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Indiana Michigan Power
Cook Nuclear Plant
One Cook Place
Bridgman, MI 49106
IndianaMichiganPower.com

October 27, 2015

AEP-NRC-2015-105
10 CFR 50.54(f)
10 CFR 50.4

Docket Nos.: 50-315
50-316

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
11555 Rockville Pike
Rockville, MD 20852

Subject: Donald C. Cook Nuclear Plant Unit 1 and Unit 2
Additional Information for NRC Audit of Flood Hazard Reevaluation Conducted in Response to March 12, 2012, NRC Request for Information Regarding Fukushima Near-Term Task Force Recommendation 2.1: "Flooding"

References:

1. Letter from E. J. Leeds, U. S. Nuclear Regulatory Commission (NRC), to All Power Reactor Licensees and Holders of Construction Permits in Active or Deferred Status, "Request for Information Pursuant to Title 10 of the *Code of Federal Regulations* 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," dated March 12, 2012, Agencywide Documents Access and Management System (ADAMS) Accession No. ML12053A340.

2. Letter from J. P. Gebbie, Indiana Michigan Power Company (I&M), to the NRC, "Donald C. Cook Nuclear Plant Unit 1 and Unit 2, Response to March 12, 2012, Request for Information, Enclosure 2, "Recommendation 2.1: Flooding," Required Response 2, Hazard Reevaluation Report," dated March 6, 2015, AEP NRC 2015-14, .ADAMS Accession No. ML15069A334.

3. Letter from T. Govan, NRC to L. J. Webber I&M, "Nuclear Regulatory Commission Plan for the Audit of Indiana Michigan Power Company's Flood Hazard Reevaluation Report Submittal Relating to the Near-Term Task Force Recommendation 2.1-Flooding for Donald C. Cook Nuclear Plant, Units 1 and 2 (TAC Nos. MF6096 and MF6097)," dated June 4, 2015, ADAMS Accession No. ML1512A083.

By Reference 1, Enclosure 2, the U. S. Nuclear Regulatory Commission (NRC) requested that licensees perform a reevaluation of all appropriate external flooding sources, and requested that the reevaluation apply present-day regulatory guidance and methodologies. Reference 2 provided the requested Flood Hazard Reevaluation Report (FHRR) for the Donald C. Cook Nuclear Plant (CNP).

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NRR

By Reference 3, the NRC staff documented its intent to perform a regulatory audit of Indiana Michigan Power Company's (I&M's) supporting calculations for the CNP FHRR. The NRC staff has identified five Information Needs to support the audit. This letter provides I&M's responses to those Information Needs.

Enclosure 1 to this letter provides an affirmation regarding the information contained herein. Enclosure 2 provides I&M's responses to the five NRC Information Needs.

There are no new or revised regulatory commitments made in this letter. If there are any questions concerning this letter, please contact Mr. Michael K. Scarpello, Manager, Nuclear Regulatory Affairs, at (269) 466-2649.

Sincerely,

Joel P. Gebbie
Site Vice President

JRW/ams

Enclosures:

1. Affirmation
2. Indiana Michigan Power Company Responses to NRC Information Needs Re: Audit of Donald C. Cook Flood Hazards Reevaluation

c: A. W. Dietrich, NRC Washington, DC
T. Govan, NRC Washington, DC
J. T. King, MPSC
MDEQ – RMD/RPS
NRC Resident Inspector
C. D. Pederson, NRC Region III
A. J. Williamson, AEP Ft. Wayne, w/o enclosures

Enclosure 1 to AEP-NRC-2015-105

AFFIRMATION

I, Joel P. Gebbie, being duly sworn, state that I am Site Vice President of Indiana Michigan Power Company (I&M), that I am authorized to sign and file this request with the U. S. Nuclear Regulatory Commission on behalf of I&M, and that the statements made and the matters set forth herein pertaining to I&M are true and correct to the best of my knowledge, information, and belief.

Indiana Michigan Power Company

Joel P. Gebbie
Site Vice President

SWORN TO AND SUBSCRIBED BEFORE ME

THIS 27th DAY OF October, 2015

Anne M. Palma
Notary Public

My Commission Expires 10-16-2017

ANNE M. PALMA
Notary Public, State of Michigan
County of Berrien
My Commission Expires 10-16-2017
Acting in the County of Berrien

Enclosure 2 to AEP-NRC-2015-105

INDIANA MICHIGAN POWER COMPANY RESPONSES TO NUCLEAR REGULATORY COMMISSION INFORMATION NEEDS RE: AUDIT OF DONALD C. COOK FLOOD HAZARDS REEVALUATION

Information Need 1: All Flood Causing Mechanisms – Comparison of Reevaluated Flood Hazard with Current Design Basis

Background: Recommendation 2.1 of the 50.54(f) letter provides instructions for the Flood Hazard Reevaluation Report (FHRR). Under Section 1, Hazard Reevaluation Report, Items c and d, licensees are requested to perform:

> c. Comparison of current and reevaluated flood causing mechanisms at the site. Provide an assessment of the current design basis flood elevation to the reevaluated flood elevation for each flood causing mechanism. Include how the findings from Enclosure 4 of this letter (i.e., Recommendation 2.3 flooding walkdowns) support this determination. If the current design basis flood bounds the reevaluated hazard for all flood causing mechanisms, include how this finding was determined.
>
> d. Interim evaluation and actions taken or planned to address any higher flooding hazards relative to the design basis, prior to completion of the integrated assessment described below, if necessary.

The CNP [Donald C. Cook Nuclear Plant] FHRR, section 3.0, provides a comparison of the reevaluated flood hazards with the current licensing basis (CLB) instead of the current design basis, for all flood-causing mechanisms. Table 4-1 of the FHRR summarizes this comparison. It also appears that the term "CLB" is used repeatedly throughout the FHRR content when the licensee was intending to refer to the "CDB".

Request: The licensee is requested to clarify, and where necessary correct, the comparison of the reevaluated flood hazard to the current design bases.

Indiana Michigan Power Company (I&M) Response

The Donald C. Cook Nuclear Plant (CNP) Flood Hazard Revaluation Report (FHRR) does contain the terms current licensing basis (CLB) and CLB in lieu of the appropriate terms current design basis (CDB) and CDB. As described in the 10 CFR 50.54(f) letter, Enclosure 2, Requested Information Section, addressees were requested to provide an assessment of the CDB flood elevation to the reevaluated flood elevation for each flood causing mechanism. The CNP FHRR includes the description of the CDB external flood mechanism and elevation in Section 2.2. Section 2.3 of the FHRR provides the flood mitigation features for the applicable CDB external flood mechanism and elevation, but does so under the heading "Current Licensing Basis Flood Protection and Mitigation Features (CLB)." The terms current licensing basis and CLB are used in lieu of the appropriate terms current design basis and CDB in the CNP FHRR from the Overview section through Section 4, Conclusions.

Although the terms current licensing basis and CLB are used in Section 2.3, the features and flood causing mechanism described therein constitute the CDB. As required by the 10 CFR 50.54(f) letter, the evaluations and comparisons in the remainder of Section 2, and Sections 3 and 4, were performed utilizing the CDB. Each instance of the term current licensing

basis or CLB throughout the CNP FHRR should therefore be assumed to refer to the current design basis or CDB

Information Need 2: Storm Surge – Wave Runup

Background: The licensee stated in the FHRR that the bottom profile at Holland, MI is sufficiently similar to the profile near the site such that wave effects estimated at Holland can be used as representative of the site. ERR [electronic reading room] Document MD-12-FLOOD-006-N, Rev. 0 [Revision 0] and FHRR section 3.5.1.6 describe the representative NOAA [National Oceanic and Atmospheric Administration] station 9087031 ("Holland, MI" [Michigan]) as being 57 miles north of the site. Figure 9 in that ERR document shows the similarity between the bottom profile at the Holland, MI location and the site; the ERR document, in error, references Figure 8 for this comparison. The FHRR does not provide this graphic showing a basis for the justification of using the Holland, MI information as being representative of the bottom profile at the site. The staff did not find that the justification was clear with regard to other conditions that could significantly influence wave effects other than the assumption that the 57-mile proximity of the site to the Holland station and the similarity of the bottom profile of both locations. Offshore wave conditions (height, period and direction) are other factors influence wave effects. The USACE [United States Army Corps of Engineers] WIS [Wave Information Study] stations along the shore of Lake Michigan are one source of information that may be used to evaluate the similarity of offshore wave conditions of both locations.

Request: Provide the justification for using the Holland, MI wave information as representative of the site wave characterization. Reference as necessary appropriate ERR document(s) and figures and other information to support this assumption.

I&M Response

Note: Appendix A of this enclosure identifies the referenced documents and provides supporting figures and table for the responses to Information Needs 2 and 3.

Electronic Reading Room (ERR) Document MD-12-FLOOD-006-N Rev. 0, Page 21 incorrectly references Figure 8 in lieu of Figure 9 for the beach profile comparison.

The information available at the nearby Holland, MI gage (located approximately 57 miles to the north of CNP) was used in ERR Document MD-12-FLOOD-006-N Rev. 0 to estimate wave runup at CNP.

Wave runup is a function of incident wave conditions (e.g. height, period, and direction), and change in depth near the shore or beach geometry (Section 1 of FEMA Coastal Flood Hazard Analysis and Mapping Guidelines Focused Study Report (Reference 1)). Figure 1 in Appendix A, (which is Figure 1 from Reference 1) illustrates the wave runup concept.

Figure 9 of ERR Document MD-12-FLOOD-006-N Rev. 0 shows the similarity of the beach profile at Holland, MI to the beach profile at CNP, from the shoreline out to about 2.5 miles from shore. Figure 9 from ERR Document MD-12-FLOOD-006-N Rev. 0 is reproduced in Appendix A as Figure 2.

Information Need 2 requests additional justification for using the Holland, MI wave information as being representative of CNP site wave characterization. Clarification of the wave characterization in ERR Document MD-12-FLOOD-006-N Rev. 0 is provided below.

Wave height, period, and direction from Reference 2 (Hindcast Wave Information for the Great Lakes: Lake Michigan), were compared to the same attributes at locations near the Holland Michigan National Oceanic and Atmospheric Administration (NOAA) Station (9087031) and the CNP site. Figure 3 in Appendix A shows the relative location of stations from the Hindcast WIS, the Holland NOAA station, and the CNP site.

Figure 4 in Appendix A shows a comparison of wave height at the Wave Information Study (WIS) gage stations taken from the WIS data in Table 4 of Reference 2. The waves near Holland, MI are similar in height to those near the CNP site. Holland 50-year return period waves are about 7 meters in height, and the 50-year return period waves are about 6.5 meters in height near CNP.

Table 1 in Appendix A shows a summary of largest wave, largest wave period, and wave direction from the WIS (Pages A312 to A362 of Reference 2). All of the WIS stations have similar mean peak wave periods (3.9 to 4.1 seconds) and largest wave periods (9 to 10 seconds). The largest wave sizes are slightly higher near Holland (6.9 to 7.3 meters) than near CNP (6.3 meters), and most frequent direction and average direction associated with the largest waves are also similar between the WIS gages. The WIS wave characterization parameters are very similar between WIS Station 55 (just south of Holland, MI) and WIS Station 59 (just north of the CNP site).

The beach slope and wave characterization parameters are similar between the NOAA station 9087031 ("Holland, MI" gage) and the CNP site. The WIS wave characterization data do not significantly differ between the Holland, MI gage site and the CNP site. Inclusion of the WIS stations' wave characterization data does not alter the similarity conclusions in MD-12-FLOOD-006-N Rev. 0.

Information Need 3: Storm Surge – Wave Runup

Background: The FHRR stated in section 3.5.2.3 that wave setup and runup was determined by differencing curve-fit values of lake water levels with and without wave runup and setup included; these fits are based on observations collected at the Holland, WI [MI] station 9087031 and extend out to a 1000-year return period. The ERR Document MD-12-FLOOD-006-N, Rev 0 was reviewed by staff which was found to be consistent with the FHRR. The licensee's estimate for 1,000,000-year wave runup and setup is based by differencing the curve fit values of the water levels with and without runup and setup included. The curve fits for the Holland, WI station #9087031 are shown graphically and the values for 1-year and 1000-year recurrence intervals are used to establish a trend in the difference between the curves. The difference between the curves is 2.5 ft. [feet] and 2.7 ft. for the 1-year and 1000-year returns periods, respectively. This difference is attributed to wave effects at those return periods at the site of the analysis and the licensee states that these are representative of the condition near the DC Cook site. The licensee used the 1-year and 1,000-year differences to qualitatively estimate the 3.0-ft wave setup and runup at the 1,000,000-year level. The uncertainty associated with the method (visual extrapolation of graphic) used to extrapolate the return interval beyond 1000 years is not discussed.

Request: Provide a discussion of the uncertainty associated with the extrapolated wave runup estimation method and provide a justification for not using a more rigorous method to develop the wave runup estimate.

I&M Response

Note: Appendix A of this enclosure identifies the referenced documents and provides supporting figures and table for the responses to Information Needs 2 and 3.

To better understand the uncertainty associated with the original wave runup and setup extrapolation from ERR Document MD-12-FLOOD-006-N Rev. 0, two alternative evaluations of wave runup and setup extrapolation approach were explored.

The blue lines in Figure 8 from ERR Document MD-12-FLOOD-006-N Rev. 0 (Figure 5 in Appendix A) represent best fit curves for the water surface level and water surface level with runup and setup plotted against return period data. Water surface level points at 1, 10, 100, and 1,000 years were digitized from these curves and used to generate the plots in Figures 6 and 7 in Appendix A.

A best-fit log function was fit to the GPD points in Figure 6 in Appendix A, and the resulting curves were extended or extrapolated to include water surface levels and water surface levels with runup and setup at higher recurrence levels. Using these curves to determine 1,000,000-year return period water level (586.5 ft.) and water level with runup and setup (589.61 ft.), the runup and setup can be calculated as follows:

> $Runup_{1,000,000}$ = water level with runup and setup – water level = 589.61 ft. - 586.5 = 3.11 ft.

In the second alternative approach, a double logarithmic function was used to replicate the apparent curvature of the 1 to 1,000-year recurrence lines in Figure 5 in Appendix A. The curves were developed to extend or extrapolate water surface level and water surface level with runup and setup at the Holland, MI gage as shown in Figure 7 in Appendix A. In this alternative, the curved portion of the lower recurrence water levels resulted in a flatter extrapolation (which is typical of long term prediction trends). Using the resultant 1,000,000-year return period water level (584.37 ft.) and water level with runup and setup (587.14 ft.), the runup and setup was calculated as follows:

> $Runup_{1,000,000}$ = water level with runup and setup – water level = 587.14 ft. - 584.37 ft. = 2.77 ft.

The uncertainty of extrapolating available historic records to predict long term wave runup and setup magnitude can be understood by using a series of alternative evaluations. The qualitative visual extrapolation of the water surface level and water surface level with runup and setup curves within ERR Document MD-12-FLOOD-006-N Rev. 0 resulted in a 3.0 ft. wave runup and setup at the 1,000,000-year level. The best-fit log curve extrapolation shown in Figure 6 in Appendix A yields a more conservative 3.11 ft. wave runup and setup. The higher result of this evaluation is due to the flatter nature of the extrapolated curves and the slightly higher comparative slope of the water surface level with runup and setup curve. This result is the conservative case since an extrapolated recurrence curve is expected to trend downward, or

decrease in slope. The double logarithmic curve extrapolation shown in Figure 7 in Appendix A illustrates another more rigorous alternative extrapolation of the water surface level curves. This method results in a 2.77 ft. wave runup and setup magnitude.

The two more rigorous alternative extrapolation approaches lead to runup and setup magnitudes between 2.77 ft. (best fit of the GPD curve data) and 3.11 ft. (more conservative extrapolation of water level and water level with wave runup and setup). These alternative evaluations show that a conservative estimate of 1,000,000-year level CNP wave runup and setup magnitude is 3.11 ft. This results in a wave runup and setup range of 2.8 ft. to 3.1 ft. Thus the original qualitative visually extrapolated runup and setup value of 3.0 ft. used within ERR Document MD-12-FLOOD-006-N Rev. 0 is reasonable and appropriate.

Information Need 4: Local Intense Precipitation

Background: For the local intense precipitation analysis (LIP), the licensee stated in section 3.2.1 of the FHRR that the rainfall hydrograph from National Oceanographic and Atmospheric Administration Hydrometeorological Reports (HMR) 51, 52 and 53 for the Case 3 (most conservative) analysis and the licensee produced site-specific probable maximum precipitation (SSPMP) hydrograph for the less conservative Case 2 analysis. Case 2 and Case 3 analyses are discussed in NRC [U. S. Nuclear Regulatory Commission] NUREG/CR-7046.

Request: Provide a discussion of the Case 3 conditions analyzed with the SSPMP rainfall hydrograph (e.g. rooftop drains plugged, protected storm drainage system), and the Case 2 conditions analyzed using the HMR rainfall hydrograph.

I&M Response

(Hierarchal Hazard Assessment) (HHA) Case 3 was not explicitly modeled with the site-specific probable maximum precipitation (SSPMP) rainfall hyetograph as part of the FHRR. In ERR document MD-12-FLOOD-014-N Rev. 1 Section 5.0, "FLO-2D Model Development for HHA Case 3," Page 19 of 144, "Rainfall Hyetograph," the rainfall pattern used in HHA Case 3 was taken from Design Input 2.5, the probable maximum precipitation (PMP) based on the Hydrometeorological Reports (HMRs). The Case 3 conditions analyzed using the HMR rainfall hyetograph are detailed in ERR MD-12-FLOOD-014-N Rev. 1, Section 3.1.

HHA Case 2 and its associated conditions, including using a hyetograph developed from NOAA HMRs, are detailed in MD-12-FLOOD-005-N Rev. 0 Section 3.2. MD-12-FLOOD-005-N has been posted in the ERR.

As described in ERR document MD-12-FLOOD-014 Rev. 1, Section 5, Page 17 of 144, multiple inputs were revised with more representative parameters for HHA Case 2, which was analyzed using a SSPMP rainfall hyetograph.

The differences in conditions between HHA Case 3 (HMR-based PMP) and HHA Case 2 (SSPMP) are summarized in ERR document MD-12-FLOOD-014-N Rev. 1 Section 5.0, Page 17 of 144, "HHA Case 2."

The NRC staff also requested a copy of the data files used for the Local Intense Precipitation (LIP) calculation (ERR document MD-12-FLOOD-014-N). These data files were submitted to the NRC by a letter from J. P. Gebbie, Indiana Michigan Power Company, to the NRC, "Donald C. Cook Nuclear Plant Unit 1 and Unit 2, Additional Information Regarding Flood Hazards Reevaluation Reports," dated June 16, 2015.

Information Need 5: Local Intense Precipitation

Background: In section 3.2.1 of the FHRR, the licensee stated that rooftop runoff was allowed to flow to internal storm drains within the buildings then offsite, not to adjacent sites. However, the roof drains are assumed to be "plugged" in Case 3, so the parapets may be overtopped and then flow to adjacent surface cells. This adjacent flow may cause water surface elevations to be greater at cells adjacent to buildings which could include critical locations (i.e. doors and other openings).

Request: Provide a discussion of the plugged roof drainage analyzed with additional runoff to adjacent cells in the Case 3 analysis.

I&M Response

The Case 3 analysis inundation results that include the roof runoff to the adjacent model cell are provided in ERR document MD-12-FLOOD-014-N Rev. 1.

The transference of the water from the roof to the adjacent ground is further described in the following excerpts from ERR document MD-12-FLOOD-014-N Rev. 1:

> **3.0 Assumptions...**
>
> 3.1) LIP HHA Case 3:...
>
> > 3.1.b) Building roofs drain to nearest ground surface cells. This assumption considers that the parapet rooftop cannot contain building rooftop rainfall and this volume of rain is distributed to the ground below the Protected Area rooftops.
>
> **5.0 METHODOLOGY...**
>
> **Model Components...**
>
> **Obstructions:** Cells within building footprints were brought above the ground survey grade by adjusting individual building cell elevations to an arbitrary elevation above the maximum LIP inundation level (640.11 feet). This adjustment of model cell elevations allows buildings to disrupt the movement of stormwater at ground level. Rooftop runoff is passed laterally to the nearest adjacent ground cells in HHA Case 3. This approach is consistent with the assumption that passive drainage systems (rooftop drains in this case) are ineffective (Assumption 3.1.b).

6.0 CALCULATIONS...

FLO-2D) Model Development for HHA Case 3...

Obstructions:...

For HHA Case **3,** the most conservative passive rooftop drainage system assumption is that roof drains plug entirely and all the rainfall runoff from rooftops will ultimately drain to the nearest adjacent ground cells.

The results of the Case 3 analysis are provided in Table 6 of ERR document MD-12-FLOOD-014-N, Rev. 1.

Appendix A, Supporting Information

Reference 1.

Wave Runup and Overtopping, FEMA Coastal Flood Hazard Analysis and Mapping Guidelines Focused Study Report, February 2005.

Reference 2

Hindcast Wave Information for the Great Lakes: Lake Michigan, Hubertz, Driver, Reinhard, Coastal Research Center, October 1991.

Figure 1 (Figure 1 from Reference 1), Wave Runup Sketch

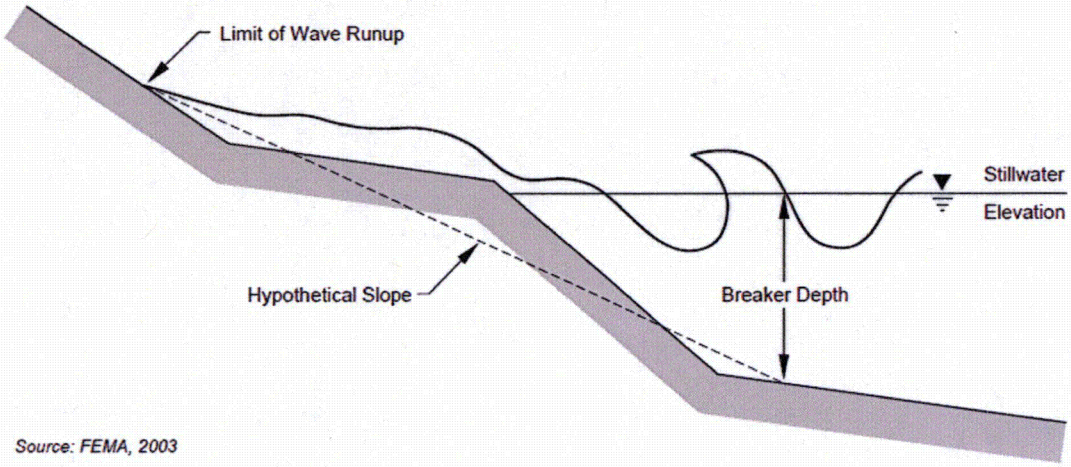


Figure 2 (Figure 9 from ERR Document MD-12-FLOOD-006-N Rev. 0), Beach Profile Comparison - CNP and Holland, MI

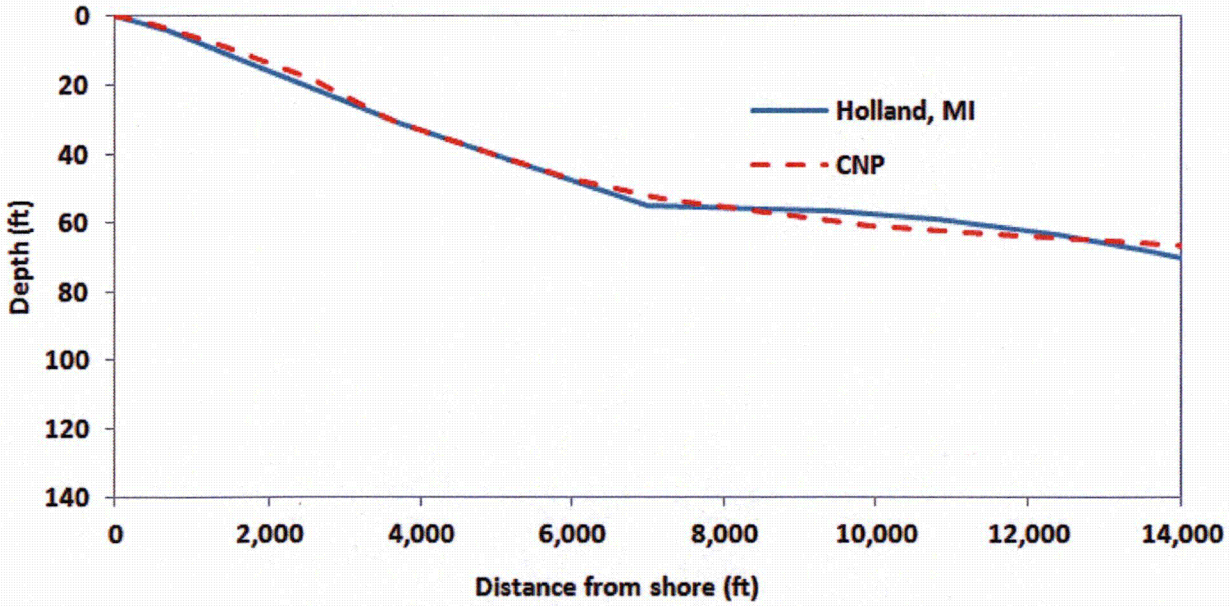


Figure 3. Relative Location of Holland, MI NOAA Gage, Cook Site, and WIS Stations 53, 54, 55, 59, and 60

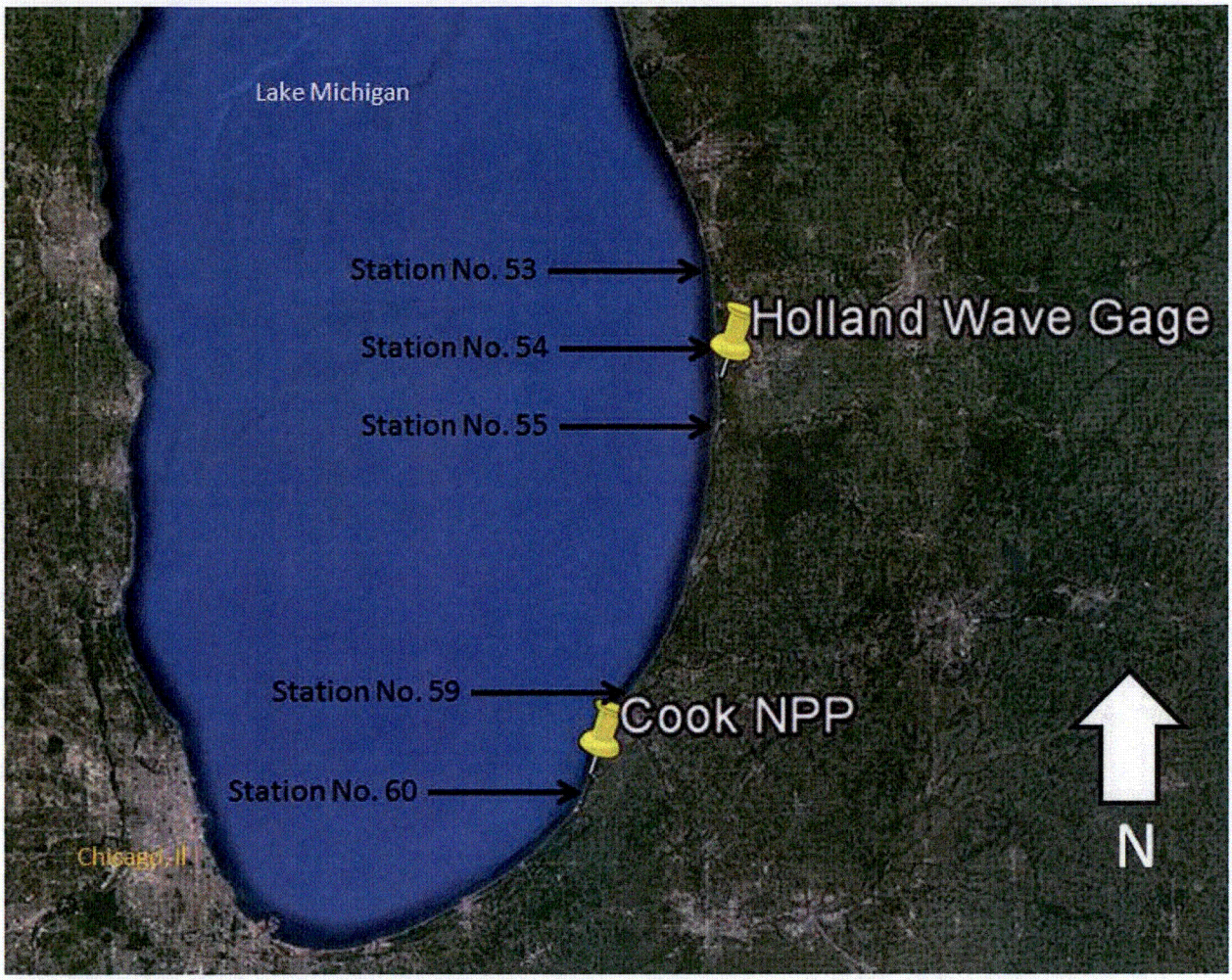


Figure 4. Wave Height Comparison between Holland and CNP Locations

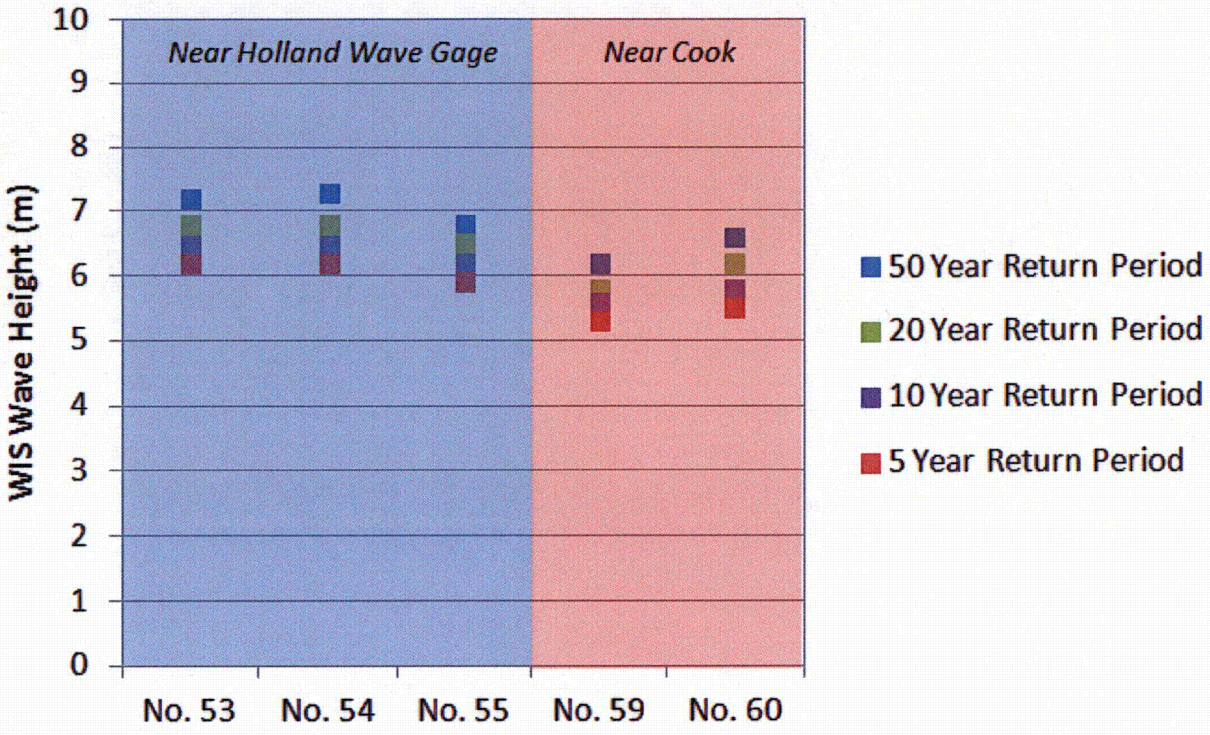


Table 1. Comparison of Wave Height, Period, and Direction between Holland and CNP Locations

	WIS Station	Mean Peak Wave Period (sec)	Largest Wave (m)	Largest Wave TP (sec)	Most Frequent Direction Band Center (deg)	Avg Direction Associated w w Largest Wave (deg)
Holland, MI	53	4.1	7.3	10	202.5	227
	54	4.1	7.2	10	202.5	228
	55	4	6.9	10	225	324
CNP	59	3.9	6.3	10	225	320
	60	4	6.3	9	225	325

Figure 5. Water Level and Water Level with Runup at Holland Gage (Figure 8 from ERR Document MD-12-FLOOD-006-N Rev. 0)

Figure 8. Water Level and Water Level with Runup and Setup at Holland, MI Gage 9087031 (Reference 14)

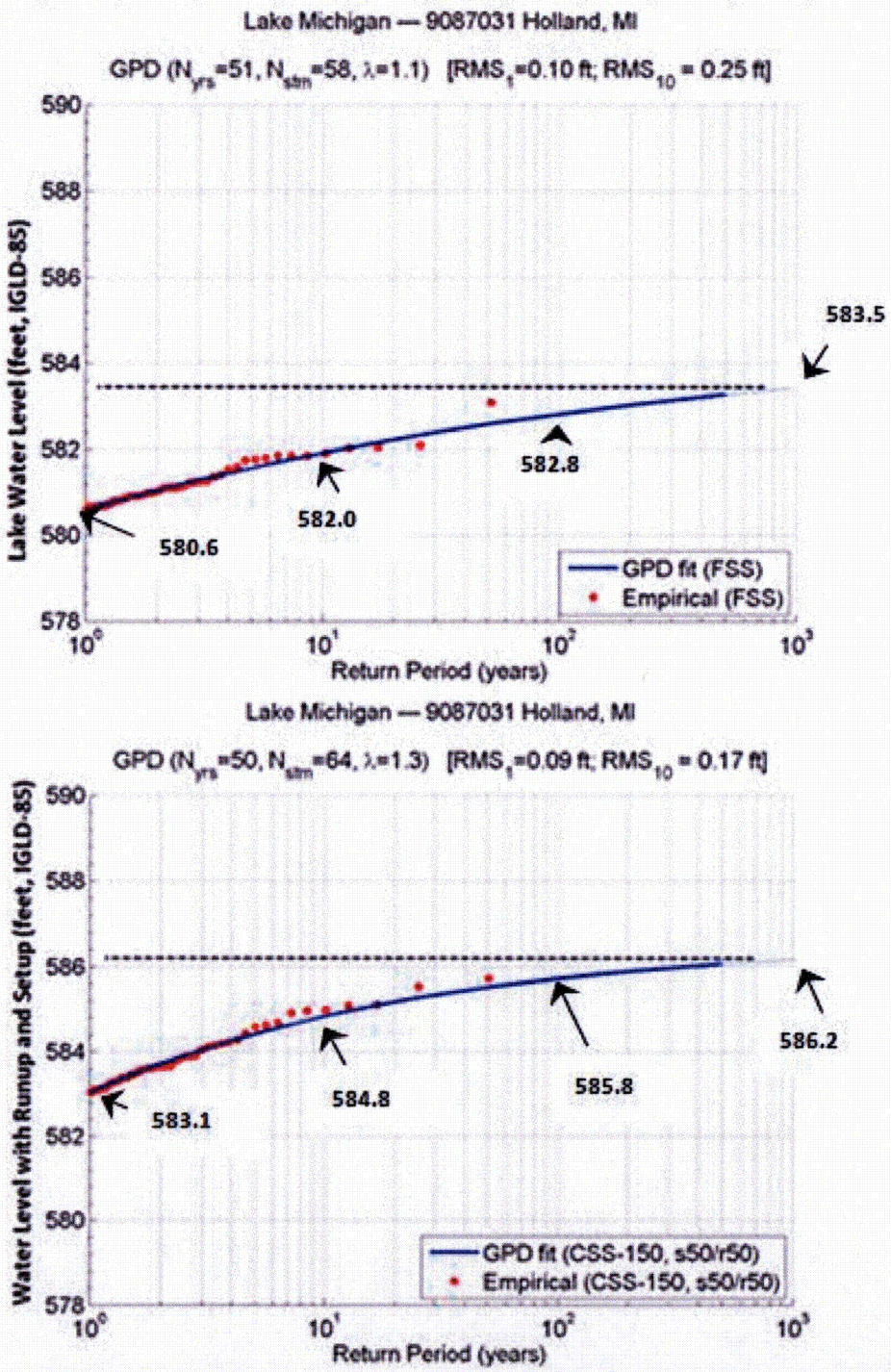
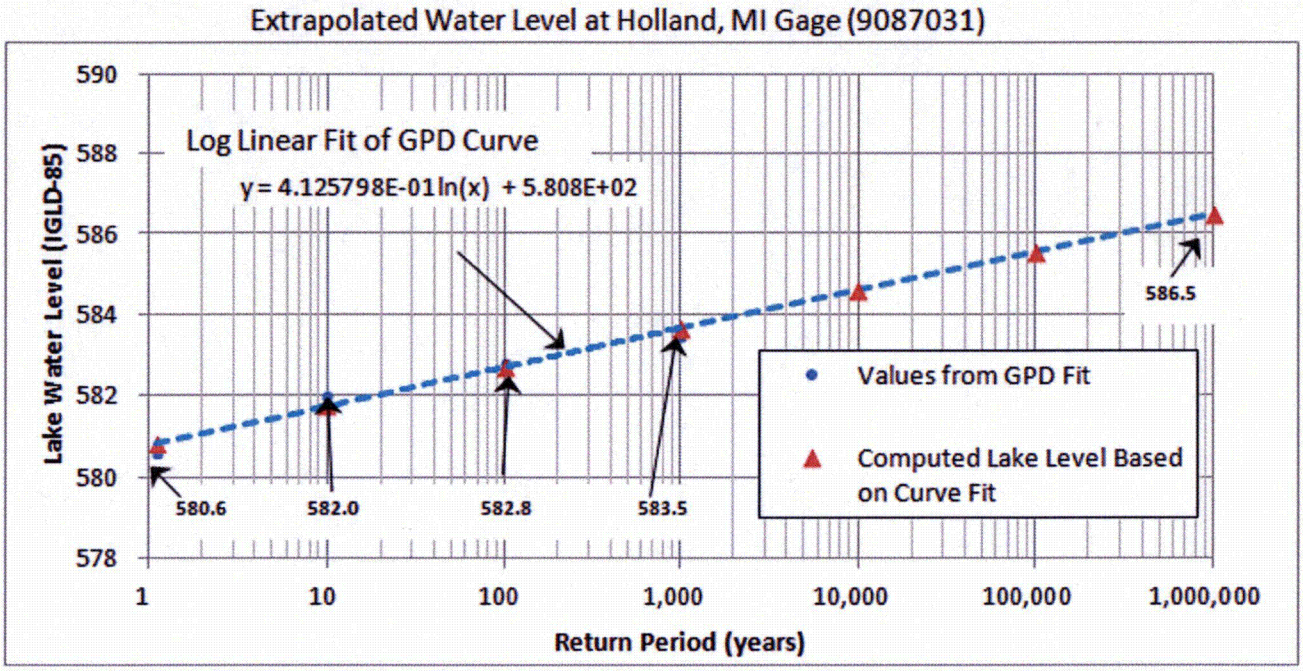


Figure 6. Logarithmic Fit and Extrapolation of GPD Curve Values from Figure 5



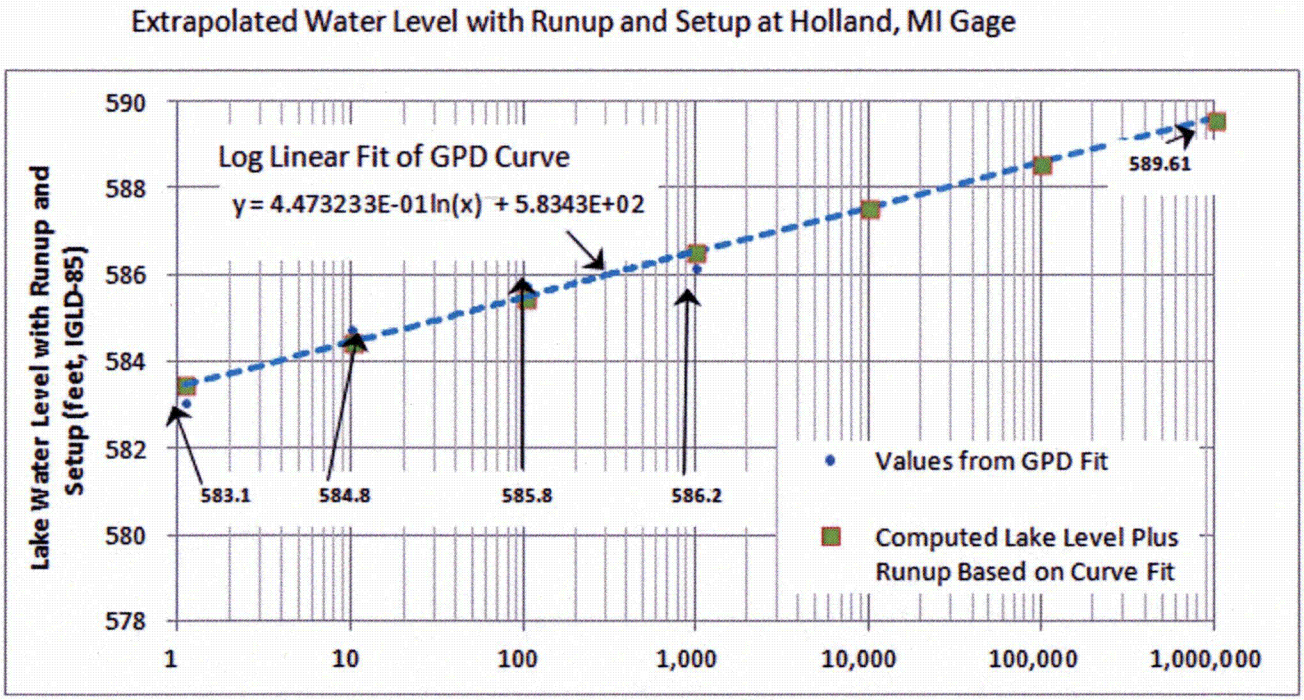
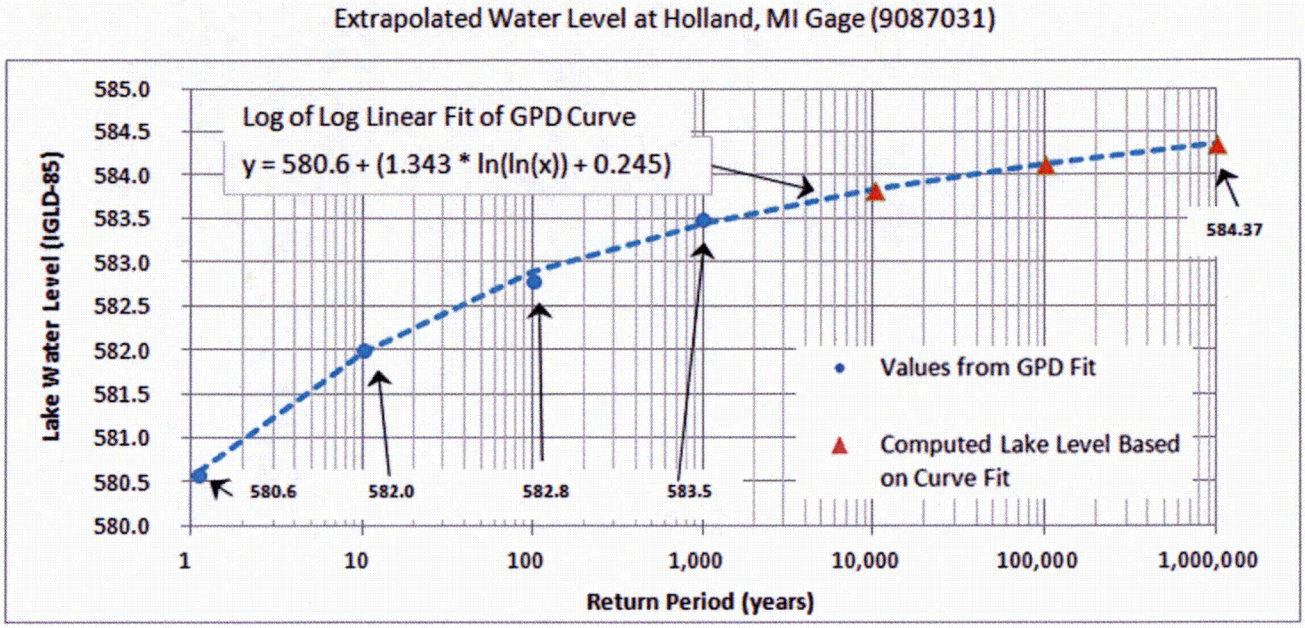
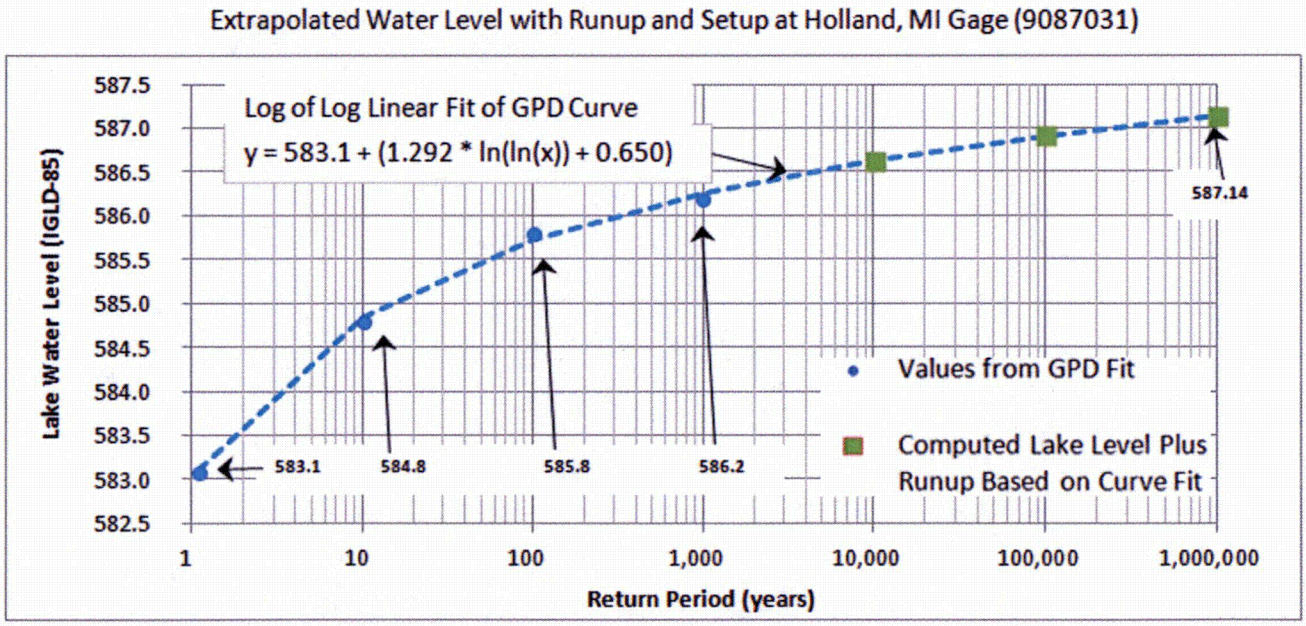



Figure 7. Log of Logarithmic Fit and Extrapolation of GPD Curve Values from Figure 5