Received, Clerk's Office 1/26/2018

Will County Station
§316(a) Demonstration

Prepared for

Midwest Generation, LLC – Will County Generating Station
529 East 135th Street
Romeoville, Illinois 60446

Prepared by

EA Engineering, Science, and Technology, Inc., PBC
444 Lake Cook Road, Suite 18
Deerfield, IL 60015
(847) 945-8010

January 2018
Version: FINAL
EA Project No. 62416.17

Received, Clerk's Office 1/26/2018

This page intentionally left blank

TABLE OF CONTENTS

Page

Received, Clerk's Office 1/26/2018

LIST OF ACRONYMS AND ABBREVIATIONS

ACRCC	Asian Carp Regional Coordination Committee
AEL	Alternate Effluent Limits
ALU	Aquatic Life Use
ANS	Aquatic Nuisance Species
BIC	Balanced Indigenous Community
BIP	Balanced Indigenous Population
Biomass	Total Mass of Organisms in a given area or volume
BOD	Biochemical Oxygen Demand
CAWS	Chicago Area Waterway System
CPE	Catch-Per-Unit-Effort
COD	Chemical Oxygen Demand
ComEd	Commonwealth Edison Company
Cont.	Continued .
CSO	Combined Sewer Overflow
CSSC	Chicago Sanitary and Ship Canal
CTD	Conductivity, Temperature, and Depth
CTM	Critical Thermal Maximum
CW	Cooling Water
CWA	Clean Water Act
D/S	Downstream
DAF	Design Average Flow
Deg	Degree
DELT	Anomalies (Deformities, Erosions, Lesions, Tumors)
DHI	Danish Hydraulics Institute
DO	Dissolved Oxygen
DSP	Detailed Study Plan
dw	Dry Weight
ed.	Edition
E	Pielou evenness
EA	EA Engineering, Science, and Technology, Inc. (prior to 12 December 2014) EA Engineering, Science, and Technology, Inc., PBC (12 December 2014 and thereafter)
EAV	Emergent Aquatic Vegetation
EPA	Environmental Protection Agency
EPRI	Electrical Power Research Institute
EPT	Ephemeroptera (mayflies), Plectoptera (stoneflies), Trichoptera (caddisflies)
ESE	Environmental Science & Technology
FPDWC	Forest Preserve District of Will County
HCP	Habitat Conservation Plan
HD	Hester-Dendy
HMS	Hanson Material Service
GIS	Geographic Information System
GLMRIS	Great Lakes and Mississippi River Interbasin Study

Received, Clerk's Office 1/26/2018

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

I&M	Illinois and Michigan
IAC	Illinois Administrative Code
IBI	Index of Biotic Integrity
IDNR	Illinois Department of Natural Resources
IDPH	Illinois Department of Public Health
IEPA	Illinois Environmental Protection Agency
IESPB	Illinois Endangered Species Protection Board
IISG	Illinois-Indiana Sea Grant
IL/Ill.	Illinois
ILCS	Illinois Compiled Statutes
INHS	Illinois Natural History Survey
INPC	Illinois Nature Preserves Commission
IPCB	Illinois Pollution Control Board
ISGS	Illinois State Geological Survey
ISWS	Illinois State Water Survey
IWBmod	Modified Index of Well-Being
LDPR	Lower Des Plaines River
MCI	Macroinvertebrate Community Index
Microbes	Viruses and Protozoa
MIKE3	Three-Dimensional Mathematical Model
MRP	Asian Carp Monitoring and Response Plan
MRWG	Monitoring and Response Workgroup
MSDGC	Metropolitan Sanitary District of Greater Chicago (prior to 1989)
msl	Mean Sea Level
MWAT	Maximum weekly average temperature
MWGen	Midwest Generation, LLC
MWRDGC	Metropolitan Water Reclamation District of Greater Chicago (1989-present)
NAVD 88	North American Vertical Datum of 1988
NAWQA	National Water-Quality Assessment
NPDES	National Pollutant Discharge Elimination System
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
O&M	Operating and Maintenance
OEPA	Ohio Environmental Protection Agency
OPE	Organophosphate esters
PAH	Polycyclic Aromatic Hydrocarbon
PBDE	Polybrominated Diphenyl Ether
PCB	Polychlorinated biphenyls
POTW	Publicly-Owned Treatment Works
QHEI	Qualitative Habitat Evaluation Index
RAS	Representative Aquatic Species
RH	Relative Humidity
RIS	Representative Important Species

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

RM	River Mile
RNA	Regulated Navigational Area
SAV	Submerged Aquatic Vegetation
SOC	Synthetic Organic Compound
sp./spp.	Species
STORET	USEPA's STOrage and RETrieval System for Water Quality Data
SW	Shannon Weaver diversity index
SWRP	Stickney Water Reclamation Plant
T&E	Threatened & Endangered
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TOC	Total Organic Compound
TSS	Total Suspended Solids
UAA	Use Attainability Analysis
UILT	Upper Incipient Lethal Temperature
UIW	Upper Illinois Waterway
USACE	U.S. Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UWAG	Utility Water Act Group
vol.	Volume
WCGS	Will County Generating Station
Wr	Relative Weight
WRP	Water Reclamation Plant
Ws	Standard Weight
WSE	Water Surface Elevation
WWTP	Wastewater Treatment Plant
YOY	Young of the Year
ZOP	Zone of Passage

Received, Clerk's Office 1/26/2018

LIST OF ABBREVIATED MEASUREMENTS

kg	Kilogram
g	Gram
mg	Milligram
µg	Microgram
ng	Nanogram
km	Kilometer
m	Meter
cm	Centimeter
mm	Millimeter
m^3	Cubic Meter
hr	Hour
min	Minute
sec	Second
uS	microSiemens
mi	Mile
mi^2	Square Mile
ft(‘)	Foot (Feet)
in(“)	Inch(es)
ha	Hectare
ac	Acre
ton	Short ton
L	Liter
cfs	Cubic Feet per Second
fps	Feet per Second
MGD	Million Gallons per Day
gpm	Gallons per Minute
cfu	Colony Forming Unit
°C	Degree Celsius
°F	Degree Fahrenheit
MW	Megawatts
kHz	Kilohertz
hr	Hour
min	Minute
sec	Second

Received, Clerk's Office 1/26/2018

This page intentionally left blank

Received, Clerk's Office 1/26/2018

1. INTRODUCTION

1.1 ROADMAP TO THE DEMONSTRATION

This Demonstration supports Midwest Generation, LLC's ("MWGen") request for thermal alternative effluent limits (AELs) for Will County Generating Station (WCGS) under §316(a) of the Clean Water Act. It is based on over 40 years of monitoring and analyses of the fauna and ecosystems associated with the Chicago Sanitary and Ship Canal (CSSC) in the vicinity of WCGS. These programs and analyses are discussed in detail in the documents that comprise this Demonstration. The Demonstration presents both prospective (Appendix B) and retrospective (Appendix C) analyses which show that the proposed thermal AELs will assure the protection and propagation of a balanced, indigenous community (BIC) of shellfish, fish, and wildlife in and on the CSSC near WCGS, thereby meeting the §316(a) criteria outlined in the USEPA 1977 guidance document, as well as the Title 35, Subtitle A, Chapter I, Part 106, Subpart K rules.

While each of the appended documents contains important information supporting MWGen's request, this Summary, along with Appendices B and C, are likely to be of particular interest to most readers. Section 2 summarizes engineering and hydrothermal information used in the development of this Demonstration and the above rationales. Section 3 of this Summary describes the proposed thermal AELs and explains the historical and legal context for the request. Section 4 presents the Master Rationale which summarizes the key findings of this Demonstration in support of the conclusion that the BIC of the CSSC in the vicinity of WCGS will be adequately protected under the proposed set of thermal AELs. Section 5 presents the Representative Important Species (RIS) Rationale which summarizes field, laboratory, and literature data used in the development of this Demonstration to explain that RIS will not suffer appreciable harm as a result of the proposed thermal AELs. Section 6 presents the Biotic Category Rationale and summarizes the Demonstration finding that impacts associated with the proposed thermal AELs will be sufficiently inconsequential to assure that each of the biotic categories constituting the CSSC BIC will be protected.

Appendix A describes the CSSC in detail, while Appendices B and C respectively provide the above-described prospective and retrospective assessments. Appendix D details the operations at WCGS and recent hydrothermal analysis of the WCGS discharge, including thermal plume studies performed in 2016 and 2017 (Appendix D). Appendix H presents the prior thermal plume study performed at WCGS in 2011. Appendix E reviews the various WCGS data collection programs which are referenced throughout this Demonstration. Appendices F and G present annual fisheries monitoring reports from 2015 and 2016.

1.2 RESOURCE AGENCY INTERACTION

A detailed study plan (DSP) in support of the Demonstration was developed and submitted to the Illinois Environmental Protection Agency (IEPA) and the Illinois Department of Natural Resources (IDNR) on 3 December 2015. IEPA approval of the detailed study plan was provided in written correspondence dated 3 March 2016. Several questions raised by IDNR regarding certain aspects of the study plan were satisfactorily addressed, resulting in the receipt of IDNR approval via email on 9 June 2016.

A subsequent meeting was held with IEPA and United States Environmental Protection Agency Region 5 (EPA) personnel on 2 November 2016 to present and to obtain approval of an expedited thermal AEL development schedule. Two changes were requested to the prior approved DSP:

> (1) The original DSP stated that the results from 2016 and 2017 on-going fisheries monitoring program would be compared with those obtained since 1994 to evaluate spatial and temporal trends in the fish community under single unit operation at WCGS. However, because the 2015 and 2016 data were collected during single unit operation at the WCGS and under representative conditions, MWGen requested to use the two years of recently collected fisheries data (2015 and 2016) to support the AEL development process, instead of waiting to collect an additional year of new data in 2017.
>
> (2) The original DSP stated that the habitat within each lower Lockport Pool electrofishing location would again be evaluated using the QHEI (Qualitative Habitat Evaluation Index) in 2016 and 2017. Based on comparing previous habitat evaluation results to the information obtained during the 2016 study, it was believed that sufficient habitat information for lower Lockport Pool existed to move forward with the WCGS thermal AEL development process. The existing habitat data from 1995, 2010, and 2016 provides an adequate basis on which to develop the AELs, particularly given that the habitat conditions observed during the 2016 QHEI study are not reasonably expected to change in 2017. Therefore, MWGen requested that IEPA approve the use of the 2016 QHEI data and previously collected habitat data in the thermal AEL development process, replacing the requirement to collect additional QHEI data from these same locations in 2017.

These two recommended changes were incorporated into the original DSP on 5 December 2016 as Revision 1 to the original DSP and submitted to the Agency for consideration, with a copy to EPA. IEPA provided approval for the modified DSP in correspondence dated 12 December 2016.

2. ENGINEERING AND HYDROLOGICAL SUMMARY

This section summarizes engineering and hydrothermal information used in the development of the Demonstration and the above rationales. Supporting detailed information is provided in Appendix D.

2.1 WILL COUNTY STATION OPERATIONS

2.1.1 Thermal Interaction

The stream segment of the CSSC directly adjacent to the WCGS has been designated as impaired in IEPA's Integrated Water Quality Report and included as a "Medium" priority on the Section 303(d) List for many years, including the recently issued draft 2016 list (IEPA 2016), as well as listings dating back to 2000 (Appendix A).

The causes and potential sources of impairment listed in the most recent IEPA 2016 report are as follows:

Potential Causes	**Potential Sources**
Polychlorinated biphenyls	Source Unknown
Iron	Combined Sewer Overflows
Manganese	Sediment Resuspension (Contaminated Sediment)
Oil and Grease	Urban Runoff/Storm Sewers
Dissolved Oxygen	Impacts from Hydrostructure Modification/Flow Regulation
Total Phosphorus	Municipal Point Sources

As detailed in Appendix A, there is no evidence to suggest that WCGS operations have any impact on the levels of these parameters found in the CSSC.

2.2 HYDROLOGY

WCGS is located at river mile (RM) 296 on the CSSC, which is part of the Chicago Area Waterway System (CAWS). The CAWS consists of 78 miles of man-made canals and modified river channels that serve the metropolitan Chicago area for drainage of urban stormwater runoff, treatment of municipal wastewater effluent, and support of commercial navigation. Certain segments of the waterways also support recreational boating, fishing, streamside recreation and aquatic habitat for wildlife. Approximately 75 percent of the length of the CAWS consists of constructed canals where no waterway existed previously, including the CSSC, and the remainder are natural streams that have been deepened, straightened and/or widened to such an extent that reversion to a natural state is not possible (Appendix A). The flow is artificially controlled by four hydraulic structures managed by MWRDGC.

The Lockport Controlling Works is the single flow outlet control for the CAWS. All flow from the CAWS approximately 884 square mile watershed discharges from the CSSC to the Des Plaines River north of the city of Joliet. The confluence is 1.1 miles downstream of the Lockport Lock and Dam. The lower Des Plaines River then extends downstream approximately 17 RM to its confluence with the Kankakee River, forming the headwaters of the Illinois River.

The Lockport Pool has a normal pool elevation of 551.76 feet above mean sea level (msl), but varies considerably, as the level is controlled to minimize flooding in the Chicago metropolitan area. Lowering canal level provides additional capacity to handle stormwater flows that feed into the canal system, either via run-off or from the large number of combined sewer overflow (CSO) points (393) located throughout the metropolitan Chicago area.[1] Abrupt and frequent fluctuations, on the order of three to five feet or more, are most common during or immediately preceding predicted rainfall events. Lockport Pool is bordered throughout most of its expanse by cut limestone walls. The only major tributaries to the CSSC are the Chicago River and the Cal-Sag Channel, which is another constructed waterway that is part of the CAWS. The confluence of the Cal-Sag Channel and CSSC is at RM 303.5, approximately eight miles upstream of the WCGS. Immediately downstream of the Lockport Lock and Dam is the Brandon Pool, which is also largely bordered by limestone walls, with flow and water level controlled by the USACE Brandon Road Lock and Dam, located at RM 285.

Mean annual canal flow, as measured by the USGS at the Lemont site (USGS 05536890), is 2,480 cfs (2006-2015). The 7-day 10-year low flow for this portion of the CAWS is 1,315 cfs (ISWS 2003a). This low flow is based on the discharges from the three large publicly owned treatment works (POTW) which discharge into the CAWS. These POTW discharges essentially dictate the base flow of the system (Appendix A).

2.3 INTAKE AND OUTFALL CONFIGURATION AND OPERATION

2.3.1 Intake

The CSSC is the single surface water intake source for cooling water for WCGS. The Station utilizes a once-through circulating water system for condenser cooling. Under four-unit operation, cooling water was withdrawn through three intake structures positioned adjacent to each other in the Lockport Pool of the CSSC at RM 295.6. Each intake is flush with the canal shoreline. When operational, Units 1 and 2 withdrew water through a shared screenhouse, which housed four, 10 ft wide traveling screens with a "worst-case" design through-screen velocity of 1.68 fps. The screenhouse for Units 1and 2 contained four CW pumps and four service water pumps. Use of this intake structure was halted upon retirement of Units 1 and 2 in December 2010. The Unit 3 screenhouse also contains four, 10 ft wide traveling screens, with a "worst-

[1] https://www.mwrd.org/irj/go/km/docs/documents/MWRD/internet/protecting_the_environment/Combined_Sewer_Overflows/pdfs/Outfalls_Along_Waterways.pdf

Received, Clerk's Office 1/26/2018

case" design through-screen velocity of 1.14 fps. Unit 3 was served by four CW pumps and two service water pumps. The Unit 3 screenhouse is not presently being used due to Unit 3's deactivation. The Unit 4 screenhouse contains six, 10 ft wide traveling screens with a "worst-case" design through-screen velocity of 1.68 fps. Unit 4 utilizes three CW pumps and two service water pumps. Each of the unit intakes are designed to withdraw water from the entire water column.

2.3.2 Discharge

WCGS has a single discharge canal which was designed to be used by all four generating units when they were active. This common discharge canal is located at the downstream end of the Station property and is oriented in a downstream position adjacent to the canal wall. Cooling water, once passed through the cooling condensers, exits the plant through this approximately 250 ft-long discharge canal which leads directly back to the CSSC. There are no flow controlling structures or gates associated with the WCGS discharge canal.

2.4 HYDROTHERMAL ANALYSIS

From 2016 to 2017, a three-dimensional hydrothermal model was developed for the discharge from WCGS to the CSSC (Appendix D). The model was executed for summer and winter scenarios using typical river, weather and station operational weather conditions, as well as actual "worst-case" data derived from the 2011-2016 period of record. The geographical extent of the model extends almost all the way down to the Lockport Lock and Dam.

The modeling results show that under typical scenarios, the WCGS thermal plume influence downstream (*i.e.*, beyond the 26-acre allowed mixing zone) is within the Use B numeric thermal standards which are applicable on July 1, 2018. The model results (and thermal plume study data) indicate that the water temperatures during the summer at the downstream model extent are meeting the Use B numeric thermal standards. This is also true for the typical winter scenarios.

The modeling results indicate that even under worst-case conditions, a major portion of the CSSC cross-section between the WCGS discharge and the downstream locations in the lower Lockport Pool maintains temperatures adequate to support CSSC biological communities. This is true even at higher temperatures than would be allowed by the Use B thermal standards. (Section 3.1.2 and Appendix B). Therefore, operation under the proposed seasonal thermal AELs for WCGS should not cause adverse harm to the BIC of the CSSC. Additional details of the hydrothermal modeling and analyses are provided in Appendix D.

.

3. PROPOSED ALTERNATE THERMAL LIMITS

3.1 BACKGROUND AND PROPOSED ALTERNATE THEMAL LIMITS

WCGS is a coal-fired steam electric generating facility located on the CSSC in Romeoville, Illinois at River Mile 295.6. Historical station operation included four coal-fired generating units with a total capacity of 1,163 megawatts (MW). Units 1 and 2, 167 MW each, started commercial service in 1955; both units were retired in late 2010. Unit 3 (278 MW) began commercial service in 1957. It was deactivated in early 2015. Unit 4, the remaining generating unit (551 MW), began commercial operation in 1963 and is currently the sole operating unit at the station. Thus, compared to pre-2010 historical operations, the current rated capacity of the WCGS is substantially less, by approximately fifty percent, than its previous maximum total rated capacity.

The CSSC is part of the Chicago Area Waterway System (CAWS), a man-made watercourse completed in 1900 to convey treated sewage and stormwater away from Chicago and its drinking water source, Lake Michigan, to the Illinois River and eventually the Mississippi River and the Gulf of Mexico. The CAWS consists of 78 miles of canals, which serve two principal purposes to the Chicago area: drainage of urban stormwater runoff and treated municipal wastewater effluent, and support of commercial navigation. The flow and level of the canal system in the vicinity of the WCGS is regulated by the Lockport Lock and Dam, which is controlled by the U.S. Army Corps of Engineers (USACE), in coordination with the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC). Approximately 75% of the length of the CAWS consists of man-made canals and the remainder of it consists of natural streams that have been deepened, straightened, and/or widened to accommodate the navigation and flood control uses.

WCGS utilizes a once-through circulating water system for condenser cooling. Under four-unit operation, cooling water (CW) and service water was withdrawn from the Lockport Pool of the CSSC at a total design intake flow rate of approximately 1,296 MGD (900,000 gpm). Under current unit operation (Unit 4), the design flow rate is approximately 570 MGD (395,842 gpm), which is a reduction in the original station flow of 56%. Circulating water used to cool and condense steam from the generating process is discharged to the CSSC.

WCGS has a single discharge canal which was designed to be used by all four generating units. The discharge canal is approximately 250 ft long. It is located at the downstream end of the station property and is oriented in a downstream position adjacent to the canal wall. Once passed through the cooling condensers, cooling water exits the plant through the discharge canal which leads directly back to the CSSC. There are no flow controlling structures or gates associated with the WCGS discharge canal.

The Station discharges wastewater in accordance with National Pollutant Discharge Elimination System (NPDES) Permit No. IL0002208, which was most recently issued by IEPA on 15 May 2014, with a subsequent modification issued 24 April 2017. The thermal discharge from WCGS

Received, Clerk's Office 1/26/2018

is designated in the NPDES Permit as Outfall 001. Further details on WCGS operations are provided below in Section 6.0 and in Appendix D.

The CSSC, which is the receiving stream for WCGS's thermal discharge, had formerly been classified as a Secondary Contact and Indigenous Aquatic Life water under Section 302 of the Title 35 Illinois Administrative Code (IAC). These Secondary Contact waters were regulated by a set of water quality limitations that were less stringent than the General Use limits that applied to most of the waters in the state, due to the inherent limitations of the system, as discussed in Appendices A and C.

The Secondary Contact and Indigenous Aquatic Life Standards applied to portions of the Chicago, Calumet, and lower Des Plaines river drainages that were altered—in various stages during the mid-1800s into the mid-1900s—to promote commercial navigation and to eliminate untreated sewage from flowing into Lake Michigan. These waters remain impacted by hydro-modification, alteration in flow, and stormwater and wastewater discharges from the urban development of the Chicago area. Since the adoption of the Secondary Contact and Indigenous Aquatic Life Standards in the 1970s, water quality has improved as the result of point source discharge controls, as well as related wastewater control technology advances by publicly owned treatment works, which generated consideration for revising the applicable uses and standards.

As the result of two use attainability analyses (UAAs) conducted by IEPA (one on the lower Des Plaines River and one on the CAWS), as well as several years of UAA rulemaking public hearings, the Illinois Pollution Control Board (IPCB) approved and adopted new use designations and definitions for these waterways. In IPCB Docket No. R2008-09(A) Opinion and Order (August 18, 2011), the CSSC near the WCGS was designated as a non-recreational use water (Title 35, Ill. Adm. Code §303.227(b), due to the frequent CSOs in the CAWS, as well as the proximity to the USACE Aquatic Nuisance Species Dispersal Barrier system (Appendix A), On February 6, 2014 (IPCB Docket No. R2008-09(C) final water quality standards were adopted for the CAWS and Lower Des Plaines watersheds (IPCB Docket No. R2008-09(D), which became effective 1 July 2015.

As the result of the above proceedings, the CSSC near WCGS has been designated as a Chicago Area Waterway System Aquatic Life Use B water:

> "*Waters designated as* ***Chicago Area Waterway System and Brandon Pool Aquatic Life Use B Waters*** *are capable of maintaining, and shall have quality sufficient to protect, aquatic life populations predominated by individuals of tolerant types that are adaptive to unique physical conditions and modifications of long duration, including artificially constructed channels consisting of vertical sheet-pile, concrete and rip-rap walls designed to support commercial navigation, flood control, and drainage functions in deep-draft, steep-walled shipping channels. Such aquatic life may include, but is not limited to, fish species such as common carp, golden shiner, bluntnose minnow, yellow bullhead and green sunfish.*" (35 Ill. Adm. Code 303.240, Emphasis added).

Section 303.201 of the Water Use Designations and Site-Specific Water Quality Standards (35 Ill. Adm. Code 303) specifies that "*Except as otherwise specifically provided, all waters of the State must meet the General Use standards for Subpart B of Part 302*". 35 Ill. Adm. Code 303.220 - 303.240 describe the designated recreational and aquatic life uses for the CAWS as of 1 July 2015, as amended by the UAA rulemaking proceedings described above.

Water quality standards applicable to the CAWS are found in 35 Ill. Adm. Code 302 Subpart D: Chicago Area Waterway System and Lower Des Plaines River Water Quality and Indigenous Aquatic Life Standards. The temperature standards specifically applicable to the CSSC near WCGS, are as follows (only applicable sub-sections are listed):

Section 302.408 Temperature

b) The temperature standards in subsections (c) through (i) will become applicable beginning July 1, 2018. Starting July 1, 2015, the waters designated at 35 Ill. Adm. Code 303 as Chicago Area Waterway System Aquatic Life Use A, Chicago Area Waterway System and Brandon Pool Aquatic Life Use B, and Upper Dresden Island Pool Aquatic Life Use will not exceed temperature (STORET number (°F) 00011 and (°C) 00010) of 34°C (93°F) more than 5% of the time, or 37.8°C (100°F) at any time.

c) There shall be no abnormal temperature changes that may adversely affect aquatic life unless caused by natural conditions.

d) The normal daily and seasonal temperature fluctuations that existed before the addition of heat due to other than natural causes shall be maintained.

e) The maximum temperature rise above natural temperatures shall not exceed 2.8°C (5°F).

f) Water temperature at representative locations in the main river shall not exceed the maximum limits in the applicable table in subsections (g), (h) and (i), during more than one percent of the hours in the 12-month period ending with any month. Moreover, at no time shall the water temperature exceed the maximum limits in the applicable table that follows by more than 1.7°C (3.0°F)

h) Water temperature in the Chicago Area Waterway System and Brandon Pool Aquatic Life Use B waters listed in 35 Ill. Adm. Code 303.240, shall not exceed the limits in the following table in accordance with subsection (f):

Months	Daily Maximum (°F)
January	60
February	60
March	60
April	90
May	90
June	90
July	90

August	90
September	90
October	90
November	90
December	60

(Source: Amended at 39 Ill. Reg. 9388, effective July 1, 2015)

WCGS remains in full compliance with the interim limitations imposed by Section 302.408(b).[2]

Compliance with applicable CSSC thermal limits is determined through the use of an Agency-approved Near-Field Thermal Model, which utilizes real-time station operating data and 24-hour antecedent flow to calculate fully mixed temperatures in the main body of the waterway. The results produced by the Near-Field Thermal Model have been demonstrated to be equivalent to the approximate edge of the allowed 26-acre mixing zone for WCGS. The WCGS Near-Field Thermal Model was patterned after IEPA's *Illinois Point Source Strategy for Waste Load Allocation* document dated January 17, 1991. (See Appendix D, Exhibit D for further Near-Field Thermal Model details).

The new standards summarized above and which go into effect on July 1, 2018, specifically Sections 302.408(c), (d), (e), (f) and (h), are those for which thermal Alternate Effluent Limitations (AELs) are being sought by MWGen through the §316(a) demonstration process, as well as an alternative zone of passage (ZOP) provision.

This Demonstration was conducted in order to determine if less stringent site-specific thermal AELs for WCGS would continue to meet the required §316(a) criteria. As shown in the Demonstration, there is no evidence that operation of WCGS in accordance with the former Secondary Contact thermal limits, nor the identical current interim thermal limits (§302.408(b)) which are applicable until July 1, 2018, has caused appreciable harm to a BIC in the CSSC. The numeric thermal AELs proposed for WCGS in this Demonstration are more stringent than the prior Secondary Contact limits, and should likewise not result in any such appreciable harm.

In addition, this Demonstration shows that the CSSC BIC will be adequately protected if the 3ºF temperature increase above the proposed thermal AELs is allowed for 5% of the time within a calendar year.

The hydrothermal modeling effort summarized in Appendix D provides predictive information regarding worst-case and more typical thermal compliance scenarios under the expected range of conditions under which WCGS operates during the summer and winter periods of the year. The

[2] In addition, pursuant to the IPCB Order in AS96-10, dated 3 October 1996 and amended 16 March 2000, the WCGS thermal discharge is also subject to the alternate I-55 Bridge temperature limitations, as outlined in NPDES Permit Special Conditions 4B and 4C. The WCGS thermal discharge has consistently complied with these limitations, including during the period of four operating unit operations. The alternate I-55 Bridge temperature limitations are not the subject of this Demonstration.

data from the hydrothermal modeling effort, along with historical station operating information, have also provided the basis for development of the proposed transitional month thermal AELs.

A biothermal assessment was prepared to support MWGen's request for alternative thermal standards in the WCGS NPDES Permit (Appendix B). This predictive assessment used the MIKE3 model to characterize and predict hydrothermal conditions in the CSSC downstream of the WCGS discharge (Appendix D). The MIKE 3-predicted thermal plume dimensions and distribution in the CSSC were compared to available biothermal metric data related to survival, avoidance, spawning, and growth of fish. This assessment evaluated the predicted effects of the WCGS thermal plume temperatures on the aquatic community represented by seven selected RIS under three summer period scenarios:

(1) "Worst case" summer, using actual weather, canal flow and Unit 4 load conditions from 7 July 2012;

(2) "Typical" July conditions using a median CSSC flow from the time period 2011-2016, along with 75th percentile weather and station operating conditions (this time period includes the 2011-2014 period when two units (3 and 4) were operating); and

(3) "Typical" July conditions using the 10th percentile CSSC low flow from the same time period, with the same 75th percentile values used for the remaining model input as in Scenario 2.

The maximum surface temperature near the edge of the allowable mixing zone under the "worst-case" scenario was 35.6ºC (96ºF), the maximum compliance temperature requested by MWGen as part of the proposed summer thermal AEL[3]. Based on continuous temperatures from 2011-2016 recorded at the WCGS discharge, temperatures of the magnitude approaching those modeled for the "worst-case" scenario are expected in July and August from about 1% to 5% of the time. Discharge temperatures exceeding 33.9°C (93°F) can be expected up to 20% of the time within the summer period from June through September, based upon actual data from 2011-2016. The frequency and magnitude of the WCGS discharge temperature is dependent on the combination of ambient weather conditions, canal flows and power demand. These higher temperatures typically occur during periods of peak summer power demand.

There are occasions when canal flow may remain low for an extended duration, thereby lessening the available heat dissipation within the allowed mixing zone. These conditions result in higher calculated near-field compliance temperatures. This is the basis for MWGen's proposal for a numeric summer thermal AEL of 33.9°C (93°F), applied at the edge of the allowed mixing zone in the CSSC. The prior, long-standing Secondary Contact thermal limit of 33.9°C (93°F) has been shown, through the review of long-term biological study results, to have not had any detrimental effect on the BIC, and is therefore appropriate for application on a

[3] 96ºF would be the maximum allowed excursion temperature, subject to the proposed excursion hour provisions included in the proposed thermal AEL language.

significantly more limited basis as a summer period AEL for MWGen's WCGS thermal discharge.

For the summer condition, all three model scenarios demonstrate that WCGS cannot consistently meet the criteria required by the new Use B thermal limits that go into effect on July 1, 2018. However, the model results indicate that WCGS would be able to meet less stringent thermal limitations, which are proposed as part of this Demonstration, while still providing adequate protection of the balanced indigenous aquatic community of the CSSC.

These modeling results also indicate that a major portion of the CSSC cross-section between the WCGS discharge and the downstream model extent (the areas where more suitable aquatic habitat exists) maintains temperatures fully adequate to support biological communities under both typical summer and adverse flow and weather conditions and continue to provide an adequate zone of passage for aquatic life (See Appendix B). Moreover, these conditions are maintained at edge of mixing zone temperatures that are above the new Use B thermal limitations imposed by Section 302.408 of Ill. Adm. Code Title 35, Subtitle C, Chapter I of the Illinois Pollution Control Board Rules and Regulations.

Most importantly, the summer operation of WCGS under the prior Secondary Contact thermal standards for the past 38 years has resulted in no documented adverse impact on the indigenous aquatic community of the CSSC, including during the more recent period when canal water quality conditions have been nominally improved due to updated municipal wastewater treatment in the upstream reaches. With fewer units in operation at WCGS than in the past, there is even less likelihood of adverse impacts from its thermal discharge into the CSSC, especially under the thermal AELs which are proposed, as they are more stringent than the former Secondary Contact thermal limits.

The winter period has historically not been an issue with regard to thermal compliance under the prior Secondary Contact thermal limits and under these continuing pre-July 1, 2018 interim §302.408(b) limitations. However, the applicable July 1, 2018 Use B limits specify a maximum edge of mixing zone limit of 60°F from December through March, which is 33°F cooler than the prior thermal standard. Therefore, it was apparent from review of prior WCGS 2011-2016 winter discharge temperature data and corresponding canal flow conditions that there would be periods, ranging from one to 34% of the time, when this limitation simply could not be met without significant WCGS operating restrictions.

Flows in the CSSC during the winter months are predominantly low and are composed almost entirely by POTW effluent, which is warmer, on average, than the water temperatures that would be encountered during the winter months in a natural waterway. The Northern Illinois area is also prone to weather extremes, during both the summer and winter. This was most recently evidenced by the unseasonably warm air temperatures in February 2017, which broke long-standing NWS-Chicago records for February on five separate dates, and exceeded prior winter (December-February) records on three of those five dates.[4] For these reasons, it was important

[4] http://www.weather.gov/lot/February2017warmth

to also model WCGS winter operations, to obtain an estimate of thermal plume geometry and extent during this time of year. Both typical expected seasonal conditions, as well as a valid, real-world representation of what would be considered a "worst-case" winter operating scenario, were used for winter model input.

Three scenarios were developed through review of the winter month weather data for the 2011-2016 period of record:

(1) "Worst case" winter, using a dataset created by combining the highest measured hourly air temperatures, relative humidity and intake temperatures from each identified date during the four winter months with the most extreme weather conditions.[5] This was paired with the minimum hourly low flow conditions encountered for each of these winter month dates and applying a 75th percentile WCGS winter megawatt load;

(2) "Typical" winter conditions, using a median CSSC flow from the four winter months during the time period 2011-2016, along with 75th percentile weather and station operating conditions; and

(3) "Typical" winter with low flow conditions, using the 10th percentile CSSC low flow for December and March (2011-2016), with the same 75th percentile values used for the remaining model input as in Scenario 2.

Results from the winter modeling exercise demonstrate that the typical WCGS surface thermal plume disperses quickly under lower air temperature conditions, with more subsurface mixing and diffusion than found during the summer period. Similar to the summer model results, winter plume geometry and its extent is dictated by canal flow conditions. Chronic and/or sporadic low flow results in larger plume areas and slower heat dissipation, however, at no time does the winter plume temperature, even under the worst case winter scenario, result in conditions which would impair movement of aquatic life both upstream and downstream of the discharge or otherwise adversely affect the CSSC BIC. However, under the combination of adverse flow conditions and unseasonal winter weather, the modeling results also confirm that WCGS cannot consistently meet the Use B winter thermal limit of 60°F, even with the allowed 3°F excursion for up to 1% of the hours in any 12-month period.

The winter model results indicate that the station would be able to meet the less stringent thermal limitations that are proposed in this Demonstration, while still providing adequate protection of the balanced indigenous aquatic community of the CSSC. These proposed winter thermal AELs are more stringent than the prior Secondary Contact thermal limits and are more reflective of the actual seasonal variation in CSSC temperatures, which are altered from what would be encountered in a natural system, with or without power plant input, due to the predominance of POTW effluents.

[5] February 2017 was included in this analysis due to the fact that is was unseasonably warm, and also because the two WCGS winter thermal plume studies to support model development were conducted during this month.

The aquatic community in the CSSC is not actively spawning or growing during the winter months, and there are no species present or expected to reside in the limited canal habitat that require a "chilling period" during the winter to complete their life cycle. Therefore, there should be no adverse impact from the temperature contribution from the WCGS discharge during this period, either under the prior thermal standards, nor the proposed thermal AELs. Likewise, since the ambient winter canal water temperatures are artificially elevated by the dominant contribution of POTW effluent, there is little likelihood of cold shock mortality should the WCGS experience an unplanned unit trip, as the maximum proposed winter thermal AELs are all within the temperature change tolerance for warm water aquatic life (Appendix B).

Zone of Passage Discussion:

Historically, there has never been a 5°F "above natural temperatures" limit applied to this constructed and manipulated canal system, as is now provided in Section 302.408(e) for the period beginning July 1, 2018. WCGS does not create any type of thermal block in the canal which cannot be traversed by the indigenous aquatic community, during summer or winter operations. There are, however, two other significant deterrents to a zone of passage (ZOP) for the indigenous aquatic community in the CSSC near WCGS. Only approximately one mile upstream of the WCGS, the USACE has installed a multi-phase electric barrier system which effectively negates any zone of passage, thereby eliminating the potential for any motile aquatic life from upstream to pass through the barrier and continue downstream past WCGS, or to move upstream beyond the barrier. Approximately 5.5 river miles downstream, the second major physical barrier is the Lockport Lock and Dam. As such, MWGen believes that the application of the 5°F delta T provision is overly restrictive and unnecessary in order to maintain and protect the balanced indigenous aquatic community of the CSSC near WCGS, especially because an adequate ZOP will continue to be maintained by the station thermal discharge.

Based on review of historical operating and canal flow data, it can be expected that a 75% or greater ZOP under the proposed thermal AELs would be available in the CSSC near WCGS most of the time. However, due to the frequency of erratic flow fluctuations, as well as low flow conditions where the dilution ratio may be less than 3:1, IEPA already allows for a reduced ZOP of 50%. The WCGS thermal discharge will be able to meet this criterion under the proposed thermal AELs, based on the existing hydrothermal modeling results. At no time would there be an instance when the ZOP would be completely eliminated, based on station operations.

The thermal AELs proposed for the transitional months should also provide for a more seasonally-based progression between the proposed summer and winter AELs, thereby further limiting the need for a specific delta T provision to minimize abrupt changes in temperature. In addition, the proposed thermal AELs for several of the transition months (April, May, and November) are more stringent than the corresponding limits under Use B and closer to seasonal temperatures expected in the CSSC.

Therefore, based on the measured data and modeling information presented herein, as well as the biological assessment provided in Appendix B, the following thermal alternative effluent limitations are proposed for WCGS, in lieu of the provisions contained in Title 35, Subtitle C, Chapter I, Section 302.408 (c), (d), (e), (f), and (h) and Section 302.102(b)(8) (zone of passage requirement):

Received, Clerk's Office 1/26/2018

Proposed Thermal AELs:

(1) Water temperature at representative locations in the CSSC shall not exceed the maximum limits listed below for more than 5% of the time. Moreover, at no time shall water temperature exceed the maximum limit by more than 1.7°C (3°F).

(2) A Zone of Passage (ZOP) for aquatic life in which the proposed thermal AEL standards are met shall be maintained at 50 % or greater at all times.

(3) Proposed Numeric Thermal AELs for WCGS:

Month	Daily Maximum (°F)
January	70
February	70
March	75
April	80
May	85
June	93
July	93
August	93
September	93
October	90
November	85
December	75
Excursion Hours	Daily maximum not to be exceeded by more than 5% of the time in a calendar year; at no time shall water temperature exceed the maximum limits by more than 3°F

The above proposed thermal AEL limits for WCGS are effective at the edge of the allowed 26-acre mixing zone and would continue to be complied with through the use of the existing IEPA-approved Near-Field compliance model (included as Exhibit D to Appendix D).

As discussed above, these proposed seasonally-based thermal AELs will effectively replace the function of provisions (c), (d), (e), (f), and (h) of the Use B limits for the CSSC near WCGS.

A comparison of the former, current, and future thermal numeric standards along with the proposed thermal AELs are summarized below in Table 2-1 and also discussed in Section 5.0 of Appendix D.

Received, Clerk's Office 1/26/2018

Table 2-1. Existing and Proposed Thermal Alternative Effluent Limits for WCGS:

Month	Prior Secondary Contact Standards & Interim 35 IAC § 302.408(b) Standards (effective 1 July 2015-30 June 2018)	Use B Thermal Standards (Effective 1 July 2018)**	Proposed WCGS Thermal AELs
	Daily Maximum (°F)	Daily Maximum (°F)	Daily Maximum (°F)
January	93	60	70
February	93	60	70
March	93	60	75
April	93	90	80
May	93	90	85
June	93	90	93
July	93	90	93
August	93	90	93
September	93	90	93
October	93	90	90
November	93	90	85
December	93	60	75

Received, Clerk's Office 1/26/2018

	Prior Secondary Contact Standards & Interim 35 IAC § 302.408(b) Standards (effective 1 July 2015-30 June 2018)	Use B Thermal Standards (Effective 1 July 2018)**	Proposed WCGS Thermal AELs
Excursion Hours	Shall not exceed 93°F more than 5% of the time, or 100°F at any time	Shall not exceed maximum limits during more than 1% of the hours in the 12-month period ending with any month; At no time shall water temperature exceed the maximum limits by more than 3.0°F	Daily maximum not to be exceeded by more than 5% of the time in a calendar year; at no time shall water temperature exceed the maximum limits by more than 3°F

**In addition to the numeric limits, Use B also has the following narrative requirements:

(c) There shall be no abnormal temperature changes that may adversely affect aquatic life unless caused by natural conditions.

(d) The normal daily and seasonal temperature fluctuations that existed before the addition of heat due to other than natural causes shall be maintained.

(e) The maximum temperature rise above natural temperatures shall not exceed 2.8°C (5°F).

4. MASTER RATIONALE FOR DEMONSTRATION

This Section summarizes findings of this §316(a) Demonstration in support of MWGen's application for thermal alternative effluent limitations (AELs) to take the place of the new numerical and certain narrative provisions of 35 Ill. Adm. Code § 302.408(c) through (f), (h) and (i), which become effective on July 1, 2018. The Demonstration has been prepared in accordance with 35 Ill. Admin. Code 106, Subpart K, consistent with 40 CFR 125.70-125.73 (Federal Register 2014) and the Draft *Interagency Technical Guidance Manual* (USEPA and NRC 1977) (Interagency Guidance Manual). Under §316(a), the proposed alternative thermal effluent limitation (AEL) must, "*assure the protection and propagation of a balanced, indigenous community* (BIC) *of shellfish, fish, and wildlife in and on the body of water into which the discharge is made*" (USEPA and NRC 1977). 35 Ill. Admin. Code 106.1110 and 40 CFR Subpart H both identically define the BIC as the "*biotic community typically characterized by diversity, the capacity to sustain itself through cyclic seasonal changes, presence of necessary food chain species, and by a lack of domination by pollution tolerant species.*"

To support the issuance of thermal AELs the applicant may use predictive methods, or in the case of an existing facility such as WCGS, use studies to demonstrate the *absence of prior appreciable harm* (USEPA and NRC 1977). This Demonstration employs both methods. The retrospective evaluation demonstrating that the past and existing operation of WCGS has not caused prior appreciable harm to the BIC is presented in Appendix C of this Demonstration. Hydrothermal surveys and modeling of the WCGS thermal discharge in the CSSC were performed (Appendix D) to support a detailed assessment that predicts negligible potential effects of the thermal discharge on selected RIS (Appendix B). Support for these conclusions is summarized below.

4.1 SUPPORTING INFORMATION

4.1.1 Retrospective Demonstration of No Prior Appreciable Harm to the Balanced, Indigenous Community

Monitoring programs conducted in the waterway near WCGS show that the once-through cooling operation of WCGS under the current effective thermal water quality standards set forth in 35 Ill. Adm. Code §302.408(b), or the prior Secondary Contact thermal limits, has not resulted in *prior appreciable harm* to the BIC occurring in and on the CSSC downstream of the WCGS cooling water discharge. The retrospective assessment of the WCGS discharge (Appendix C) discusses the findings of these studies relative to the biotic categories the Interagency Guidance Manual recommends for evaluation in conducting §316(a) Demonstrations: phytoplankton, habitat formers, zooplankton, shellfish and macroinvertebrates (including freshwater mussels), fish, and other vertebrate wildlife. The available empirical studies in the CSSC clearly document that this man-made and artificially controlled waterway does not exhibit the typical temporal and spatial variability which is characteristic of a complex natural ecosystem. However, there remains a diverse biological assemblage which is predominately influenced by the limited aquatic habitat inherent to the canal system. Thus, there remains a balanced indigenous community (BIC) reflective of the CSSC. Over two decades of biological studies performed by

WCGS, covering its current operating configuration, as well as under multiple unit operation, indicate that the aquatic community in the vicinity of the WCGS discharge is similar to that in adjacent areas of the CSSC upstream of the WCGS discharge, as well as areas downstream in the lower Lockport Pool, with differences that are reflective only of the presence or absence of areas of more suitable habitat and not related to the influence of the WCGS thermal plume. Findings for each of these biotic categories are summarized in Section 5.0.

4.1.2 Predictive Biothermal Assessment

A predictive biothermal assessment (Appendix B) was undertaken to complement the retrospective analysis and to provide additional information for assessing potential effects of the WCGS thermal discharge on the BIC of the CSSC under both the current and the proposed alternate thermal limits. The predictive assessment uses intensive thermal surveys and a hydrodynamic model of the WCGS thermal plume, along with six years (2011-2016) of hourly operational data, weather, and flow conditions to describe the distribution and dynamics of the thermal plume in the CSSC under both typical and "worst-case" summer and winter scenarios:

Summer Model:

- The "**typical summer"** assessment scenario used median July flow in the CSSC, 75th percentile intake and discharge temperatures, Unit 4 load, and weather parameters (air temperature and relative humidity). This set of conditions was determined to be most reflective of a typical summer operating mode for WCGS.

- The "**typical low flow summer"** condition assessment scenario used the 10th percentile low July flow for the CSSC. This flow is over 60% lower than that used for the typical summer condition scenario. Low flows and erratic flow fluctuations are characteristic of the CSSC. The remaining model input parameters for the typical low flow summer scenario are identical to the typical summer scenario, thereby providing a model output which is reflective of the impact of low flow conditions upon heat dissipation in the waterway.

- To evaluate thermal plume characteristics under infrequent, more extreme meteorological conditions (**"worst-case summer")** scenario, the hydrothermal model was used to assess the unusual conditions of high air temperatures and low flow that occurred during July 2012. There were seven consecutive days with a maximum daily ambient water temperature of 90°F or greater during early July 2012. The average monthly July air temperature (81.1 °F) ranked third in the 144-year period of record maintained by the National Weather Service (NWS)-Chicago office.[6]

  The maximum recorded temperature for the WCGS area from 1-7 July 2012 was 37.2°C (99°F); air temperatures were even higher within the Chicago city limits.[7]

[6] http://www.weather.gov/lot/July_Temperature_Rankings_Chicago
[7] http://www.weather.gov/lot/2012July_heat

Received, Clerk's Office 1/26/2018

WCGS cooling water intake temperatures were as high as 30.6°C (87°F).[8] The maximum WCGS discharge temperature to the discharge canal during this period was 39.4°C (103°F). Compliance with the then-effective Secondary Contact thermal limit was maintained at the edge of the allowed 26-acre mixing zone, based on prior thermal studies and application of near-field model calculations.

Winter Model:

- The "**typical winter**" assessment scenario used median flow in the CSSC for December through March, 75th percentile intake and discharge temperatures, Unit 4 load, and weather parameters (air temperature and relative humidity) for December and March (the two winter months with the most variability). This set of conditions was determined to be most reflective of a typical winter operating condition for WCGS.

- The "**typical low flow winter**" assessment scenario used the 10th percentile low flow average for the months of December and March for the CSSC.[9] This flow is over 48% lower than that used for the typical winter condition scenario. Low flow conditions are common in the CSSC during the winter months, when there is no Lake Michigan diversion and little or no precipitation that results in run-off. The remaining model input parameters were identical to the typical winter scenario, thereby providing a model output which is reflective of the impact of chronically low flow conditions upon heat dissipation and distribution in the waterway.

- To evaluate thermal plume characteristics under infrequent, more extreme meteorological conditions (**"worst-case winter")** scenario, the hydrothermal model was used to assess the impact of unseasonably high air temperatures and low flows that have occurred during the four winter months over the 2011-2016 timeframe.[10]

The following dates were selected as most representative of worst-case unseasonably high temperature conditions for each winter period:

[8] WCGS was operating under a Provisional Variance from 3 July through August 19 (1EPA 12-02 and 1EPA 12-26) from the AS 96-10 thermal limits in effect at the I-55 Bridge.
[9] The 10th percentile low flow average for all four winter months was 982 cfs, which was determined to be too low for consideration as a constant value over a 24-hour period; this low flow value has never been maintained over an entire 24 hour period. Therefore, only December and March values were used.
[10] February 2017 was included in this analysis because it was unseasonably warm, and also because the two WCGS winter thermal plume studies to support model development were conducted during this month.

Selected Date	Daily High Air Temperature (F)	Daily Low Air Temperature (F)
January 31, 2012	56	43
March 21, 2012	83	65
December 13, 2015	61	57
February 18, 2017	68	41

(Note that February 2017 is also the when the winter thermal plume studies were conducted for WCGS).

- The highest air temperature date was selected from review of hourly data records for each of the four winter months. The winters of 2011, 2013 and 2014 were all intermediate in terms of weather parameters. January 2012 had the 20th highest air temperatures in the 145-year NWS—Chicago office period of record.[11] March 2012 holds the record for the warmest winter month from the same NWS dataset. December 2015 ranked fourth highest out of 145 years in terms of average monthly temperature. Several local temperature records were broken in February, 2017, including the 17 February 2017 thermal plume study date.[12]

- WCGS winter cooling water intake temperatures were as high as 23.8°C (74.8°F), with median winter values ranging from 5.7°C (42.3°F) to 8.9°C (48.0°F). The maximum measured winter discharge temperature for the 2011-2016 period was 25.6°C (78°F), but may not have been reflective of an extended full load condition, since WCGS has historically gone into extended maintenance outages during the winter. To maintain operational flexibility throughout the winter months, MWGen is pursuing a set of thermal AELs for this period which would take unseasonable weather and adverse flow conditions with correspondingly higher winter unit load demand into consideration.

  In order for a representative "worst-case" winter operating condition to be modeled, discharge temperatures at higher loads were estimated based on established condenser delta T data. [For example, with a maximum measured intake temperature of 19.4°C (66.9°F), the expected 75th percentile load discharge temperature would be 26.7°C (80.1°F)].

Given the number of species that compose the fish community near WCGS, it is not feasible to evaluate every species that could be affected; therefore, consistent with Interagency Guidance Manual, selected Representative Important Species (RIS) were used to characterize and assess the potential effects of the thermal discharge on important life history functions (*e.g.*, migration, reproduction, growth, performance, and survival). The RIS were selected as representative of the BIC that currently exists in the vicinity of WCGS, or could exist with other improvements in

[11] http://weather.gov/lot/January_Temperature_Rankings_Chicago
[12] https://www.weather.gov/lot/February2017Warmth

water quality that might result from the implementation of the revised water quality standards imposed by the recently completed Use Attainability Analysis (UAA) for the CAWs.

The hydrothermal model developed for the CSSC in the vicinity of the WCGS discharge is an effective tool for assessing the spatial distribution and range of temperatures within the WCGS thermal plume relative to temperature effects on aquatic organisms predicted by laboratory studies. Consequently, the model is used in conjunction with laboratory-based thermal effects data to predict the potential effects of operation of WCGS in accordance with currently applicable thermal water quality limits, as well as under the proposed thermal AELs on survival, growth, and reproduction of RIS. This biothermal analysis supports a determination that the proposed thermal AELs are not expected to cause appreciable harm to the BIC in the Lower Lockport Pool of the CSSC or areas downstream of the Lockport Lock and Dam. Moreover, the long-term fisheries monitoring program that has been conducted near WCGS for the past 23 years also provides real-world evidence that water temperatures in the Lower Lockport Pool, even under the prior Secondary Contact thermal limits, have not had an adverse impact on RIS survival, growth or reproduction. Therefore, no appreciable harm is expected under the proposed thermal AELs for WCGS, which are more stringent than the prior Secondary Contact limits.

Under the typical summer and typical summer low flow scenarios modeled for this Demonstration, discharge temperatures do not exceed the chronic or acute thermal mortality threshold or avoidance temperatures for the RIS. These two scenarios are typical of previous and expected future summer operations at WCGS. Thus, no appreciable harm is predicted under the proposed thermal AELs, which is consistent with the demonstration of no prior appreciable harm (Section 6—Biotic Category Rationale).

The model output for the winter scenario data indicates that even under "worst-case" conditions, there would be no temperatures which would have an adverse impact on the CSSC aquatic community in terms of causing mortality, inducing avoidance, or limiting reproductive success.

The proposed winter thermal AEL values are all within the thermal change tolerance for warm water aquatic species documented in the USEPA Red Book (USEPA 1976, p. 432). The CSSC, even without power plant discharges, is characteristically warmer than a natural waterway during the winter months, as its primary flow source (from 70 up to 100%) during these months is treated POTW effluent, with an average winter month temperature of 51.6°F.[13] Therefore, the BIC of the CSSC in the lower Lockport Pool is already well-acclimated to warmer winter water temperatures than would be typical of a natural system. Thus, the proposed winter thermal AELs will continue to ensure adequate protection of the CSSC BIC.

The proposed WCGS thermal AELs for the transitional months (April, May, October and November) are reflective of the seasonal variation in ambient water temperatures during these periods. These months represent periods when both air and water temperatures transition between the extremes of summer and winter. Six years of historical data provide the same type

[13] Based on review of MWRDGC's Stickney Discharge Temperature data reported in monthly Discharge Monitoring Reports for December through March, 2011-2016.

of inter-annual variation in transitional month water temperatures that is seen for the remainder of the year. Therefore, in place of developing modeling scenarios for these months, MWGen proposes the application of a seasonal "stair-step" approach to the transitional month AELs; one which is reflective of the natural variability observed during the spring and fall, and is more realistic than either the former Secondary Contact thermal limits or the Use B numeric limits for these months. This seasonally variable approach will ensure continued protection of the BIC, and will effectively supersede, yet still fulfill, the intent of the narrative criteria outlined in Section 302.408(c), (d), and (e), as applied to the CSSC near WCGS.

Consistent with the Interagency Guidance Manual, the predictive modeling analyses demonstrate that the proposed thermal AELs for WCGS will assure the propagation and protection of the BIC represented by the RIS that could reside in the CSSC, given its permanent physical constraints and anthropogenic influences. The modeled "worst-case" summer and winter scenarios further indicate that the proposed seasonal thermal AELs would result in temperature conditions adequate to support and protect the BIC near the WCGS thermal discharge. Survival, reproduction, development, and growth would not be appreciably reduced due to operation under the proposed thermal AELs. The potential for mortality associated with high discharge temperatures is negligible under the "worst case" conditions modeled for WCGS, and would be even less so under typical seasonal weather and flow conditions. Similarly, the WCGS thermal plume is not expected to block or inhibit access to any potential spawning habitat, spawning activities, or the development and growth of eggs, larvae, and early juveniles of RIS and the BIC. Consequently, the WCGS thermal discharge is not expected to reduce normal annual growth and performance of RIS and the BIC in the CSSC.

4.1.3 Potential for Increase in Abundance or Distribution of Nuisance or Pollution-Tolerant Organisms

Aquatic nuisance species (ANS) are organisms introduced into new habitat that have the ability under certain conditions to alter ecosystems and lead to degradation of biological communities by reducing biodiversity through competition with native species, alteration and degradation of habitat, and declines in populations of important indigenous species. The impacts from certain species of ANS may cause not only environmental degradation, but can also have economic impacts associated with lost commercial and/or recreational opportunities and increased cost for prevention, eradication, and control.

Of the documented ANS in Illinois, many are found throughout the UIW, which includes the CSSC. The USACE constructed and operates an electric dispersal barrier system (RM 296.4) in the vicinity of the WCGS (RM 295.5) to stop passage of Asian carp and other ANS to the Great Lakes (Electric Barriers Overview, accessed March 2017; also see Appendix A, Section 5.6). Along with this barrier, the Asian Carp Regional Control Committee has implemented several initiatives to both better understand and control the spread of these ANS species (See Appendix A). Based on all studies conducted, to date, there is no indication that WCGS operations have any contributory effect on Asian carp or other ANS in the waterway.

Since 2010, monitoring for Asian carp in the CSSC has resulted in the capture of the following non-native fishes: Common Carp, Goldfish, Common Carp x Goldfish hybrid, Alewife, White Perch, Round Goby, Oriental Weatherfish, Threadfin Shad, Rainbow Trout, Grass Carp, Brown Trout, Chinook Salmon, Coho Salmon, Tilapia, Rainbow Smelt, Silver Arrowana, and Threespine Stickleback (Appendix A). These species represented 14% of the total number of fish collected and 22% of the total species captured. Most of these ANS have been captured during the MWGen long-term fisheries monitoring program, as well. During the recent 2016 study near WCGS, there were six exotic species captured (Appendix F). In 2015, 10 exotic taxa were collected (Appendix G). Non-native species have been consistently collected during the long-term monitoring program on the CSSC (Appendix C).

WCGS operations have not been responsible for these non-native introductions or their spread through the CSSC and UIW in general. Operation of WCGS under the proposed thermal AELs will not have any influence on the future of ANS in the system.

Consistent with the Interagency Guidance Manual, the proposed thermal AELs for the WCGS thermal discharge are not expected to cause a shift in composition and abundance toward nuisance or pollution-tolerant species. Ongoing monitoring programs demonstrate no shift in community composition towards nuisance concentrations/ abundance of these species in the vicinity of WCGS.

4.1.4 A Safe Zone of Passage Is Available

This assessment indicates that the RIS and aquatic community that they represent are not likely to avoid significant areas of habitat in the vicinity of the WCGS thermal plume under either typical or "worst-case" temperature conditions. Thus, it is unlikely that the thermal plume would interfere with the migration and localized movement patterns (*e.g.,* diel and seasonal onshore/offshore, upstream/downstream, or spawning) of the fish community in the CSSC. Even under extreme high temperature conditions such as those modeled under worse-case conditions, avoidance of the primarily channel habitat downstream of the WCGS discharge, if it occurred, would be of very short duration and, therefore, would not be expected to affect overall access and utilization of habitat in the area because there will be a zone of passage maintained in the water column.

Both retrospective and predictive assessments demonstrate that an adequate zone of passage for resident fish species is available during their respective periods of occurrence in the vicinity of the WCGS cooling water discharge.

In contrast, the most significant influences on aquatic life in the waterway near the WCGS in recent history have been related to the USACE's Aquatic Nuisance Species (ANS) Dispersal Barrier complex, which is further described in Appendix A. While this barrier system is designed to block the movement of Asian carp, it also prevents the normal upstream and downstream movement of other fish species. The barrier also limits the areas available to sample biota upstream of the WCGS and can result in an accumulation of upstream migrating fish immediately downstream of the barrier and within the vicinity of the WCGS intake structure area, which has been documented by the Asian carp researchers and by the MWGen long-term fisheries monitoring program (Appendices E, F and G). This accumulation of upstream migrating fish has nothing to do with suitable habitat conditions but rather is due to the fact that their continued upstream migration is abruptly and artificially stopped by the presence of the barrier.

4.1.5 No Adverse Impact on Threatened or Endangered Species

Federally threatened and endangered (T&E) fish species have not been collected in the CSSC study area near WCGS. In fact, no federally listed fish species are known to occur in Will County, Illinois (Appendix A). One endangered mussel species, sheepnose (Plethobasus cyphyus) has been reported from Will County, but the lower Lockport Pool near the WCGS is not conducive to this mussel species, which occurs in larger rivers and streams where it is usually found in shallow areas with moderate to swift currents that flow over coarse sand and gravel substrates.

State-listed fish species were not collected during the source water surveys conducted by the WCGS long-term adult fisheries monitoring program until 2012, when the state threatened Banded Killifish (*Fundulus diaphanus*) was collected in the lower Lockport Pool at the sampling location furthest downstream from the WCGS. Increased catches of Banded Killifish occurred annually from 2013 through 2016 when 199 specimens were subsequently collected, primarily from the two most downstream sampling locations (Locations 302B and 302A, which are 2.4 and 2.9 River Miles downstream from WCGS, respectively). Banded Killifish were caught in unique habitat for a main channel border in the lower Lockport Pool due to the presence of shallow littoral zone areas with dense aquatic vegetation. Banded Killifish normally inhabit clear, glacial lakes with abundant aquatic vegetation. The area near WCGS does not provide this type of habitat, nor does most of the lower Lockport Pool (Appendices A, C, F and G).

The Banded Killifish population in the lower Lockport Pool seems to be expanding, even under the less stringent temperature limits than the proposed WCGS thermal AELs. Therefore, it is unlikely that the WCGS cooling water discharge has or would be expected to have adverse effects on any state or federally listed species.

4.1.6 No Impact to Unique or Rare Habitat

Aquatic habitat in the CSSC upstream and downstream WCGS is dominated by open, relatively deep channel with fine sediment substrate. Habitat quality ranks fair to very poor because of a lack of riffle/run habitat, lack of clean, hard substrates (*i.e.*, gravel/cobble), excessive siltation, channelization of the CSSC, poor riparian and floodplain areas, and lack of instream cover.

Unique or rare aquatic habitat that could be affected by operation of the cooling water system does not occur in the segment of the CSSC near WCGS. Flow modification in the CSSC has permanently altered flow conditions and aquatic habitat. Long-term, irreversible modification of aquatic habitat in the CSSC is not the result of the thermal discharges from WCGS and habitats would continue to exist in the absence of the discharge. Therefore, these influences have been suitably considered in analyzing the BIC that would occur near WCGS in the absence of the thermal discharge and other pollutant-related impairments.

4.1.7 No Appreciable Harm to the Balanced, Indigenous Population by the Use of Biocides

WCGS does not use biocides, or any other chemical processes, to minimize biofouling of its condenser cooling system. Instead, it uses the process of dehumidification to eliminate biological films and build-up on condenser tubes. This is done by isolating individual water boxes and circulating heated air through the condenser tubes, thereby drying the interior and eliminating biological growth. There are no chemicals released from this process which could alter or harm the aquatic community of the CSSC.

4.2 FINAL ASSESSMENT DETERMINATION

4.2.1 Standard for Determination of Successful §316(a) Demonstration

In a 316(a) Demonstration, the standard used in the assessment of the thermal component of power plant discharges is whether a BIC of shellfish, fish, and wildlife has been and will be maintained in or on the receiving water body despite the thermal discharge. Consistent with the Interagency Guidance Manual (1977), the standard -- protection of the BIC-- is satisfied if the following are met:

- No substantial increase in abundance or distribution of any nuisance species or heat tolerant community;
- No substantial decreases of formerly abundant indigenous species or community structure to resemble a simpler successional stage than is natural for the locality and season, other than nuisance species;
- No unaesthetic appearance, odor, or taste of the water;
- No elimination of an established or potential economic or recreational use of the waters;
- No reduction in the successful completion of life cycles of indigenous species;
- No substantial reduction of community heterogeneity or trophic structure;
- No adverse impact on threatened or endangered species;
- No destruction of unique or rare habitat;
- No detrimental interaction with other pollutants, discharges, or water-use activities.

Because this demonstration includes a request for a change in the current thermal limits, the demonstration addresses how these criteria will continue to be satisfied in the future if the proposed limits are adopted. For the reasons summarized below, the retrospective and prospective evaluations of the WCGS thermal discharge demonstrate that the above criteria will be satisfied if the proposed thermal AELs are adopted.

4.2.2 No Substantial increases in abundance or distribution of any nuisance species or heat tolerant community

To date, no substantial changes in abundance of nuisance species in the vicinity of WCGS have been observed under less stringent thermal limits than under the proposed AELs. Less heat will be discharged under the proposed AELs which will not benefit the abundance or distribution of nuisance species.

4.2.3 No Substantial Decreases of Formerly Abundant Indigenous Species Other Than Nuisance Species

Based on results reported by the monitoring programs described in Appendices E, F and G, abundance of most indigenous species near WCGS either has been unchanged or has increased since 1991 under less stringent thermal limits than the proposed AELs. Overall, the retrospective analysis shows greater abundance at locations downstream of the WCGS discharge, suggesting that the thermal discharge does not significantly influence species abundance. The long-term fish monitoring program conducted in this area, which covers several different WCGS operating combinations (*e.g.*, 4 units, 2 units, 1 unit), does not show any pattern that would indicate that temperature has a significant effect on fish distribution or abundance. Instead, habitat, or more specifically, the lack of suitable habitat, remains the primary stressor. In addition, the prospective analysis shows that the proposed AELs, which are lower than the existing thermal limits, will not interfere with maintaining the indigenous fish species populations in the receiving waters for the WCGS thermal discharge.

The demonstration of no prior appreciable harm on benthic macroinvertebrate and fish communities presented by the retrospective assessment supports the conclusion that the lower trophic levels on which they are dependent for food have been similarly unaffected and that no appreciable harm will result if the proposed AELs are authorized because the added heat above the July 1, 2018 thermal standards that may be discharged will be lower than previously allowed for the WCGS thermal discharge.

4.2.4 No Unaesthetic Appearance, Odor, or Taste of the Water

There is no evidence of an unnatural odor or an unaesthetic appearance in the CSSC receiving waters and implementation of the proposed AELs is not expected to cause such impacts. The reach of the CSSC influenced by the WCGS discharge is currently listed as an impaired waterbody for Aquatic Life Use due to the influence of urban runoff and POTW discharges that dominate flow in the canal. It is not listed as impaired because of temperature. The incremental decrease in heat that would result if the proposed AELs were authorized would not cause a change in odor or aesthetic appearance near the WCGS discharge.

4.2.5 No Elimination of an Established or Potential Economic or Recreational Use of the Waters

No economic or recreational uses of the CSSC have been eliminated or minimized because of the WCGS thermal discharge. The CSSC in the vicinity of WCGS has been designated as Non-Recreational by the IPCB in R08-9(A). Under Section 301.324(b) of 35 Ill. Adm. Code, Title 35, Chapter I, Subtitle C, *"Non-recreational" means a water body where the physical conditions or hydrologic modifications preclude primary contact, incidental contact and non-contact recreation.* Therefore, no recreational uses are approved for the CSSC near WCGS. Those recreational fish species that exist in the system are depressed because of poor habitat conditions, and are also subject to the long-standing fish consumption advisories for the CSSC issued by the Illinois Department of Public Health due to PCB contamination that is unrelated to operation of WCGS. The prospective demonstration for the RIS indicates the small increment in additional heat above the new standard that would be allowed under the proposed AELs will not affect these conditions because the AELs would be more stringent than prior thermal limits that have not affected the economic or recreational use of the CSSC.

4.2.6 No Reductions in the Successful Completion of Life Cycles of Indigenous Species, Including those of Migratory Species

Retrospective analyses of the long-term monitoring program and historical biological analyses indicate that thermal effects under less stringent thermal limits than would exist if the proposed AELs are authorized, have not compromised the overall success of indigenous species in completing their life cycles. These observations combined with the prospective demonstration for RIS indicate that the small increment in added heat that could be released if the proposed AELs are authorized will not cause a change in these conditions.

4.2.7 No Substantial Reductions of Community Heterogeneity or Trophic Structure

Data collected during the long-term monitoring program conducted at WCGS since the 1990s indicate that the number of species collected has remained reasonably constant. Long-term changes in the fish community can be attributed to changes in the CSSC unrelated to the operation of WCGS. Similarly, the difference between the proposed AELs and the water quality standards is small and is not expected to contribute to such changes.

4.2.8 No Adverse Impacts on Threatened or Endangered Species

The retrospective analysis identified 11 state-listed fish species and six state-listed mussel species, but no federally-listed threatened or endangered fish species occur in the area of the WCGS thermal discharge. Habitat in the lower Lockport Pool is not conducive to the state-listed mussels or the one federally-listed mussel species. The analysis indicates that one state-listed fish species, Banded Killifish, occurs near WCGS, but that it has become established in recent years and has not been impacted by the WCGS thermal discharge. Therefore, threatened or endangered species are not expected to be impacted if the proposed AELs are authorized.

4.2.9 No Destruction of Unique or Rare Habitat, without a Detailed and Convincing Justification of Why the Destruction Should not constitute a Basis of Denial

There are no unique or rare habitats downstream of the WCGS discharge that could potentially be affected by the thermal discharge. The CSSC permanently altered the habitat of lower Lockport Pool into which the WCGS cooling water is discharged. The habitat downstream of the WCGS discharge is dominated by relatively deep open channel with substrates that are common throughout the canal. Shallow water vegetated and non-vegetated habitat is limited to a narrow band immediately adjacent to the shoreline downstream of the WCGS discharge.

4.2.10 No Detrimental Interactions with Other Pollutants, Discharges, or Water-Use Activities

The operation of WCGS has not had a detrimental effect on recreational (*e.g.,* boating and fishing) or commercial (*e.g.,* shipping and fishing) water-use activities in the CSSC. Cumulative effects of thermal additions discharged by industries upstream have not occurred. No harmful interactions with other pollutants, such as organic carbon, phosphorus, and nitrogen, are expected if the proposed WCGS thermal AELs are adopted.

4.2.11 Findings of Demonstration for Alternative Thermal Limits under §316(a)

Consistent with the Interagency Guidance Manual, the prospective analysis uses physiological and behavioral responses of RIS to temperature to predict that the temperatures, dimensions, and configuration of the WCGS thermal plume operating with currently-authorized thermal effluent limits do not have the potential to adversely affect the reproduction, growth, or survival of these key species. Although temperature tolerance data are not available for all life history functions for every RIS, the predictive analysis using available data in conjunction with the retrospective analysis, supports a finding that the operation of the WCGS under the proposed thermal AELs would continue to maintain the BIC.

Consistent with the Interagency Guidance Manual, the prospective assessment demonstrates that the WCGS operations under the proposed AELs does not cause appreciable harm to, or interfere with, the successful completion of key life history functions of the RIS. Adequate area is available for migratory and resident species to move upstream and downstream. Under the proposed AELs, temperatures in the thermal plume are such that RIS might exhibit avoidance behavior. However, avoidance of these limited areas will not preclude RIS access to required habitat. Temperatures that could adversely affect development and maturation of eggs, larvae, and early juvenile life stages of RIS are limited to a very small portion of the thermal plume area;

due to their planktonic nature, these life stages are not expected to remain within these small high temperature areas long enough to exhibit permanent adverse effect.

Aquatic organisms experience considerable spatial variation in water temperature and a wide range of seasonal temperatures in the absence of a thermal plume; cumulative growth of aquatic organisms is the culmination of their overall thermal experience throughout the year. At any time, the temperature experienced by an organism may be below, above, or at optimum conditions. Under the proposed AELs, the WCGS thermal plume will not significantly alter this overall experience; at any given time, portions of the plume can also be below, above, or at optimum for growth. During some periods, temperatures within the plume can be closer to optimum than ambient temperatures. Elevated temperatures within the thermal plume are not likely to result in an increase in mortality to RIS above background natural mortality. Potentially lethal temperatures are confined to a small portion of the plume during those limited times when extremely warm meteorological conditions occur. Further, juvenile and adult fish are generally able to detect and avoid potentially lethal temperatures.

The retrospective (Appendix C) and prospective (Appendix B) analyses presented in this Demonstration support the following findings for the relevant factors identified in the Interagency Guidance Manual:

1. *There has been no prior appreciable harm to the BIC associated with the long history of WCGS operations, including its operation under the thermal effluent limits of the existing NPDES Permit;*

2. *The existing aquatic community near the WCGS thermal discharge is like that observed in other parts of the CSSC outside of the influence of the WCGS thermal plume and downstream of the Asian carp electrical barrier, which is a strong indication that the WCGS thermal discharge is not adversely impacting the BIC community;*

3. *The BIC is characterized by typical diversity, a capacity to sustain itself through seasonal cycles, and a dynamic food chain, including an appropriate mix of key trophic level species; and*

4. *The proposed AELs will not preclude overall improvements to the composition of the BIC in response to possible future improvements in water quality and habitat conditions.*

Consistent with the Interagency Guidance Manual, these findings support a determination in favor of authorization of the proposed WCGS thermal AELs.

5. REPRESENTATIVE IMPORTANT SPECIES RATIONALE

A discharger applying for an AEL pursuant to §316(a) must demonstrate that the thermal AELs will assure the protection and propagation of a BIC of shellfish, fish, and wildlife in and on the body of water receiving the discharge. The BIC should typically be characterized by diversity, the ability to sustain itself through cyclic seasonal changes, and include a balance of species among trophic levels to sustain the food chain. Where impaired water quality has affected the aquatic community, the desired BIC should not be dominated by species whose presence is the result of a water quality impairment that will be eliminated by compliance with Clean Water Act goals.

While the CSSC is listed as an impaired waterbody (Appendix A, Section 5.6), the impairments have not been shown to impact the expected aquatic community of this altered, man-made waterway. Potential sources of impairment in the CSSC near WCGS have also remained largely unchanged, and are consistent with the many industrial and municipal inputs to the waterway: municipal point sources, urban runoff/storm sewers, hydrostructure and flow regulation/modification, hydrologic/habitat modification, CSOs, and sediment resuspension/contaminated sediment, as well as unknown sources, have all been used in each of IEPA's 305(b)/303(d) reports to characterize the potential sources of impairment to the CSSC segment to which the WCGS discharges. Even if additional improvements in overall water quality of the CSSC are realized, this would not change the underlying factors which largely dictate the current and expected future aquatic assemblage: hydrostructure and flow regulation/modification and hydrologic/habitat modification. It is important to note that water temperature has never been included as a potential cause or source of impairment for this waterway segment.

In the Illinois Pollution Control Board (IPCB) Order in R08-9 (Subdocket C), the determination was made that the CAWS and Brandon Pool ALU B waters are capable of protecting aquatic life populations predominated by individuals of tolerant types such as Common Carp, Golden Shiner, Bluntnose Minnow, Yellow Bullhead, and Green Sunfish. These are all species which are able to adapt to the physical limitations of the CSSC, including its marginal habitat conditions.

The following five decision criteria outlined in the Interagency Guidance Manual have been evaluated as part of the predictive assessment of potential effects on RIS of the proposed AELs. The RIS were selected as representative of the community of fish and shellfish that could be present in the CSSC in the vicinity of WCGS. The RIS were approved by the IEPA, after notice to and review by the EPA, as part of the review and approval of the Detailed Study Plan. Appendix C determined that no prior appreciable harm to the BIC has resulted from the long-term operation of the WCGS thermal discharge under the currently-authorized thermal limits that are less stringent than the proposed AELs. Historical and site-specific surveys of selected biotic categories representing appropriate food chain trophic levels demonstrated that the aquatic community in the immediate vicinity of the WCGS discharge is not consistently or significantly different from that found in the lower Lockport Pool upstream or downstream of WCGS outside of the influence of its thermal plume.

Received, Clerk's Office 1/26/2018

The goal of the predictive assessment (Appendix B) was to demonstrate that species representative of the potential BIC (the selected RIS) would not be adversely affected by the proposed AELs. The decision criteria set forth in the Interagency Guidance Manual are necessary to demonstrate completion of critical life cycle functions to sustain the populations of these species in the UIW and maintain a BIC of fish and shellfish to meet the designated uses of the segments of the UIW in proximity to DNS. Each decision criterion is discussed below.

5.1 POTENTIAL FOR BLOCKAGE OF MIGRATION

As part of this application for AELs for the WCGS thermal discharge, MWGen is required to demonstrate that an adequate zone of passage for resident and seasonal migrant species is assured. Given that the predictive biothermal assessment indicated that the RIS and the aquatic community that they represent are not likely to avoid significant areas of habitat near the WCGS thermal plume, it is unlikely that the thermal plume would interfere with the migration and localized movement patterns (*e.g.*, diel and seasonal onshore/offshore, upstream/downstream, or spawning) of the fish community in the CSSC. Under the worst-case summer scenario, temperatures in the immediate discharge zone at 180 ft downstream of WCGS provide a zone of passage in about 37% to 54% of the cross-sectional area of the CSSC. The smallest zone of passage (37.1%) was under the 90°F isotherm. The proportion of the water column that would provide a zone of passage under the typical July scenarios nearly doubled under median flows and increased about 50% under low flows. Temperatures in the CSSC at 7,000 and 11,000 ft downstream of the WCGS discharge were predicted not to limit upstream/downstream movements under worst-case and the two typical July scenarios as 96 to 100% of the water column are projected to be below known avoidance temperatures. Only under the worst-case condition, at the 7,000 ft downstream of the WCGS discharge location, was the zone of passage for the 90°F isotherm less than 75% of the water column. Although a zone of passage of less than 75% may affect some species in a limited fashion, the instances where the zone of passage downstream of the WCGS thermal discharge is less than 75% (but not less than 50%) are expected to be rare and limited in duration. Under these limited conditions, there would be only temporary and infrequent avoidance of the plume. Given the nature of the BIC in the CSSC, a temporary reduction in the extent of the zone of passage is unlikely to result in adverse harm.

Migration of RIS to preferred habitat for spawning typically occurs from late April into July. Although across their geographic range Channel Catfish can continue spawning into August, median ambient water temperatures typically exceed the upper temperature range for spawning by early July. During the seasonal periods when adults or juveniles of the Channel Catfish may migrate through the CSSC near WCGS, the proposed AELs will still provide an area for adequate passage by the RIS, including the Channel Catfish. Therefore, the thermal plume associated with both typical and typical high temperature conditions during WCGS operation is not predicted to interfere with migratory functions (Appendix B) associated with spawning of resident RIS.

5.2 POTENTIAL FOR EXCLUSION FROM UNACCEPTABLY LARGE AREAS OF HABITAT

Areas of the thermal plume with water temperatures in excess of avoidance temperatures or the tolerance limits of fish and aquatic invertebrates would be unavailable to the affected species. Mobile aquatic organisms generally avoid water temperatures that are potentially lethal; consequently, extensive mortality from exposure to elevated temperatures is rare, but exclusion from the warmest areas of the WCGS thermal plume could be a concern during infrequent extreme ambient temperature conditions. Thermal tolerance data reviewed for this demonstration support the finding that greater than 75 percent of the cross-section at the WCGS thermal discharge can be inhabited for extended periods of time with little likelihood of thermal-related mortality under both the typical temperature scenarios (Appendix B). There is no rare, unique, or critical habitat in CSSC downstream of the WCGS discharge from which the RIS might be excluded.

5.3 POTENTIAL EFFECTS ON SPAWNING AND EARLY DEVELOPMENT

Reproductive success is integral to sustaining a BIC, including through their typical seasonal cycles. Maturation of gonads and the timing and progression of spawning are closely tied to water temperature (among other factors) for many aquatic species. In addition, the survival, development, and hatching of fertilized eggs and maturation of larvae can be strongly influenced by water temperature, among many other factors. The timing, frequency, duration, and intensity of spawning events and development of early life stages for many species in the CSSC near WCGS are strongly influenced by storms and associated runoff and municipal discharges (including CSOs) that can affect freshwater flow, air temperature trends, and water physicochemistry.

The data reviewed in the predictive assessment indicate that the WCGS thermal discharge would not have an adverse effect on spawning and early development of resident and seasonal RIS that could potentially utilize habitat in the CSSC; water temperatures acceptable for these activities would be available in at least 75 percent of the WCGS thermal plume cross-section under typical temperature scenarios (Appendix B) throughout most of the spawning period of these species. In addition, no unique or critical habitat for spawning and early development of RIS or threatened/endangered species exists in the CSSC.

5.4 POTENTIAL EFFECTS ON PERFORMANCE AND GROWTH

Although theoretical “optimum” conditions for physiological performance, feeding, and growth of aquatic organisms may occupy a narrow temperature range, these functions and activities are ongoing and vary over the wide range of seasonal temperatures experienced by these organisms. Many temperate species typically exhibit negligible growth during winter with peak growth during the warmer seasons. Thus, aquatic organisms in their natural environment rarely experience temperatures at optimum conditions reflected by controlled laboratory studies for a significant length of time. Most species experience optimum temperature conditions during a relatively short period of the annual seasonal cycle and those conditions are likely to vary from

Received, Clerk's Office 1/26/2018

year to year. Even on a daily basis, natural ambient water temperatures can fluctuate in and out of the optimum range. If the cumulative conditions that promote growth occur over an annual period adequate to sustain normal growth increments, the BIC will be sustained.

Many mobile aquatic species have demonstrated in laboratory “preference-avoidance” studies the ability to detect and select a preferred range of temperatures within a temperature gradient. The range of temperatures preferred by a species generally coincides with temperatures associated with optimum growth and physiological performance under the specified acclimation conditions. In their natural environment, mobile aquatic organisms are able to select areas within appropriate habitat where water temperatures are most amenable to physiologic performance and optimum growth. Other factors, including the availability of preferred food items, also have a strong influence on growth.

Data for thermal preference and growth generally indicate that predicted temperatures within most of the WCGS thermal plume under typical summer temperature conditions are within the maximum range for optimum growth and well below the upper zero growth temperature of the RIS. Under the worst-case modeled summer temperature condition, ambient temperatures were generally near the upper zero growth temperature and exceed the upper optimum temperature for growth for the less thermally tolerant of the RIS, but only for a limited period. The worst-case modeled summer temperature condition was not near the upper zero growth temperature nor did it exceed the upper optimum temperature for the more thermally tolerant Channel Catfish, Common Carp, and Largemouth Bass.

For the RIS, ambient temperatures upstream of the WCGS discharge and in the thermal plume downstream of the discharge are adequate to support normal growth patterns under typical summer temperature conditions in the waterway. This is consistent with data collected during field surveys between 1991 and 2016 that show relatively good growth for the more common species, including the RIS.

5.5 POTENTIAL FOR REDUCED SURVIVAL FROM THERMAL SHOCK

Thermal shock can result from a sudden increase (plume entrainment) or decrease (cold shock) in the temperature to which aquatic organisms are acclimated.

5.5.1 COLD SHOCK

Winter temperature limits are intended to protect fish acclimated to discharge temperatures should the heat source (*i.e.,* the thermal plume) be abruptly stopped. Cold shock is the loss of equilibrium associated with exposure to a sudden decrease in water temperature. Under extreme circumstances, it can result in death. The proposed AELs for WCGS during the winter months affect the period during cooler ambient temperatures when cold shock would normally be concern if the plant shuts down when fish are acclimated to warmer discharge temperatures.

Four factors are important in evaluating the potential of cold shock: the length of time fish have resided at the elevated temperatures in the plume, the difference between discharge and ambient

Received, Clerk's Office 1/26/2018

temperatures, the rate of temperature decrease, and the absolute magnitude of the lower temperature. The fish must reside at the higher temperature long enough to become acclimated (a physiological reorganization). The difference between this higher (acclimation) level and the new, lower temperature must be sufficient to disrupt this acclimation. Both the rate and the magnitude of change required to do this vary with the absolute temperature of the new (colder) situation. The rate issue is moot for power plant assessments because, when a power plant ceases to operate, the decay of the near field plume is not very rapid. There is residual heat in the system following a shutdown, such that temperatures will remain elevated for a period of time as the circulating water pumps generally continue to operate as the equipment is cooled. Therefore, the decline in temperature of the near-field plume is relatively gradual (hours versus minutes) in the event of a shutdown.

For the WCGS thermal discharge, it is the magnitude of change that is more important. As the final temperature drops below 40ºF and approaches 32ºF, the magnitude of change necessary to cause cold shock is progressively reduced. However, at final temperatures exceeding 45ºF, cold shock typically does not occur, regardless of the magnitude of the change. In the case of WCGS, winter ambient temperatures are normally near 50°F because the source of much of the CSSC flow is treated wastewater during the winter. Therefore, if the WCGS were to suddenly cease discharging, the expected drop in ambient temperatures is not expected to fall below the 45ºF threshold where concerns about adverse impacts on aquatic life arise.

5.5.2 THERMAL PLUME ENTRAINMENT

Early life stages of fish and invertebrates whose distribution and transport are dominated by water currents would be at greater risk of plume entrainment and exposure to rapid temperature increases. The majority of the early life stages of species that comprise this drift move through the area of the WCGS thermal plume during the period when the summer AELs would apply. For ichthyoplankton that have early life stages that do occur into July, mortality is not predicted based on available thermal tolerance data. Early life stages frequently have higher thermal tolerance than adults. Eggs and larvae of RIS Common Carp and Channel Catfish (Appendix B) acclimated to temperatures of 10-33°C (50-91.4°F) tolerate acute exposure to temperatures of 31-41°C (87.8-105.8°F) and chronic exposure up to 38.8°C (101.8°F).

Received, Clerk's Office 1/26/2018

6. BIOTIC CATEGORY RATIONALE

This section presents the Biotic Category Rationale and summarizes the Demonstration finding that the water temperatures associated with the proposed thermal AELs will be sufficiently protective of the biotic categories constituting the BIC. Supporting detailed information is provided primarily in Appendix C, with additional supporting detail in Appendices A, E, F, G, and H.

6.1 PHYTOPLANKTON

6.1.1 PHYTOPLANKTON DECISION CRITERIA

In accordance with the Interagency Guidance Manual, the phytoplankton section of the §316(a) Demonstration will be judged successful if the applicant can demonstrate that:

1. A shift towards nuisance species of phytoplankton is not likely to occur;

2. There is little likelihood that the discharge will alter the indigenous community from a detrital-based to a phytoplankton based system; and,

3. Appreciable harm to the balanced indigenous population is not likely to occur as a result of phytoplankton community changes caused by the heated discharge.

6.1.2 PHYTOPLANKTON RATIONALE

The most recent comprehensive phytoplankton surveys conducted in the UIW (Upper Illinois Waterway) and its tributaries, in 1991 and 1993, evaluated chlorophyll and phytoplankton abundance along the waterway from the Chicago Locks downstream to below Dresden Island Lock and Dam. Results from that study indicated that total density increased with distance downstream in the UIW (Detailed in Appendix C).

Since nearly all of the phytoplankton community originated as components of periphyton, improved and expanded periphyton habitat in the Brandon and Dresden Pools, compared with the Lockport Pool, resulted in the downstream pools having the highest total density of phytoplankton. These studies also show that phytoplankton populations in the UIW are continually in a state of flux associated with changes and gradients in physical and chemical factors moving downstream, and that species in the UIW and its tributaries are those adapted to eutrophic (nutrient rich, warmwater) systems.

Most of the phytoplankton samples throughout the UIW had Shannon-Weaver diversities of greater than 2.0, with some as high as 3.2. Pielou evenness values were greater than 0.6 and in most of the samples, exceeded 0.7. Sites at WCGS (RM 295.7 and 295.6 in the Lockport Pool) had values of less than 2.0 and less than 0.6, respectively. Aquatic systems characteristically have higher populations of some species rather than equal densities of all of the species and rarely reach 1.0, the maximum value for evenness. The low values obtained for WCGS were not found to be related to power generation, because a similarity index (Morisita's Index) of 0.984 indicated that the community above the station was closely related to that in the discharge below the station. In addition, diversity and evenness were both higher in the discharge sample than in the intake sample. The low values were instead the result of less favorable periphyton habitat in the canal system, as well as a reflection of the significant flow and level fluctuations that are prevalent in this waterway on a year-round basis, which in turn increases turbulence and suspension of sediment particles. Suspended sediment particles are known to increase turbidity, which reduces the amount of light available to algae for photosynthesis. Other similarity values were high for comparisons of phytoplankton communities in samples from downstream power plant discharges compared with similar locations which do not receive effluent from power stations. These results indicate that members of the phytoplankton communities in the system receiving warm-water effluents were like those outside of thermal discharge influence and that they are not impacted on a long-term basis by power generation.

Incidental observations made by WCGS plant personnel noted only a single instance of a phytoplankton bloom in the CSSC near the station during the drought year of 2012, when there was greatly reduced flow through the canal system, punctuated by several heavy storm events and subsequent CSOs discharged into the system from upstream sources. This bloom did not appear to be dominated by "nuisance" (*e.g.*, blue-green) species of algae.

The MWRDGC performs annual monitoring of phytoplankton productivity (chlorophyll *a*) throughout the UIW, including locations both upstream and downstream of the WCGS. Data collected since 2004 shows the same progressive increase in downstream concentrations as the 1991 and 1993 UIW studies, all of which are indicative of both improved physical habitat and less turbulent conditions in the lower portion of the waterway. Chlorophyll *a* levels have remained relatively stable near WCGS, and are similar to samples taken immediately upstream in the canal system, indicating no adverse impact due to station operations (Appendices A and C).

The Asian Carp Regional Coordinating Committee's Monitoring and Response Work Group (MRWG) has also performed monitoring of chlorophyll *a* levels in the UIW annually since 2010, including some portions of the CAWS near WCGS (Appendix C). Chlorophyll-a concentration differed by each waterway section monitored. Chlorophyll-a concentration (which is an indicator of phytoplankton density) tended to increase from upstream to downstream, primarily a consequence of dramatically lower concentrations within the upper waterway. These results corroborate those found during the earlier ComEd-sponsored studies, as well as the continued monitoring work done by MWRDGC, in that the physical habitat and flow conditions in the UIW largely dictate phytoplankton abundance and diversity throughout the system, with the sparsest phytoplankton populations in the CSSC.

Based on current and prior studies conducted in the CAWs, the WCGS thermal discharge has not caused any appreciable harm to the phytoplankton community. Hence, the proposed, WCGS thermal AELs, which are more stringent than the limits which have been in place for more than 40 years, are not expected to have any detectable effect on the phytoplankton community in the Lockport Pool, and thus, will not cause appreciable harm to the BIC.

Received, Clerk's Office 1/26/2018

Consistent with the Interagency Guidance Manual, both the historical and more current data demonstrate that the proposed thermal AEL for the WCGS condenser cooling water discharge have not and are not expected to *cause appreciable harm* to the phytoplankton and periphyton communities of the CSSC. Operation of the WCGS cycle cooling water system under the prior Secondary Contact and present interim temperature limitations in 35 Ill. Adm. Code §302.408(b) has *not caused a shift in the phytoplankton community towards nuisance species* and blooms. Operation of the WCGS condenser cooling water system has not caused a change in the sources of primary production in the CSSC. The seasonal *cycles in diversity, species composition, and abundance of the primary producer community have been sustained* over the operational history of WCGS. The diversity of phytoplankton and periphyton primary producers *supports a diverse food chain* in the CSSC, unaffected by thermal discharges from WCGS, and limited only by the physical forces/flow and water quality of this man-made canal system. This is also reflected by the indigenous aquatic species assemblage present in the lower Lockport Pool, which has remained relatively stable over time. The temperatures requested under the proposed thermal AELs would therefore not be expected to have any adverse effects on phytoplankton communities in the vicinity of WCGS.

6.2 HABITAT FORMERS

6.2.1 HABITAT FORMER DECISION CRITERIA

In accordance with the Interagency Guidance Manual (USEPA and NRC 1977), the "habitat former" section of the §316(a) Demonstration will be judged successful if the applicant can show that:

1. The heated discharge will not result in any deterioration of the habitat formers community or that no appreciable harm to the balanced indigenous population will result from such deteriorations; and

2. The heated discharge will not have an adverse impact on threatened or endangered species as a result of impact upon habitat formers.

6.2.2 HABITAT FORMER RATIONALE

The CSSC near the WCGS discharge is dominated (86%) by relatively deep open channel with limited habitat diversity; off channel habitat with silt and sand substrates, accumulated detritus, periphyton, and submerged aquatic vegetation (SAV) accounted for only 5% of the total available habitat within the study area. Upstream of the WCGS discharge there is less habitat diversity than downstream as it was mostly channel habitat with silt, hardpan, and bedrock substrates (Appendices A and C).

To evaluate aquatic habitat changes that may have occurred since the mid-1990s, a habitat assessment was performed at electrofishing locations near WCGS in 2016. QHEI assessments were completed during early July and early September, before and after aquatic macrophytes had matured. As was found in the 1993 and 1994 habitat assessments, the low 2016 QHEI scores are the result of many factors, including a lack of riffle/run habitat, lack of clean, hard substrates, excessive siltation, channelization, poor quality riparian and floodplain areas, and lack of cover. While limited aquatic macrophyte growth and littoral zones do occur in the lower Lockport Pool, the reduction in habitat complexity (particularly near the WCGS discharge), is the primary basis for biota limitations, and is not related to the operation of WCGS or its thermal discharge.

The WCGS thermal discharge does not affect the quality of aquatic habitat in the lower Lockport Pool and has not caused appreciable harm to the habitat former community. The distribution and abundance of habitat formers and habitat quality in this artificially constructed and anthropogenically-influenced impounded waterway are dictated primarily by dominance of limited and/or poor quality channel habitat and the subsequent lack of appropriate conditions for the development of greater diversity of habitat former types. The habitat former community would be essentially the same regardless of the operation of the WCGS cooling water discharge with the proposed thermal AELs.

6.3 ZOOPLANKTON

6.3.1 ZOOPLANKTON DECISION CRITERIA

In accordance with the Interagency Guidance Manual, the zooplankton section of the §316(a) Demonstration will be judged successful if the applicant can show that:

1. Changes in the zooplankton community in the primary study area that may be caused by the heated discharge will not result in appreciable harm to the balanced indigenous population;

2. The heated discharge is not likely to alter the standing crop, relative abundance, with respect to natural population fluctuations in the far field study area from those values typical of the receiving water body segment prior to plant operation;

3. The thermal plume does not constitute a lethal barrier to the free movement (drift) of zooplankton.

6.3.2 ZOOPLANKTON RATIONALE

The zooplankton community is not expected to be adversely impacted by the WCGS thermal discharge. First, because they spend their entire life in a variable environment, zooplankton have evolved broad physiological tolerances and behavioral patterns that allow them to survive changing conditions. Second, zooplankton are rapidly transported and dispersed by currents, such that organisms would not spend significant amount of time (conservatively less than 10 minutes) in the immediate discharge zone. Third, they have short generation times and high reproductive capacities, allowing populations to readily offset the loss of individuals and to recover rapidly from local and short-term perturbations. With optimum temperature and food supply, zooplankton such as rotifers and cladocerans can double their numbers up to five times per day. Accordingly, the probability is low that there could be meaningful change (positive or negative) in growth or reproduction of zooplankters transported through the WCGS thermal plume (See Appendices A and C).

Historical studies of the UIW have not considered zooplankton due to their low numbers and disproportionate biomass or classified the zooplankton community broadly throughout the system as Protozoa and Rotatoria. Zooplankton sampling has been conducted near the WCGS within the CSSC. A survey from 2010-2013 conducted by the Illinois Natural Historical Survey examined two locations, Lockport Lock and Dam (RM 291) and Worth Street (RM 311) that provides a general community assessment of the CSSC near WCGS. The Lockport Lock and Dam and Worth Street sampling sites both were observed to have zooplankton communities dominated by rotifers. Densities ranged from 25 to 250 individuals/L, where other taxa (cladocerans and copepods) were found in lower concentrations (less than 25 individuals/L). These results, from both upstream and downstream of WCGS, indicate that station operations have no measurable effect on the CSSC zooplankton assemblage based on the similarity of the upstream and downstream assemblages.

The CSSC zooplankton assemblage is primarily determined by the dominance of main channel habitat, lack of backwater sources, the short residence time within the CSSC, and the physical-chemical limitations of the CSSC. Consistent with these limiting conditions, available zooplankton studies reflect a limited community in the CSSC, both upstream and downstream of WCGS. There is no evidence indicating that the WCGS discharge has had any measurable effect on the downstream zooplankton assemblage. Given that station operating conditions have remained essentially unchanged and community structure of higher trophic levels have remained similar or improved over time, it can be concluded that WCGS has no measurable effect on the zooplankton assemblage.

Review of both the historical and more current zooplankton data for the CSSC near WCGS indicates that the thermal discharge has not caused *appreciable harm* to the zooplankton community in the near field area of the WCGS thermal discharge or in areas downstream. The composition of zooplankton community in portions of Lockport Pool influenced by the WCGS thermal plume is similar to the communities found both upstream and downstream of the station. The *seasonal cycles of zooplankton composition and abundance have been sustained* in the CSSC, and continue to be dictated by residence time and the physical construct of the canal system. There is no indication of adverse impact as the result of WCGS operations under the former Secondary Contact thermal limits and therefore, there is no expectation that operation under the more stringent, proposed thermal AELs would result in any such adverse effect on the zooplankton community in the vicinity of WCGS.

Received, Clerk's Office 1/26/2018

6.4 SHELLFISH AND MACROINVERTEBRATES

6.4.1 SHELLFISH AND MACROINVERTEBRATE DECISION CRITERIA

In accordance with the Interagency Guidance Manual, the shellfish and macroinvertebrate section of the §316(a) Demonstration will be judged successful if the applicant can show that no appreciable harm to the balanced indigenous population will occur as a result of macroinvertebrate community changes caused by the heated discharge including the following criteria:

1. Standing crop – Reductions in the standing crop of shellfish and macroinvertebrates may cause no appreciable harm to the balanced indigenous population within the water body segment;

2. Community Structure – Critical functions of the macroinvertebrate fauna are being maintained in the water body segment;

3. Drift – Invertebrates do not serve as a major forage for the fisheries, food is not a factor limiting fish production in the water body segment, and/or drifting invertebrate fauna are not harmed by passage through the thermal plume.

6.4.2 SHELLFISH AND MACROINVERTEBRATE RATIONALE

6.4.2.1 Benthic Macroinvertebrate Community

Benthic macroinvertebrate surveys near WCGS have been conducted infrequently, due to the lack of suitable habitat in the CSSC. Benthic macroinvertebrate populations in the CSSC were evaluated as part of the 1993 UIW study (Appendix C). Hester-Dendy (HD) artificial substrate samplers were placed at five locations near WCGS; two upstream, and three downstream, including the artificial embayment area immediately in front of the Des Plaines River diversion channel. Only four of the five samples were retrieved. The total density was similar between all four locations. The WCGS discharge had the lowest density, but also had the highest species richness and diversity, reflecting an increased occurrence of a variety of oligochaetes (aquatic worms) and chironomids (midges). The isopod *Caecidotea* spp. was the most abundant taxon collected at the three most upstream locations, whereas the amphipod *Hyalella azteca* was the most abundant at the farthest downstream sampling location near the Lockport Lock and Dam (Appendix C).

The results of benthic macroinvertebrate studies conducted since the 1993 UIW study have been consistent with that study. In studies performed for the MWRDGC in 2005, HD and Ponar samples were taken at two sampling locations in the Lockport Pool well upstream of WCGS (Location 75-Cicero Ave. and Location 41-Harlem Ave.), as well as one near the Lockport Lock and Dam (Location 92-Lockport Lock and Dam). Oligochaetes were the dominant organisms found throughout the study area. The dominance of tolerant taxa at all three stations and in both sample types indicated similar impairment. Although based on increased EPT richness and a comparatively lesser abundance of oligochaetes in the downstream sample (Location 92-Lockport Lock and Dam), this location appears to be somewhat less stressed. This study was repeated in 2006, with some added sampling locations on the CSSC upstream of WCGS. The results were essentially consistent with the 2005 findings, with the most downstream location (92) exhibiting stressed but improved conditions over the upstream samples (See Appendix C).

In the most recent study, conducted in 2010, HD samples were collected at six stations and Ponar grabs were taken at six stations in the CSSC (Stations 40, 75, 41, 42, 48, and 92)—five upstream of WCGS and one downstream. Combined, the two sample types yielded 39 total taxa and three EPT taxa. In this study, HD total taxa richness was lower among upstream Stations 40, 75, and 41 (average 14 taxa), but slightly higher at downstream Stations 42, 48, and 92 (average 19 taxa). EPT richness was represented by one or four taxa at downstream Stations 42, 48, and 92 while none were observed at upstream Stations 40, 75, and 41.

Community composition and total density also varied longitudinally. Among the three upstream locations, total density was noticeably higher and largely driven by tolerant oligochaeta, which was dominant at each station. Compared to upstream, downstream, oligochaeta abundance and total density were substantially lower while Turbellaria, the EPT taxon *Cyrnellus fraternus*, and the tolerant taxon *Dicrotendipes lucifer* were most abundant at Stations 42, 48, and 92, respectively. Ponar total taxa richness was similarly low among the four upstream stations (six to eight taxa) and noticeably higher (14 taxa) at Station 92, the furthest downstream station. Oligochaeta was the dominant taxon at all five stations representing more than 95 percent of the total density. Total density was highest at Station 40, similar among Stations 75, 41, and 92, and lowest at Station 42. In all cases, density was driven by oligochaeta abundance (EA 2012). These results demonstrate that the benthic community throughout the WCGS study area continues to be largely dominated by pollution tolerant taxa that are capable of achieving high densities in the CSSC. The collective data also shows that most of the locally improved benthic communities are found downstream of WCGS, which indicates that the thermal discharge from the station is not exerting a negative impact.

Benthic habitat in the Lower Lockport Pool remains poor and unable to support a diverse benthic macroinvertebrate community. These results are consistent with the main channel habitat associated with the CSSC and the absence of shallow littoral zones and gradually sloping banks. Limited habitat, along with sedimentation and water quality issues, are primary factors limiting the benthic community in the CSSC.

Consistent with Interagency Guidance Manual, the empirical data demonstrate that the indigenous macroinvertebrate community in the CSSC near WCGS is dominated by pollution tolerant taxa which is capable of utilizing the sparse benthic habitat available in this man-made waterway. Pollutant sensitive EPT taxa richness was increased at monitoring locations downstream of the WCGS discharge, which have somewhat more depositional material, rather than hard-pan and scoured limestone characteristic of most of the canal system. This indicates that spatial differences in the benthic macroinvertebrate community in the vicinity of WCGS are influenced by substrate conditions rather than the WCGS thermal discharge. The empirical data indicate that the WCGS's compliance with prior Secondary Contact thermal limits has *not caused appreciable harm* to the benthic community near the WCGS discharge. Therefore, operation of the WCGS condenser cooling water system under the proposed thermal AELs is not expected to result in reductions in the standing crop of the benthic macroinvertebrate community. Operation of the WCGS condenser cooling water system has not and is not expected to result in a reduction in the diversity of the benthic macroinvertebrate community. Operation of WCGS under the proposed thermal AELs is *not expected to interfere with maintenance or critical, seasonal, life history cycles* (*e.g.*, spawning and recruitment) of the benthic macroinvertebrate community in the vicinity of WCGS.

6.4.2.2 Freshwater Mussels

There is general agreement among Illinois state natural resources agencies that significant mussel populations are not known to exist in the CSSC due to poor habitat quality. The CSSC has a navigable depth of more than 20 feet, which is controlled and maintained by the USACE. As such, there is no past or current data to indicate that benthic organisms, including mussels (if/when present), would be adversely impacted by the WCGS thermal discharge, either now or under the thermal AELs proposed in this demonstration.

The Illinois Natural History Survey performed a recent study (2009-2011) of the Lake Michigan and Des Plaines River tributaries to determine the presence of freshwater mussels (Appendix C). Site 10 (IEPA Site G-11) was in the upper Des Plaines River, approximately two miles upstream of the confluence of the Des Plaines River and the CSSC, where potential mussel habitat is clearly superior to that present in the adjacent CSSC. There was no mussel work done in the CSSC proper, due to lack of habitat, as well as sampling safety concerns. Only dead and relic shells of three common mussel species (Giant Floater *Pyganodon grandis*, Paper Pondshell *Utterbackia imbecillis*, and Fat Mucket *Lampsilis siliquoidea*) were collected at INHS Site 10, which had a MCI Community Index Score of zero. Given that no live mussels were found in the upper Des Plaines River, they would not be expected to be present in the CSSC near WCGS where habitat is significantly poorer.

The MWRDGC regularly performs biological, habitat, and sediment surveys throughout the waterways under its jurisdiction. The most recent, published study from 2010 includes sampling at two locations proximal to WCGS (Appendix C): Location 48 (Stephen Street—upstream of WCGS) and Location 92 (Lockport Powerhouse—downstream of WCGS). These locations are identical to the remainder of the CSSC in this area, due to their vertical-walled configuration and heavy barge traffic. At Location 92, *Corbicula fluminea* was the only mussel species found in both the petite ponar and Hester Dendy samples. The only other mussel species found at the Stephen Street site (Location 48) in 2010, through Hester Dendy sampling, were *Corbicula fluminea*, *Dreissena bugensis*, and *Pisidium* sp., all either non-indigenous/invasive or common species that would be expected to be found in this artificial waterway, given its sparse habitat, heavy barge traffic, and erratic flow regime.

MWRDGC studied 11 benthic stations on the southern portion of the Chicago River System in 2010 (including the Chicago River, South Branch of the Chicago River, Bubbly Creek, and the CSSC). The few mussel species found in this portion of the waterway consisted primarily of non-native and/or invasive species (Appendix C). The non-indigenous mottled fingernail clam (*Eupera cubensis*) was found in Hester-Dendy samples from the Cicero Avenue, Route 83, and Stephen Street locations on the CSSC, beginning in 2006. *Eupera cubensis* is native to the southern United States coastal plain and was also found at the Harlem Avenue, Route 83, and Lockport locations in the CSSC during 2006 (Appendix C).

The most recent sediment sampling by the MWRDGC in 2011 also continues to show pervasive contamination of the upper reaches of the waterway, including the Lockport and Brandon Pools. Noticeably higher levels of cadmium, chromium, copper, lead, mercury, and zinc were found in the upper pools, compared to the lower Dresden Pool (Appendix C). As such, contaminated sediments also limit the potential for significant native mussel populations in the waterway adjacent to WCGS.

Adding to the extremely marginal habitat availability in the CSSC, the entire waterway from the Asian Carp Electric Barrier (just upstream of WCGS), downstream to the Lockport Lock and Dam (a total distance of approximately 7 River Miles) was treated with rotenone in late 2009. While rotenone is considered a targeted piscicide, there have been documented impacts to benthic gill-breathing organisms.

The purpose of this §316(a) demonstration was to determine whether the WCGS thermal discharge is currently having, or is expected to have under the proposed thermal AELs, any significant adverse impacts on the aquatic community of the CSSC. Because prior studies have shown that the thermal plume is surficial in nature, and that a zone of passage is maintained for aquatic life, there is no expectation that any benthic organisms would be negatively impacted by the thermal discharge, even if mussel species were present (Appendices B and D).

Consistent with Interagency Guidance Manual, these empirical data show that the CSSC mussel community is extremely limited due to the physical characteristics of this man-made waterway and its lack of suitable habitat, and is not related to the thermal discharge from WCGS. The WCGS thermal discharge has not and is not expected to result in a reduction in the diversity of the CSSC freshwater mussel community. Operation of the WCGS under the proposed thermal AELs is *not expected to interfere with maintenance or critical, seasonal, life history cycles* (*e.g.*, spawning and recruitment) of the freshwater mussel community in the vicinity of WCGS.

6.5 FISH

6.5.1 Fish Decision Criteria

In accordance with the Interagency Guidance Manual, the fish section of the §316(a) Demonstration will be judged successful if the applicant can prove that the fish community will not suffer appreciable harm from:

Received, Clerk's Office 1/26/2018

1. Direct or indirect mortality from cold shock;

2. Direct or indirect mortality from excess heat;

3. Reduced reproductive success or growth as a result of plant discharge;

4. Exclusion from unacceptable large areas; or

5. Blockage of migration.

6.5.2 Fish Rationale

6.5.2.1 Reproductive Success

Monitoring studies conducted to evaluate possible impacts of operating under current thermal limits for WCGS provided empirical data to support a determination that the WCGS once-through cooling water discharge has not adversely affected spawning and reproductive success of the CSSC fish community. Information on the seasonal abundance and diversity, inter-annual variability, and long term trends of the fish community in the CSSC near WCGS has been provided by ichthyoplankton entrainment studies in 2005 and 2016 and monitoring of the juvenile and adult fish community from 1994 through 2016. Results from those programs show that the current thermal limits for the CSSC have not caused appreciable harm to the fish community and its ability to sustain typical seasonal cycles of reproduction and recruitment.

Entrainment studies conducted in 2005 and 2016 provided information on the occurrence of ichthyoplankton in the lower Lockport Pool (Appendices B and C). Ichthyoplankton taxa representing five life stages (egg, yolk-sac, post yolk-sac, larvae, and juveniles) of fishes common in the lower Lockport Pool were collected during both studies. Entrained ichthyoplankton were comprised of distinct taxa including three RIS (Gizzard Shad, Common Carp, and Bluntnose Minnow), cyprinid types, Yellow Bullhead, Freshwater Drum, and Round Goby. Aside from Gizzard Shad and Common Carp, other taxa/life stage groups accounted for less than 1% except for Freshwater Drum type eggs, which accounted for about 2% of the total number of ichthyoplankton collected. About 3.0% of the specimens collected represented sportfish (Channel Catfish, Yellow Bullhead, *Morone* sp., *Lepomis* sp., *Pomoxis* sp., Yellow Perch, and Freshwater Drum). Invasive species were represented by Round Goby. Other species besides the distinct taxa likely occurred in the samples, but it was not possible to taxonomically differentiate them with certainty.

Seasonally, ichthyoplankton occurred in the lower Lockport Pool from late April through late August. In 2005, water temperatures ranged from about 65°F (18°C) in April to near 90°F (32°C) in August and temperatures were somewhat cooler in 2016, ranging from <60°F (°C) in April to about 84°F (°C) in August. Nearly 99% of the estimated entrainment in 2005 at WCGS occurred between late May and early July 2005 and 99% occurred from late May through August 2016.

Results of entrainment studies reflect the abundance of early life stages in the CSSC of mostly forage fish, consisting primarily of clupeids. Forage fish are abundant in the lower Lockport Pool as indicated by the long-term fish community surveys (Section 5.5.2.2). Forage fish (particularly the clupeids) have high fecundity and extended spawning seasons. The overall low relative abundance of species that build nests and/or provide parental care (*e.g.*, catfish, bass, and sunfishes) is typical of entrainment at power plant intakes. Low numbers of these species reflect spawning and life development characteristics that reduce susceptibility to entrainment. The life history of fishes is important in determining the extent to which they are at risk to entrainment. In addition to nest building species that provide parental care, cover orientated species and species with demersal and/or adhesive eggs will have lower risk to entrainment. Conversely, species with a pelagic lifestyle and those with buoyant, semi-buoyant, or non-adhesive eggs such as the clupeids and Freshwater Drum are at greater risk. Most freshwater fishes have low risk life cycles because of their spawning strategies.

Temporal differences in the actual ichthyoplankton numbers in 2005 and 2016, are indicative of the inherent variability in biological systems. Taxa and life-stage identities of the ichthyoplankton assemblage at a given site are generally quite consistent over decades unless there are major modifications to the ecosystem. The fact that the same basic assemblage of fish species, in the same general percentages, have consistently been found in the adult fish monitoring program over a 17-year period, provides substantive evidence that the fish community in the lower Lockport Pool near WCGS has remained stable and reflective of the overlying habitat, water quality, and hydrodynamic characteristics of this man-made and artificially-controlled canal system.

6.5.2.2 Juvenile and Adult Distribution

Studies conducted from 2005 through 2016 in lower Lockport Pool documented the occurrence of 47 species including 40 native species and seven non-native species. Six of the seven RIS have dominated the catch, accounting for 80% of the total catch. Nine species were collected each year including five of the seven RIS: Gizzard Shad, Common Carp, Bluntnose Minnow, Green Sunfish, and Largemouth Bass. The other two RIS, Channel Catfish and Banded Killifish, were collected during 11 and five of the 12 years, respectively. Banded Killifish were initially collected from the lower Lockport Pool in 2012 and have been collected annually since. Common Carp was the only non-native species collected each year, but most non-native species were collected frequently. The RIS represent several trophic levels including forage (Gizzard Shad and Bluntnose Minnow), omnivores (Channel Catfish and Green Sunfish), and a top predator (Largemouth Bass). Other species that were collected most years included Emerald Shiner, Spotfin Shiner, Oriental Weatherfish, Round Goby, Yellow Bullhead, and Freshwater Drum. In total, 12 species were collected during all or nearly all the years monitored near WCGS.

Monitoring of the fish community in lower Lockport Pool between 2005 and 2016 yielded annual species (native + exotic) counts of 17 to 27 species with an average of 23 species. Except for a low number of species in 2005 (17), species counts were relatively stable. Native species richness in the WCGS study area averaged from two to five and were similar during the three operational monitoring periods (Appendices C and F).

Annual electrofishing catch rates of native species ranged from 42.2 to 153.3 fish per km and were statistically similar across the 2005-2016 study period. Annual differences in catch rates were primarily due the variability in the abundance of seven native species including four RIS (Gizzard Shad, Bluntnose Minnow, Green Sunfish, and Largemouth Bass). Lower contributions of these native species in 2016 reflect reduced catches of Green Sunfish and a relatively high catch rate of Banded Killifish that contributed nearly 10% to the total catch that year. Species not collected most years were incidental, occasional, or exotic species.

Mean catch rates at the four sampling locations in lower Lockport Pool were compared to evaluate spatial differences upstream and downstream of the WCGS discharge. Catch rates were much lower upstream of WCGS and immediately downstream of the discharge than at the two most downstream locations where the habitat is slightly better. Of the 47 species collected from lower Lockport Pool, 17 were collected at all four locations including each of the RIS. Twenty uncommon species, which were collected infrequently and in low numbers, occurred at one or two of the four locations. Nineteen of the most common species had higher catch rates at the locations downstream of the WCGS discharge. Lower catch rates upstream of WCGS are reflective of the lack of suitable habitat in the CSSC that reflects its vertical rock canal walls and uniform depth of the navigational channel.

Fish community well-being (IWBmod), which uses the number of fish, weight, and diversity was applied to the electrofishing data as an indicator of fish health in the lower Lockport Pool. Mean IWBmod scores for the 2005-2016 monitoring period ranged from 2.5 to 3.7 and were statistically similar among years. Mean IWBmod scores were low regardless of how many units were operating at WCGS. During 4-unit operation from 2005 through 2010, IWBmod averaged 3.2, compared to 3.3 during 2-unit operation, and 3.0 during 1-unit operations. The similarity of IWBmod over time suggests that operation of WCGS has had little effect on the wellbeing of the fish community in the lower Lockport Pool. It is more likely that environmental conditions in the lower Lockport Pool resulting from operation of the navigation system and use of the system for the collection and transport of treated wastewater (and at times untreated CSOs) has a greater effect on the fishery and prevents it from obtaining ratings that are more indicative of a natural river system.

The relative weight (Wr) of fish and incidence rate of DELT anomalies (deformities, erosions, lesions, and tumors) were used to evaluate the condition of fish in the CSSC. Relative weight (Wr), a measure of fish condition, indicates whether fish are growing and gaining weight at normal rates. Mean Wr of species for which sample sizes were adequate to calculate relative weights ranged from 72 to 138 and averaged 113 (all species and years combined), indicating fish in lower Lockport Pool were generally in good condition. Of the 14 species collected in adequate numbers and lengths to assess annual trends, mean Wr was 90 or greater 90% of the time. Of the four RIS for which annual mean Wr was calculated, each had means greater than 90%. There were no apparent differences in mean Wr among the 4-unit (2000-2010), 2-unit (2011-2014), or 1-unit (2015-2016) monitoring periods. Based on relative weight (Wr), fishes collected from the lower Lockport Pool since 2005 were consistently in good condition, especially the four RIS for which relative weights were calculated.

Incidence rates of DELT anomalies is an indicator of stress or contamination, which may be caused by a variety of environmental factors, including chemically contaminated substrates. DELT affliction rates for the lower Lockport Pool were in the good to fair range nine of 12 years. Affliction rates were influenced by the numbers of Bluntnose Minnow, Emerald Shiner, and/or Gizzard Shad in the annual catches, three species that exhibit low incidence rates of DELT anomalies. Excluding these three species from the DELT calculations, the interyear trends declined from 2005 through 2010, when all four units at WCGS were operating. The recalculated incidence rates were lowest in 2012 and 2016 when two units and one unit was operating, respectively. A long-term decline in incidence rates did not occur after 2007 except for the lower rates in 2010 and 2016. Based on the overall (all species combined) incidence rates observed for the 12-year monitoring period, fish in the lower Lockport Pool were in fair condition with a few exceptions. Annual incidence rates exceeded 3.0 on only three occasions and averaged 2.45 during 4-unit operation (2000-2010), 2.0 during 2-unit operation (2011-2014), and 2.5 during 1-unit operation (2015-2016), indicating the incident rates are not related to the operation of WCGS and more likely are related to other environmental conditions associated with the CSSC.

Consistent with the Interagency Guidance Manual, these empirical data demonstrate that the proposed AELs are supportive of seasonal cycles of spawning and reproduction of the fish community in the CSSC; these important life history functions are sustained and do not appear to be reduced near the WCGS thermal plume compared to upstream areas of the CSSC. A fish community is supported commensurate with the physical characteristics of this man-made waterway and its lack of suitable habitat and does not appear to be excluded from a significant portion of the CSSC. An adequate zone of passage exists near the WCGS thermal plume with the current thermal limits and proposed AELs. There is no indication of adverse impact as the result of WCGS operations under the former Secondary Contact thermal limits and therefore, there is no expectation that operation under the proposed thermal AELs would result in any such adverse effect on the fish community in the vicinity of WCGS

6.6 OTHER VERTEBRATE WILDLIFE

The waters and shoreline of the Lockport Pool of the CSSC is not routinely used by various resident mammals (*e.g.*, muskrat, white-tailed deer, and wild turkey), song birds (*e.g.*, black-capped chickadee and tufted titmice), reptiles (*e.g.*, northern water snake and red-eared slider), and amphibians (*e.g.*, northern leopard frog and American bullfrog), due to its man-made nature and straight limestone walls, with a water level that is normally 6 feet or more below the top of the canal wall. There are no natural or constructed ingress/egress points for wildlife along almost the entire expanse of the Lockport Pool, within which the WCGS is located.

Observed wildlife use in the canal system adjacent to the WCGS consists of occasional, short-term foraging visits by seagulls (from Lake Michigan) and common waterfowl species that are able to descend directly on the water. Frequent barge traffic in this narrow waterway precludes

Received, Clerk's Office 1/26/2018

any long-term occupancy by water birds. Due to the depth of the canal, wading birds are precluded from this area. There has been no observed use of the canal in the WCGS study area for nesting, nursery, and foraging grounds, or by migratory birds (*e.g.*, waterfowl and American white pelicans) for resting areas. Bald eagles have been observed along the CAWS and in the vicinity of the Lockport Pool during routine fisheries monitoring studies performed near WCGS. Bald eagles overwinter along the Illinois River and have recently nested in northeast Illinois in Cook, Kane, and Will counties.[14] Nesting sites are not known to exist in close proximity to the CSSC shoreline due to lack of instream cover and large trees.

The WCGS thermal discharge plume does not disrupt normal migratory patterns by attracting large numbers of birds during spring and fall migration periods or by causing conditions that attract large overwintering populations of otherwise migratory species. In addition, as discussed in this Demonstration, there is no unique or critical nesting, rearing, or feeding habitat for waterfowl in the immediate vicinity of WCGS.

The Lockport Pool does not provide unique or critical habitat for the survival and growth of any wildlife species.

Activity of other vertebrate wildlife has not been limited by the current Secondary Contact thermal limits that WCGS has operated under since the 1970's and are not expected to be affected by the proposed limits. The thermally influenced area within the CSSC is relatively small and higher water temperatures occur in the summer when migratory waterfowl use is at its lowest. Limited aquatic habitat and physically restricted access prevent any significant or deliberate use of this portion of the canal system by resident wildlife.

Consistent with Draft Interagency Guidance (1977), other vertebrate wildlife can be considered as a *low potential impact biotic category* relative to the WCGS thermal discharge.

[14] https://www.fws.gov/midwest/eagle/conservation/baeacounties.html