of the canal where the vertical walls have been gouged away by barge traffic, as well as the elements and age. There are also intermittent areas of woody debris and detritus that may be used as cover for certain benthic organisms.

Little Calumet River at Calumet Sag Channel – The riverine habitat at the confluence of the Little Calumet River with the Calumet Sag Channel consist of a manmade canal, with no natural riverine function. The shoreline is retained by concrete or riprap revetment. Physical habitat structure consists of slumping riprap banks, sunken logs, sand bars and man-made debris. This area has been completely modified from its natural condition.

Des Plaines River at Brandon Road Lock and Dam – The riverine habitat at the Brandon Road Lock site consists of modified river and manmade canal, with no natural riverine function. The shoreline is retained by concrete, sheet pile or riprap revetment. Physical habitat structure consists of slumping riprap banks, sunken logs, and man-made debris.

Illinois River at Dresden Island Lock and Dam – The riverine habitat at the Dresden Island Lock site consist of a natural channel, with flow contributions from both the Des Plaines and Kankakee Rivers. Existing physical habitat provides good habitat for the abundant and diverse fishery.

Riparian Plant Communities

Generally, these areas are highly disturbed lands with small patches of volunteer plant communities. These sites have the following composition:

Old fields are dominated by Late Boneset (*Eupatorium serotinum*) and tall goldenrod (*Solidago altissima*). The woodland tree layer is dominated by White mulberry (*Morus alba*) and the shrub layer is dominated by Elderberry (*Sambucus canadensis*). This area receives periodic floodwater. These species are indicative of a high level of past disturbance that decimated the original native plant species.

The forested areas are a mixture of wet floodplain forest and mesic woodland with small areas of emergent marsh. The forested areas are dominated by Cottonwood (*Populus deltoides*), Maple (*Acer* sp.*),* and Ash (*Fraxinus* sp.) with a shrub layer dominated by Japanese bush honeysuckle (*Lonicera* sp.). The dominant vine is Riverbank grape (*Vitis riparia*). The herbaceous layer is represented by mostly Creeping Charlie (*Glechoma hederacea*) and White snakeroot (*Eupatorium rugosum*). The forested areas are of low quality, typified by low coverage of herbaceous species and dominance of the invasive shrub species (*Lonicera japonica*). The emergent marsh areas are dominated by a mix of Cattails (*Typha latifolia*) and Common reed (*Phragmites australis*). Although the cattails are native, their dominance along with the high abundance of Common reed indicates this area is of low quality and is experiencing chronic disturbance.

The riverbanks are wooded with openings dominated by herbaceous species. The herbaceous species are dominated by Reed canary grass (*Phalaris arundinacea*), which is a highly invasive species and is typical of wet/mesic disturbed areas. The wooded areas are low quality as well with some larger trees and a shrub layer dominated by Japanese bush honeysuckle and European buckthorn (*Rhamnus cathartica*), both non-native, highly invasive species.

Aquatic Communities

The aquatic communities and riparian zones of the study area have been marginalized by previous impacts of hydrologic and fluvial-geomorphic modification. A total of 49 species of fish (Appendix D Table 1) have been collected from the Des Plaines River, CSSC, and I&M Canal: 43 from the Des Plaines River, 19 from the CSSC, and 21 from the I&M Canal. The majority of fish species that occur in the area are ecologically tolerant, meaning they are able to thrive in degraded habitats. Species intolerant to silt and turbid water are found in the Des Plaines River, CSSC, and I&M; however, abundance of these species is low.

Macroinvertebrate species diversity within the CAWS is lower than in the Des Plaines River due to poor habitat (Appendix D Table 2). Fissures in the man-made walls of the canals as well as organic matter inputs provide minimal habitat for invertebrates and other aquatic species. In 1999, the MWRDGC collected two crayfish species, *Orconectes rusticus* rusty crayfish and *Orconectes virilis* virile crayfish, from the CSSC. The rusty crayfish is introduced from the Ohio River system via the release of unused live fishing bait.

Other Wildlife

Terrestrial wildlife communities on the study area have been degraded due to hydrologic and geomorphic alterations and fragmentation of habitats by industrialization. The majority of the sites are covered in anthropogenically induced bottomland forest and ruined industrial parcels. Birds that are associated with these types of habitats and may inhabit the area include marsh birds, nesting and migrant waterfowl and woodland birds. Muskrat, beaver, mink, otter, and raccoons are mammals often associated with bodies of water because they construct their shelters in or near rivers and streams as well as gather food. Aquatic dependent mammals such as these as well as other species of mammals may be found utilizing the study area. In addition, several species of reptiles that are semi-aquatic and feed on stream invertebrates and fish may use the area, as well as certain species of amphibians that utilize wetlands during reproduction.

Natural Areas

Because there are no natural areas close enough to the proposed sites, there is no opportunity for the proposed actions to affect habitat or ecological integrity.

Threatened & Endangered Species

Based on the location of the proposed sites, there would be no threatened and endangered species anticipated or critical habitat present. Consultation with the USFWS is ongoing in the project; however, the District has made a 'no effects' determination in regards to Threatened and Endangered Species. Consultation under Section 7 of the Endangered Species Act is not anticipated for this project.

Immediate ANS Target Species

There are two Asian carp (Cyprinidae) species of concern that are threatening to enter the Great Lakes basin via the CSSC. The following describes the current target species.

Bighead carp can grow to a length of 130 cm (51") and weigh up to 40 kg (88 lbs.). This carp feeds by filtering plankton from the water column with its large terminal and upturned mouth. This fish requires large river habitat where it reproduces prolifically and may grow rapidly. Bighead carp has been identified as a means to remove excess nutrients in wastewater by consuming algae which grow in eutrophic water. Since it can grow to a large size, it has the potential to deplete zooplankton populations; thereby indirectly, adversely impacting all species of larval fishes, planktivorous adult fishes, and native mussels (Unionoida). Bighead carp are native to Asia, in Southern and Central China. Bighead carp have been spotted in about 18 states in the United States and is established in Illinois within the Mississippi, Illinois and Ohio Rivers. It also can be found in the Cache, Big Muddy, Kaskaskia and Wabash Rivers and in Chain Lake.

Silver carp can grow to a length of 105 cm (41") and weigh up to 50 kg (110 lbs). This freshwater fish is biologically similar to the bighead carp and has also been stocked for phytoplankton control in eutrophic water bodies, and is used for food by humans. This fish feeds by filtering phytoplankton, zooplankton, bacteria and detritus from the water column. In

great numbers, this fish could consume plankton required by larval fish, invertebrates and native mussels. Silver carp are native to Asia and can be found in several major Pacific drainages in eastern Asia from the Amur River of Eastern Russia to the Pearl River in China. In North American it has been documented in Alabama, Arizona, Arkansas, Colorado, Florida, Hawaii, Illinois, Indiana, Kansas, Louisiana, Missouri, Nebraska and Tennessee. In Illinois, it has been found in the Mississippi, Ohio, Cache, Illinois and Wabash Rivers, and several of their tributaries, including the Big Muddy River, Horseshoe Lake, the Cache River drainage, and the Embarras River below Lake Charleston.

2.4 – Cultural, Archaeological & Social Resources

Archaeological & Historical Properties

One site in the study area has been listed on the National Register of Historic Places, one that has been declared eligible for such a listing, and one that is potentially eligible. The Illinois and Michigan (I&M) Canal was listed on the National Register of Historic Places by the Illinois State Historic Preservation Agency. The Chicago Lock has been determined to be eligible for the National Register of Historic Places by the Illinois State Historic Preservation Agency based on its historic engineering importance. The T. J. O'Brien Lock and Controlling Works in Chicago were determined to be a noncontributing property to the eligible National Historic Register eligible property "Chicago to Grafton, Illinois Navigable Water Link, 1839-1946". Since then the lock has become over fifty years old, making it potentially eligible for the National Register of Historic Places.

The I&M Canal, is the only property within the project area that is both on the National Register of Historic Properties and that extends through all three Illinois counties. The CSSC also extends through all three counties, and although it is eligible for the National Register, it is not currently listed. Within this portion of Cook County, two properties in Western Springs are on the National Register of Historic Properties, the Western Springs First Congregational Church (listed 2006) and the Western Springs Water Tower (listed 1981). Three properties within the Village of Lemont are also listed on the National Register. These are the Lemont Central Grade School (listed 1975), the Lemont Methodist Episcopalian Church (listed 1986), and the St. James Catholic Church and Cemetery (listed 1984). With the exception of the I&M Canal, no properties in this area of Du Page County are listed on the National Register of Historic Properties. Properties listed on the National Register within this portion of Will County include the Red Round Barn (listed 1988) in Romeoville, and the five structures and two historic districts listed within Lockport, Illinois to the south of the project area. There will be no construction within the I&M Canal, and further, all of the other listed properties will be avoided and none will be within any of the selected sites within the project area.

Most prehistoric sites in the Des Plaines River, Chicago and Calumet watersheds occupy high or well-drained ground, in areas unlikely to be affected by proposed measures; however, the historic occupation of the Des Plaines valley was focused more on water accessibility putting the majority of historic sites within the floodplain. However, all six of our potential locations for additional fish barriers/deterrents have been heavily modified by earlier industrial or canal related construction and no intact archaeological or cultural resources are present.

The region's history has been driven by its location and the developing waterway system. A trading post was established near the mouth of the Chicago River in the 1770's, followed by Fort Dearborn in 1803. Large-scale settlement in this area of northern Illinois only began after the area was ceded by the Potawatomi Indians to the United States Government in 1816 removing the threat of tribal conflict. Settlement was rapid with large numbers of German immigrants establishing farms in the area in the 1820s and 1830s. Chicago was incorporated in 1833 and granted a city charter in 1837. The city grew based on its favorable location between the Great Lakes and the Mississippi River system.

Farming was an early economic driver for the area, with grain and livestock shipped to the markets in Chicago. The first community along this stretch of the Des Plaines River was Lemont. The town was established in 1836 by land speculators gambling on future development stemming from the planned I&M Canal. The community soon served as the agricultural and commercial hub of the region. This area of Illinois experienced rapid population growth based on construction of the I&M Canal from 1837 to 1848. After 1848 Lemont served as a departure point and transit stop for canal traffic. The first railroad was constructed through Lemont in 1854 and the town later developed into a railroad community as canal traffic dwindled. The commercial importance of Lemont faded after 1900 as additional railroads and other transportation links bypassed the town. Lemont's historic buildings and proximity to the I&M Canal National Heritage Corridor have made tourism a major element of the local economy. Recently the town has also developed into a bedroom community for the growing Chicago metropolitan area. Surrounding towns include Lockport, Bolingbrook, Darien, and Romeoville.

The I&M Canal ran 96 miles (155 km) from the Chicago River at the Bridgeport neighborhood in Chicago and joining the Illinois River at LaSalle-Peru, Illinois. It was finished in 1848 and allowed boat transportation between the Great Lakes to the Mississippi River and the Gulf of Mexico. The canal enabled navigation across the Chicago Portage and helped establish Chicago as the transportation hub of the United States, opening before railroads were laid in the area. It ceased transportation operations in 1933. Portions of the canal have been filled. One segment, including a number of engineering structures, between Lockport and LaSalle-Peru, was designated a National Historic Landmark in 1964. Today much of the canal is a long, thin park with canoeing and a 62.5 mile (100 km) hiking and biking trail (constructed on the alignment of the mule tow paths). It also includes museums and historical canal buildings. It was designated the first National Heritage Corridor by US Congress in 1984.

The CSSC was designed to carry treated sewage away from Chicago by reversing the flow of the Chicago River and directing its flow into the Illinois River drainage. Completed in 1900, the canal was also planned as a replacement for the outdated I&M, thus providing a shipping link between the Great Lakes and the Mississippi Valley. The CSSC is 28-miles long, 24-feet deep, with the width varying between 160-200-feet. The canal was extended to Joliet by 1907. The Cal-Sag Channel connected the CSSC to the Calumet River in 1922. Construction of the CSSC was the largest earth-moving operation that had been undertaken in North America up to that time, and provided important training to a number of engineers who later worked on the Panama Canal. Although not on the National Register of Historic Properties, The system has been named a Civil Engineering Monument of the Millennium by the American Society of Civil Engineers.

The presence of the I&M Canal and later the CSSC focused the economy of the project area toward the Des Plaines River valley and the water-based transportation of materials. Industries such as gravel quarries and refineries were developed in the region to take advantage of this transit corridor. Away from the river agriculture dominated the area's economy until recently. This portion of all three counties remained characterized by farms and widely separated small towns until the explosive development of the 1990s and early 2000s reshaped the area into suburban bedroom communities for Chicago.

Social Setting

The project area extends through portions of three Illinois counties, Cook, Du Page, and Will. Cook County, Illinois has a racially and ethnically diverse population of 5,294,664 (2008) with a median household income of $73,910.00 (2004) and a median home value of $290,800. Du Page County has a median household income of $105,400 and a median home value of $421,540. For Will County the median household income is $96,773 and the median home value is $323,900. The portions of all three counties within our project area are comprised of a number of suburban communities that form a portion of the Chicago metropolitan area with its diverse industrial and commercial base.

Recreation

The undeveloped nature of large portions of the Des Plaines River valley, the Chicago Sanitary and Ship Canal, and the Cal-Sag Canal makes this area a popular destination for outdoor sports including bird watching, hunting, fishing and boating. The proposed locations of the temporary measures are technically off limits to recreational activities on land because they are privately owned or owned by the government for non-public purposes. However, recreational vessel traffic may be disrupted during the construction and installation of the IRRMs, which will likely require a closure of the waterway. The USACE will work with the USCG to ensure that notice is provided in a timely fashion to minimize impacts on navigation to the extent possible. Because installation will not take a significant amount of time, impacts to recreational vessels should be minimal.

Hazardous, Toxic and Radioactive Wastes

A screening-level HTRW investigation has been performed for four potential acoustic/bubble/strobe (ABS) fish deterrent construction sites: the Little Calumet River at the Calumet Sag Channel confluence, the Calumet River at T.J. O'Brien Lock and Dam, the Des Plaines River at Brandon Road Lock and Dam, and the Chicago River at Throop Street. Two alternative South Branch sites were also investigated: Crowley's Yacht Yard and Loomis Street. The primary means of HTRW investigation was an EDR Database Search and site visits. Due to the expedited schedule for the Interim IIIA Report, a full HTRW investigation was not performed at this time, but further investigation is recommended for selected sites to occur as soon as additional design information is available. The initial HTRW screening identified the following issues:

- Chicago River at Throop Street – A cluster of Former Manufactured Gas Plant (MGP) CERCLIS sites are located in close proximity to all the Throop Street location, as well as the two additional sites that were evaluated. The CERCLIS sites have likely caused soil

and groundwater contamination at the ABS deterrent sites. These MGPs and other area industrial activities have lead to sediment contamination as well. Several other LUSTs and Voluntary Remediation Sites are also located in close proximity to the project site, but the CERCLIS sites are the primary concern. Due to the fact that the Crowley's Yacht Yard site is located on one of the aforementioned open CERCLIS sites, it is recommended that Office of Counsel guidance be sought regarding the potential for legal liability or other issues.

- Calumet River at T.J. O'Brien Lock and Dam – Several SWF/LF, LUSTs, and CERCLA sites were identified in the area, but none are anticipated to impact the project. Because the construction site is currently cleared and level, little earthwork and no groundwater disturbance is likely to be required, so there is little chance of encountering HTRW during construction.

- Little Calumet River at Calumet Sag Channel – Several LUST sites were identified in the area, as well as a CERC-NFRAP and another state-listed site. None of these sites are seen to be a concern to the project due to their NFA statuses, or hydraulic separation from the site. A site visit revealed no additional HTRW concerns. Based on this review, it is believed land-based construction without groundwater disturbance is unlikely to encounter HTRW.

- Des Plaines River at Brandon Road Lock and Dam – A high priority LUST is located approximately ½ mile from the project site, which has impacted area groundwater. It is possible groundwater on the site may be contaminated, and therefore excavation below the water table should be avoided.

No investigation can wholly eliminate the risk of HTRW, due to the inherent uncertainty with urban environments and former industrial sites. Given the industrial nature of the project areas, at the South Branch Chicago River sites in particular, additional detailed HTRW investigation would need to occur if selected as an appropriate location for a fish deterrent measure. Assuming extensive earth-disturbing activities, particularly excavation below the water table, can be avoided during land-based construction, HTRW may not be an issue for the project. Sediment quality remains as a potential concern for all of the sites, and this issue has not yet been investigated.

CHAPTER 3 – INTERIM IIIA RISK REDUCTION

3.1 – Method of Risk Assessment

Due to the perceived nature of the threat, USACE used an Interim Risk Reduction analysis, following an existing USACE process, to rapidly evaluate potential interim measures that could be used to mitigate unacceptable risks (USACE EC 1110-2-6064, Interim Risk Reduction Measures (IRRMs) for Dam Safety). While this expedited process was designed to evaluate dam structures, its concepts are applicable to other circumstances that require expedited development of solutions to reduce risk. This expedited process requires the identification of potential failure modes, an analysis of the consequences identified with each identified potential failure mode, and an analysis of alternatives considered to reduce the probability of failure and/or consequences associated with the failure modes.

3.2 – Identified Failure Modes

For the purposes of this analysis, "failure" is defined as the movement of bighead or silver carp from waters below (downstream of) the electric dispersal barrier to the CAWS above (upstream of) the electric dispersal barrier. Described below are four general methods of bypass of the barrier that were judged to be relevant potential failure modes.

Inter-Basin cross-connections during flood events – The Des Plaines River runs parallel to the west of the CSSC for about 25 miles before merging with the CSSC just below Lockport Lock and Dam. Along the stretch where the river and CSSC run parallel are a number of low areas where water can cross over to alleviate flooding. In order for Asian carp to be transported around the barriers from the Des Plaines River, they would have to be present in the Des Plaines River at the time a flood occurred, then swim or be carried in waters of sufficient depth to pass over the divide between the river and CSSC. The frequency and intensity of precipitation necessary for flood waters to overtop the divide north of the barriers is not known.

Another potential pathway is through the Illinois & Michigan (I&M) Canal which runs parallel to the CSSC to the east. A set of culverts connects the I&M and CSSC upstream of the barrier. Below these culverts there are stretches of the I&M that often have little, if any, water and contain thick stands of vegetation. However, water does flow in the I&M during times of significant precipitation. The frequency and intensity of precipitation necessary to make the I&M a continuous waterway passable by fish from below the barriers to the culverts connecting to the CSSC is not known.

USACE is studying the frequency and intensity of storms necessary to create these potential bypasses as part of the Efficacy Study. A final analysis and recommendations for long-term solutions to reduce the risk of bypasses via these pathways will be included in the Final Efficacy Study Report. In the meantime, the Interim I report recommended short-term solutions to reduce the risk of these potential bypasses. The recommended solutions were approved by the ASA (CW) on 12 January, 2010 and will be implemented by October 2010.

Movement/Release by Humans – This can occur deliberately or inadvertently. Possible means include use of juvenile Asian carp as bait fish, release of captured or purchased live fish due to cultural practices (i.e., reportedly in some cultures it is customary to return a live fish or fishes

to nature after capturing or purchasing fish for eating), release of fish previously held in aquaria, or deliberate movement of fish. Movement of live Asian carp has apparently occurred in the Chicago area. On several occasions in the last seven years, documented captures of bighead carp have occurred from lagoons in the City of Chicago. The lagoons have no tributaries and are isolated from other water sources; therefore, the only logical explanation of how they were introduced to the lagoons is live release.

Although sale of live bighead and silver carps once occurred in Illinois, the State of Illinois and the City of Chicago have enacted laws banning the sale of live bighead and silver carps. This includes a ban on sale for use as live bait, although there is concern that juvenile bighead or silver carp might be inadvertently included in bait because they are difficult to distinguish from some native species when small in size. The Illinois Department of Natural Resources is planning to investigate the bait sale industry to determine the likelihood of movement of Asian carp via this pathway and how it may be reduced or eliminated.

Inadvertent movement of fish by vessels – This can potentially occur by a vessel facilitated transfer of non-potable water across the fish barrier, by fish becoming attached or held on a vessel hull or between vessels (such as connected barges), or by fish becoming entrained and pulled along in the wake of vessels.

Ballast water from overseas ports is a well-documented pathway for movement of aquatic nuisance species into the Great Lakes. Vessels on inland rivers do not ballast at the same frequency or volume as larger vessels that traverse more open waters. However, the importance of ballast and bilge water as a pathway for movement of ANS within inland waterways is not well-defined. To address this risk vector, the Coast Guard issued a temporary interim rule in December 2009 prohibiting the transfer of non-potable water for discharge across the barrier. The Towboat/Barge Sampling Workgroup consisting of members from academia, industry, and regulatory agencies has been chartered to study this as a possible pathway or failure mode. This issue is slated to be addressed by the MRRWG of the ACRCC.

Failure of the Electrical Dispersal Barrier to perform as designed - This can occur if an electrical barrier loses all or partial power so that it is not operating at the set operating parameters or if the set operating parameters are not sufficient to deter fish.

Each barrier has backup diesel-powered generators that automatically activate if a complete or partial power loss occurs in the feed from the local electrical utility. Loss of power due to failure or malfunction of barrier electrical or mechanical equipment is also possible and has occurred on some occasions. The redundancy provided by multiple barriers helps reduce risk at these times. USACE is continuously working to improve the reliability of the electrical and mechanical systems.

The barrier electric fields can be controlled by manipulating the frequency, length (duration), and magnitude (voltage) of the direct current pulses in the CSSC. USACE is engaged in an ongoing research program to identify the optimal combination of these operating parameters for deterring all sizes of bighead and silver carp. The Efficacy Study Interim II report will describe this research and summarize the results.

3.3 – Problems, Opportunities & Consequences

There are inherent uncertainties and unknowns in this evaluation process, both regarding the potential impact of Asian carp in the Great Lakes and the efficacy of various measures intended to impede carp migration. These problems dictate the need for a strategy that has the flexibility and robustness to develop and incorporate new and better monitoring techniques, methods and tools and to quickly apply them where appropriate.

The present opportunity is to prevent further movement of the two target invasive species, silver and bighead carps, between the Mississippi River and Great Lakes Basins. The full range of potential impacts of these two species of Asian carp could have on the Great Lakes system as whole in terms of ecology and economics is at present not fully defined; however, invasive species have been documented around the world to be one of the main causes of biodiversity loss (Wilson 1991, Kowarik 1995, Vitousek et. al. 1997, Ward 1998, Gido & Brown 1999, Lockwood & McKinney 2000, Blair 2000, Rahel 2000, McKinney 2001, Woodruff 2001, Mooney & Cleland 2001, Lake & Leishman 2004, Leung 2006, Lepriuer et al 2008). In general terms, to prevent adverse ecological and cultural effects of an alien species, several actions may be undertaken, which include: a cessation of the transport of live alien species; restoration of ecosystems structure and functions; and the eradication, or reduction of already established invasive species. Measures implemented under this interim to manage the dispersal of Asian carps into Lake Michigan via the CAWS can provide a means to address these action items.

Two distinct challenges present themselves in the CAWS: (1) A large and growing population of silver and bighead carps in the Illinois River is migrating upstream toward the electrical dispersal barrier; and (2) that the possibility that Asian carp may already exist in the CAWS beyond the electrical dispersal barrier via the failure modes discussed above. Interim measures that may address the first challenge, may not in turn address the possible presence of fish above the dispersal barrier. Various alternatives intended to address both of these challenges are discussed below.

3.4 – Interim Risk Reduction Measures

IRRMs were considered to reduce the risk and/or consequences associated with the failure modes identified in Section 3.2. This analysis and the methods used are primarily based on the work completed by an interagency group, headed by the Minnesota Department of Natural Resources (MNDNR) and published in the 2004, "*Feasibility Study to Limit the Invasion of Asian Carp into the Upper Mississippi River Basin*," (Appendix D). The Feasibility Study evaluated a full range of deterrent technologies and locations along the Upper Mississippi River where deterrents might be effective in deterring Asian carp migration. While the MNNDR study was focused on application of Asian carp deterrent measures in the Upper Mississippi, the PDT felt there was sufficient similarity between the navigable portions of the Upper Mississippi and the Illinois and Chicago Area Waterways that the recommendations of the study could be utilized as the basis for the current analysis. Further, this study is one of the few efforts that focused on fish deterrent measures specific to silver and bighead carps. Therefore, the PDT reviewed the study and utilized the recommendations of this study to evaluate potential measures for implementation in the IWW and CAWS.

A range of measures were considered, and those that were deemed to have the greatest probability of success at reducing the risk of Asian carp migration in the CAWS and that could be rapidly implemented were further evaluated. Each of these measures were then looked at independently for engineering feasibility, environmental and social acceptability, and cost efficiency. Three deterrent types (acoustic deterrents, air bubble curtains, and strobe lights) were investigated further since they can be quickly deployed, do not impede navigation, and would not pose a risk to public safety. These deterrents are behavioral guidance technologies which include various methods that employ sensory stimuli, including light, sound or air bubbles, to elicit fish behaviors that will result in migrating fish avoiding, or moving away from areas where the technologies are employed. In all cases, the purpose is to discourage fish from entering a particular area, and to make it more attractive to move to another location where they could be harvested or eradicated. The final step looked at optimizing the operating parameters of potential combinations of measures, i.e., combination deterrent systems that utilize two or more deterrent systems or hybridized systems to increase the efficacy of the deterrents.

At the outset of this process, and based on the 2004 Study, USACE believed that these technologies showed promise for quick implementation at a relatively low cost. In the course of this evaluation, USACE determined that these technologies are more expensive and more time consuming to install and operate at appropriate parameters than first thought. While these technologies do show promise for use in the CAWS, they are not an immediate or inexpensive solution. Furthermore, while two reports have specifically recommended using these technologies to control Asian carp populations in other locations, USACE knows of only one small scale field study of the efficacy of the deterrent against Asian carp. The results of this study are not final at this time, but they are promising. Given the lack of field use of this technology for deterring Asian carp and a lack of other large scale field uses, these measures are demonstration technologies.

Physical and electrical barriers are probably the most effective at deterring or stopping fish; however, long-term operation and maintenance of electrical barriers require significant investments and take a long time to construct. The installation of physical barriers between the basins poses many complicated environmental, social, and economic implications that must be fully assessed before making a recommendation. The use of additional electrical dispersal barriers and physical methods will be assessed in the Great Lakes Mississippi River Interbasin Study (GLMRIS). In the meantime, USACE and its partners in the ACRCC believe that taking concerted interim measures and being ready to respond to changing information in a coordinated manner is the best way to manage and reduce risk.

Strobe Lights

Strobe lights have been extensively evaluated as a fish deterrent in both laboratory and field trials, and have been used in conjunction with other behavioral devices to increase the level of fish diversion (Patrick & Christie 1985, MNDNR 2004). Combinations with bubble curtains may enhance the effectiveness of both, as the light can be projected onto the bubble curtain. Strobe lights can repel fish by eliciting an avoidance response. Stone and Webster (1986) found that a strobe light system at Saunders Generating Station in Ontario was found to be 65 to 95 percent effective at repelling or diverting American eels (*Anguilla rostrata*). Factors that influence light

system efficiency for deterring fish include turbidity and the intensity and the duration of the flash.

Effective levels of deterrence have been achieved with a number of species, but to date the lights have worked most effectively on American shad (*Alosa sapidissima*) juveniles. Successful fish deterrence with strobe lights has often been site specific, which indicates that hydraulic and environmental conditions, along with project design and operation, are other factors that must be considered for a successful system installation. Many species of larval fish are attracted to lights, so additional measures may need to be implemented to capture larval fish near the ABS fish deterrent during spawning season.

High Pressure Sodium and Mercury Lights

High pressure sodium lights (1,000 watts) have been used to attract and hold blueback herring (*Alosa aestivalis*) to slow water areas located near a powerhouse spillway. These lights are similar to those used by commercial fisherman to concentrate blueback herring for harvest. Preliminary studies have shown that blueback herring and other fishes can be attracted to high-pressure sodium or mercury vapor lights. (Nestler et al 1995).

Mercury lights have been used as attractants for species-specific applications. Alewives have been attracted to a zone of filtered mercury light, whereas Coho salmon (*Oncorhychus kisutch*) and rainbow trout (*Oncorhynchus mykiss*) displayed no attraction (Puckett & Anderson 1988). Insufficient data are available to determine whether mercury lights are life-stage specific. Attractants may be used in combination to congregate fish that are avoiding other behavioral barriers or deterrents.

High pressure Sodium and Mercury lights were eliminated from further consideration by the PDT. These types of lights function as attractants and not deterrents. Further, the effectiveness of these lights to attract Asian carp is unknown. While the use of attractants may enhance the functionality of deterrent measures, the PDT felt that other types of attractants, such as the use of pheromones or habitat enhancements, might be more effective for the target species than the High pressure Sodium and Mercury lights.

Air Bubble Curtains

Air bubble curtains are created by pumping compressed air through a diffuser to create a continuous dense curtain of bubbles, which can cause an avoidance response in fish. The rising curtain then forms a wall that will deflect fish under optimal conditions such as the reflection of light and the generation of underwater noise and vibration by the bubbles. Solomon (1992) cited fish deflection efficiencies for bubble barriers in laboratory tests of up to 98%, falling to a range of 51% to 80% in darkness or high turbidity levels. The cost of a bubble curtain is relatively low in comparison to electrical dispersal barriers, although large, deep-water installations can be expensive, both in terms of capital costs of the compressor and housing, and of power requirements. Many factors affect the response of fish to air bubble curtains; including temperature, turbidity, light intensity, water velocity and orientation in the channel. Bubbler systems should be constructed from materials that are resistant to corrosion and rusting. Installation of bubble curtain systems should consider positioning of diffusers in areas where siltation or zebra mussels (*Driessena polymorpha*) may clog air ducts or in areas where

bubble curtain disruption may occur as a result of barge or flow related turbulence. Where zebra mussels are likely to clog air ducts, periodic maintenance of the system would be required to ensure that mussels are removed.

Acoustic Deterrents

Fish vary in their sensitivity to underwater sound, which will clearly influence the potential efficiency of an acoustic barrier. When considering audible range frequencies, hearing sensitivity is determined by the presence or absence of a swim bladder and by any anatomical specializations that improve the conduction of sound from the swim bladder to the inner ear (Hawkins 1986). Fish size is also an important factor in relation to acoustic deterrence efficiency. Observations have confirmed that smaller sized fish may be more tolerant and could require stronger, higher frequency sound in order to be effective. Habituation to sound is generally not a problem with migratory fish, since they are not typically in contact with the sound for a long period. Nevertheless, it must be considered with resident fish populations, where fish may be in contact with the sound for extended periods and therefore develop a tolerance.

Acoustic deterrents are generally designed to minimize the risk of habituation by altering the deterrent signals on a daily basis. Deflection is generally the most effective course of action for an acoustic deterrent where the fish are diverted away from the river structure and into a targeted area. Blocking like a barrier perpendicular to river flow can be more difficult if the fish are not diverted away from the protected area because the risk of habituation to the sound signal increases. Although regularly changing the signal pattern can minimize habituation, acoustic deterrents are not considered to be as effective as electrical barriers for blocking movement. Therefore, it is considered necessary to provide a desirable flow regime or habitat for the fish to be guided towards. The ideal sound field should form a steep acoustic gradient approaching the entrance, free from acoustic nulls (voids) caused by destructive interference within the sound field. The presence of such nulls could cause fish to be guided into instead of away from the river structure.

The hearing range of most fish falls within the audible range of humans, with maximum sensitivity lying in the sub-3 kHz band (Hawkins 1981). Audible frequency deterrents typically exploit hearing sensitivity in the 20 to 500 kHz range. The key factors for successful fish deflection resulting from hearing sensitivity taken from Lambert et al (1997) are:

1) the sound signal should be within the 20 to 500 kHz frequency spectrum
2) the nature of the signal should be a repellant to fish
3) the sound level received by the fish at the required point of deflection should be sufficiently above ambient noise level

Some of the common causes of acoustic deterrent failure include:

1) emission of sounds at frequencies outside the main hearing band of fish (0 to 600 kHz)
2) ineffective signal types
3) inadequate sound levels
4) failure to compensate for background noise

5) unsuitable or inadequate sound generation equipment
6) unusual sound propagation patterns caused by interference
7) excessive water velocities
8) failure to provide a clear escape route or diversion area
9) poor design

Two methods of generating an acoustic barrier are presently in use. The first uses arrays of underwater loudspeakers or sound projectors to produce a diffuse omni-directional field of sound that can block fish movement. The other employs sound sources coupled to a bubble curtain to produce a discrete "wall of sound" (known as an "evanescent" or rapidly decaying field) that can be used for more precise guidance of fish.

Some laboratory testing has been completed that measured the auditory response in bighead and silver carp for acoustic barrier optimization. The analysis identified the range of lowest-highest detectable sound for these two species of Asian carp. "The results indicate the importance of matching the sound generated by an acoustic fish deflection system to the hearing range of the target species if high efficiency is to be achieved." (Nedwell, Lovell and Pegg, 2005).

Hybrid Deterrents

Hybrid deterrents, or combinations of different deterrents, have been found to increase the effectiveness of individual behavioral barriers such as strobe lights and bubble curtains. These studies have been undertaken in the context of various fish species. As explained below, while two studies have recommended use of hybrid deterrents against Asian carp, only one study has directly addressed the efficacy of these deterrents against Asian carp and its findings are not final.

Underwater strobe lighting and bubble curtains have been found to successfully divert/deter approximately 77 to 80 percent of all fish normally approaching hydroelectric turbine forebay areas (MNDNR 2004). Results of case studies for these systems have reported optimum diversion efficiency of a Sound Projector Array based acoustic bubble curtain to be approximately 90%. However, these studies caution that site specific conditions and the species targeted influence deterrent effectiveness (MNDNR 2004). A 2009 field test of an acoustic-bubble-strobe deterrent in California was successful in deterring approximately 82% of migratory fish in the Sacramento-San Joaquin River Delta. The measure was developed by integrating all the strobe lights and acoustics into the bubble curtain to enhance the effectiveness of the deterrents. This combination was tested by the University of Illinois and the Illinois Natural History Survey in August 2009 on Quiver Creek, a small tributary to the Illinois River where Asian carp are present. Results of that study have not been published, but a follow up study of the hybrid technology is planned for May – October 2010. Assuming USACE moves forward with construction of a deterrent or deterrents, USACE would explore working with the results of this study to calibrate the system to the settings for deterring Asian carp.

The *Management and Control Plan for Bighead, Black, Grass and Silver Carp in the United States.* compiled and edited by the USFWS in October 2007, recommended construction and operation of a, "Sound Projector Array-based acoustic bubble curtain fish deterrent at two locks

and dams on the Upper Mississippi River to prevent the spread of Asian carps throughout the basin." That plan identified the USACE, if funded and authorized, to lead the planning, design and installation of these fish deterrents as demonstration projects, (Conover 2007). The Draft *Asian Carp Control Strategy Framework* also identifies potential application of this new technology as one potential type of interim measure to address the threat that Asian carp pose. USACE previously considered using IRRM measures such as acoustic bubble deterrents to deter Asian carp migration during the shutdown and maintenance of the Electric Dispersal Barriers that occurred in December 2009. However, the acoustic bubble barriers were not selected in that instance, because rotenone was determined to be a better solution for the significant, but short term, risk posed by the maintenance activity.

3.5 – Risk Reduction Action Analysis

3.5.1 – Fish Deterrent (IRRM) Type Selection

The primary risk to be reduced is the potential for Asian carp to establish a sustainable population either in the CAWS or in Lake Michigan itself. The potential risk reduction measures identified above would not have adverse affects to navigation, induce flooding or have a significant adverse effect on the environment as discussed in Chapter 4. Nor do they pose safety risks. The following matrix (Table 1) shows a modified analysis based upon the results from the MNDNR feasibility study on the efficacy of the identified risk reduction measures (MNDNR 2004 Appendix D).

The qualitative analysis contained in Table 1, provides a means to evaluate and compare the different technologies evaluated for this study. Four rating elements were developed based on the analysis in the MNDNR study. The rating elements are as follows:

Fish Deterrence Effectiveness - This element was based on the optimum diversion efficiency or the effectiveness of the specific IRRM to deter the target species. The ratings ranged from 0-3, with a 0 allocated to the no-action plan. The remaining ratings (between 1-3) have an effectiveness between of 80 -100 as noted in the table footnotes.

Probability of Success - This element is an indicator of how successful the technology could be in deterring the target species, if all of the short-comings of the technology are taken into account. For example, bubble curtains by themselves do not function in high flows, so the probability of success received a low rating for this element. However, bubble curtains in combination with other technologies received higher ratings, since there was technological redundancy in the combination that might address some of the short-comings of the stand-alone bubble curtains.

O&M Costs - This element is an indicator of range of probable O&M costs. Higher O&M costs were associated with some technologies or combinations of technologies. The ratings from 0-3, with a 0 allocated to the no-action plan.

Table 1 - Rating Matrix for CAWS Deterrent Barriers[1, 2]

#	Interim Risk Reduction Measure	Fish Deterrence Effectiveness (0-3)	Probability of Success (0-3)	O&M Costs (0-3)	Combo Effectiveness (0-3)	Totals Rating Points
1	No Action	0.0	0.0	0.0	0.0	0.0
2	Strobe Lights	1.0	1.0	2.0	0.0	4.0
3	Air Bubble Curtain	1.0	0.5	2.0	0.0	3.5
4	Acoustic Deterrent	1.0	1.0	2.0	0.0	4.0
5	Hybrid Deterrent (Bubble / Acoustic Combo)	2.0	2.0	1.0	2.0	7.0
6	Hybrid Deterrent (Bubble/ Strobe Combo)	2.0	1.5	1.0	2.0	6.5
7	Hybrid Deterrent (Acoustic/Bubble /Strobe Combo)	2.0	2.5	1.0	3.0	8.5
8	Hybrid Deterrent (Acoustic / Strobe Combo)	2.0	2.0	1.0	2.0	7.0

[1]Fish Deterrence Effectiveness: 3=95-100%, 2=80-95%, 1=<80%, 0=none

Probability of Success: 3=High, 2=Medium, 1=Low; 0=none

Probable O&M Costs Range: 3=Lowest Cost, 2=Average Cost 1=Highest Cost; 0=none

Combo Effectiveness: 3=High, 2=Medium, 1=Low; 0=none

[2] Recommendation is independent of O&M costs.

Combo Effectiveness - This element acknowledges the additive effectiveness of multiple deterrent technologies at one location. The ratings from 0-3, with a 0 allocated to the no-action plan. A combination of two technologies received a rating of 2, while the combination of 3 technologies received a rating of 3.

Based on the results of this analysis, the combination deterrent, acoustic-bubble-strobe (ABS) deterrent (IRRM #7) appears to have the greatest potential to be an effective deterrent to Asian carp movement. The omni-directional sound field produced by a sound projector array is not only focused along the bubble curtain, but can maintain sound field effectiveness in the event a passing barge or lock discharge disrupts the integrity of the air bubble curtain. In addition to the criteria evaluated (Table 1), the acoustic based system received additional prioritization due to silver and bighead carps being easily startled and scattering away from approaching boats and engine noise. The sound source for the recommended IRRM can be calibrated to approximate an Asian carp specific audiogram.

The ABS deterrent provides great flexibility in operations by allowing controlled adjustments to the strobe light, acoustic deterrent and bubble curtain. This should allow the system to be adaptable to normal variations in water velocity, turbidity and temperature in the waterway. Operating such a deterrent system also offers numerous opportunities for scientific investigations to better understand the behavior of the Asian carp and other fish species. Installation of the recommended ABS fish deterrent system would be a demonstration project to apply the recommended IRRMs that has the potential to deter migration of Asian carp in IWW and CAWS. While it offers many potential benefits, it is a demonstration technology with

numerous variables and uncertainties that could affect performance. In addition to the need to field-calibrate and refine operations, this type of project would require a comprehensive sampling and analysis strategy to monitor operational effectiveness of the deterrent system and an integrated management/harvest plan to manage fish accumulation in the location to which the fish are being deterred. The USACE is working with the IDNR and the USFWS to identify data needs to effectively operate this system and measure its efficacy, as well as to assess the possibilities of using the ABS fish deterrent measure in conjunction with other technologies such as the use of attractants (i.e. pheromones, plankton, lights, etc.) that could help guide fish into certain control zones.

It is currently unknown exactly how factors such as turbidity, navigation traffic, flooding, and other factors, including zebra mussels may impact the efficacy of the technology. While there have been some field scale tests that have demonstrated the effectiveness of the ABS fish deterrent against other fish species it is largely unknown exactly how effective the ABS deterrent measure will be against the target species. As a result, USACE recommends continual monitoring once these technologies are operational so that adjustments can be made to ensure maximum efficacy. Also monitoring and calibration is necessary to record which adjustments to the system are most effective under a variety of environmental conditions. USACE and its partners believe that these technologies show sufficient promise to merit their deployment.

3.5.2 – Site Plan Formulation Process

Two types of sites were considered for the implementation of the measures recommended through the IRRM selection process:

1) Sites downstream of the electric dispersal barrier. These sites would allow demonstration and calibration of the deterrent at a location near a known population of Asian carp. The identification of a demonstration site to allow calibration of the system to the settings most effective for Asian carp was considered an essential part of the IRRM process. This location may also potentially alleviate propagule pressure on the electric dispersal barrier by reducing population size.

2) Sites upstream of the electric dispersal barrier. These sites would provide additional opportunities to potentially reduce and manage risk as close to the inlets to Lake Michigan as is feasible to address the potential failure modes discussed in Section 3.2. The identification of additional locations within the CAWS where a fish deterrent could be used to potentially reduce risk of Asian carp passage through the CAWS to Lake Michigan was considered prudent given the level of concern regarding the target species.

3.5.3 – Demonstration/Downstream ABS Fish Deterrent Measure (IRRM) Site Selection

Site location and alignment of the ABS fish deterrent measures were considered based on a number of factors, many of which were outlined in the MNNDR Feasibility Study. Locating ABS fish deterrent measures below downstream lock channel entrances at lock and dam facilities was determined to be appropriate for operation of the selected ABS fish deterrent measure, provided that other factors such as channel velocity, water depth and other site conditions were favorable. The rationale for locating the ABS fish deterrent measures downstream of locks was

to take advantage of the associated dams that can be barriers to upstream migration and to orient the fish away from the navigation channel and lock gates and toward backwater locations where management measures, including control and/or eradication of Asian carp, could be utilized. Other factors that were considered in site selection included the availability of real estate and utilities, the existence of opportunities to bypass the lock and dam (through other flow paths), as well as the geographic and physical conditions of the site.

An additional factor in the location of a demonstration ABS fish deterrent measure was the location of the site in terms of the Asian carp migration front, as well as the proximity to the Electric Dispersal Barriers. The MNDNR study recommended locating measures downstream of lock and dam structures (to take advantage of the pool in front of the dam), as well as ahead of the known migration front of the Asian carp.

The Corps considered the Dresden Island site, the Brandon Road site, and the Lockport Lock and Dam site as potential demonstration/downstream sites. However, because Asian carp have been observed and tagged in the Dresden Island Pool, the Dresden Island Lock and Dam was quickly eliminated as an appropriate site. The two remaining sites, the Brandon Road Lock and Dam and the Lockport Lock and Dam sites both include a number of features that appear to be conducive for a demonstration project location. While both sites have a large pool on the downstream side of the Lock and Dam, there are a number of physical bypass opportunities at the Lockport Lock and Dam that might allow the Asian carp to bypass the ABS fish deterrent measure. These bypasses include parallel streams or canals that allow passage past the lock and dam to upstream locations. These bypasses were used to eliminate the Lockport Lock and Dam site from further consideration as an appropriate site for the demonstration project.

The Brandon Road Lock and Dam facility is located at the northern end of the Dresden Island pool upstream of locations where Asian carp have been recovered. While one silver carp was recovered during rotenone application in the Lockport Pool in December 2009, additional individuals of the target species have not been recovered in the Lockport Pool. The presence of the target species is needed to calibrate elements of the demonstration ABS fish deterrent to the target species. Fisheries biologists can tag and release Asian carp downstream of the demonstration ABS fish deterrent, and the electric dispersal barrier. The pool on the downstream side of the Brandon Road Dam will provide a suitable location for Asian carp deterred by the ABS to be congregate and be collected by fisheries biologists.

With the presence of a known Asian carp population, telemetry and visual observations can be used to observe whether the Asian carp are deterred by the demonstration project or whether they pass through the ABS fish deterrent. An analysis of deferred passage versus total attempts as well as fish behaviors could be used to re-evaluate a number of parameters related to the efficacy of the demonstration ABS fish deterrent technologies. Further, because the electric dispersal barrier is located upstream of the, Brandon Road Lock and Dam, the barrier can provide redundancy to the ABS fish deterrent demonstration technologies while the measures are being optimized.

In summary, the PDT determined that the Des Plaines River at Brandon Road Lock and Dam was the most suitable location for the installation of the demonstration/downstream ABS fish deterrent measure.

3.5.4 – Advance ABS Fish Deterrent Measure Site Selection

A demonstration ABS fish deterrent in the Des Plaines River at Brandon Road Lock and Dam provides the opportunity to evaluate the effectiveness of this demonstration technology under field conditions ahead of the anticipated advance of large numbers of Asian carp. It also allows calibration of the technology to specific conditions in the CAWS and calibration to address specifics of the target species. As such, it has the potential to reduce the number of Asian carp approaching the electrical barriers when the deterrent is fully functional. However, it does not address the possibility that Asian carp already or may soon exist beyond the electrical barriers in the CAWS through any of the failure modes identified in Section 3.2.

USACE uses the phrase "advance measures" to describe precautionary measures that can be put in place before a potential need arises during an emergency. Advance measures are structures, tools and/or systems designed to facilitate a more rapid, coordinated and effective response in the case of a foreseeable condition requiring a rapid response, or in some cases a pre-positioned response. The PDT conducted an evaluation of other suitable, advance locations where implementation of the ABS fish deterrent technology could potentially reduce risks related to Asian carp within the CAWS.

Site selection for the advance fish deterrent measure locations included criteria that were used for the demonstration sites, as well as a number of additional considerations. Five approximate locations within the CAWS were initially identified as being suitable for installation of the ABS fish deterrent measure because average current velocity is generally less than 1 foot/second at each location. While lock operations can affect velocity profiles in close proximity to lock gates and water intake and outlet locations, the final location of an ABS deterrent in the stream would be determined during design to assure the ABS deterrent is located beyond the zone where localized changes in velocity occur due to lock operations. The final location of an ABS deterrent in the field may also be adjusted during design to account for any unforeseen site conditions that may affect the efficacy of the ABS deterrent. The following site prioritization provides a qualitative assessment of the evaluation of sites judged to be appropriate locations for advance fish deterrent measures, based on the USACE current knowledge of the conditions at these locations.

Site Prioritization

Five (5) sites were identified for locations of advance fish deterrents measures within the CAWS, and a decision matrix with five key parameters was established by the planning team in order to determine the necessity and prioritization of each site. Three parameters directly influencing the efficacy of an ABS fish deterrent in the CAWS were assigned a relative score of 1 through 5 with five being most efficient. Two additional parameters critical to rapid implementation, availability of Real Estate and Utilities were assigned a relative score of 1 through 3 with three being most readily available, unless otherwise described (Table 2). The following describes each parameter used to evaluate and base selection of a suitable array of locations for installation of ABS deterrent measures within the CAWS.

Real Estate – As a practical matter, ability to acquire property quickly is important to how soon the IRRM could be deployed. Land at the optimum location for placement of a deterrent system is needed for a control facility and must be obtainable and accessible. If land is already

owned by USACE or a non-Federal stakeholder, then it has the ability to expedite small footprint projects of this sort. However, because this factor does not affect the efficacy of the IRRMs it was weighted by giving it a lower number of total potential points than factors that directly influence how well the measure will work once it is constructed. Relative scores were assessed by assigning a value of 3 for land owned by the USACE; 2 for land not owned by USACE but appears attainable; and 1 for land perceived to be difficult to obtain. No sites were identified as unattainable. One site, the Chicago Lock, was assigned a score of 3, and the other four sites were assigned a score of 2.

Utilities – Utilities are another consideration for projects that require power. However, because this factor does not affect how well the IRRM will work once it is constructed, it was weighted by giving it a lower number of potential points. Those sites with readily available utilities received a score of (3); moderate availability received a score of (2); and those sites that would be very difficult to run power or water received a score of (1). Two sites, Chicago Lock and O'Brien Lock, were assigned a score of 3, and the other three sites were assigned a score of 2.

Geographic Efficiency – Geographic efficiency is a subjective measure that relates to the physical characteristics that would make a location more or less preferable for locating a fish deterrent system. The downstream lock approach at a lock and dam facility was considered a high potential site because the barrier that the dam provides inhibits upward migration of fish and may offer an attractive pooling area for fish that could be used as a management and control zone. Another aspect of geographic efficiency is the relationship to upstream outlets to Lake Michigan. A location where a deterrent could be placed that deters Asian carp from multiple escape points to Lake Michigan would score higher than one that only addresses one outlet. Sites received a score of (5) if they were judged to be ideal sites in terms of physical layout, alternate pathways and attractive habitat to fish away from the location of the deterrent; (4-2) for sites that were judged to be acceptable but having potentially limiting physical or habitat constraints; (1) if they were judged to be marginally acceptable or unacceptable due to physical or habitat constraints. None of the five sites were assigned a score of 5; however, the Chicago River at Throop Street; The Calumet River at T.J. O'Brien Lock and Dam were assigned a score of 4. An effective deterrent at the Throop Street location could inhibit migration to Lake Michigan through the Chicago Lock and through the Wilmette Pumping Station; however, the available location for deterred fish is not considered to be particularly attractive habitat to an Asian carp. The T.J. O'Brien Lock and Dam was assigned a score of 4 because it is downstream of a downstream lock entrance and has suitable area for management of deterred fish. The Calumet Sag Channel at I&M location was assigned a score of 3 primarily because there are three upstream entry points into Lake Michigan beyond this point, Burns Harbor, Indiana Harbor and Calumet Harbor, but the proposed deterrent site is located a significant distance from the entrances to Lake Michigan. The location near the Little Cal confluence with the Cal-Sag was assigned a score of 3 because there is no barrier to inhibit upstream migration, and there is only one upstream potential direct entry point into Lake Michigan, Burns Harbor.

Location Effectiveness – Sites upstream of the Electrical Dispersal Barrier System were evaluated for their strategic importance in deterring progress into Lake Michigan by Asian carp that may be above the electrical barriers as a result of any of the failure modes discussed in Section 3.2. This rating factor was based primarily upon proximity to Lake Michigan and the potential for a location to be suitable for implementation of effective management and control

measures should Asian carp be detected in the CAWS above the electrical barriers. Scores ranked from (5) for the closest and most effective locations near Lake Michigan, to (1) for sites far removed from the lakefront. The Throop Street location was assigned a score of 5 due to its proximity to Lake Michigan and ability to serve as a location to facilitate potential management and control operations should Asian carp be detected in the CAWS. Chicago Lock, O'Brien Lock and the Little Cal at Cal Sag locations were both assigned a score of 4. The Cal Sag at I&M Canal site is the farthest site considered from Lake Michigan and was assigned a score of 3.

Biological Effectiveness – It is important that the site lends itself to repelling fish. Any sites that can redirect a fish to an offline area that provides an attractive habitat and where it could be harvested would receive a score of (5). A site that creates a situation where there is nowhere to go but into the deterrent would receive a score of (1) due to the risk that the fish would become habituated to the IRRM which would reduce its effectiveness. A site with an offline area that was deemed to be less attractive habitat and/or that provides diminished ability for harvesting or eradicating the target species received a score of (2-4). The T.J. O'Brien Lock and Dam, Little Calumet River at the Calumet Sag Channel and the Calumet Sag Channel at the I&M Canal locations were all assigned a score of 4 based on the attractiveness of the offline area. The Chicago River at Throop Street site has sufficient offline area, but the habitat was judged to be less attractive. The Chicago Lock was assigned a score of 1, because no suitable offline location to collect and manage deterred fish is in proximity to this site.

Table 2 provides a quantitative evaluation of the suitability of locations within the CAWS to potentially manage and control Asian carp that may have bypassed the electrical barriers by any of the failure modes identified in Section 3.2. While the site selection matrix provided a ranking of sites, the planning team also considered the optimal number of advance fish deterrent measure locations that could be implemented as part of this Efficacy Study.

Table 2 - Advance Fish Deterrent Measure Site Selection Matrix

#	Site	Real Estate	Utilities	Geo Efficiency	Location Effectiveness	Biological Effectiveness	TOTAL
1	Chicago Lock	3	3	1	4	1	12
2	Chicago River at Throop Street	2	2	4	5	3	16
3	Calumet River at T.J.O'Brien L&D	2	3	4	4	4	17
4	Calumet Sag @ I&M	2	2	3	3	4	14
5	Little Calumet River @ Calumet Sag Channel	2	2	3	4	4	15

3.5.5 –ABS Fish Deterrent Measure IRRM Scenarios

In addition to considering demonstration/calibration sites and advance measure sites (sites closer to Lake Michigan), the PDT considered whether a combination of sites could potentially provide additional risk reduction when the ABS fish deterrent measures were fully functional. The PDT considered three possible scenarios for IRRMs: Brandon Road Lock and Dam

demonstration ABS fish deterrent measure alone; Brandon Road Lock and Dam demonstration ABS fish deterrent measure plus one advance ABS fish deterrent measure at the Little Calumet River-Calumet Sag Channel confluence; and Brandon Road Lock and Dam demonstration ABS fish deterrent measure plus advance ABS fish deterrent measures at the Chicago River at Throop Street, the Calumet River at T.J. O'Brien Lock and Dam, and the Little Calumet River at the Calumet Sag Channel. These locations are depicted in Figure 4.

Brandon Road Lock and Dam Demonstration ABS Scenario

The downstream approach channel to the Brandon Road Lock was identified as an appropriate location for the installation of a demonstration ABS fish deterrent measure because this location provides the opportunity to evaluate the effectiveness of this technology under actual field conditions ahead of the anticipated advance of Asian carp. The potential presence of carp in this area will also allow calibration of the deterrent to settings most appropriate for these species. These measures have the potential to reduce the risk associated with pressure on the electric dispersal barrier.

The total approximate cost to build and initiate ABS operations at the Brandon Road Lock location is summarized in Table 3 below. The Monitoring and Sampling line includes monitoring of the ABS fish deterrent measure by the contractor, as well as costs associated with fish sampling, tracking and other efforts detailed in the monitoring plan. A risk analysis was performed on the cost estimate to develop appropriate contingencies, which was [redacted]% for the demonstration project. The detailed cost estimate and results of the Risk Analysis are contained in the Cost Estimate (Appendix C).

Figure 4 - Location of the Proposed Interim Risk Reduction Measures.

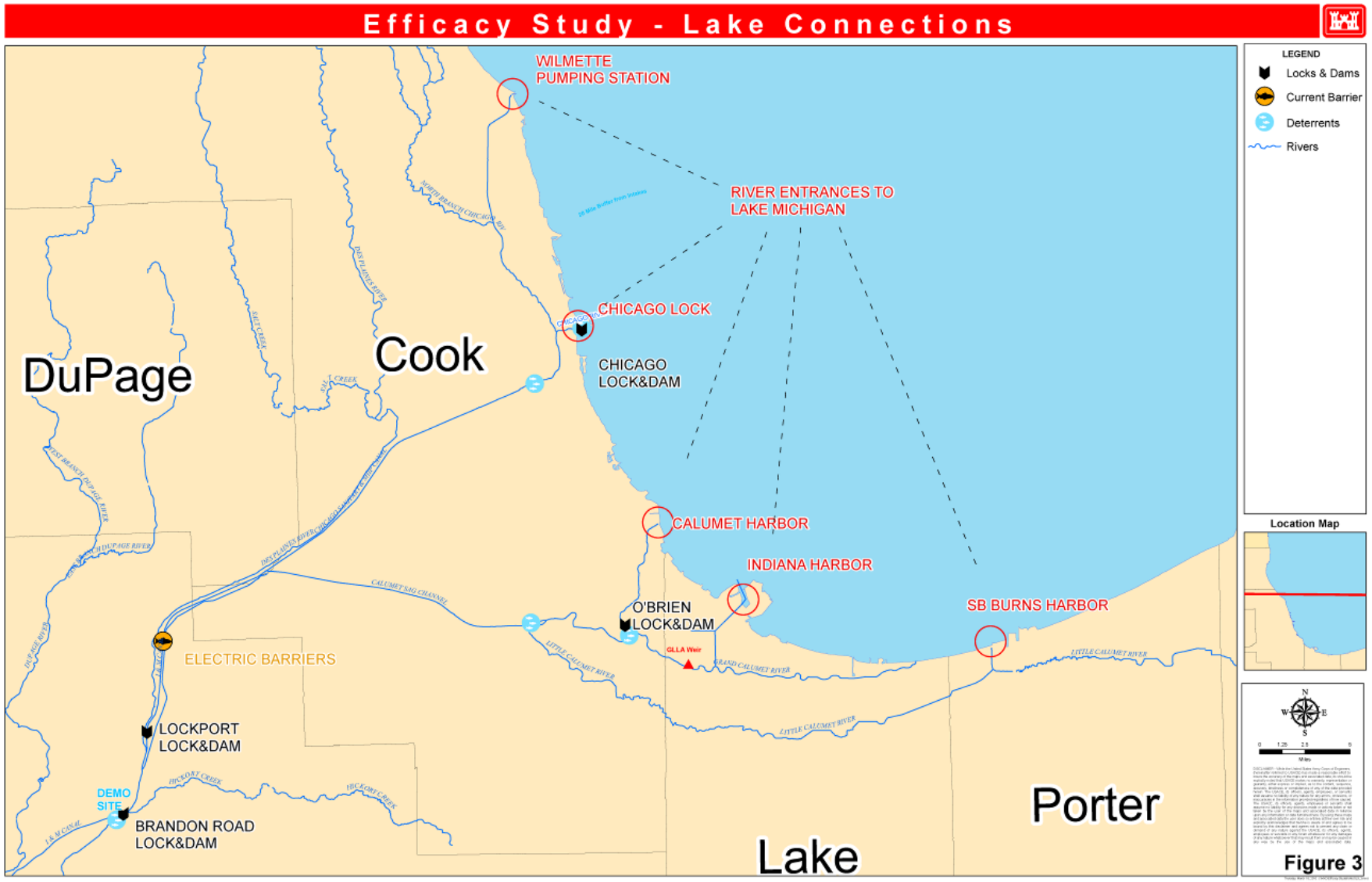


Table 3 Cost Estimate for ABS Demonstration Project at Brandon Road Lock

Item	Estimate	Contingency	Total
Construction			
Land			
Preconstruction, Eng & Design			
Eng & Design During Construction			
Construction Management			
Annual M&S Costs			
Total Project Costs			

Brandon Road Lock and Dam ABS plus the Little Calumet River ABS Scenario

The Little Calumet River is connected to Lake Michigan via Burns Ditch in Indiana. The Little Calumet River is the only waterway within the CAWS that does not currently include a structure that could be utilized to limit Asian carp movement into Lake Michigan from the CAWS. Locating an advance ABS fish deterrent measure at the confluence of the Cal-Sag Canal with the Little Calumet River in combination with the demonstration ABS fish deterrent measure at Brandon Road Lock and Dam could potentially provide additional risk reduction of Asian carp movement into Lake Michigan through the CAWS. The demonstration project could be used to refine the operation of the advance ABS fish deterrent measure located at the Little Calumet River-Calumet Sag Channel confluence.

The total cost to build and initiate operations of ABS fish deterrents at the Brandon Road Lock and Little Calumet River locations is summarized in Table 4 below. The Monitoring and Sampling line includes monitoring of the ABS fish deterrent measure by the contractor, as well as costs associated with fish sampling, tracking and other efforts that will be detailed in the monitoring plan. A risk analysis was performed on the cost estimate to develop appropriate contingencies, which was [redacted]% for the demonstration project and the one advance measure deterrent at the confluence of the Cal-Sag Canal with the Little Calumet River. The detailed cost estimate and results of the Risk Analysis are contained in the Cost Estimate (Appendix C).

Table 4 - Cost Estimate for ABS Demonstration Project at Brandon Road Lock plus an Advance Measure Deterrent at the Little Calumet River-Calumet Sag Channel Confluence

Item	Estimate	Contingency	Total
Construction			
Land			
Preconstruction, Eng & Design			
Eng & Design During Construction			
Construction Management			
Annual M&S Costs			
Total Project Costs			

Demonstration ABS Deterrent plus Advance ABS Deterrents Scenario

Of the five sites evaluated within the CAWS for the potential placement of an advance ABS fish deterrent measure to reduce the risk of Asian carp accessing Lake Michigan via the CAWS, three were selected based on the potential protection that could be provided against the failure modes identified in Section 3.2. The recommended sites for placement of advance fish deterrent measures are the Chicago River at Throop Street, the Calumet River at T.J. O'Brien Lock and Dam, and the Little Calumet River at the Calumet Sag Channel.

The total estimated cost to build and initiate operations of four ABS fish deterrents, one each at the Brandon Road Lock, Little Calumet River, Throop Street and TJ O'Brien Lock locations is summarized in Table 5 below. The Monitoring and Sampling line includes monitoring of the ABS fish deterrent demonstration and three advance measures locations by the contractor, as well as costs associated with fish sampling, tracking and other efforts that will be detailed in the monitoring plan. A risk analysis was performed on the cost estimate to develop appropriate contingencies, which was [redacted]% for the demonstration project and the three advance measure deterrent locations Little Calumet River, Throop Street and TJ O'Brien Lock. The detailed cost estimate and results of the Risk Analysis are contained in the Cost Estimate (Appendix C).

Table 5 - Cost Estimate for ABS Demonstration Project at Brandon Road Lock plus Advance Measure Deterrents at Throop Street, Calumet River at T.J. O'Brien Lock and Dam, and Little Calumet River at the Calumet Sag Channel

Item	Estimate	Contingency	Total
Construction	[redacted]		
Land			
Preconstruction, Eng & Design			
Eng & Design During Construction			
Construction Management			
Annual M&S Costs			
Total Project Costs			

3.6 – The Recommended Interim Risk Reduction Measure

The PDT evaluated scenarios that included combinations of demonstration/calibration and advance measure locations for the placement of IRRMs to potentially reduce the risk associated with Asian carp migration in the CAWS. Based on an evaluation of all factors, including the magnitude of contingencies in the cost estimates, the total costs and the potential for near-term levels in risk reduction for each of the three scenarios, the PDT recommended an IRRM that consists of the installation of a demonstration ABS fish deterrent at only one location, the Des Plaines River at the Brandon Road Lock and Dam. The need for additional advance IRRMs in the CAWS may become more acute with new data, and is being considered by the ACRCC Monitoring Workgroup, but there is insufficient basis at this time to support a recommendation for installation of this type deterrent at multiple locations in the CAWS as advance IRRMs.

The Des Plaines River at Brandon Road Lock and Dam location is situated downstream of (below) the electric dispersal barriers, but upstream of (above) the established population of Asian carp. Therefore, the efficacy of the ABS deterrent can be tested with tagged carp and upon carp that may be present in the pool with the existing operational electric dispersal barrier providing an upstream deterrent to Asian carp movement. Further, there is an area below the dam where Asian carp could be directed away from the navigation lock by the ABS fish deterrent. Included in the recommendation are provisions for sampling and monitoring of the deterrent system, as detailed in the Interagency Sampling and Monitoring Plan subsection, below.

The combination of the three technologies, acoustics, air bubble curtain and strobe lights has been shown to have efficacy in the dispersal of fish species in short term field evaluations in both Illinois and California. Quantifying the functionality and effectiveness of the ABS fish deterrent measure to address risk associated with the failure modes identified in Section 3.2 will be a primary objective of the demonstration project. This demonstration project has the potential to increase the efficacy of the electrical dispersal barrier to discourage the movement of Asian carp through the CAWS toward Lake Michigan and could provide valuable information to support future resource and infrastructure management decisions within the CAWS and elsewhere.

The Invasive Species Management Branch in the Jacksonville District of the USACE was consulted for independent technical and policy review of the draft report due to their experience with aquatic invasive species and their research of behavioral deterrents to influence behavior of the federally protected Manatee. Their review indicated, “The combination deterrent of acoustics, bubble curtain, and strobe light (ABS; IRRM) does have the greatest potential of known available technologies for success in deterring Asian carp movement.” Their review also concluded that the recommended plan is aligned with the goals and objectives of USACE Invasive Species Policy.

Implementation Plan

Subject to the extension of available implementation authority under Section 126 of P.L. 111-85 (or enactment of alternative construction authority) and sufficient funding, implementation of the ABS fish deterrent measure should be relatively simple provided that no unforeseen issues arise regarding vessel drafts, stream depth and stream bottom contours. The selected location shown is general. The precise location would be determined during design based on field surveys to ensure the best possible placement location.

Units would arrive fully assembled, and in eight-foot segments. The segments would be made up of a truss style frame, upon which the components would be affixed. The units would be installed using marine based crane and other equipment. The measures would be deployed and anchored on short concrete piers or pipe piles or a combination thereof. Divers would also be required for connecting the segments. The equipment and controls would be housed in a unit similar to a typical 30-foot construction trailer. Power will be 110 volt and 100 amp service. The Brandon Road Lock and Dam site will require some clearing, grubbing and grading. The construction site would contain a back-up electric power generator and a back-up air compressor. The control trailers would be enclosed by an eight foot high fence topped with barbed or razor wire.

It is currently presumed that one construction contractor would be selected to build, operate and maintain the demonstration ABS fish deterrent as a demonstration project for two years. This would include monitoring the software program supplied by the manufacturer that ensures consistent power supply and that the air compressors are functioning properly. Periodically, a diver will be needed to inspect the system or the unit must be lifted out of the water for inspection. It is anticipated that yearly maintenance or change-out of sound projectors/speakers will be required. Strobe light replacements are expected every two years. However, both of these maintenance periods may be affected by the need for continuous operation, stream characteristics and aquatic life forms such as zebra mussels. Maintenance would be scheduled during periods when fish movement is minimal, and would be preceded by extensive monitoring and/or other methods to ensure that target species could not bypass the ABS fish deterrent measure while maintenance is on-going.

Units have an anticipated height of approximately 2.5 feet. Navigation depths in the Illinois Waterway, CSSC and Calumet Sag Channel are 9 feet. The existing depths below the navigation channel should be sufficient at the selected location to accommodate the vertical profile of the deterrent for vessels normally loaded. In order to address all possible navigation concerns, the USACE is actively coordinating with the USCG as the design details for the ABS fish deterrent are finalized. It is anticipated that the air and electric supply lines will be hardened to prevent accidental damage by a passing vessel. Other modifications may be required to facilitate navigation.

Installation could be completed within two to three weeks after receipt of all parts. Installation does not involve any unique devices, equipment or components and, thus, should be within the expertise of many marine contractors. Currently, the anticipated lead time for assembly of the individual components is between 18 and 20 weeks for each unit from notice to proceed until delivery to the site. This time span does not include installation.

Due to the relatively long lead time for fabricating these deterrents, they cannot be installed prior to the expiration of the Section 126 authority in October 2010. Thus, the completion of installation of these barriers on the proposed schedule will require the extension of the Section 126 authority, or the enactment of another authority. Upon approval of the recommended IRRM, it is currently estimated that approximately eight months will be required for Planning, Engineering and Design (PED) and to complete installation of the ABS deterrent at Brandon Road Lock and Dam. The PDT is continuing to explore acquisition strategies that may be employed to shorten the duration after approval that operations of this demonstration project can be initiated.

Interagency Sampling and Monitoring Plan

Installation of an ABS fish deterrent is intended to be a demonstration of the applicability of this technology to potentially reduce the risks associated with the dispersal of Asian carp in the CAWS. Section 2036 (a), Mitigation for Fish and Wildlife and Wetlands Losses, and Section 2039, Monitoring Ecosystem Restoration of the WRDA 2007, were specifically considered along with other USACE planning guidance to establish objectives and criteria to measure the efficacy of the demonstration project.

The USACE is working with partner agencies to fully identify all aspects of a sampling and monitoring plan that will be implemented in conjunction with the installation and operation of this IRRM. Discussions with the Illinois DNR and the USFWS have been initiated, and both agencies have reviewed this plan and provided Letters of Intent to affirm their concurrence with the project and commit to provide support based on available resources. (Appendix E, Correspondence). The USACE and its partner agencies will establish an ABS Fish Deterrent Team to prepare and execute the fish sampling and monitoring plan in a collaborative manner that assures the best experts available from each agency will contribute to iteratively plan, monitor and make appropriate adjustments to the operation of the ABS demonstration system as well as the various elements of the fish sampling and monitoring plan.

Four primary objectives were identified for the fish sampling and monitoring plan for this demonstration project. They are:

1) Establish initial operating parameters for the ABS fish deterrent to deter movement of silver and bighead carps;
2) Determine optimal parameters for operation of the ABS fish deterrent to deter movement of silver and bighead carps;
3) Identify specific physical and environmental conditions that may reduce or enhance the effectiveness of the technology; and
4) Determine if the ABS fish deterrent technology has potential to be applied at other locations in the CAWS to potentially reduce the risk of Asian carp migration.

The detailed fish sampling and monitoring plan will be developed during the design phase by the USACE, the USFWS and IDNR to measure the efficacy of the technology under field conditions. The plan will address the four primary objectives of the demonstration project identified above, and will be designed to provide quantitative data to support refinements in operations to optimize efficiency of the fish deterrent measure in preventing the passage of Asian carp into Lake Michigan. Generally the fish sampling and monitoring plan will include a description of methods and equipment to be used to catch, tag and observe fish behavior as well as to measure variables such as stream velocity, turbidity and water depth.

The following is a partial summary of potential components that may be included in the fish sampling and monitoring plan by objective.

Establish Initial Operating Parameters – It is expected that it will take approximately one month to establish initial operating parameters for the ABS deterrent system. During this period, a test of the entire system (acoustics, bubbles and strobe lights) will be conducted to assure each component of the system has the full range of capabilities to perform as designed. Upon completion of system test, incremental adjustment of the air pressure may be conducted to establish a bubble curtain up to a pre-established maximum air pressure level, combined with observations and measurements of stream flow velocity and the bubble curtain dimensions to plot air pressure versus physical bubble curtain dimensions for various flow rates. Likewise, the acoustic and strobe systems might be incrementally adjusted and measurements taken to quantify sound and light parameter distributions at various flow rates. These and other types of potential measurements in conjunction with published literature relative to sensory stimuli affecting silver and bighead carps and ABS Fish Deterrent Team (including contractor) expertise will be considered in establishing the initial operational ranges for each parameter, acoustics, bubbles and strobe lights. Initial fish sampling with a yet to be determined array of monitoring

tools to detect fish in proximity to the deterrent will also be conducted during the period when initial operating parameters are being determined.

Determine Optimal Operating Parameters – It is estimated that it will take at least 12 months to determine the optimal operating parameters for the ABS deterrent, and that multiple iterations will occur to optimize performance. It is assumed that the plan will initially call for catching, tagging and tracking various species of fish, other than silver and bighead carps, in the Dresden Island pool below the Brandon Road Lock and Dam to evaluate behavioral responses of non-target species first. This first phase in developing optimal operating parameters would include the use of electro-fishing to retrieve fish in the deterrence location to estimate the current numbers and distribution of fish species in the pool to assist in planning and execution of fish monitoring and suppression activities associated with operation of the ABS deterrent. It is anticipated that incremental refinement of the operational parameters will occur in a number of cycles of catching, tagging, releasing and observing the behavior of potential surrogate non-target species such as channel catfish as they approach the deterrent. The final iterations in this phase might include catching, tagging and releasing a number of bighead and silver carps downstream of the barrier and observing their behavior and estimating the efficacy of the deterrent at various operational parameter settings to optimize performance.

Assess Physical and Environmental Condition Factors – Observations for the entire duration of the demonstration project will be documented to evaluate the physical and environmental factors that influence the effectiveness of the ABS deterrent. The physical factors will include, but not be limited to characterization of the size and quality of the area the fish will be diverted to (henceforth deterrence area), variations in depth profiles over time at the deterrent location and the deterrence area, fluctuations in stream velocity, turbidity, etc. The environmental factors examined will include but not be limited to variables such as ambient light intensity, water and air temperature, zebra mussels, and rust and corrosion.

Assess Potential for Application of the Technology at Other Locations – It is expected that a minimum of one year after initiation of operations will be needed to assess the viability of the fish deterrent measure as an effective management and control tool that could be applied at other locations in the CSSC and CAWS. The results of the first three objectives would be used to prepare a report that evaluates and quantifies the efficacy of the ABS fish deterrent measure at Brandon Road. It will also identify physical and environmental factors affecting performance, as well as provide a breakdown of associated costs that may serve to evaluate how the technology applied at Brandon Road may be transferrable.

The final Sampling and Monitoring Plan for the ABS fish Deterrent at the downstream lock entrance to the Brandon Road Lock and Dam will be fully coordinated with the Monitoring and Rapid Response Plan for Asian Carp in the CAWS currently being developed by the Monitoring and Rapid Response Work Group (MRRWG). The MRRWG effort is a more comprehensive plan being co-led by the IDNR and the Great Lakes Fishery Commission to produce quantitative data to support management decisions in the CAWS as well as downstream in the Illinois River where Asian carp are known to exist in significant numbers. The MRRWG intends to evaluate any existing population of Asian carp in the CAWS and the potential utility of additional barriers or deterrents in the CAWS. The fish sampling and monitoring plan for the ABS fish deterrent and Brandon Road will be designed to be consistent and complimentary to the more comprehensive MRRWG plan.

In addition to the fish sampling and monitoring at the Brandon Road site, the Sampling will work with others in the ACRCC to identify and monitor laboratory and field studies relative to Asian carp behavior and to incorporate validated information regarding the behavior characteristics of silver and bighead carps from such studies to enhance the efficacy of the ABS fish deterrent at Brandon Road Lock. One such study is referenced in Section 3.4. The University of Illinois and the Illinois Natural History Survey are leading an experimental evaluation of the acoustic, bubble curtain and strobe light technology, with a focus on efficacy in deterring Asian carp between June and October 2010 at Quiver Creek. Quiver Creek is a small stream in central Illinois in a pool of the Illinois River where significant populations of silver and bighead carps are known to exist, and the study planned for this summer is a follow on to field research on the same technology conducted between August 26 and October 7, 2009. The investigators directing both efforts have been key contributors to the available literature on the efficacy of fish deterrent systems and in measuring the efficacy of the Electrical Dispersal Barriers on the CSSC.

The estimated cost for the ABS fish deterrent includes implementation of the fish sampling and monitoring plan, which will form the basis for adaptive management of the ABS fish deterrent to achieve the four primary objectives during the two-year demonstration period.

CHAPTER 4 – ENVIRONMENTAL ASSESSMENT

4.1 – Need & Purpose of Proposed Action

The U.S. Army Corps of Engineers (USACE) was directed in, Section 3061(b)(1)(D) of WRDA 2007to conduct a study of a range of options or technologies for reducing impacts of hazards that may reduce the efficacy of the electrical dispersal barrier located in the CSSC, hereafter referred to as the Efficacy Study. The electrical dispersal barrier was designed to reduce the risk of inter-basin transfer of fish from the Mississippi River and Great Lakes drainage basins via the CSSC, and it has been partially completed. This study is one component of that effort and is evaluating both ways to further enhance the efficacy of the dispersal barrier system and to evaluate methods to prevent any carp above the barrier from dispersing into the Great Lakes in numbers that may pose a threat.

4.2 – Coordination

A Notice of Availability for comments from the public regarding the "Planned Environmental Assessment Interim Report IIIA Fish Deterrent Barriers, Illinois and Chicago Area Waterways" was placed in the Federal Register. The Federal Register containing this Notice of Availability was published in Volume 75, Number 49 on March 15, 2010. Comments concerning the level of analysis or impacts were collected until March 19, 2010. The same notice was also placed on the USACE, Chicago District webpage (www.lrc.usace.army.mil/) which was posted on March 5, 2010. All comments received by the Chicago District were considered and are summarized in Appendix E, Correspondence.

Federal Statues and Regulation Compliance

The recommended plan (IRRMs) presented in this Integrated Environmental Assessment is in compliance or the compliance is expected with appropriate statutes and executive orders including the Natural Historic Preservation Act of 1966, the Endangered Species Act of 1973, the Fish and Wildlife Coordination Act, Executive Order 12898 (environmental justice), Executive Order 11990 (protection of wetlands), Executive Order 11988 (floodplain management), the Rivers and Harbors Act of 1899, the Clean Air Act, the Clean Water Act, and the National Environmental Policy Act of 1969. Table 5 provides a summary of the compliance status for the primary environmental requirements associated with the study.

EO12898 – Environmental Justice – To the greatest extent practicable and permitted by law, and consistent with the principles set forth in the report on the National Performance Review, each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Mariana Islands. The project area is primarily a checker board of industrial lands and low quality forest. The recommended IRRMs do not have any adverse impacts to any minority or low income populations.

Clean Air Act – Due to the small scale, short construction period duration and existing quality of the immediate project area, the project is considered below the de minimis level of particulate matter of 100 tons per year. By way of reference, other Chicago District projects that are much larger in scale and earthwork have readings well below the particulate matter of 100 tons per year.

Table 6 - Compliance with Environmental Statutes and Executive Orders

Reference	Environmental Statutes and Executive Orders	Compliance Status*
16 USC 1531, et seq.	Endangered Species Act, as amended	Compliant
16 USC 460 (L),(12)	Federal Water Project Recreation Act, as amended	Compliance Unknown
16 USC 470a, et seq.	National Historic Preservation Act (NHPA), as amended	Compliant
16 USC 661	Fish and Wildlife Coordination Act, as amended	Compliant
16 USC 703 et seq.	Migratory Bird Treaty Act of 1918,as amended	Compliant
16 USC469, et seq.	Archaeological and Historical Preservation Act as amended	Compliant
25 USC 3001, et seq.	Native American Graves Protection and Repatriation Act	Compliant
33 USC. 1251 et seq.	Clean Water Act, of 1977, as amended	Compliance Unknown
42 USC 4321, et seq.	National Environmental Policy Act (NEPA), as amended	Compliant
42 USC 4901, et seq.	Quiet Communities Act of 1978	Compliant
42 USC 6901, et seq.	Resource Conservation and Recovery Act of 1976, as amended	Compliant
42 USC 7401	Clean Air Act (CAA) of 1970 as amended	Compliant
42 USC 9601	CERCLA of 1980	Compliant
7 USC 4201, et seq.	Farmland Protection Policy Act	Compliant
PL 79-525, 60 Stat 634	Rivers and Harbors Act of 1946	Compliant
CEQ Memo Aug 11,1980	Prime or Unique Agricultural Lands NEPA	Compliant
E.O. 11514	Protection and Enhancement of Environmental Quality	Compliant
E.O. 11593	Protection and Enhancement of the Cultural Environment	Compliant
E.O. 11988 (1977)	Floodplain Management	Compliant
E.O. 11990 (1977)	Protection of Wetlands	Compliant
E.O. 12088 (1978)	Federal Compliance with Pollution Control Standards	Compliant
E.O. 12898 (1994)	Federal Actions to Address EJ in Minority and Low-Income Populations	Compliant
E.O. 13007 (1996)	Indian Sacred Sites	Compliant
E.O. 13186	Responsibilities of Federal Agencies to Protect Migratory Birds	Compliant
E.O. 13340	Great Lakes Designation of National Significance to Promote Protection	Compliant

*pending agency and public review

Section 404 Clean Water Act – Wetlands of the United States would not be filled or impacted. The alignment of the IRRMs would be such that all wetlands would be avoided. The alignment would be placed within the manmade canals. A 404(b)(1) analysis is provided in Appendix D, which shows no significant adverse affects from placing the acoustic bubble curtain and strobe light deterrents beneath the water.

Section 401 Compliance – The recommended IRRM would have no adverse or degrading affects on water quality or wetlands. 401 Water Quality Certification will be sought and procured before construction activities commensurate.

USF&WS Coordination – Under provisions of the Endangered Species Act a Federal Agency must consult with the USFWS for activities that may impact Federally listed species. The small foot print of the proposed measures and the industrialized nature of the recommended sites are indicative that Federal or State listed species would not be affected, nor would any critical habitats be affected. A no effects determination has been made by the USACE. Coordination with the USFWS has been completed. The FWS letter indicated that the lights included in the

ABS fish deterrent may attract larval stage Asian carp. The coordination letter from the USFWS is contained in Appendix E, Correspondence.

SHPO Coordination – The Corps recommends a determination of no significant effects to cultural, historical or archaeological resources associated with the preferred risk reduction measures. Coordination with the Illinois Historic Preservation coordination was initiated and will be completed prior to the finalization of the Environmental Assessment. The coordination letter will be placed in the project files upon receipt.

The National Environmental Policy Act (40 CFR 1501.6) allows the action agency to establish a cooperating agency relationship with other Federal agencies that have jurisdiction by law or special expertise relevant to the project. The USACE established a relationship with the USFWS and USEPA, in which they are serving significant roles in the management and monitoring of the CSSC Dispersal Barrier project.

4.3 – Alternatives (IRRMs) Considered

As discussed in detail above (see section 3.4) a range of IRRMs and sites were assessed, and based on the best available information, these measures and locations provide the best opportunities to reduce risk of Asian carp dispersing through the CAWS. The following IRRMs, were considered to reduce the risks associated with the failure modes identified in Section 3.2:

1. No Action
2. Strobe Lights
3. Air Bubble Curtain
4. Acoustic Deterrent
5. Hybrid Deterrent (Bubble / Acoustic Combo)
6. Hybrid Deterrent (Bubble / Strobe Combo)
7. Hybrid Deterrent (/Acoustic / Bubble / Strobe Combo)
8. Hybrid Deterrent (Acoustic / Strobe Combo)

Eight (8) locations were assessed for the IRRMs:

1. Chicago Lock
2. Chicago River at Throop Street
3. Calumet River at T.J. O'Brien Lock and Dam
4. Little Calumet River @ Cal Sag Channel
5. CSSC at Lockport Lock and Dam
6. Calumet Sag Channel @ the I&M Canal
7. Des Plaines River at Brandon Road Lock and Dam
8. Illinois River at Dresden Island Lock and Dam

The Preferred Interim Risk Reduction Measure (IRRM)

The recommended IRRM is to place a demonstration acoustic deterrent, air bubble curtain and strobe light measure, (ABS fish deterrent measure) in the Des Plaines River at the Brandon Road Lock and Dam. The Des Plaines River at Brandon Road Lock and Dam location is situated downstream (below) of the electric dispersal barriers, but upstream (above) of the established population of Asian carp. Therefore, the efficacy of the ABS deterrent can be tested with

tagged carp, but with the existing operational electric barriers providing an upstream deterrent to carp movement. Further, there is an area below the dam where Asian carp could be directed away from the navigation lock by the ABS fish deterrent and from which they could be harvested by fish biologists. Other activities associated with the recommended IRRM would include frequent monitoring of the deterrent systems, evaluation of the effectiveness to deter silver and bighead carps, harvesting of Asian carp directed to the pool area, as well as other activities that could enhance the effectiveness of the demonstration deterrent.

The No-Action alternative was not selected because it did not address the objectives of the study, which are to reduce risks associated with Asian carp dispersal.

4.4 – The Affected Environment

The affected environment is described in detail in Chapter 2 – Affected Environment, with comprehensive species lists located in Appendix D. The alignment of the measures will be within the manmade canal system collectively known as the CAWS. Equipment trailers would be located on the immediate bank to a provide power house and data gathering facility. The area recommended is of little to no habitat value for native aquatic or riparian organisms given the industrial nature of the area. The No Action Alternative would not have any of the impacts incident to implementation of the various alternatives.

4.5 – Direct & Indirect Effects

Climate

The recommended IRRM would not directly or indirectly affect the regional climate. The rationale behind no affects is that all of the considered IRRMs are temporary and superficial in character. There would be no pollutants or chemicals or activities that could possibly affect climate involved.

Geology

The recommended IRRM would not directly or indirectly affect regional geology, unique geologic features or geological processes. Minor holes may have to be bored in some areas to secure fence posts or inlets for bubble curtain piping. The rationale behind no affects is that all of the considered IRRMs are temporary and surficial in character. There would be no excavation or disturbance of bedrock or fluvial geomorphic processes.

Soils

The recommended IRRM would not directly or indirectly affect the natural soils series of the preferred sites. The rationale behind the no affect determination is that sites selected have no natural soils series present and were destroyed with industrialization of these areas.

Land Use

The recommended IRRM would not directly or indirectly affect the current land uses of the study area. The rationale behind the no affect determination is that land use would not change, since these areas are classified as industrial already.

Hydrology & Hydraulics

The recommended IRRM would not appreciably affect the current hydrology and hydraulics of the study area. The rationale behind the no affect determination is that hydrology and hydraulics cannot be affected by bubbles, light or sound. Water and navigation vessels would flow through the canal system unimpeded by the implemented IRRMs.

Air Quality

The recommended IRRM, as well as other IRRMs considered, would cause localized, temporary increases in exhaust emissions from equipment and vehicles during construction, and may cause localized, temporary increases in particulate emissions from dust related to construction activities. These impacts would be limited through emissions controls and dust controls during construction, in compliance with USACE, USEPA, Illinois EPA, and local laws and regulations. The construction specifications will include language providing protection for the local environment. The project as proposed is compliant with the Clean Air Act, and will not result in significant or long-term adverse impacts to air quality.

Water Quality

The recommended IRRM could result in temporary adverse impacts to water quality due to sediment disturbance from the placement of equipment into the canal resulting in a disturbance of sediment. Short term water quality impacts during construction can be minimized by using best management practices for equipment installation as well as for any necessary sediment removal. It is possible that the addition of bubble plumes to the IWW will impact water quality over the long term. Potential beneficial impacts may include the addition of oxygen and mixing to an existing low oxygen and low energy system. Additional aeration and mixing could generally improve water quality by increasing the natural degradation of soluble organic matter and by adding oxygen to support aquatic life. Potential negative impacts of adding bubble plumes may include the re-suspension of fine grained, poor quality (high organic and metals content) sediment, which could cause a turbidity plume and could cause a lowering of the dissolved oxygen (since the organic sediments will exert an additional oxygen demand on the water column). In addition, bubblers could spur aquatic plant growth, which would cause potential aesthetic problems as well as cause diurnal and seasonal oxygen depression in the water column (due to plant respiration patterns and plant die-off at night and during cold weather). The additional potential algae production could serve as downstream food for the Asian carp and result in being an attractant to the fish. It is difficult to determine whether the overall impact will be beneficial or negative, and it is likely that both good and bad effects will be experienced depending on the design and installation of the equipment.

Riverine Habitat

The preferred IRRM would not directly or indirectly affect the riverine habitat of the Des Plaines River. The rationale behind no affects is that CAWS is already devoid of natural riverine habitat, and air bubbles, sound and light additions will not alter any of the existing habitat structure for native riverine fauna.

Riparian Plant Communities

The recommended IRRM would not directly or indirectly affect the immediate riparian plant communities of the study area. The rationale behind the no affect determination is that land use would not change, since these areas are classified as industrial already.

Aquatic Communities

The recommended IRRM would temporarily adversely impact communities of aquatic organisms both during construction and operation of the project. Construction activities would temporarily create water turbidity and noise that would disturb aquatic and near shore organisms that inhabit these areas. Operation of the deterrent through the generation of light, noise, and a bubble screen would create a long term adverse impact to all aquatic non-plant communities within the effective vicinity of the disturbances. To the extent that the acoustic measure is calibrated to selectively affect Asian carp, they may have a lesser impact on non-Asian carp species. It is anticipated that most of the adverse impacts would be to migrating fish species attempting to traverse the deterrents that are being redirected to an area for either harvesting or eradication. The fish assemblages identified in the proposed location are populated mostly by pollution-tolerant species. It is possible these non-target species could also be part of the by catch. Specific monitoring and harvesting activities to supplement the ABS fish deterrent measure have not yet been developed. If it is anticipated significant adverse impacts will occur to non-target species, measures will be undertaken through application of best management practices to minimize non-target fish mortalities. Information is not available regarding the impacts of this IRRM to benthic and free-swimming invertebrates. It is possible this deterrent system could create a disturbance that would adversely impact these organisms forcing them relocate from the vicinity of the IRRM.

Other Wildlife

Since the IRRM site is located in industrial areas, very few terrestrial wildlife species utilize the proposed project sites for habitat. For those wildlife species that do inhabit the site, it is anticipated only temporary short term adverse impacts would occur. Initially, all wildlife, including those inhabiting nearshore areas and species that utilize the water for habitat would be disturbed by noise and activities associated with construction. Once the ABS fish deterrent measure is operational, the continual disturbance resulting from the noise and light generation would result in a general relocation of the resident wildlife species to other areas in the drainage basin where anthropogenic disturbances are minimal. Other wildlife species that only visit the site on a temporary basis would avoid these areas.

Natural Areas

The recommended IRRM would not directly or indirectly affect any natural areas within the CAWS study area. The rationale behind the no affect determination is that land use would not change, and natural areas do not occur in the vicinity of the proposed sites.

Threatened & Endangered Species

The recommended IRRM would not directly affect threatened and endangered species or their critical habitats within the immediate project area; however, it would protect many threatened and endangered planktivorous species in the Great Lakes basin such as the listed ciscoes and whitefish (*Coregonus* sp.). Under provisions of the Endangered Species Act a Federal Agency must consult with the USFWS for activities that may impact Federally listed species. The small foot print of the proposed measure and the industrialized nature of the recommended site are indicative that Federal or State listed species would not be affected, nor would any critical habitats be affected. Coordination with the USFWS will be completed by start of construction.

Archaeological & Historical Properties

The recommended IRRM would not directly or indirectly affect archaeological or historic properties in the project area.

Social Setting

The recommended IRRM would not directly or indirectly affect the social setting of the study area since they would not impair the daily lives of local residents or commercial activities. However, commercial and recreational vessel traffic would be disrupted during the construction and installation of the IRRM. The Corps will try to minimize any impacts on navigation to the extent possible. Because installation will not take a significant amount of time, impacts to navigation and associated commercial activities should be minimal. The affects of the system are limited to the water column, so there are no direct or indirect affects to the social setting from the operation of the ABS deterrent measure.

Recreation

The preferred IRRM could directly or indirectly affect local recreation during construction. While, he proposed landward sites are off limits to recreational activities, recreational boating would be disrupted during construction and installation of the IRRM. The Corps will try to minimize any impacts on recreational boating to the extent possible. Recreational boating would not physically be affected by acoustic deterrents, air bubble curtains, or strobe lights once the IRRM is operational.

Hazardous, Toxic and Radioactive Wastes

Given the industrial nature of the areas surrounding the waterways, additional detailed HTRW investigations will be initiated during detailed design for the recommended IRRM. The avoidance of extensive earth-disturbing activities, particularly excavation below the water table

can be avoided during land-based construction activities, due to the requirements for the installation of the IRRMs. Further, methods can be employed to minimize disturbance of sediment during the installation and operation of the ABS fish deterrents. These actions during construction would serve to further minimize direct or indirect disturbance of HTRW. Additional details on the HTRW evaluation are contained in Appendix B.

Prime Farmlands

None of the IRRMs considered, including the recommended IRRM would directly or indirectly affect farmland or prime farmlands, since none occur in the affected area.

17 Points of Environmental Quality

The 17 points are defined in Section 122 of Rivers, Harbors & Flood Control Act of 1970 (P.L. 91-611) and include noise, displacement of people, aesthetic values, community cohesion, desirable community growth, tax revenues, property values, public facilities, public services, desirable regional growth, employment, business and industrial activity, displacement of farms, man-made resources, natural resources, air and water. Impacts to these identified points are not expected. Discussion on some of these points is as follows:

Noise –None of the IRRMs considered, including the recommended IRRM, would have significant increases in noise levels. Sound beneath the water will be inaudible to human ears above the water.

Displacement of People – The recommended IRRM would not displace any local residents within the townships of the proposed sites.

Aesthetic Values – The recommended IRRM would not have adverse affects to local aesthetics.

Community Cohesion –None of the IRRMs considered, including the recommended IRRM, would disrupt community cohesion. The project site is primarily a patch work of industrial lands.

Desirable Community Growth – None of the IRRMs considered, including the recommended IRRM, would adversely affect community growth.

Desirable Regional Growth – None of the IRRMs considered, including the recommended IRRM, would adversely affect regional growth.

Tax Revenues – None of the IRRMs considered, including the recommended IRRM, would affect tax revenues.

Property Values – The recommended IRRM would not affect property values.

Public Facilities –None of the IRRMs considered, including the recommended IRRM, would adversely affect public facilities.

Public Services – None of the IRRMs considered, including the recommended IRRM, would adversely affect public services.

Employment – None of the IRRMs considered, including the recommended IRRM, would adversely affect employment. Short term employment gains would be realized with implementing the measures.

Business and Industrial Activity – The recommended IRRM would not adverse affect local business or industrial activity.

Displacement of Farms – None of the IRRMs considered, including the recommended IRRM, would adversely affect farmland. There are no farms at the proposed project sites.

Man-made Resources – None of the IRRMs considered, including the recommended IRRM, would adversely affect man-made resources.

Natural Resources – The no action alternative could adversely affect the Great Lakes basin by allowing the dispersal of Asian carp into the basin. Any of the IRRMs considered, including the recommended IRRM, has the potential to protect the Great Lakes basin from the invading Asian carp.

4.6 – Cumulative Effects Assessment

Consideration of cumulative effects requires a broader perspective than examining just the direct and indirect effects of a proposed action. It requires that reasonably foreseeable future effects be assessed in the context of past and present effects to important resources. Often it requires consideration of a larger geographic area than just the immediate "project" area. One of the most important aspects of cumulative effects assessment is that it requires consideration of how actions by others (including those actions completely unrelated to the proposed action) have and will affect the same resources. In assessing cumulative effects, the key determinant of importance or significance is whether the incremental effect of the proposed action will alter the sustainability of resources when added to other present and reasonably foreseeable future actions.

Cumulative environmental effects for the proposed ecosystem protection project were assessed in accordance with guidance provided by the President's Council on Environmental Quality (USEPA, EPA 315-R-99-002, May 1999). This guidance provides an eleven-step process for identifying and evaluating cumulative effects in NEPA analyses.

Scope

In this environmental assessment, cumulative effect issues and assessment goals are established, the spatial and temporal boundaries are determined, and the reasonably foreseeable future actions are identified. Cumulative effects are assessed to determine if the sustainability of any of the resources is adversely affected with the goal of determining the incremental impact to key resources that would occur should the proposal be permitted.

The spatial boundary for the assessment has been broadened to consider effects beyond the footprint of the dispersal barrier area and to include far reaching influence this action would have on the Great Lakes ecosystem.

The temporal boundaries considered are:

- Past –1920s because this is the approximate time that the modification of the Illinois Waterway System was complete providing an unimpeded dispersal route to and from the Great Lakes and Mississippi River basins.
- Present – 2010 when the decision is being made on an interim risk reduction measure that would aid in preventing Asian carp from entering the Great Lakes
- Future – 2010 -2020, the time frame used for implementing a final plan to address the issue of inter-basin migration of ANS.

Projecting the reasonably foreseeable future actions is difficult at best. Clearly, the proposed action is reasonably foreseeable; however, the actions by others that may affect the same resources are not as clear. Projections of those actions must rely on judgment as to what are reasonable based on existing trends and where available, projections from qualified sources. Reasonably foreseeable does not include unfounded or speculative projections. In this case, reasonably foreseeable future actions include:

- Continued navigation in the Illinois Waterway, CSSC and Calumet Sag Channel
- Continued increase in floodplain profiles due to development and land use change
- Continued introduction of non-native species
- Continued application of environmental requirements such as those under the Clean Water Act and water quality improvement
- Implementation of various programs and projects to deal with runoff and waste water pollution and to restore degraded environments

Cumulative Effects on Physical Resources

The physical resources of the immediate spatial boundary (geology, soils, topography, land cover, hydrology) were altered from their natural condition. The creation of the Illinois and Chicago Waterway systems significantly altered what the retreating glaciers had created. The implementation of the recommended IRRM would not restore physical resources or alter them in the study area or the conjoined Great Lakes and Mississippi basins. Cumulative, adverse physical effects are not anticipated.

Cumulative Effects on Ecological Resources

The ecological resources of the spatial boundary (plants, fish, birds, prairies, streams, wetlands, etc) were altered from their natural condition. There are remnant patches left, however, that merit protection. The extensive change in hydrology, geology and land cover significantly impacted rare plant communities such as the dolomite prairie and valley seeps that etched the lower Des Plaines River Valley. The degradation of natural and native communities has allowed for invasive species to easily take over by filling in niches that were once occupied by native species. The implementation of the recommended plan will not restore ecological resources or degrade them in the Illinois Waterway or the Chicago Area Waterways but would indirectly aid

in protecting the Great Lakes aquatic ecosystem when fully functional. The fish deterrents will have adverse effects on aquatic species due the noise, lights and sounds generated by the deterrents. It is anticipated that most of the adverse impacts would be to migrating fish species attempting to traverse the barriers that are being redirected to areas for either harvesting or eradication. It is possible that non-target species could also be part of the by catch. Specific monitoring and harvesting activities to supplement the ABS fish deterrent measures have not yet been developed, so the impacts of these activities are unknown, but may be adverse. If it is anticipated adverse impacts will occur to non-target species, measures will be undertaken through application of best management practices to minimize non-target fish mortalities. Impacts to water quality will be in the immediate vicinity of the ABS fish deterrent measure during construction and operation. It is difficult to determine whether the overall impact to water quality will be beneficial or negative, and it is likely that both good and bad effects will be experienced depending on the design and installation of the equipment. In summary, while there are some effects that must be considered, implementation the recommended IRRM should not have a significant incremental effect on the status of ecological integrity within the study area. Cumulative, adverse ecological effects are not anticipated.

Cumulative Effects on Archaeological & Cultural Resources

The implementation of the recommended IRRM has no affect upon archaeological or cultural resources, either pre-European or post. Significant cultural or archaeological resources are not present in the affected area. Cumulative, adverse archaeological or cultural effects are not anticipated.

Cumulative Effects on Aesthetic Values

Aesthetics are typically a matter of conjecture. The implementation of submerged features would not detract from the current aesthetics of the sites. Cumulative, adverse aesthetical effects are not anticipated.

Cumulative Effects Summary

Along with direct and indirect effects, cumulative effects of the recommended risk reduction measures were assessed following the guidance provided by the President's Council on Environmental Quality. There have been numerous effects to resources from past and present actions, and reasonably foreseeable future actions can also be expected to produce both beneficial and adverse affects. In this context, the increments of effects from the proposed risk reduction measures are relatively minor in terms of effects, but indirectly helps protect the long term viability of the Great Lakes ecosystem. Based on the expectation of continued sustainability of all resources, cumulative effects are not considered significantly adverse. Table 7 summarizes the factors considered in the cumulative effects summary. A draft FONSI is attached.

Table 7 - Cumulative Effects Summary

	1920 - Present (Past Actions)	No Action	Recommended Risk Reduction Measure
Air Quality	Significantly Adverse	No Effect	No Effect
Noise	Significantly Adverse	No Effect	No Effect
Geology and Soils	Significantly Adverse	No Effect	No Effect
Hydrology & Hydraulics	Significantly Adverse	No Effect	No Effect
Land Use	Significantly Adverse	No Effect	No Effect
T & E Species	Significantly Adverse	Significantly Adverse	No Effect
Wetlands	Significantly Adverse	No Effect	No Effect
Aquatic Resources	Significantly Adverse	Significantly Adverse	Unknown Effect
Terrestrial Resources	Significantly Adverse	No Effect	No Effect
Recreation & Aesthetic Values	Significantly Adverse	Minor Adverse	Unknown Effect
Pre-1830 Cultural Resources	Significantly Adverse	No Effect	No Effect
Post-1830 Cultural Resources	Significantly Beneficial	No Effect	No Effect
Economic Resources	Significantly Beneficial	Adverse	No Effect
Total Impacts	Significantly Adverse	Significantly Adverse*	Unknown Effect**

CHAPTER 5 – INTERIM IIIA RECOMMENDATION

I have considered all relevant aspects of the problems and opportunities as they relate to the risk of bighead and silver carp in the Illinois Waterway and the Chicago Area Waterways. Those aspects include environmental, social, and economic effects, as well as engineering feasibility and the authority granted the Secretary of the Army under Section 126 of the Energy and Water Development and Related Agencies Appropriation Act 2010 to implement measures recommended in the efficacy study.

Provided the Section 126 Authority granted to the Secretary of the Army is extended or the proposed project is otherwise authorized, I recommend approval of an Interim Risk Reduction Measure to construct and operate a demonstration ABS fish deterrent in the Des Plaines River at Brandon Road Lock and Dam. I find that the recommended measure will not have a significant impact on the environment and therefore will not require the preparation of an Environmental Impact Statement.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch.

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Vincent V. Quarles
Colonel, U.S. Army Engineer District, Chicago
District Commander

_____

Shawn P. McGinley
Colonel, U.S. Army Engineer District, Rock Island
District Commander

CHAPTER 6 – REFERENCES

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Plate 01 - Politcal Map of the Interim IIIA Study Area

U.S. Army Corps of Engineers
Chicago District

FMV 27FEB10

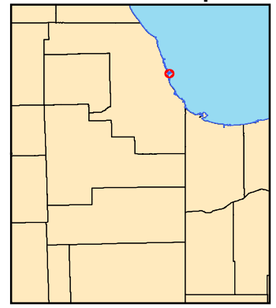
U.S. Army Corps of Engineers
Chicago District

Proposed ABS Location - Chicago Lock

LEGEND

Parcel

Location Map



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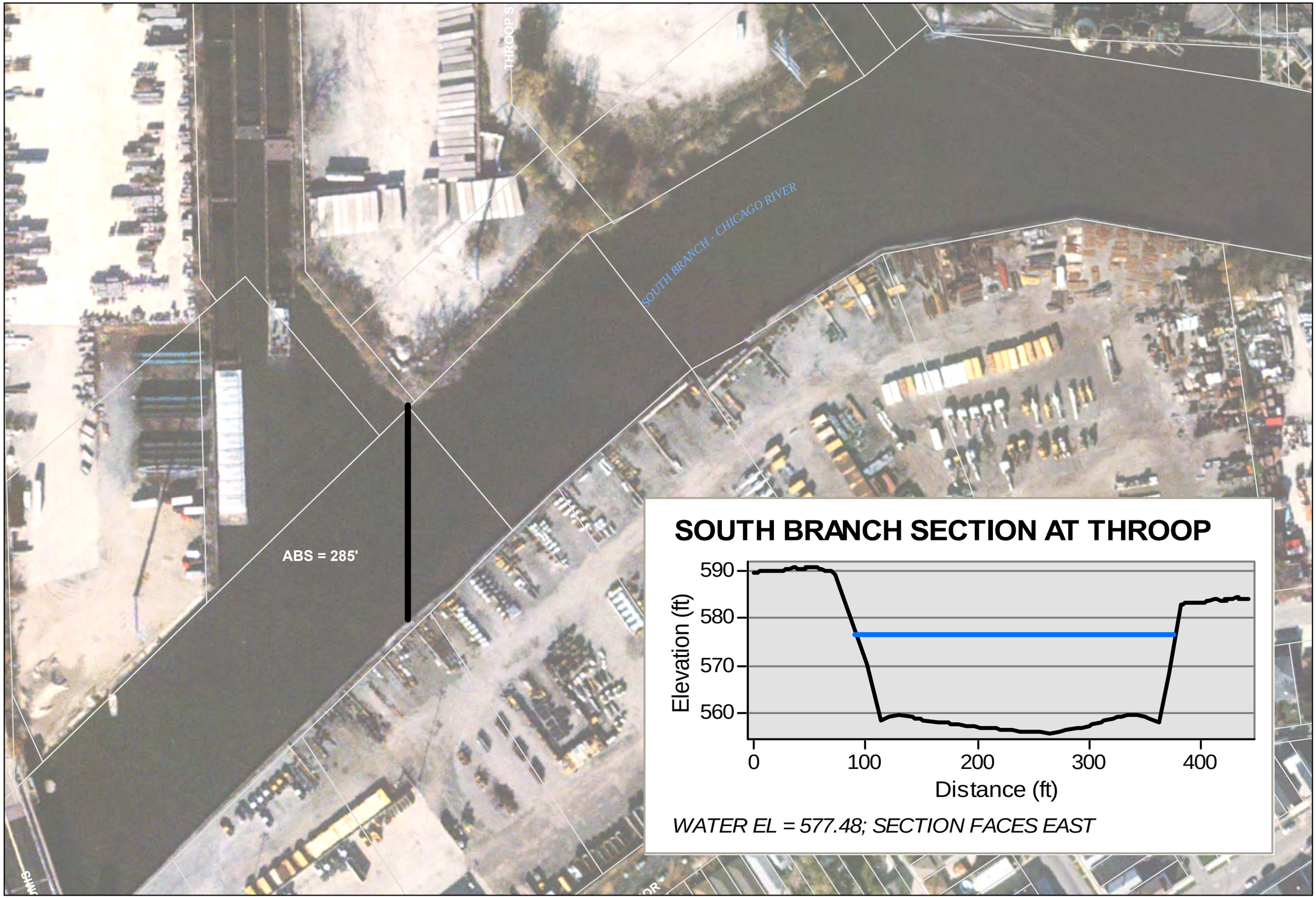
Feet

PLATE 2

U.S. Army Corps of Engineers
Chicago District

Proposed ABS Location – Chicago River at Throop Street

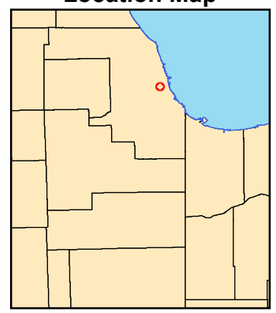


SOUTH BRANCH SECTION AT THROOP

WATER EL = 577.48; SECTION FACES EAST

Legend

Location Map



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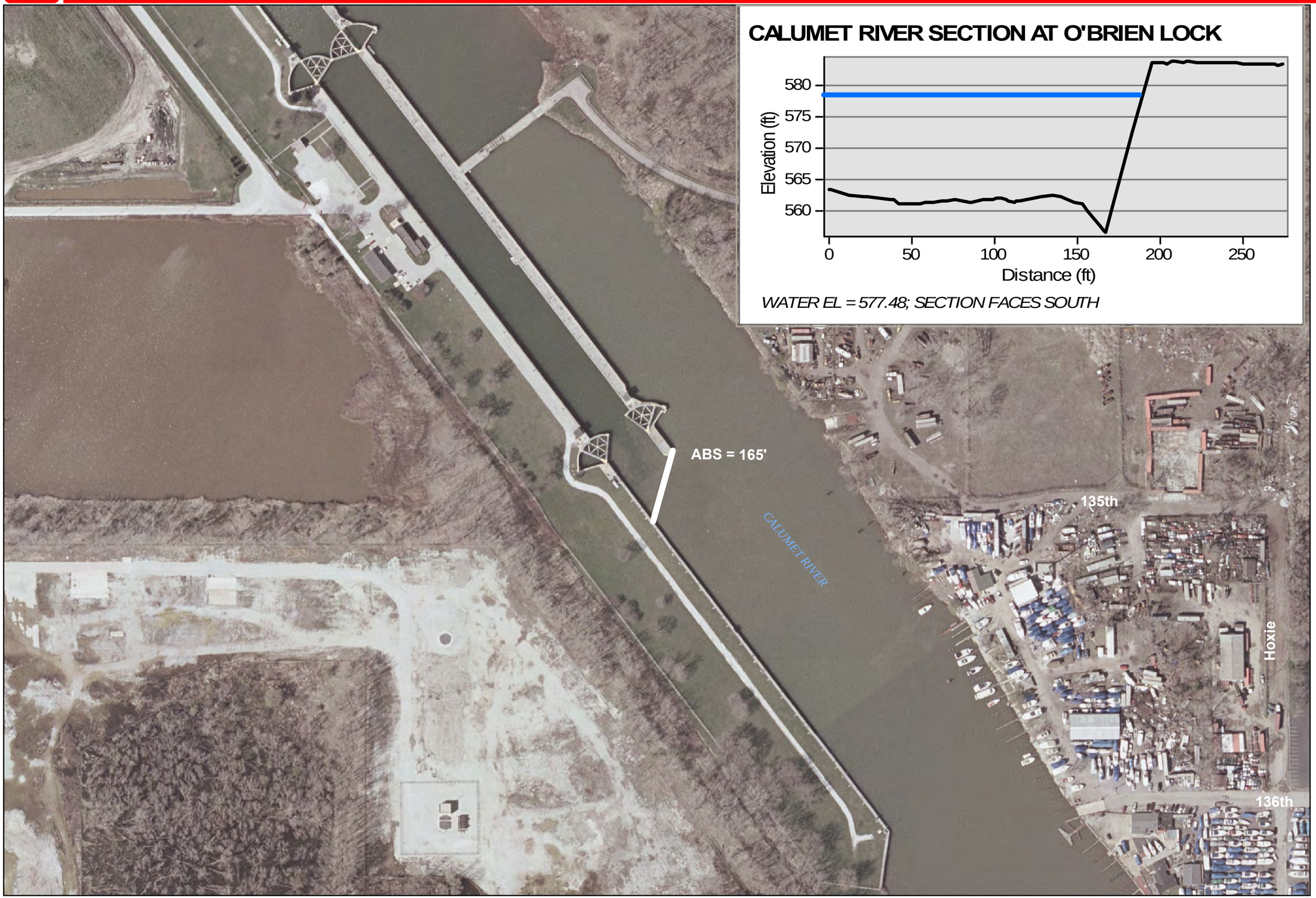
Feet

PLATE 3

U.S. Army Corps of Engineers
Chicago District

Proposed ABS Location – Calumet River at T.J. O'Brien L & D



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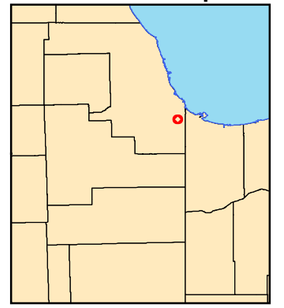
Location Map



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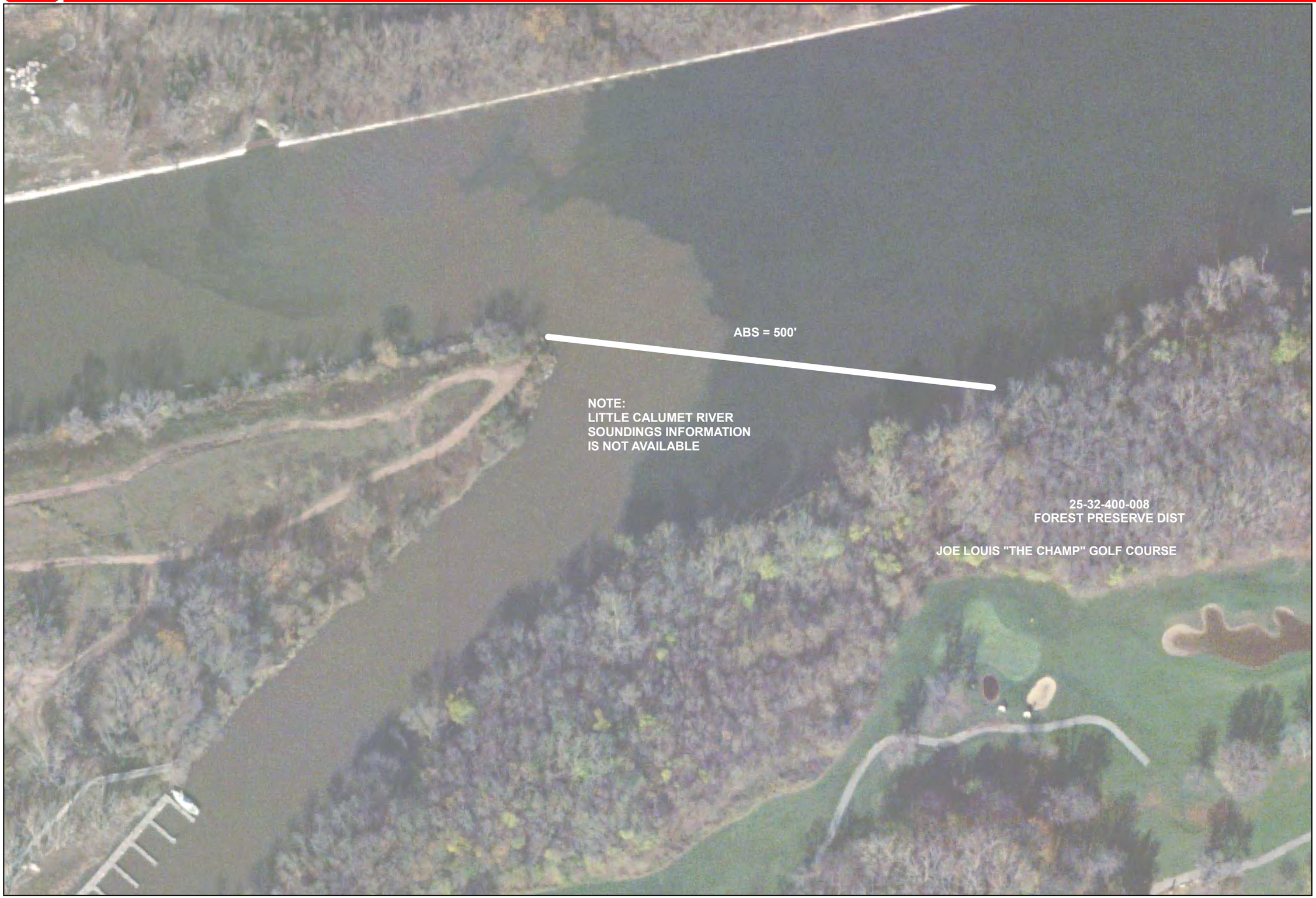
Feet

PLATE 4

U.S. Army Corps of Engineers
Chicago District

Proposed ABS Location – Little Cal River at Cal-Sag Channel



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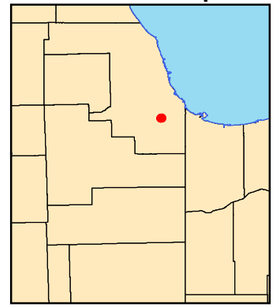
Location Map



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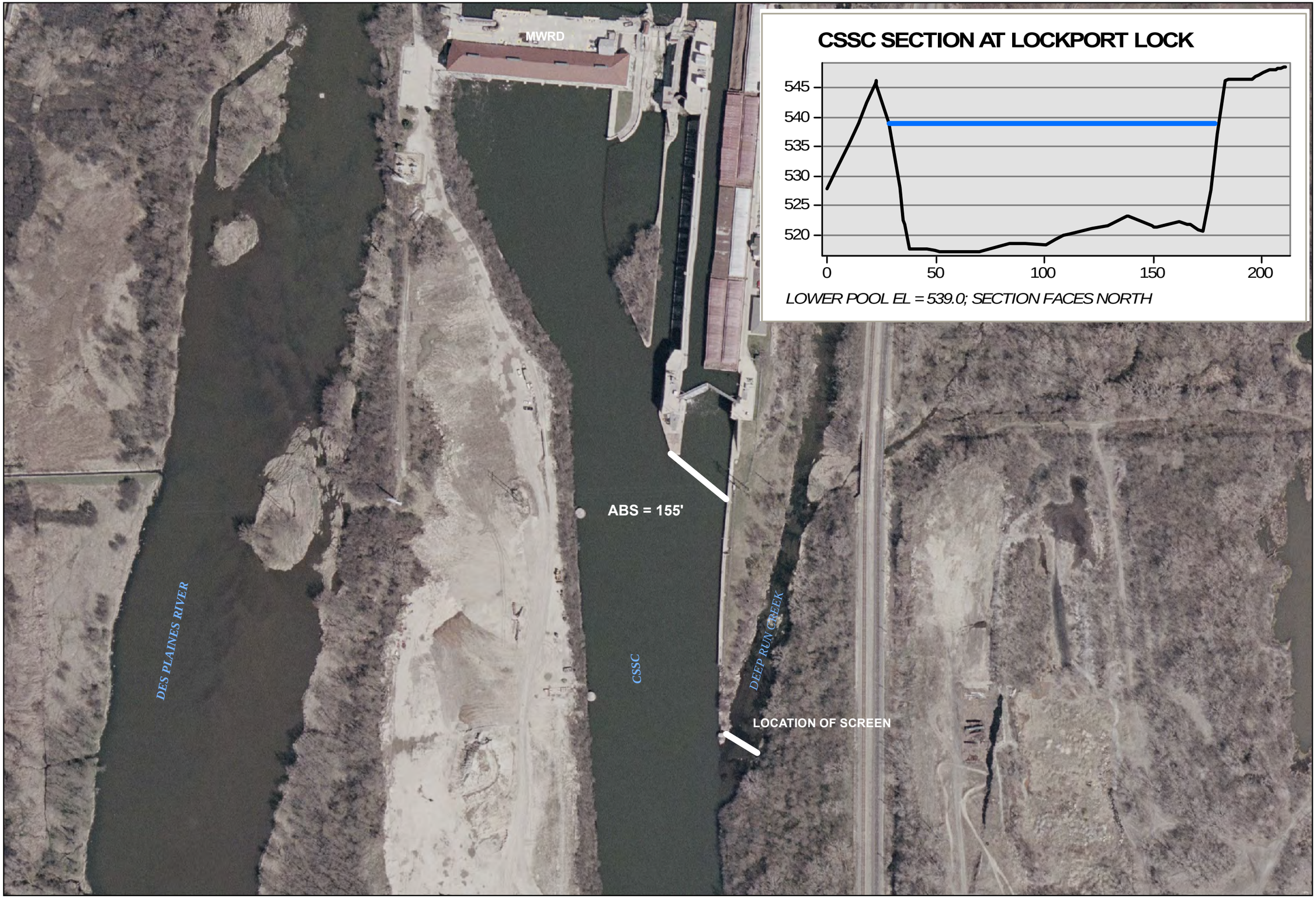
Feet

PLATE 5

U.S. Army Corps of Engineers
Chicago District

Proposed ABS Location – CSSC at Lockport L & D



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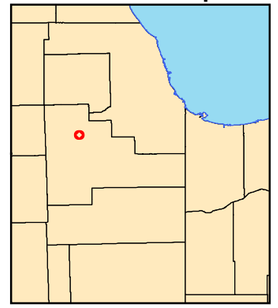
Location Map



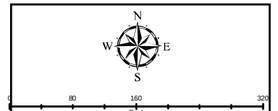
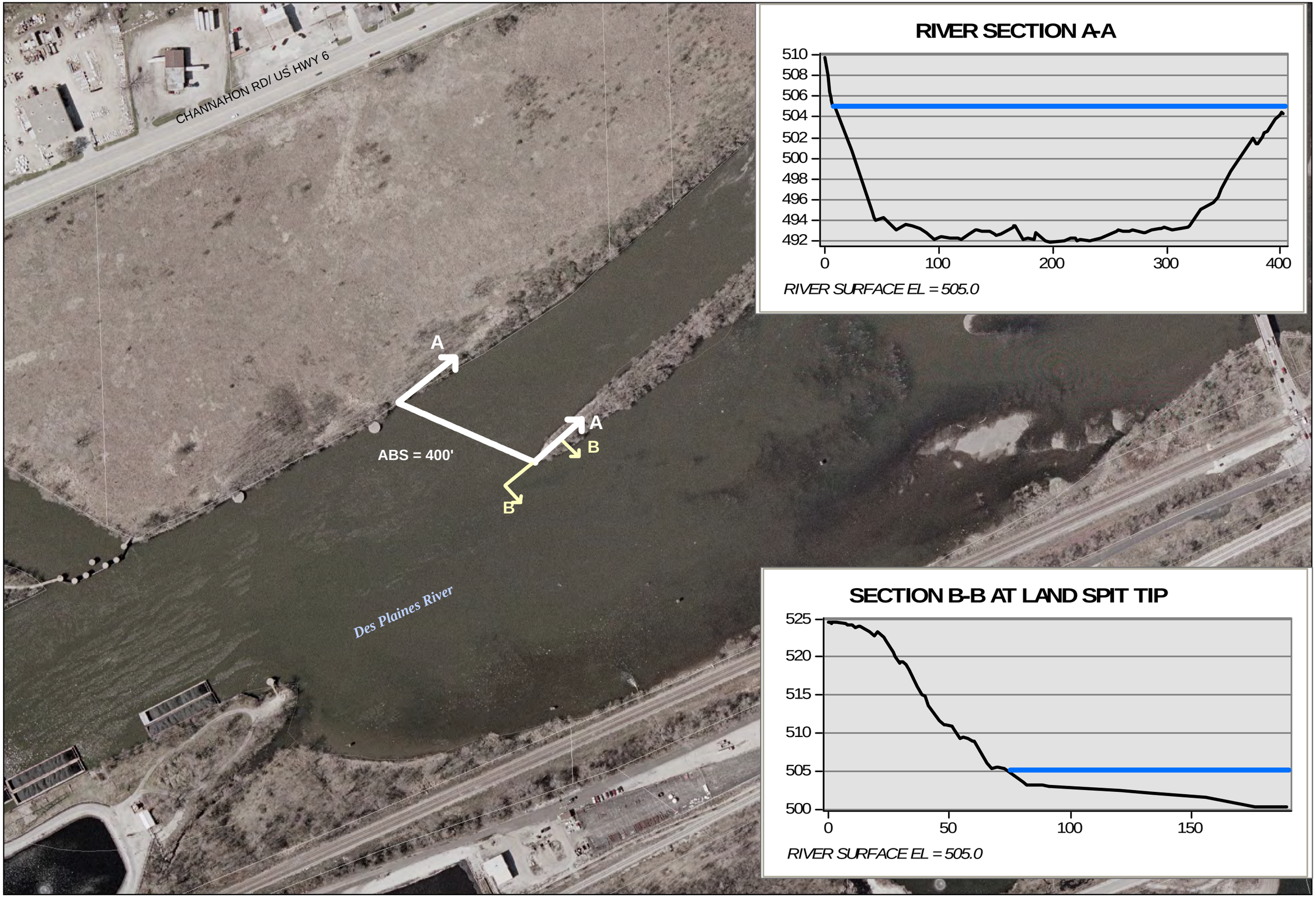


PLATE 6

U.S. Army Corps of Engineers
Chicago District

Proposed ABS Location - Des Plaines River at Brandon Road L&D



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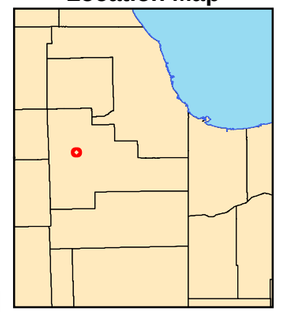
Location Map



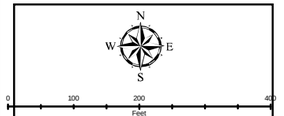
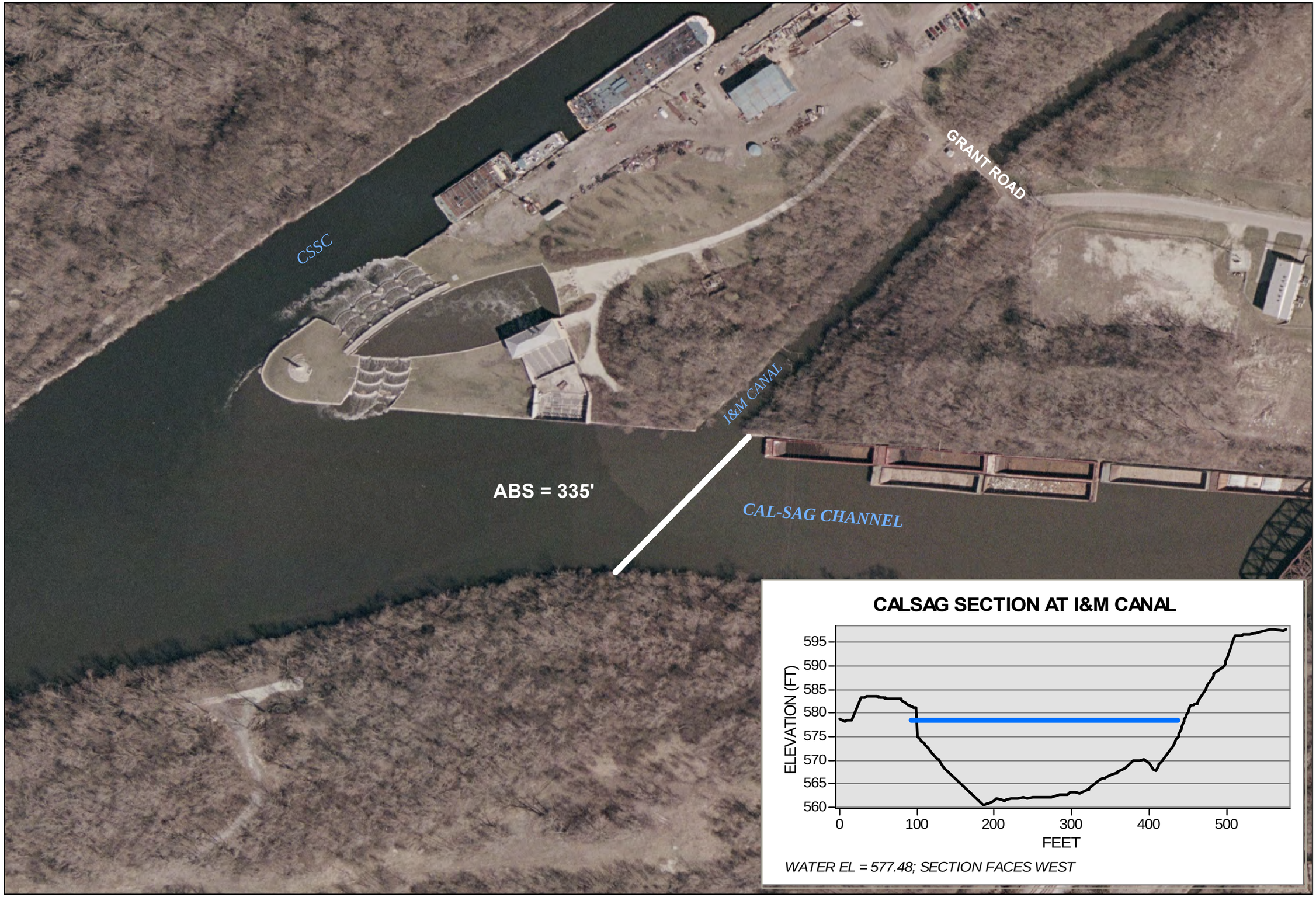


PLATE 7

U.S. Army Corps of Engineers
Chicago District

Proposed ABS Location – Calumet Sag Channel at I&M Canal

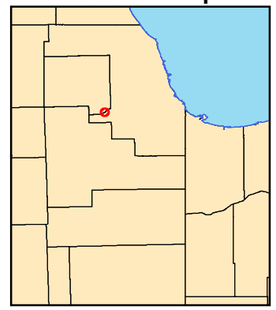


CALSAG SECTION AT I&M CANAL

WATER EL = 577.48; SECTION FACES WEST

Legend

Location Map



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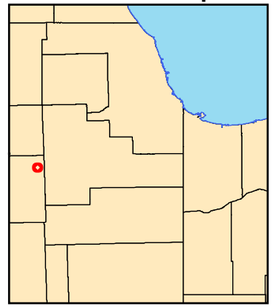
Feet

PLATE 8

U.S. Army Corps of Engineers
Chicago District

Proposed ABS Location – Dresden Island L&D

Location Map



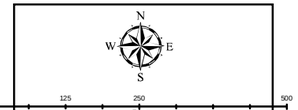


PLATE 9