

**APPENDIX A**  
**SUBSURFACE CONDITIONS**



## **SUBSURFACE CONDITIONS**

### **Available Data**

The subsurface conditions near the outlet of Pretty Lake have been interpreted from one historical exploration, whose location is shown in Figure 4-2. The data at this location is limited to geotechnical borings drilled in 1999 by Virginia Department of Transportation (VDOT) for the Shore Drive Bridge with the objective of identifying the sand bearing stratum to estimate pile tip elevations. The data only includes Standard Penetration Test (SPT) blow counts. Note that the superimposed pile tip elevations in Figure 4-2 are based on pile design length of 70 feet. The as-built pile lengths may vary according to encountered subsurface conditions. Even though the data is limited, different soil parameters were still derived using published correlations for preliminary site characterization, and conceptual design of alternative flood mitigation systems.

### **Regional Geology**

Regionally, the Pretty Lake area is located in the Coastal Plain physiographic province. Flat-lying plains and terraces dominate the landscape. The Coastal Plain is underlain by a wedge of Cretaceous to Holocene age sediments that thicken to the east and pinch out at the Fall Line approximately 70 miles west of the project area. Jurassic-Triassic age basement rocks lie approximately 1,800 feet beneath the site. The wedge of Cretaceous and younger sediments were deposited as a result of multiple marine transgressions and regressions. Sediments within the upper 150 feet beneath the site are Pliocene to Recent in age. The Pliocene and younger sediments have been deposited and subsequently eroded in places during the rising and falling sea levels that resulted from glacial and interglacial periods.

### **Historical Development**

The project area has been modified by man's activities for several years. The historical development of the Pretty Lake outlet and change in the Shore Drive bridge alignment are evident. The potential for encountering remnants of historical construction should be recognized when planning flood mitigation projects in the project area.

### **Subsurface Stratigraphy**

The stratigraphic units encountered beneath the outlet of Pretty Lake are described in descending sequence in the following discussion.

The 1999 historical investigation by VDOT for the Shoreline Drive Bridge at the entrance of Pretty Lake encountered subsurface conditions primarily consisting of very loose to loose sand fill, with boring B-5 encountering a sand with gravel interval within this depth. Beneath the fill, explorations encountered Alluvium consisting of loose to dense sands and a soft fine grained/very loose sand layer of variable thickness. Below the Alluvium are dense silty sands of



the Norfolk Formation. The subsurface stratigraphy within this section of Pretty Lake is shown in Figure 4-2 in the main text.

### Artificial Fill

The 1999 historical borings encountered a layer of artificial fill assumed to be associated with development and construction of the Shore Drive bridge. This layer consists of very loose to loose fine to medium sand that varies in thickness. Underneath Pretty Lake, the fill layer is less than 10 feet thick but is thicker to the north and south.

### Alluvium

Underlying the artificial fill is an alluvium, which has two distinct layers: a loose to dense sand layer over a fine-grained/very loose sand layer. The loose to dense sand layer is primarily medium to coarse dense sand and is considered as fluvial-estuarine sediment. This layer thickens north to south from 15 feet to 30 feet. On the north side of the section, the lower fine grained (clay and silt) layer is encountered at a depth of 25 to 30 feet. This layer initially thins towards to south, then transitions to very loose sand and thickens on the south side of the section. The thickness of this layer ranges from approximately 5 to 25 feet.

### The Yorktown Formation

The sand alluvium is underlain by a zone of loose to dense, fine sand with trace shell fragments. It is inferred that this layer is the Yorktown Formation, which is described as a granular Pleistocene age fluvial-estuarine and brackish marine deposits.

### Design Subsurface Profiles for Concept Evaluation

To evaluate possible flood mitigation systems at Pretty Lake, it was necessary to idealize the subsurface conditions, and determine soil properties that will govern the selection of an appropriate flood mitigation system. Based on the available data and published correlations between different soil parameters, the following were interpreted:

- Two idealized soil profiles representing an upper and lower bound of expected stratigraphy;
- Design strength parameters including undrained shear strength and friction angles;
- Ultimate bearing capacity values for the upper and lower boundary profiles based on a continuous strip footing with a unit width;
- Active and passive earth pressure coefficients. A drained condition was assumed for the clay and silt layer.

## Idealized Stratigraphy

The subsurface condition was idealized into two profiles. The first profile is located inside the channel where the silt and clay layer is thinnest. This profile represents an upper bound of expected design strength parameters. This profile comprises of about 30 feet of loose sand overlying 20 feet of medium dense to dense sand. Below this layer is a 5 feet layer of soft silt and clay layer. The bottom layer comprises of a 65 feet medium dense to dense silty sand layer.

The second profile is located below the southwest abutment of Shore Drive bridge. This profile represents a lower bound of expected design strength parameters. The profile comprises of a 30 feet layer of loose sand overlying a 25 feet layer of medium dense to dense sand. The clay and silt layer at this location is about 20 feet. The bottom layer comprises of medium dense to dense silty sand.

Based on the soil description and the blow counts, each layer was assigned a total unit weight (Table A-1). The total unit weights were used to estimate an effective stress profile as shown in Figures A-1 and A-2.

**Table A-1. Total Unit Weights**

Soil layer	Total Unit Weight (pcf)	
	Profile 1	Profile 2
Loose sand	105	105
Medium dense to dense sand	115	115
Silt and Clay	105	110
Medium dense to dense silty sand	120	120

## Design Strength Parameters

The strength properties for the sand layers were obtained by estimating friction angle ( $\phi$ ) profiles based on SPT blow counts (N-values). The N-values were corrected for rod length, fines content, and overburden pressure using the correlation provided by Liao and Whitman (1986). The correlations provided by Peck et al. (1974) and the American Petroleum Institute (API) (2000) were then used to estimate  $\phi$  from corrected N-values. The API method resulted in considerably higher  $\phi$  values as shown in Figures A-3 and A-4. Therefore, the mean  $\phi$  values for each layer was calculated based on Peck et al. (1974) and used as an upper bound profile. Two standard deviations were subtracted from the mean value to calculate the lower bound  $\phi$  profile. The upper and lower design  $\phi$  values for each profile are shown in Table A-2.

Since no strength data is available for the clay and silt layer, the undrained shear strength of this layer was conservatively assumed to be 500 psf and 250 psf for an upper and lower bound values, respectively.

**Table A-2. Idealized Friction Angles**

Soil Layer	Effective Stress Friction Angle (degrees)					
	Profile 1			Profile 2		
	Upper Bound	Lower Bound	COV (%)	Upper Bound	Lower Bound	COV (%)
Loose sand	30	27	5	29	26	5
Medium dense to dense sand	36	33	4	37	30	9
Medium dense to dense silty sand	35	32	4	35	32	5

### Active and Passive Earth Pressure Coefficients

Active ( $k_a$ ) and passive ( $k_p$ ) earth pressure coefficients were calculated for the two idealized profiles. This can be used to conceptually design flood mitigation alternatives where lateral earth pressure loadings are expected behind the structure such as a retaining or sheet pile wall. The pressure at which the soil fails as the wall moves away from the retained soil is called active earth pressure, whereas the pressure at which the soil fails as the wall moves into the retained soil is called passive pressure. Active and passive earth pressure coefficients were calculated according to Rankine's and Coulomb's theories (Figures A-5 to A-8). Rankine's  $k_a$  and  $k_p$  were determined based on a frictionless wall where the interface friction ( $\delta$ ) between the retaining structure and the soil is neglected. Coulomb's  $k_a$  and  $k_p$  were calculated for a steel and concrete wall by varying the value of  $\delta$ . For a steel wall,  $\delta$  was equal to  $\phi - 5^\circ$ , whereas for a concrete wall,  $\delta$  was equal to  $0.58\phi$ .

### Ultimate Bearing Capacity

Since some flood mitigation alternatives may be supported on shallow foundations, ultimate bearing capacity values, based on a continuous strip footing with unit width, were calculated. For each profile, lower and upper bound bearing capacity values were determined from the mean and lower bound friction angles, respectively (Figures A-9 and A-10). Further, ultimate bearing capacity values for the clay and silt layer were estimated based on both drained and undrained conditions. For a drained condition, the upper bound effective stress friction angle was assumed to be  $33^\circ$  degrees. The lower bound effective stress friction angle was obtained by applying a 7% Coefficient of Variation (COV) based on Duncan (2000) recommendations. Tables A-3 and A-4 summarize the bearing capacity factors, which were used to calculate the ultimate bearing capacity. The bearing capacity factors were based on correlations provided by Meyerhof (1963).

**Table A-3. Bearing Capacity Factors – Profile 1**

Bearing Capacity Factor	Loose Sand		Medium Dense to Dense to Dense Sand		Silt and Clay			Medium Dense to Dense Silty Sand	
	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Undrained	Upper Bound	Lower Bound
N <sub>c</sub>	30	24	51	39	39	26	5	46	35
N <sub>q</sub>	18	13	38	26	26	15	1	33	23
N <sub>γ</sub>	16	10	44	26	26	11	0	37	22
COV (%)	5	-	4	-	7	-	-	4	-

**Table A-4. Bearing Capacity Factors – Profile 2**

Bearing Capacity Factor	Loose Sand		Medium Dense to Dense to Dense Sand		Silt and Clay			Medium Dense to Dense Silty Sand	
	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Undrained	Upper Bound	Lower Bound
N <sub>c</sub>	28	22	56	30	39	26	5	46	35
N <sub>q</sub>	16	12	43	18	26	15	1	33	23
N <sub>γ</sub>	13	8	53	16	26	11	0	37	22
COV (%)	5	-	9	-	7	-	-	5	-

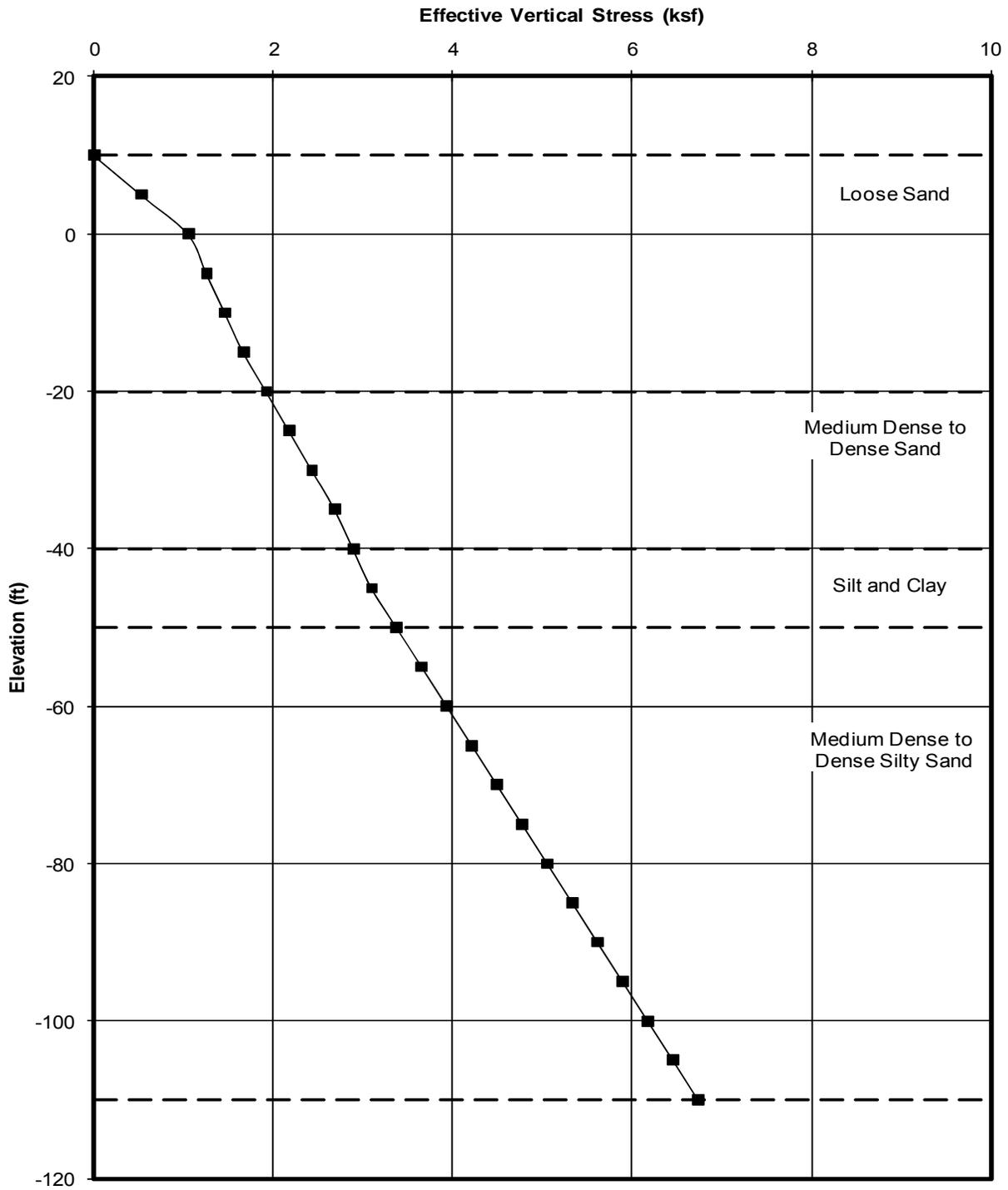
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- American Petroleum Institute (2000), “*Recommended Practice for Planning, Designing, and Constructing Fixed Offshore Platforms – Working Stress Design*,” API Recommended Practice 2A-WSD (RP 2A-WSD), 21<sup>st</sup> Ed., December 2000, API, Washington, D.C.
- Duncan, J. M. (2000), “Factors of Safety and Reliability in Geotechnical Engineering,” *Journal of Geotechnical and Geoenvironmental Engineering*, ASCE, Vol. 126, No. 4, pp. 307-316.
- Liao, S. C., and Whitman, R. V. (1986), “Overburden Correction Factors for SPT,” *Journal of Geotechnical Engineering*, ASCE, Vol. 112, No. 3, pp. 373-377.
- Meyerhof, G. G. (1963), “Some Recent Research on the Bearing Capacity of Foundations,” *Canadian Geotechnical Journal*, Vol. 1, No. 4, pp. 57-64.



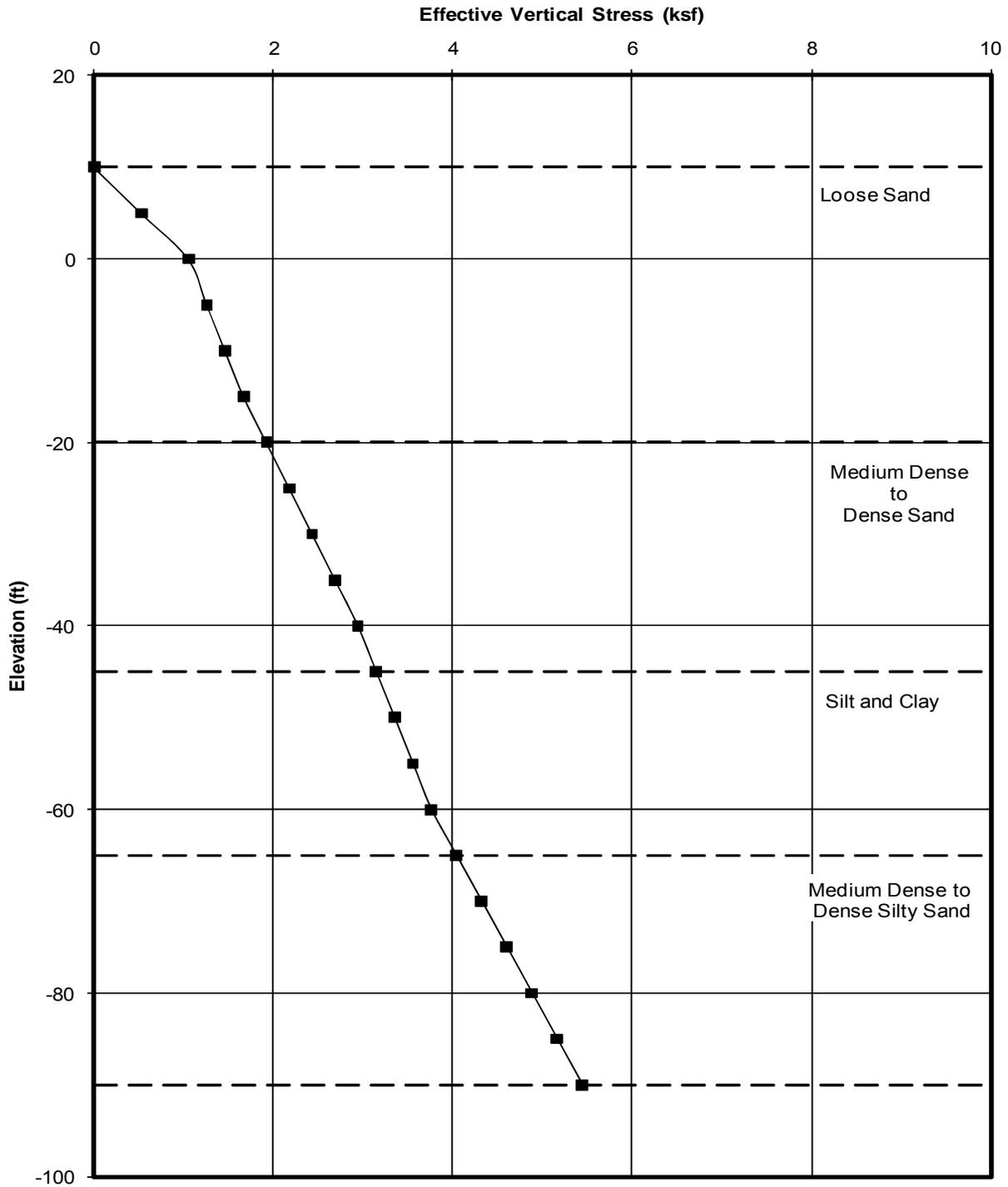
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Peck, R. B., Hanson, W. E., and Thornburn, T. H. (1974), "*Foundation Engineering*," 2<sup>nd</sup> Edition,  
John Wiley, New York.



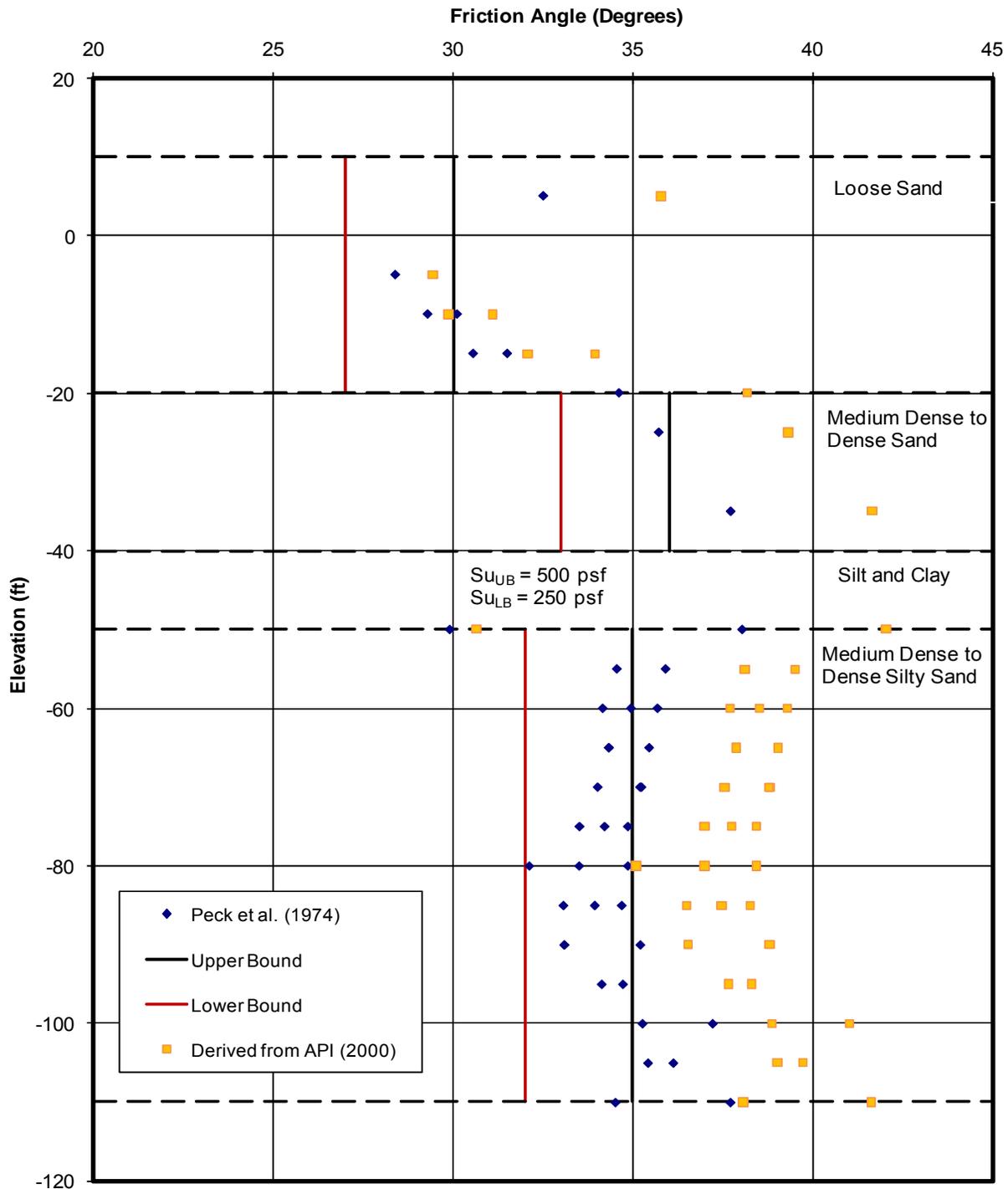
**EFFECTIVE STRESS - PROFILE 1**  
City-wide Coastal Flooding Study  
Norfolk, Virginia

FIGURE A-1

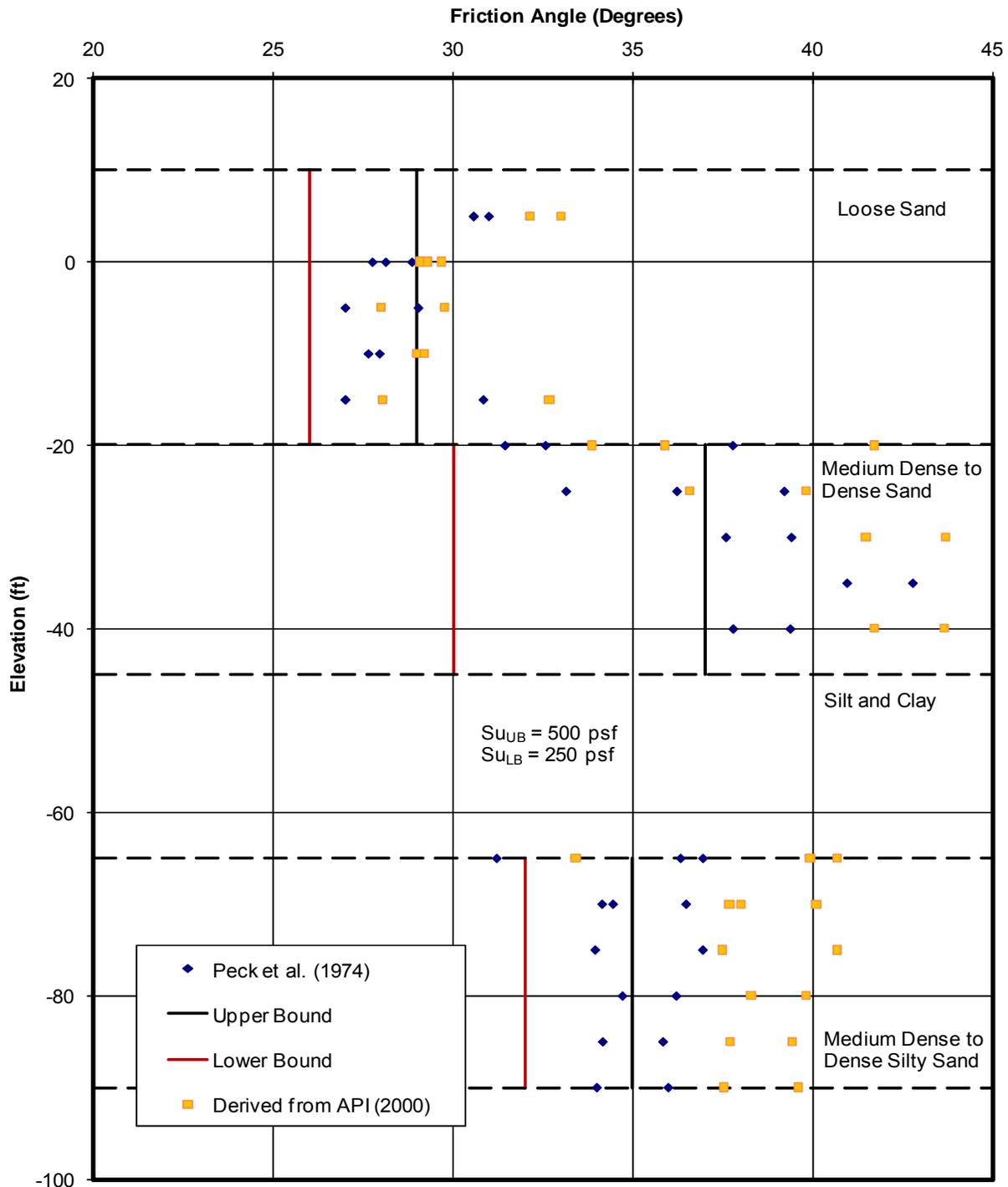


**EFFECTIVE STRESS - PROFILE 2**  
City-wide Coastal Flooding Study  
Norfolk, Virginia

FIGURE A-2



**DESIGN STRENGTH PARAMETERS - PROFILE 1**  
 City-wide Coastal Flooding Study  
 Norfolk, Virginia



**DESIGN STRENGTH PARAMETERS - PROFILE 2**  
 City-wide Coastal Flooding Study  
 Norfolk, Virginia

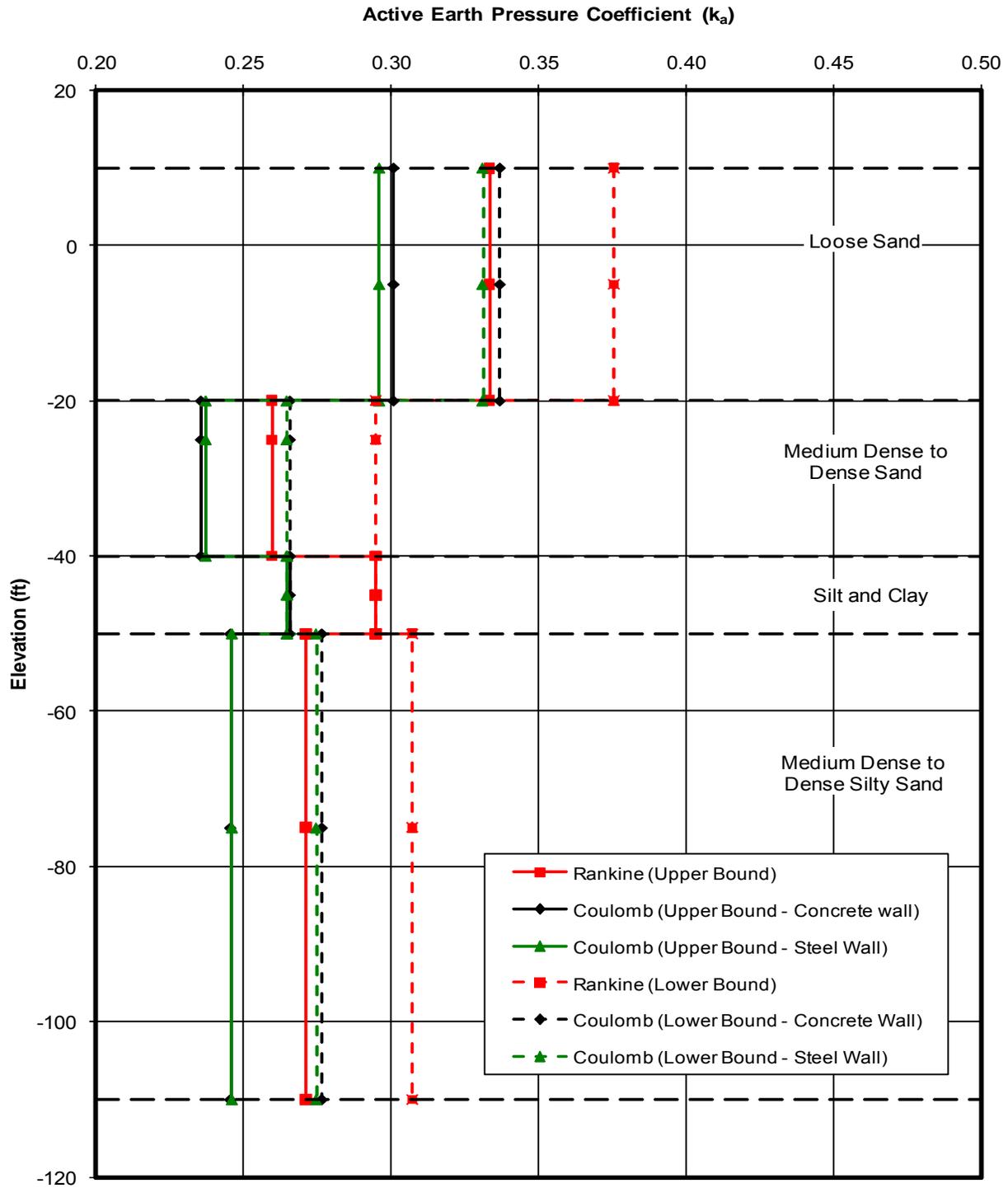


FIGURE A-5

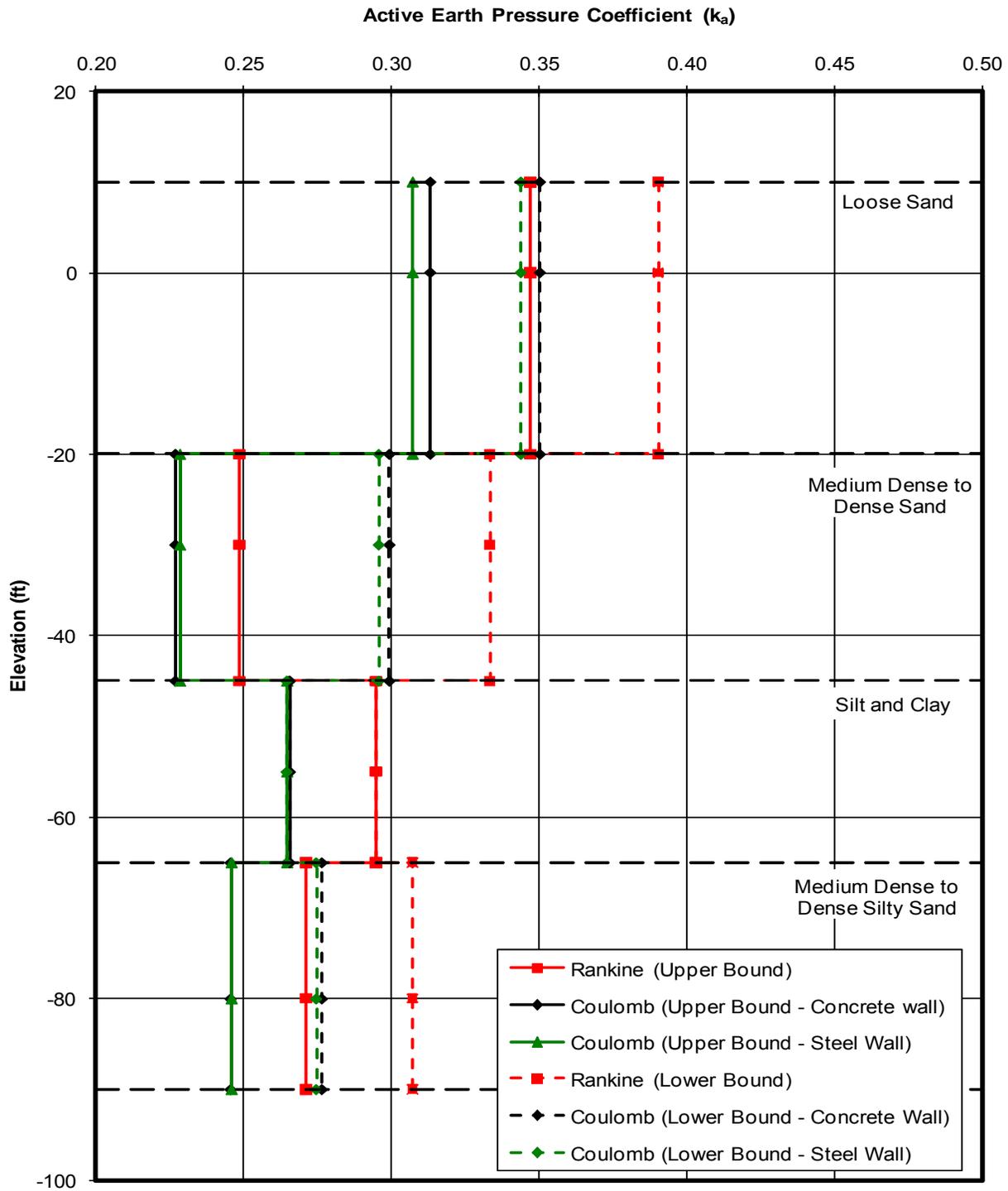
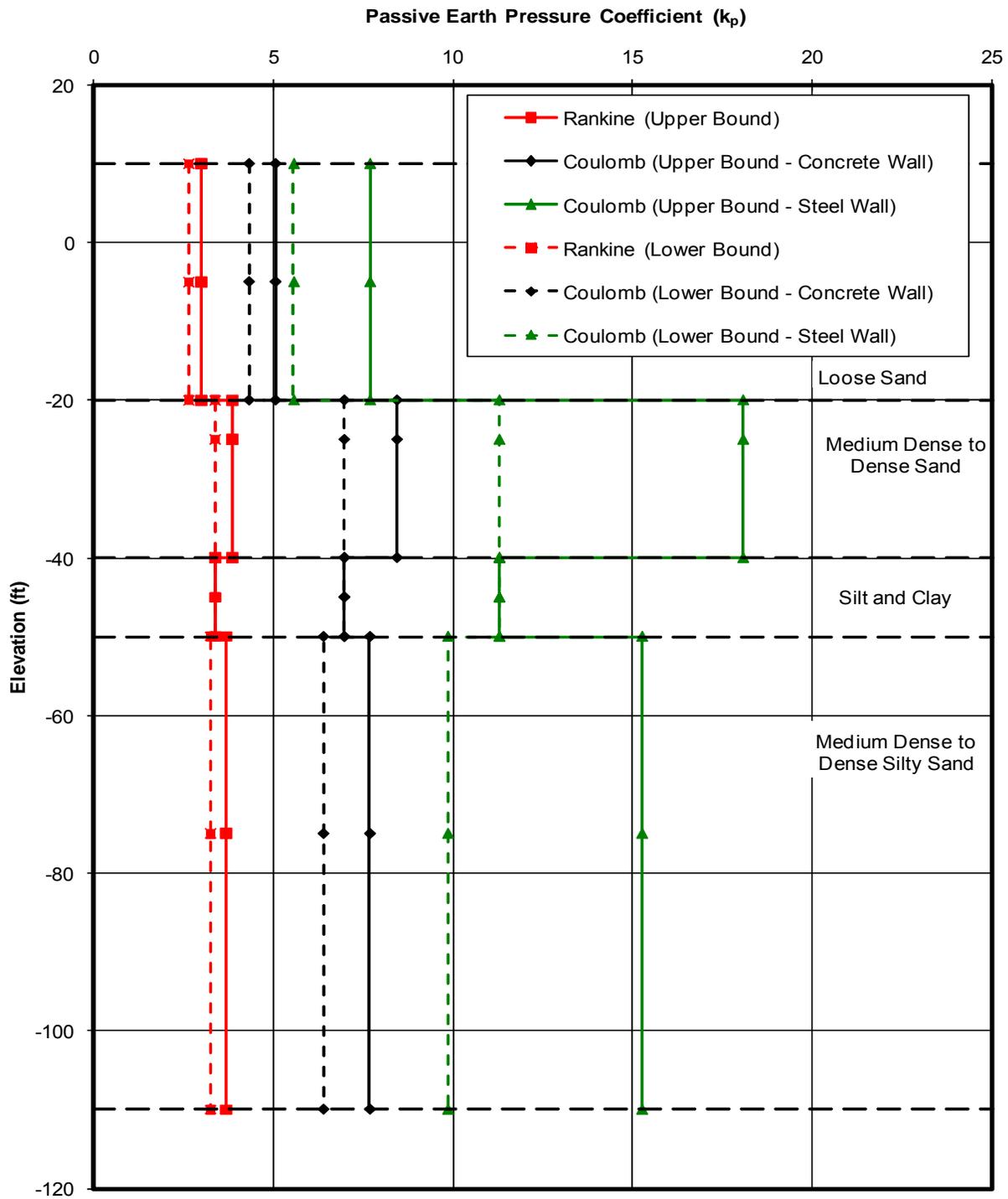
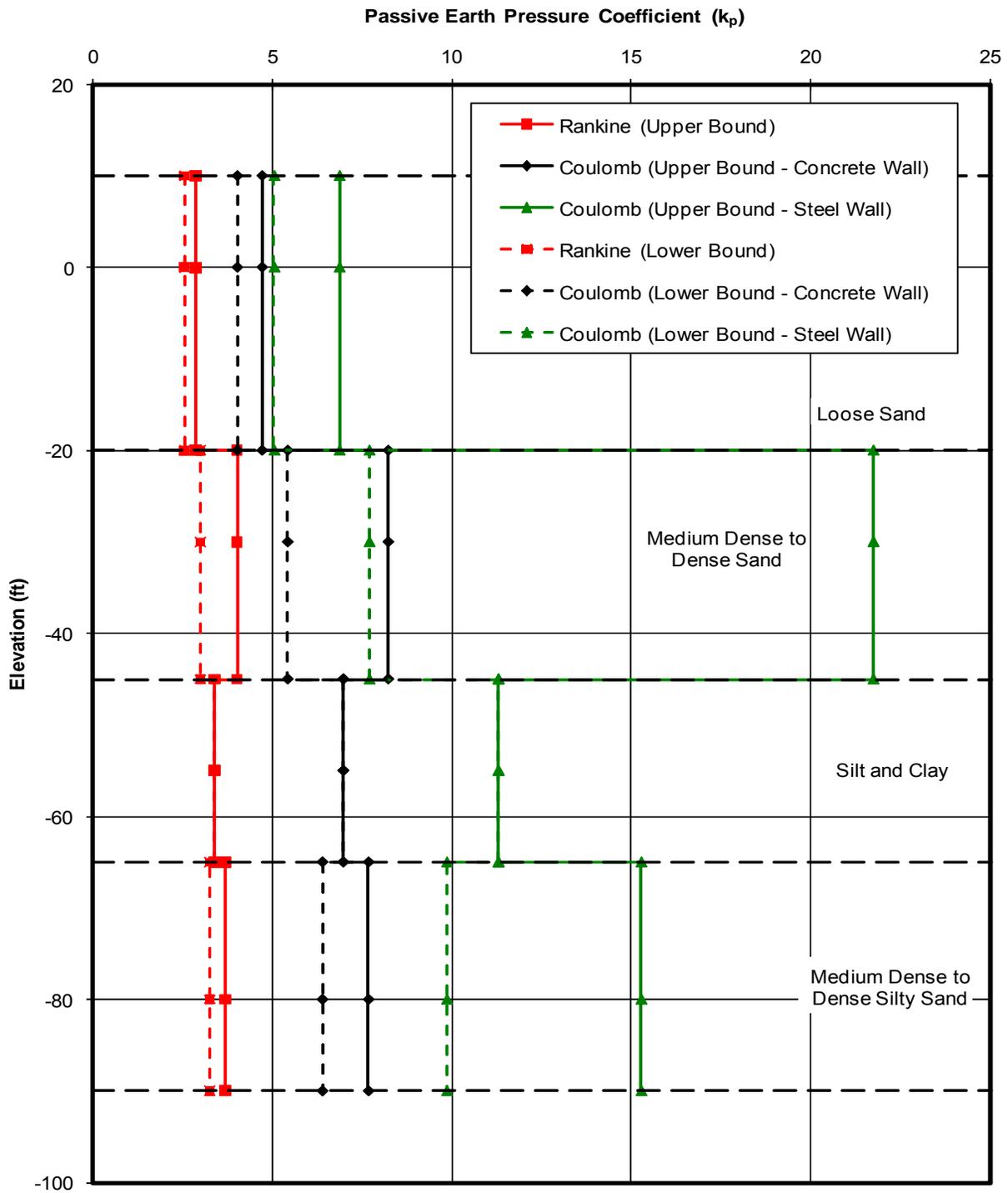


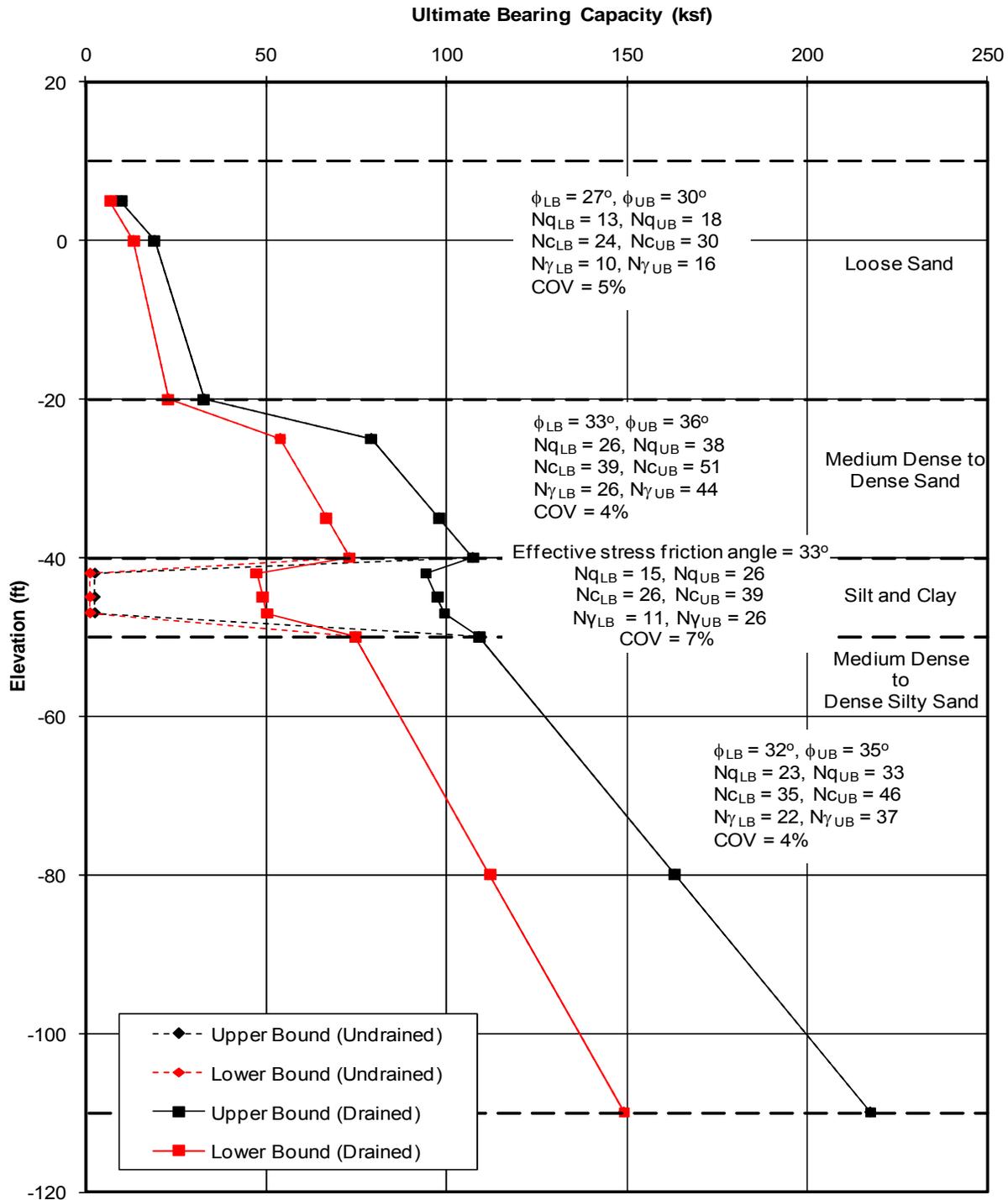
FIGURE A-6



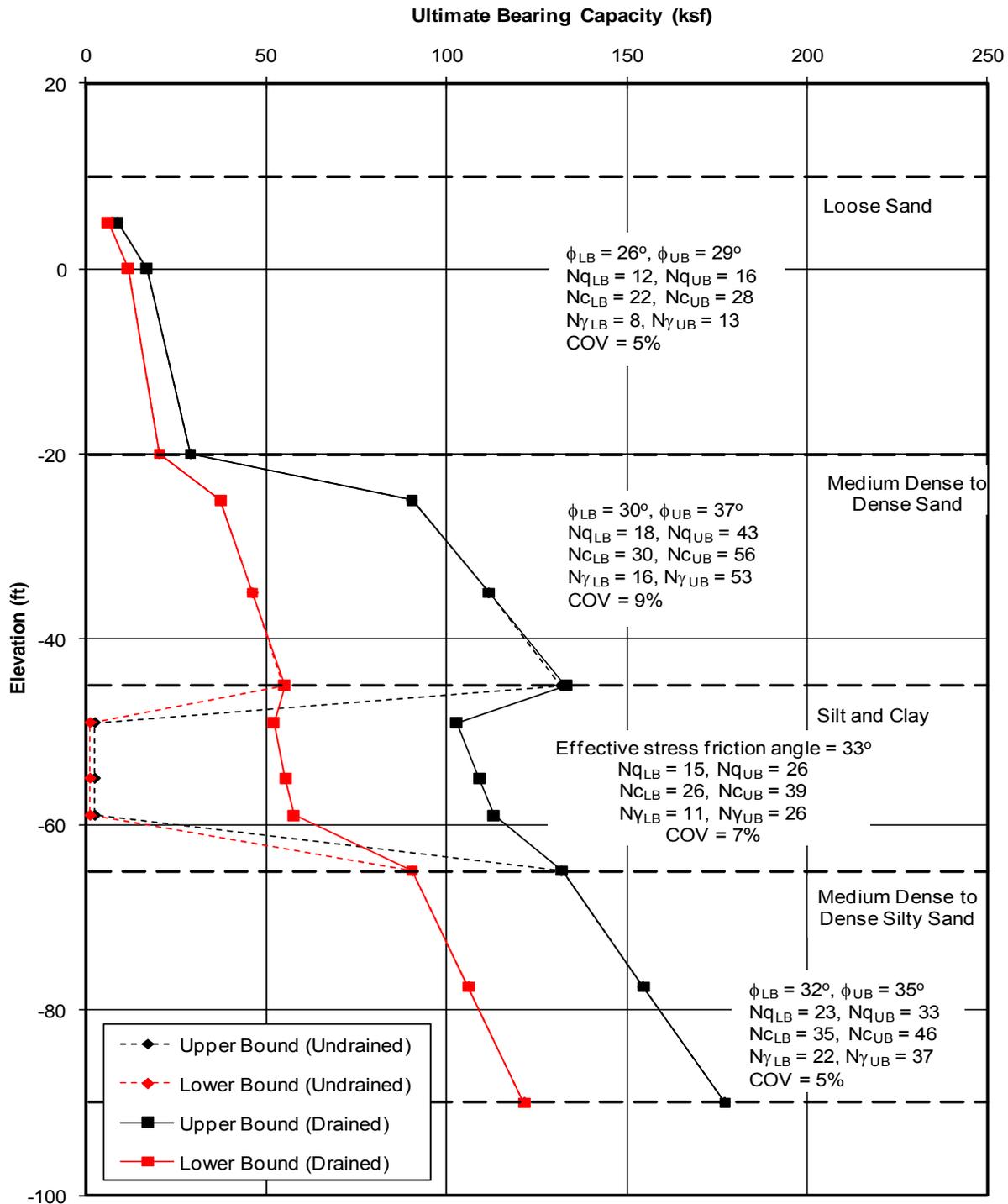
**PASSIVE EARTH PRESSURE COEFFICIENT - PROFILE 1**  
 City-wide Coastal Flooding Study  
 Norfolk, Virginia



**PASSIVE EARTH PRESSURE COEFFICIENT - PROFILE 2**  
 City-wide Coastal Flooding Study  
 Norfolk, Virginia



**ULTIMATE BEARING CAPACITY - PROFILE 1**  
 City-wide Coastal Flooding Study  
 Norfolk, Virginia



**ULTIMATE BEARING CAPACITY - PROFILE 2**  
 City-wide Coastal Flooding Study  
 Norfolk, Virginia

**APPENDIX B**  
**MODELING RESULTS**

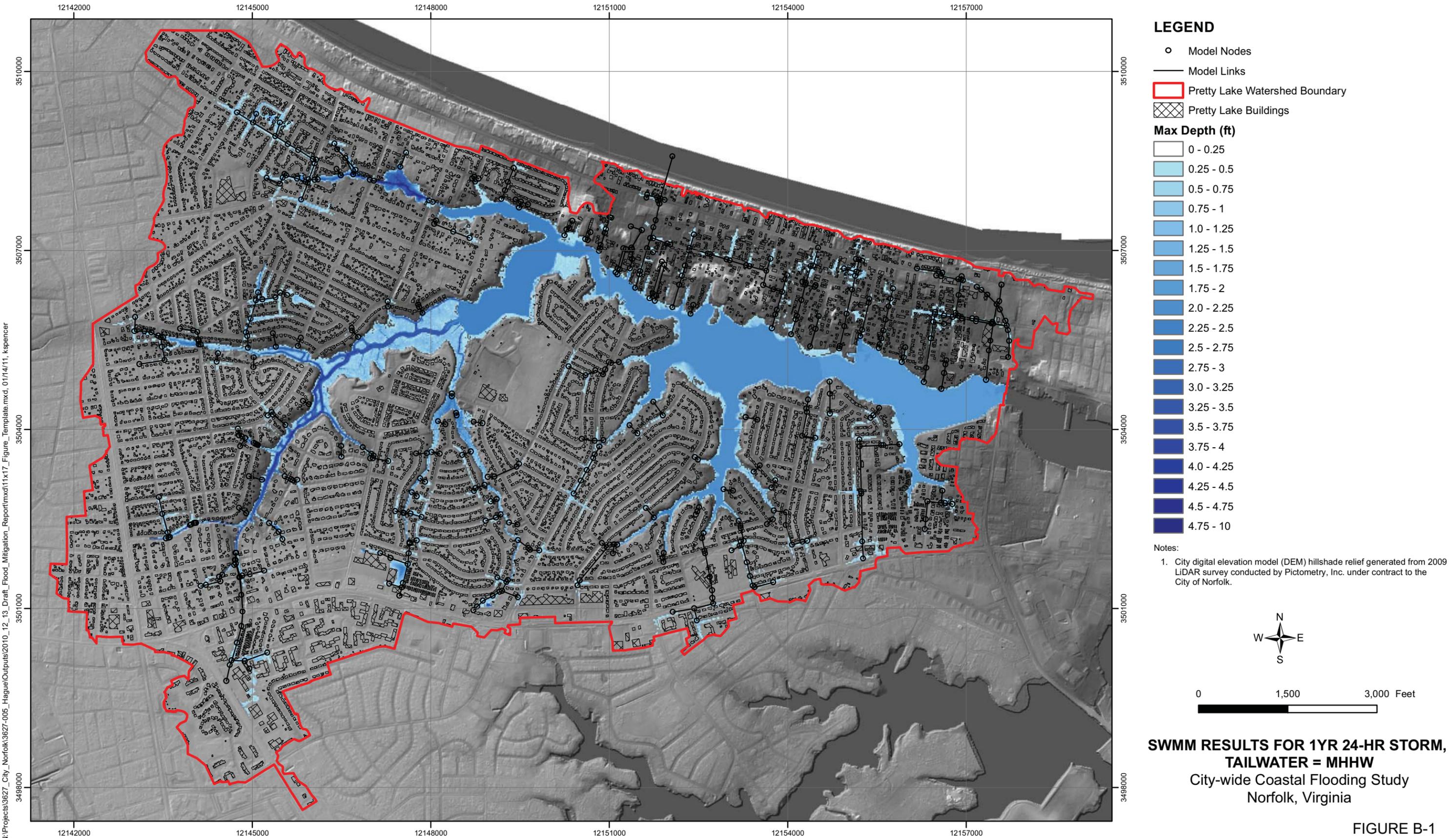
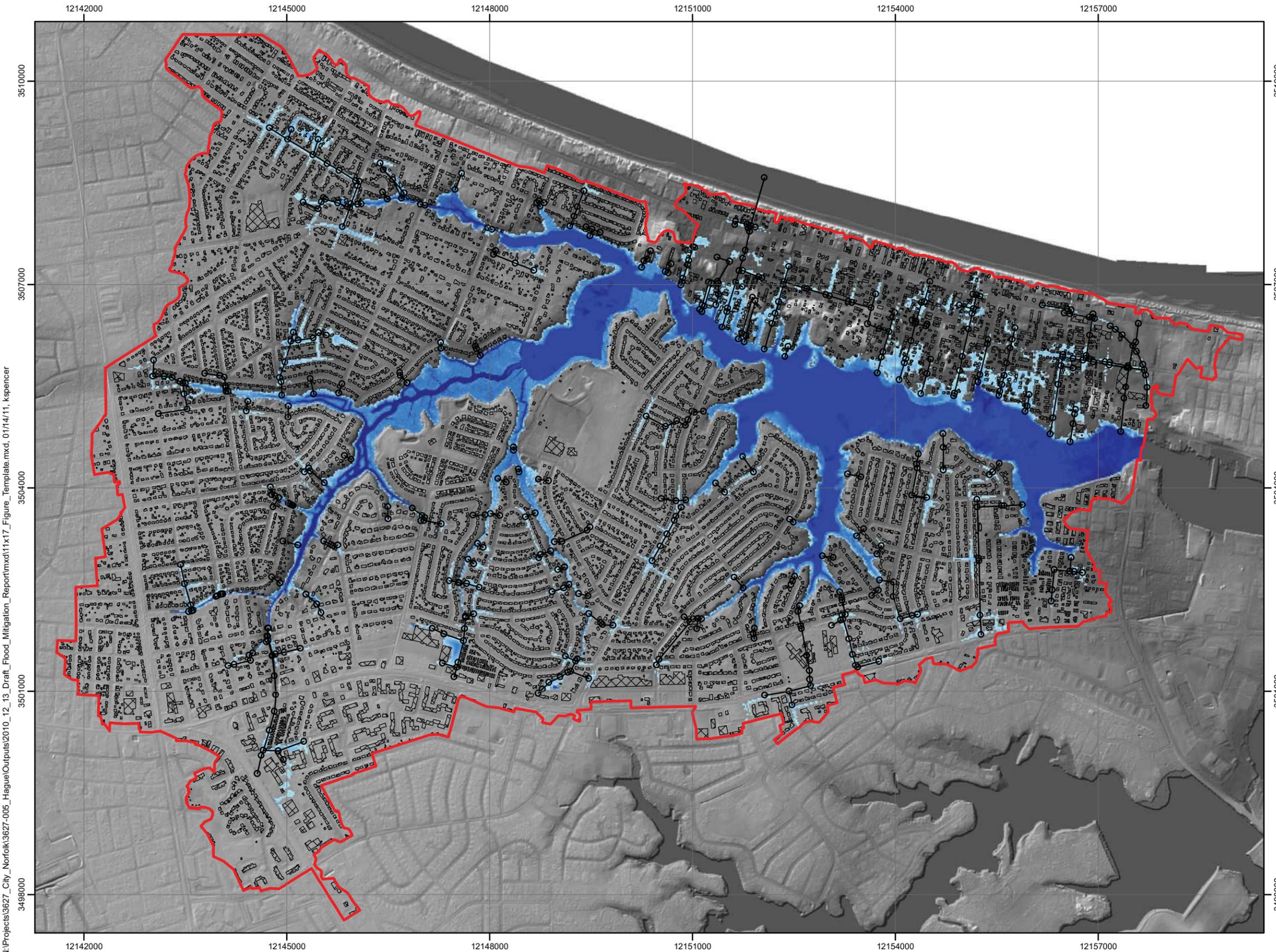


FIGURE B-1

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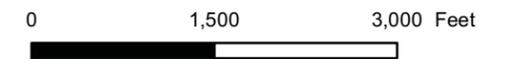
**LEGEND**

- Model Nodes
- Model Links
- ▭ Pretty Lake Watershed Boundary
- ▨ Pretty Lake Buildings

**Max Depth (ft)**

- 0 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1.0 - 1.25
- 1.25 - 1.5
- 1.5 - 1.75
- 1.75 - 2
- 2.0 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3.0 - 3.25
- 3.25 - 3.5
- 3.5 - 3.75
- 3.75 - 4
- 4.0 - 4.25
- 4.25 - 4.5
- 4.5 - 4.75
- 4.75 - 10

Notes:  
 1. City digital elevation model (DEM) hillshade relief generated from 2009 LIDAR survey conducted by Pictometry, Inc. under contract to the City of Norfolk.



**SWMM RESULTS FOR 1YR 24-HR STORM,  
 TAILWATER = 1YR STORM SURGE**  
 City-wide Coastal Flooding Study  
 Norfolk, Virginia

FIGURE B-2

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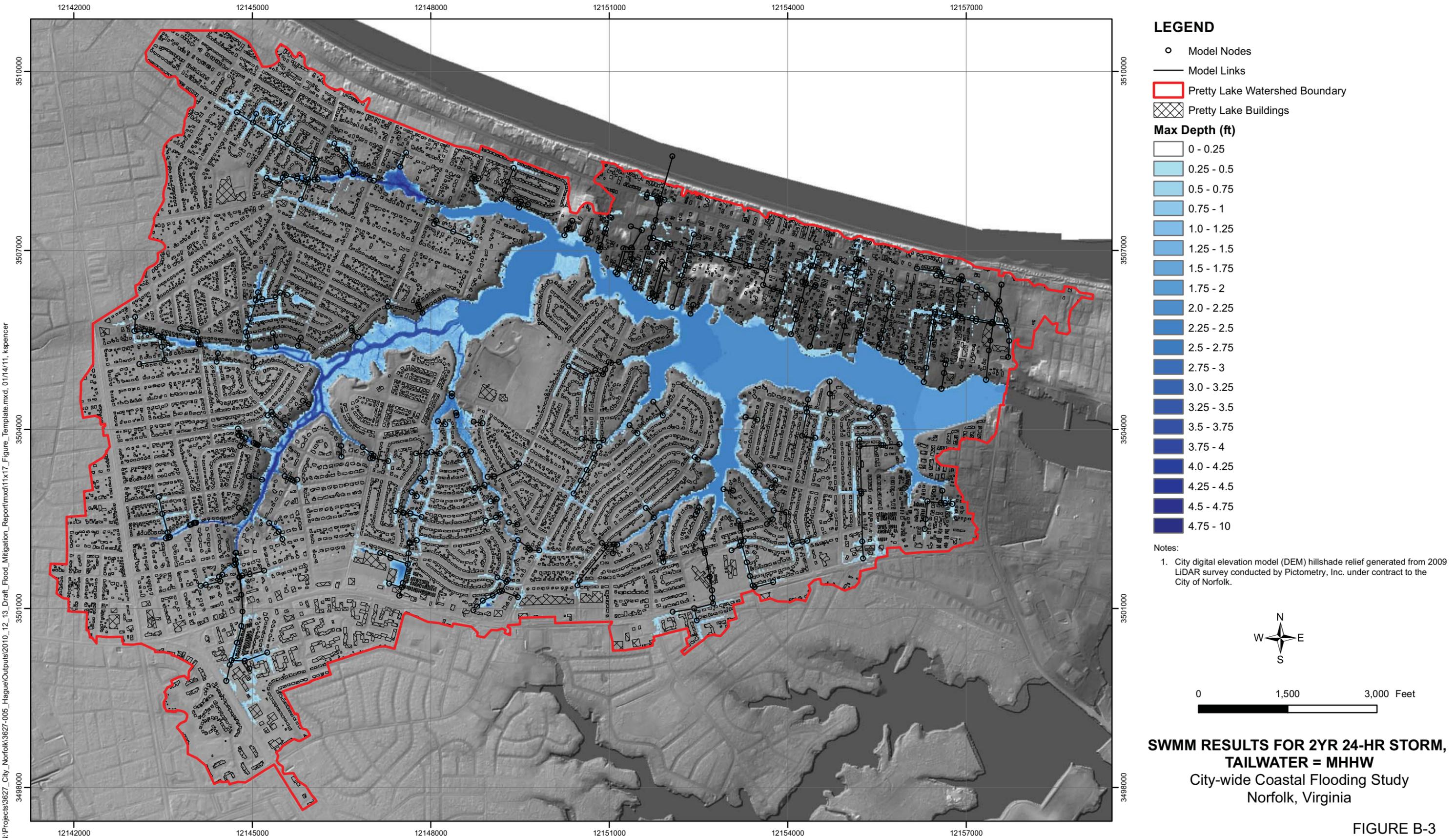


FIGURE B-3

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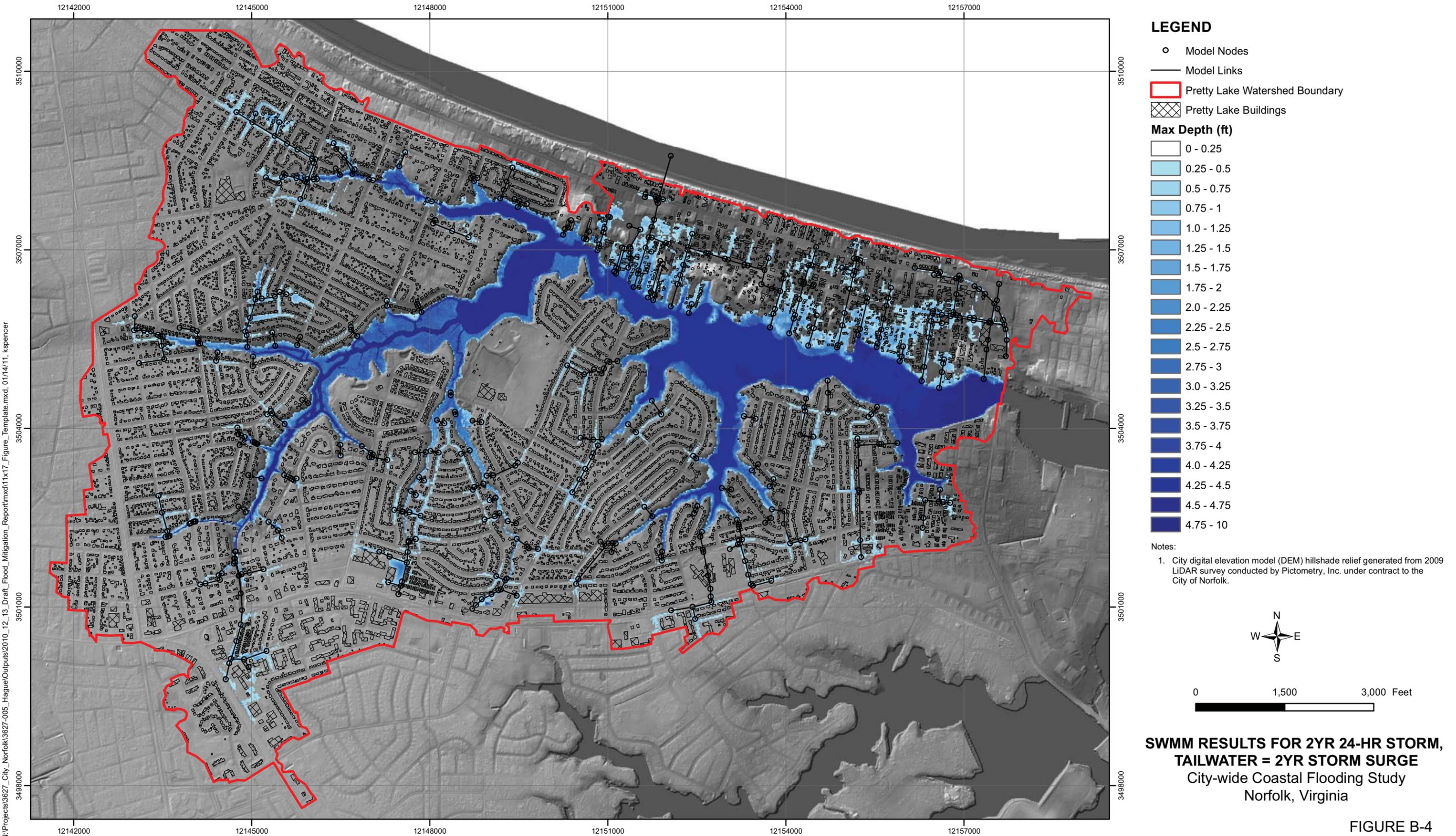


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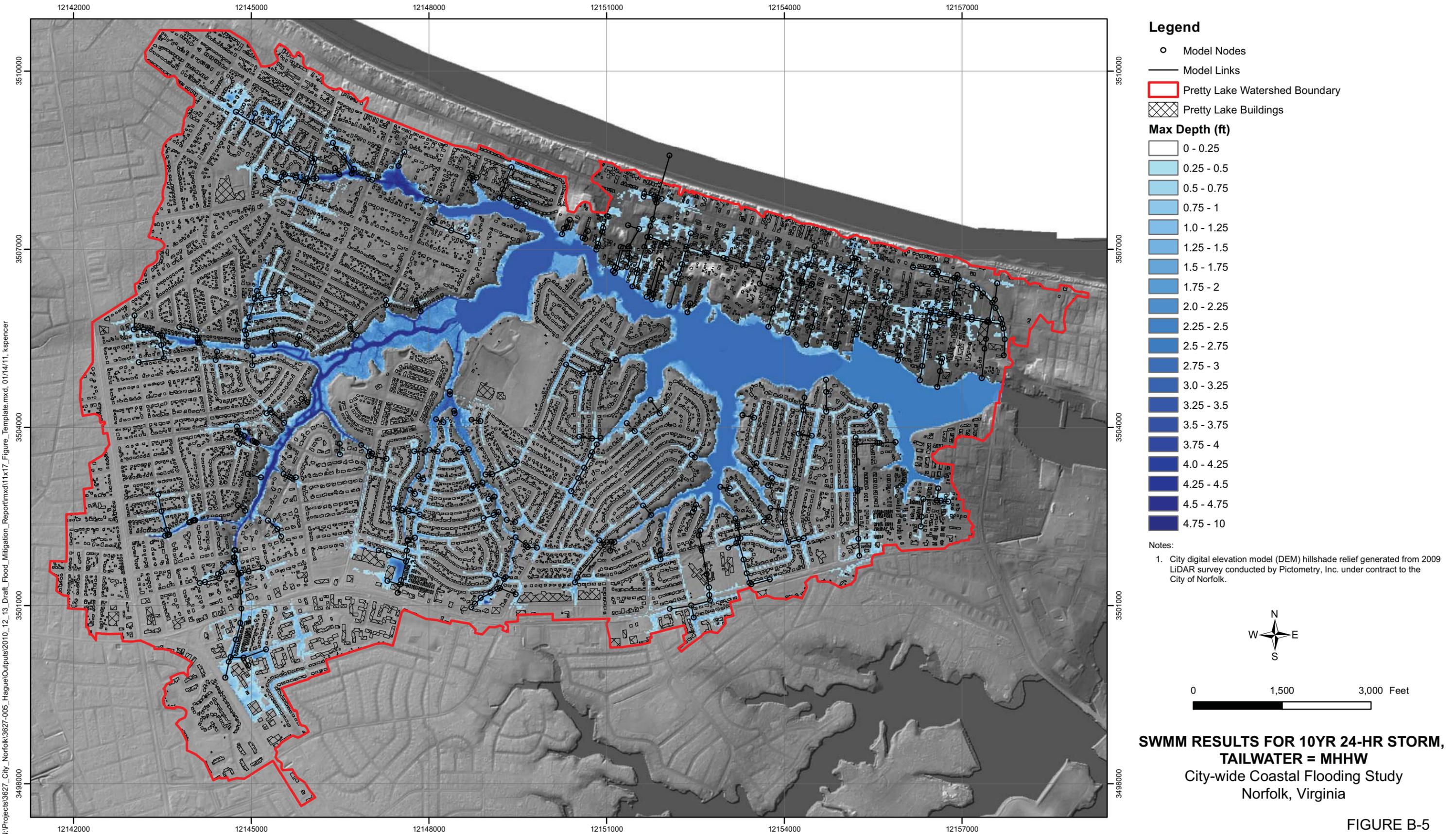


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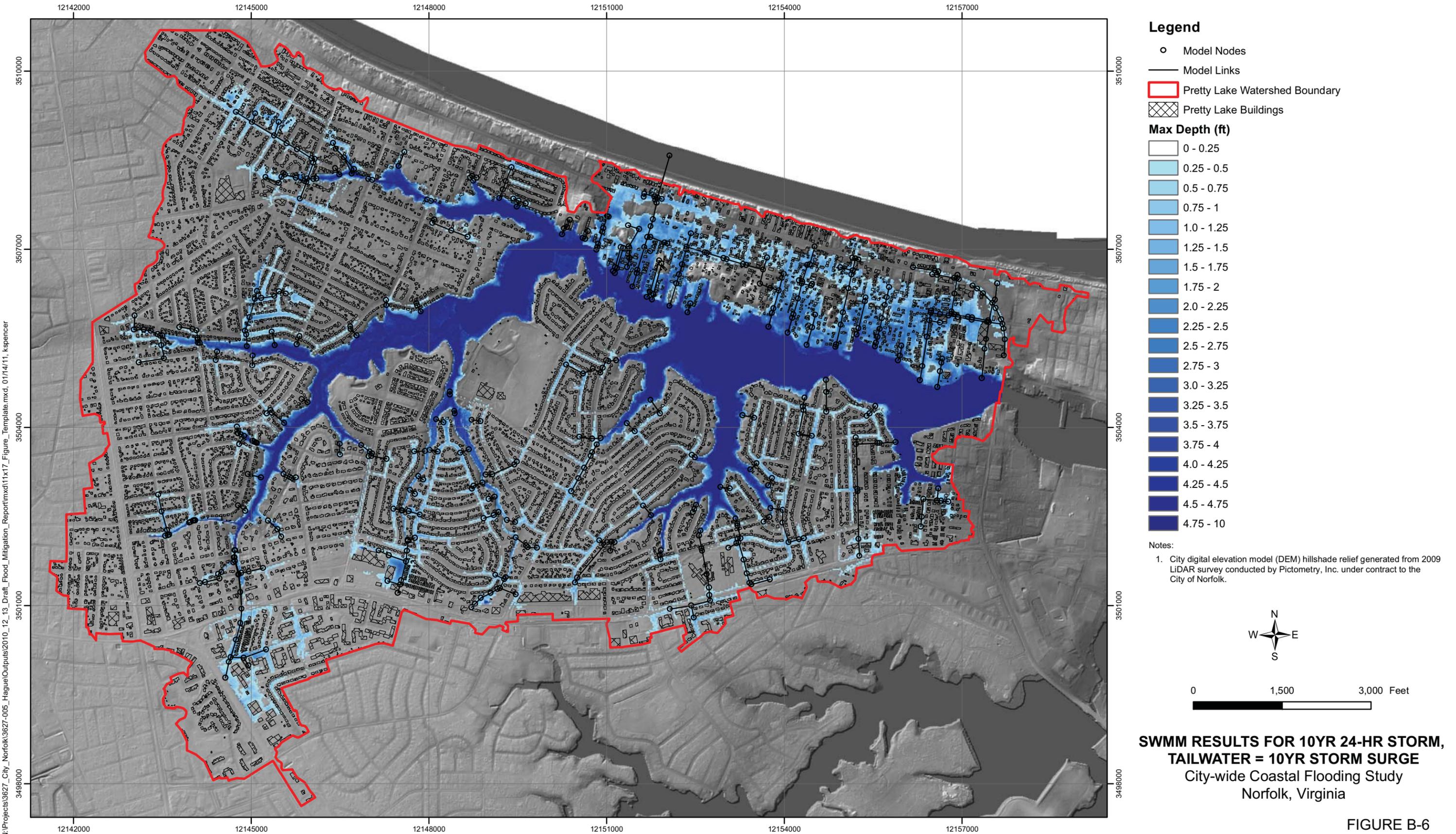


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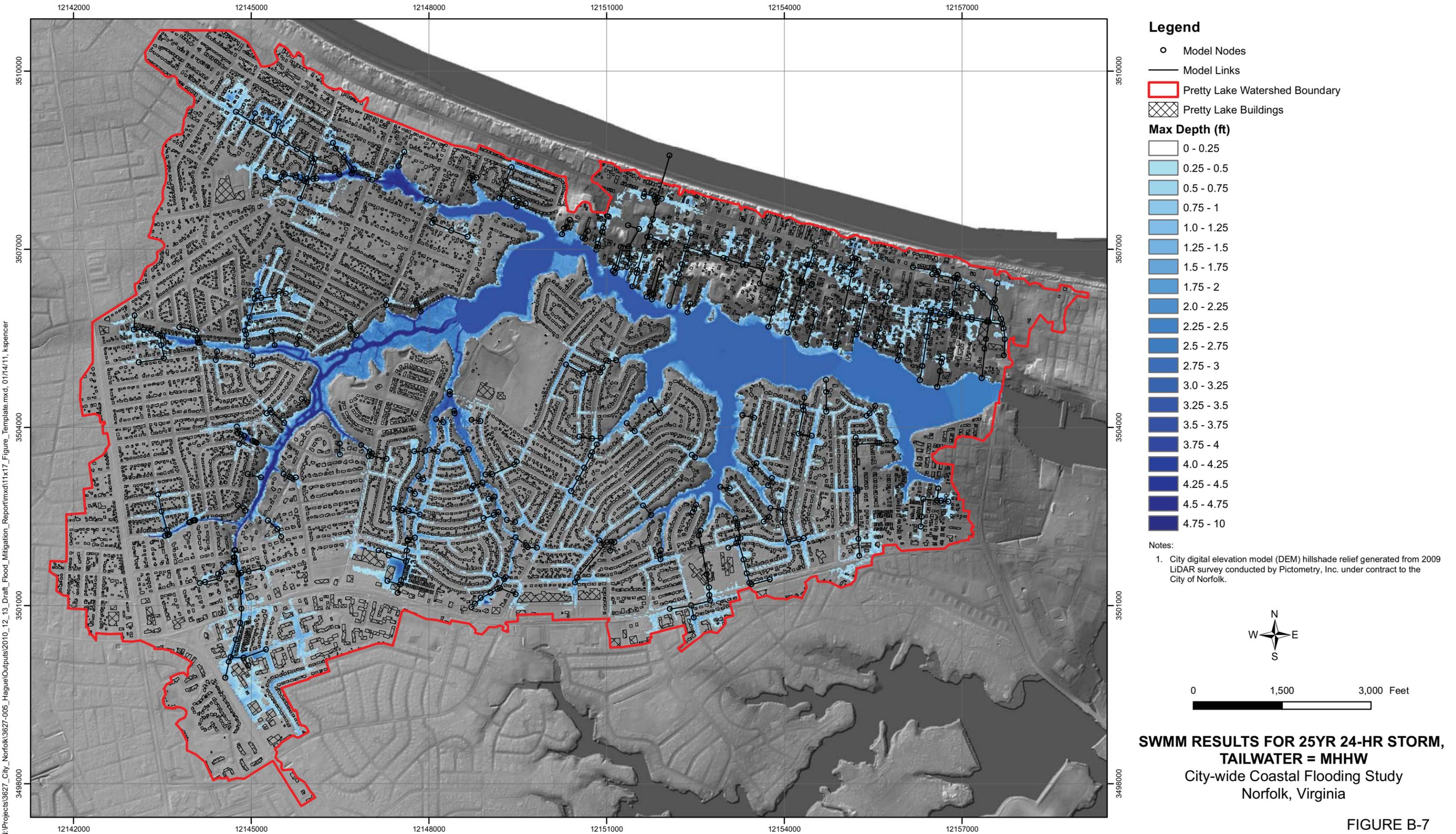


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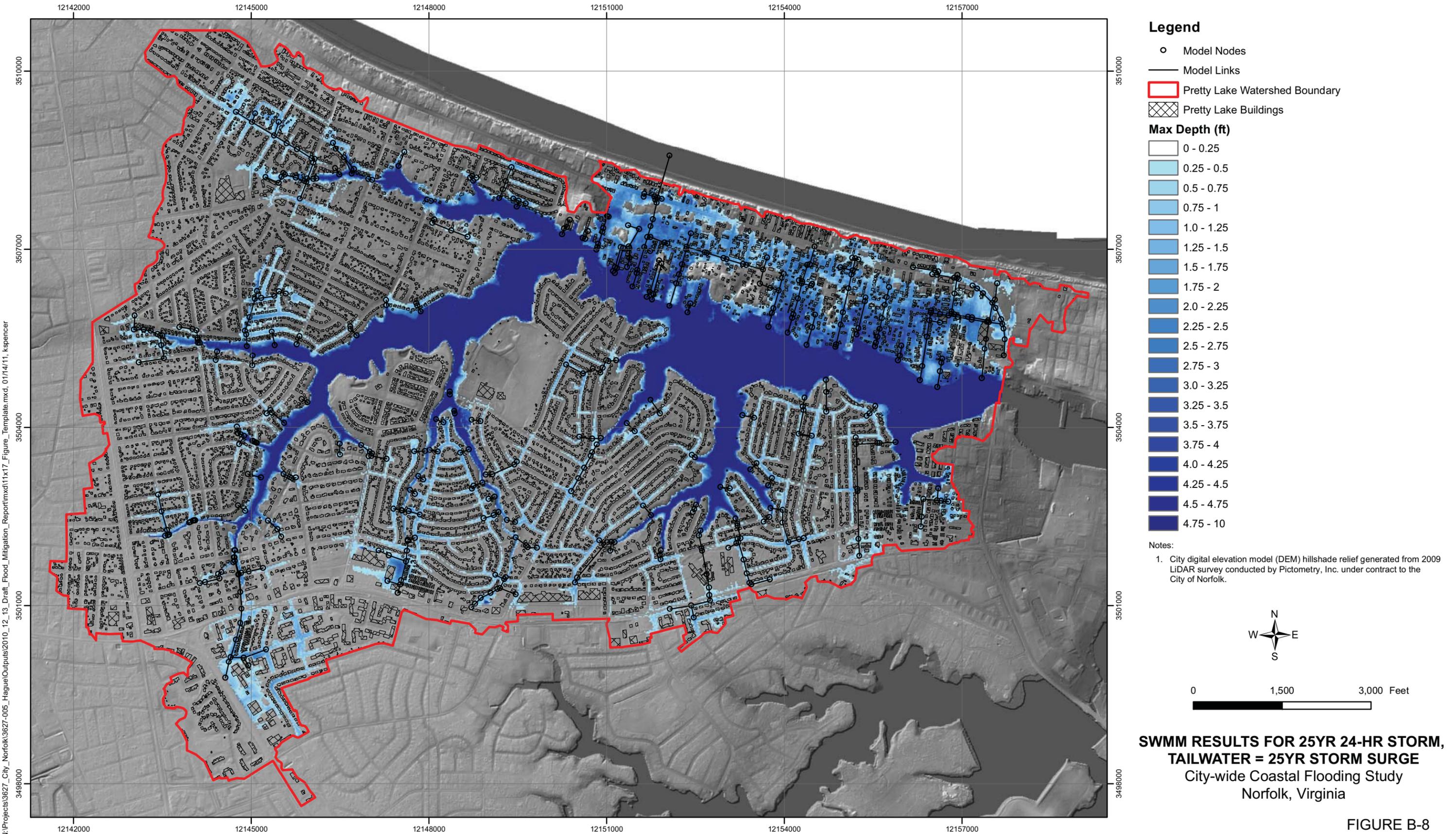


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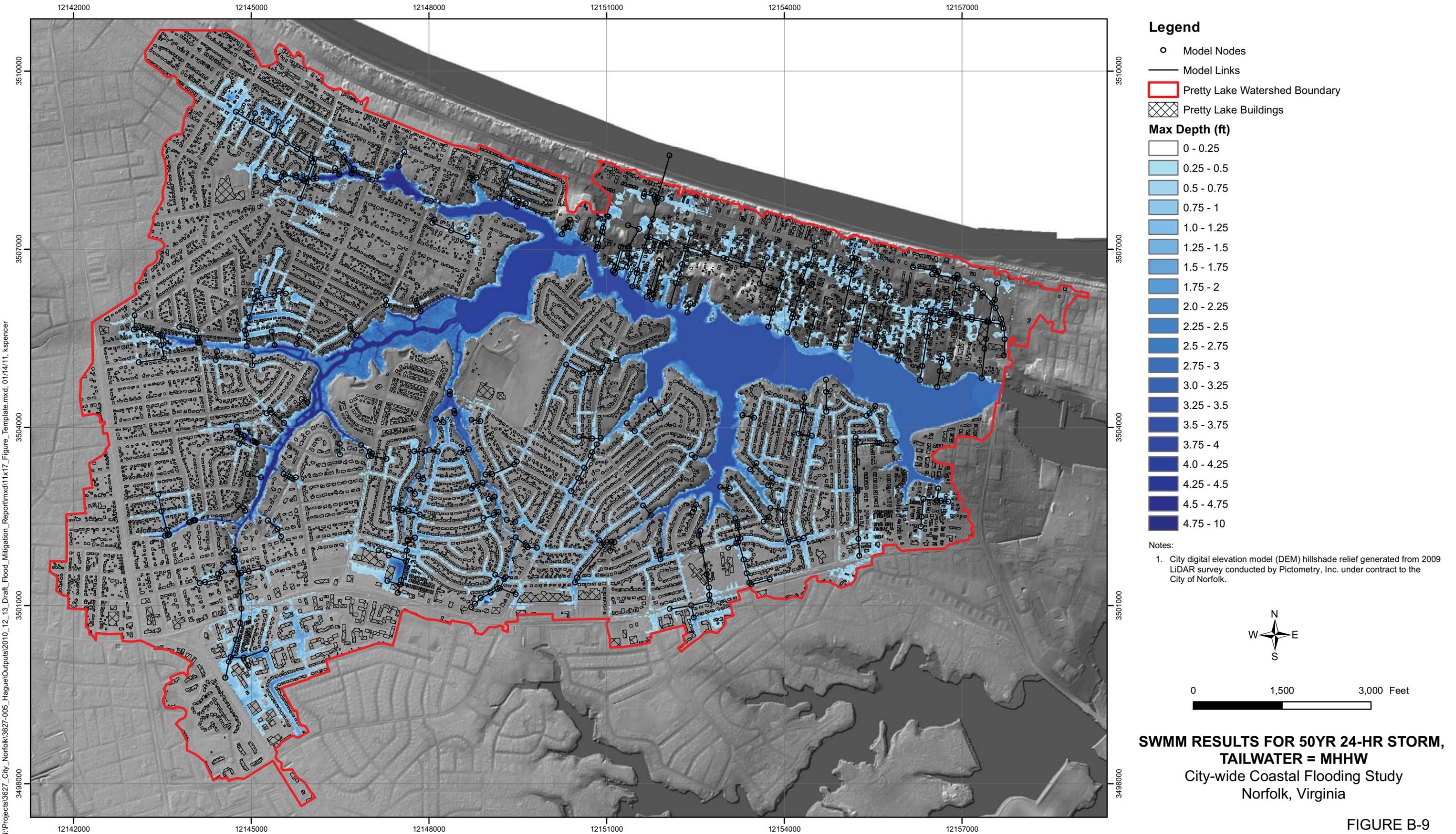


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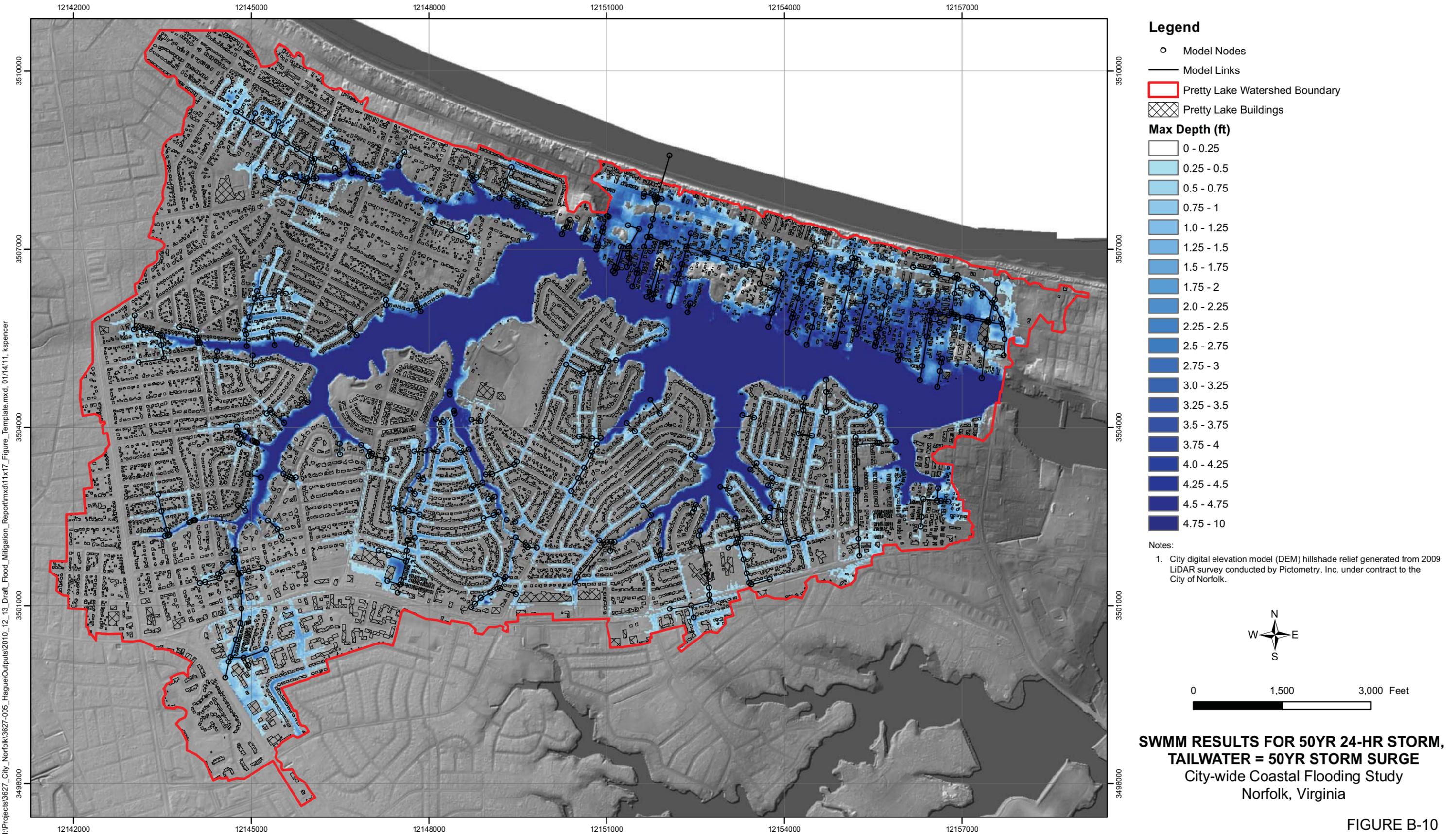


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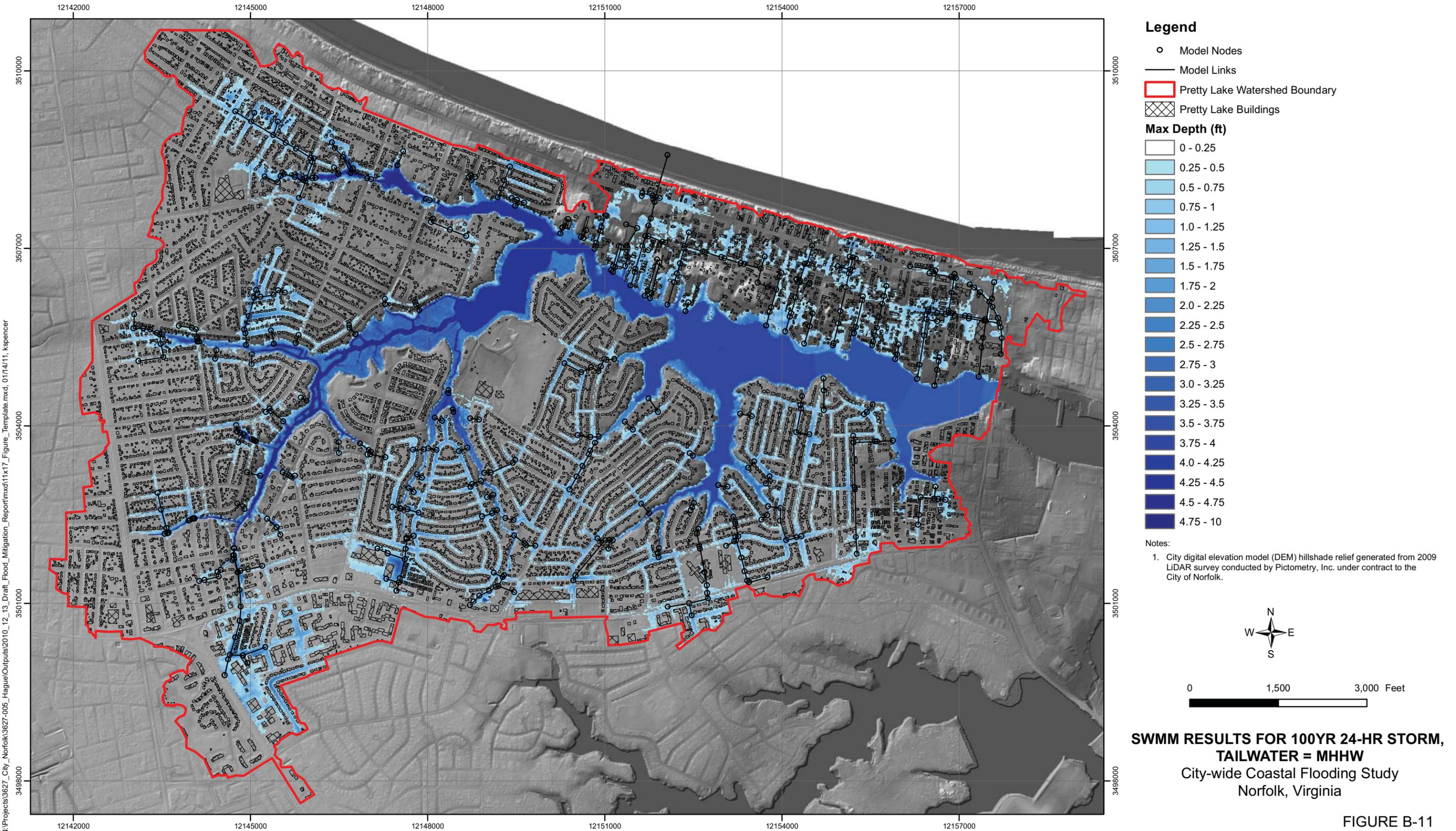
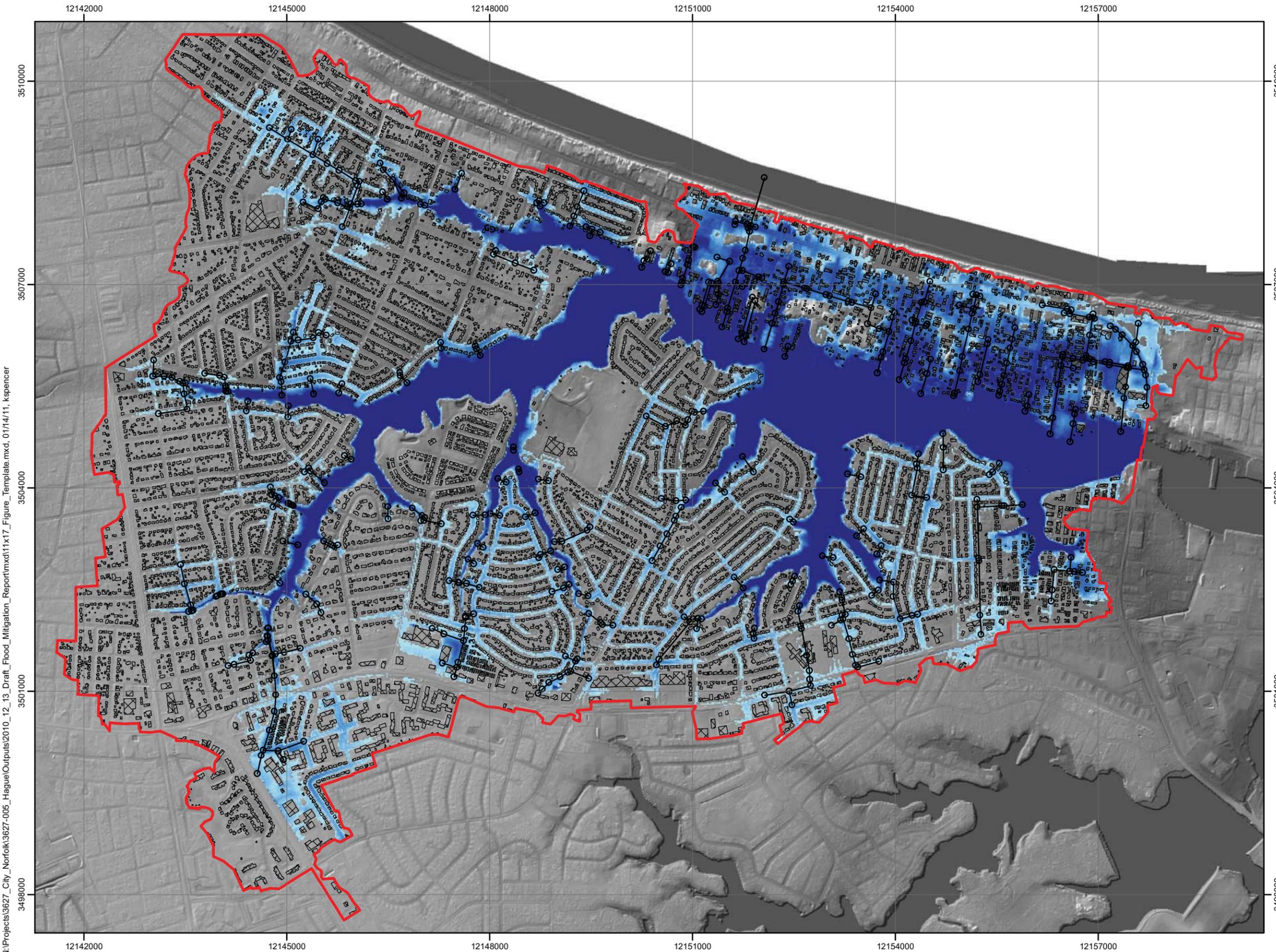


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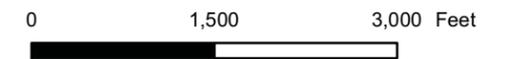
**Legend**

- Model Nodes
- Model Links
- ▭ Pretty Lake Watershed Boundary
- ▨ Pretty Lake Buildings

**Max Depth (ft)**

- 0 - 0.25
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- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3.0 - 3.25
- 3.25 - 3.5
- 3.5 - 3.75
- 3.75 - 4
- 4.0 - 4.25
- 4.25 - 4.5
- 4.5 - 4.75
- 4.75 - 10

Notes:  
 1. City digital elevation model (DEM) hillshade relief generated from 2009 LIDAR survey conducted by Pictometry, Inc. under contract to the City of Norfolk.



**SWMM RESULTS FOR 100YR 24-HR STORM,  
 TAILWATER = 100YR STORM SURGE**  
 City-wide Coastal Flooding Study  
 Norfolk, Virginia

FIGURE B-12

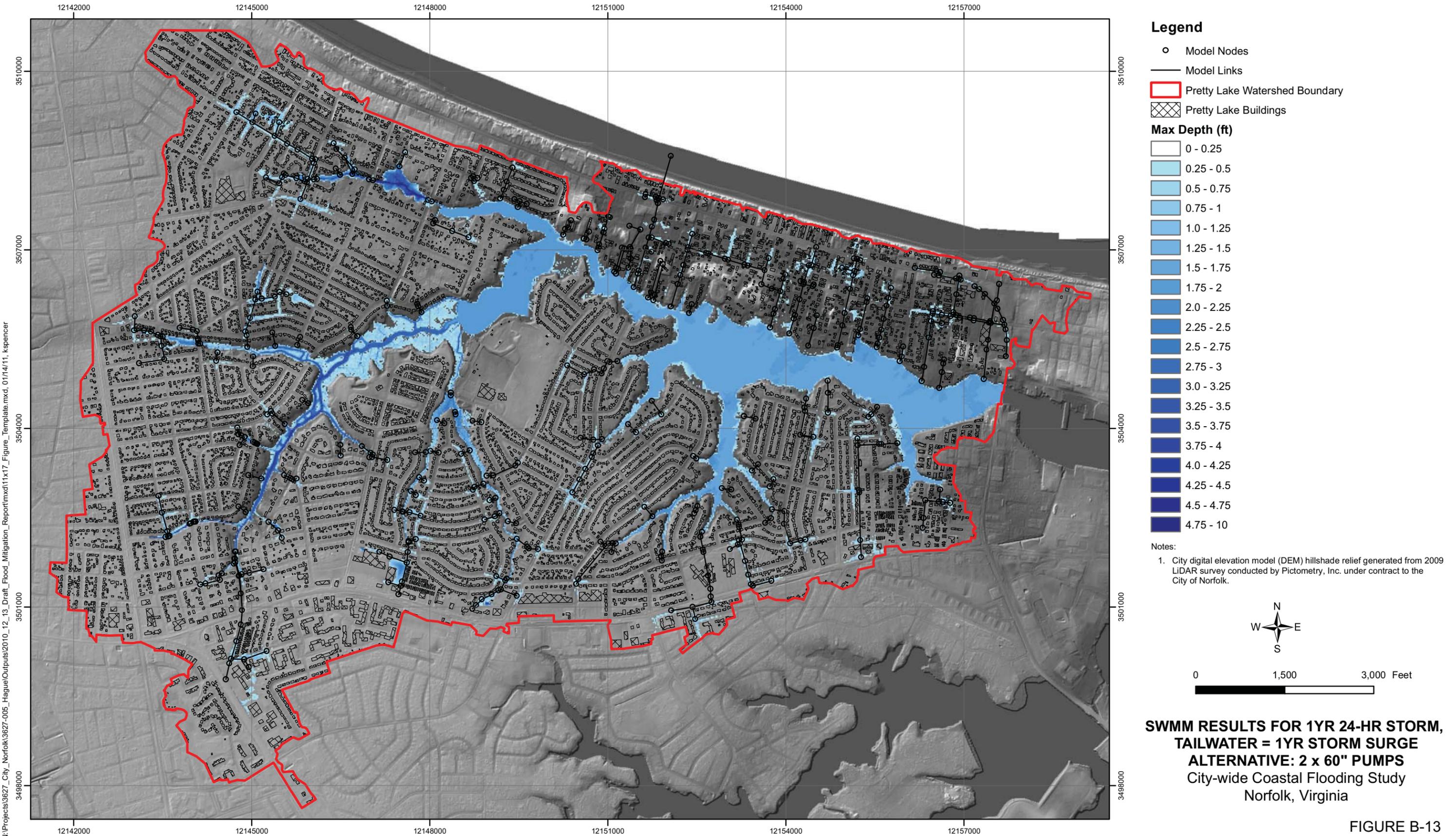


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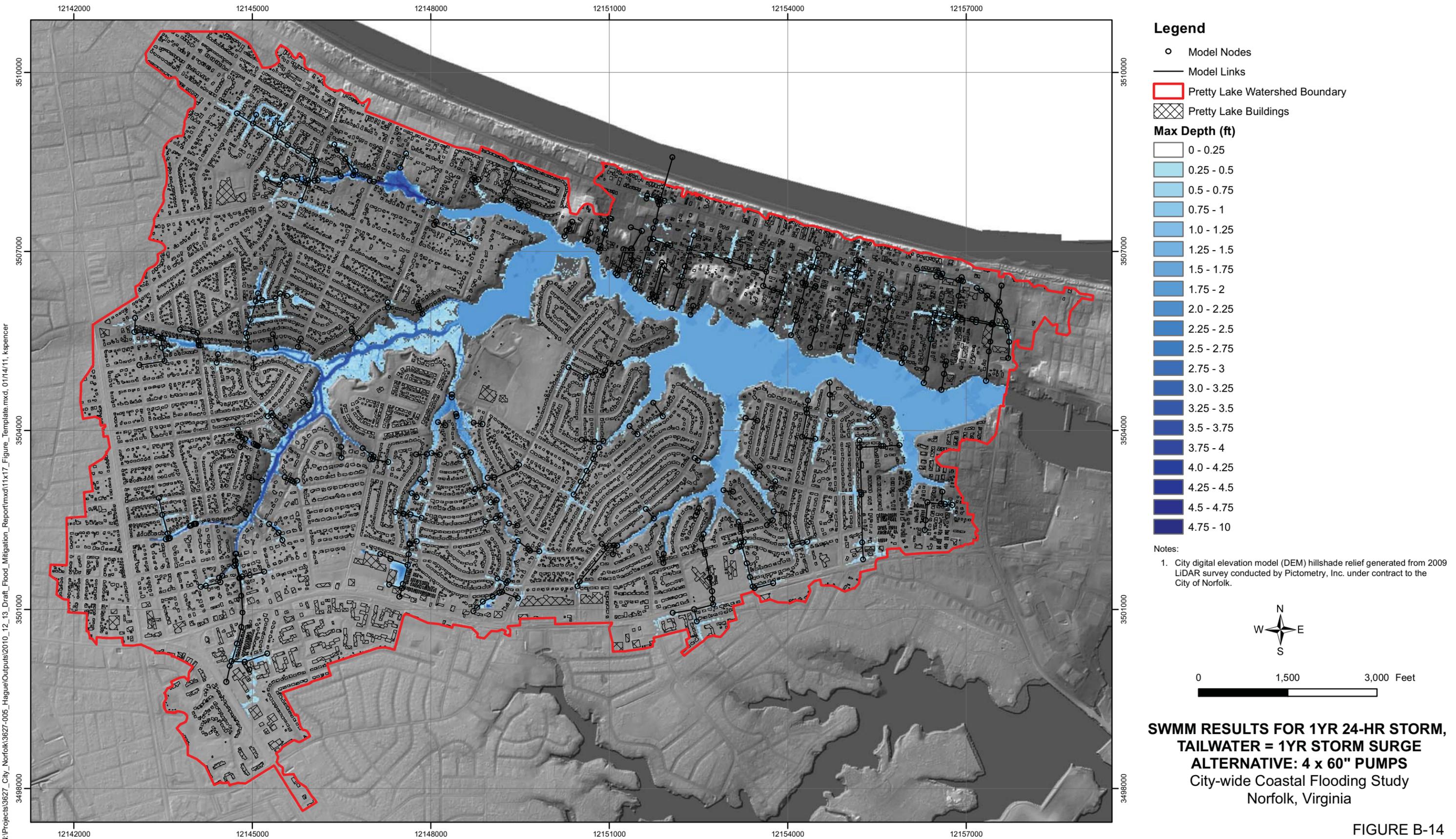


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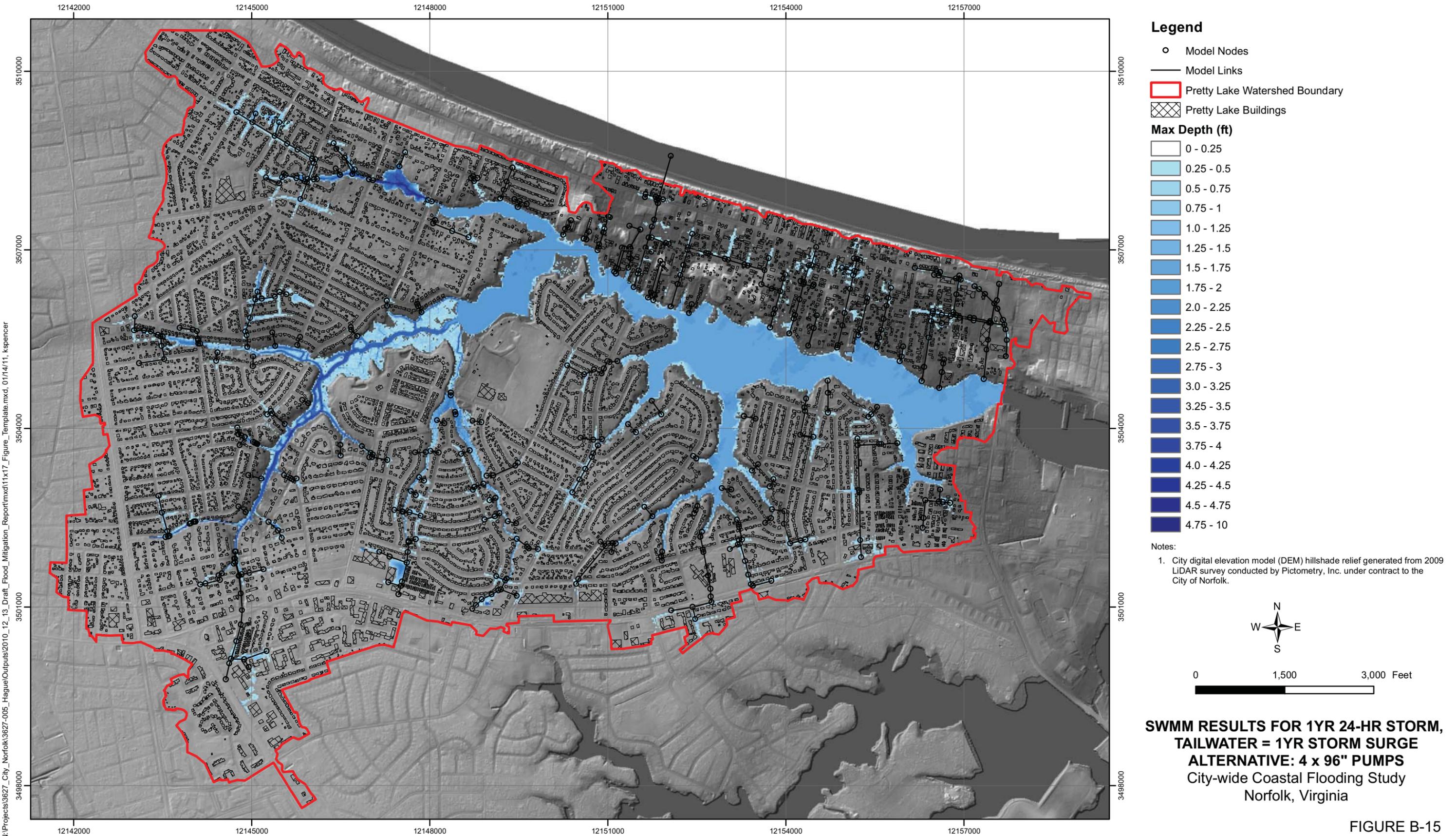


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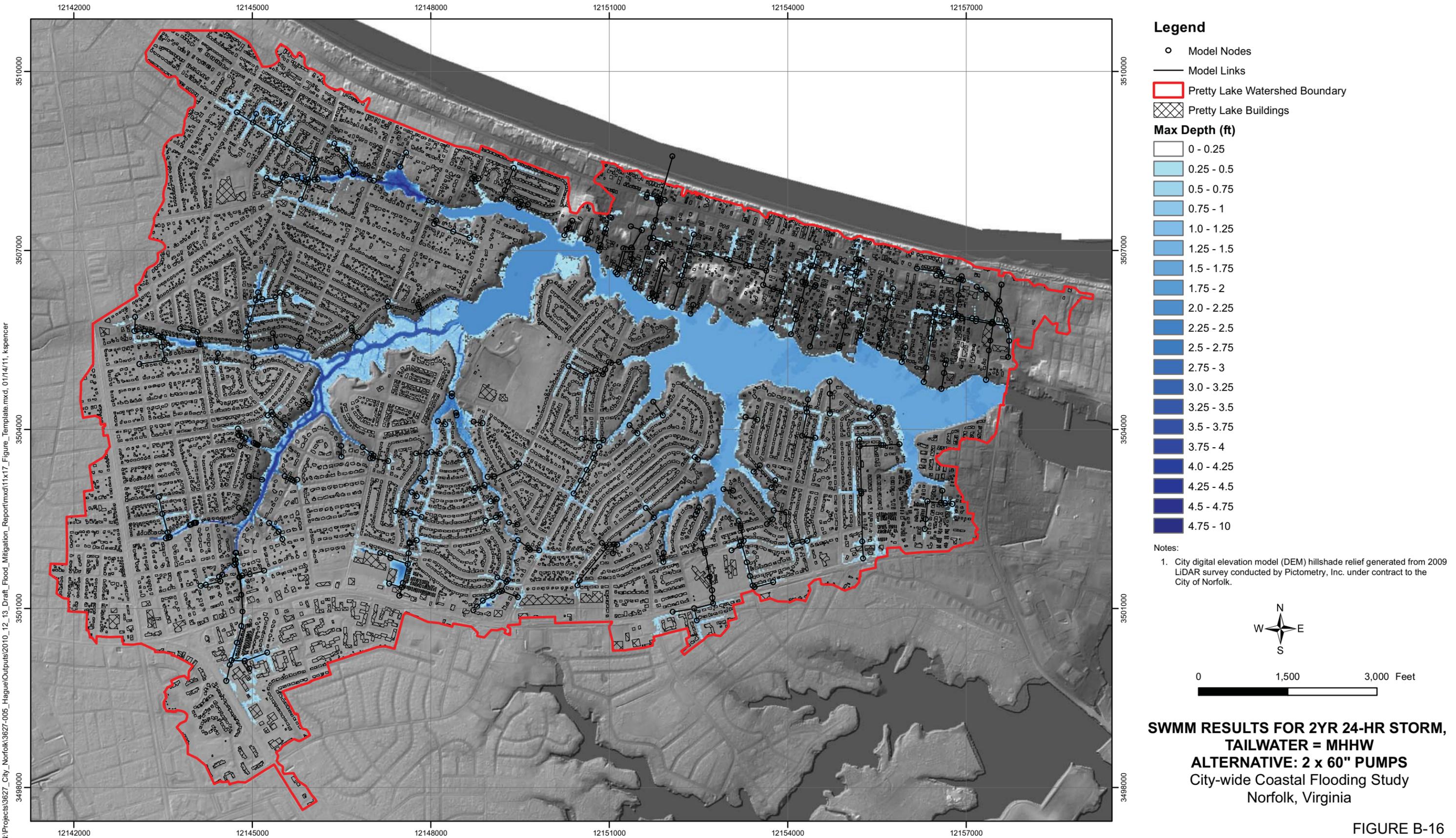


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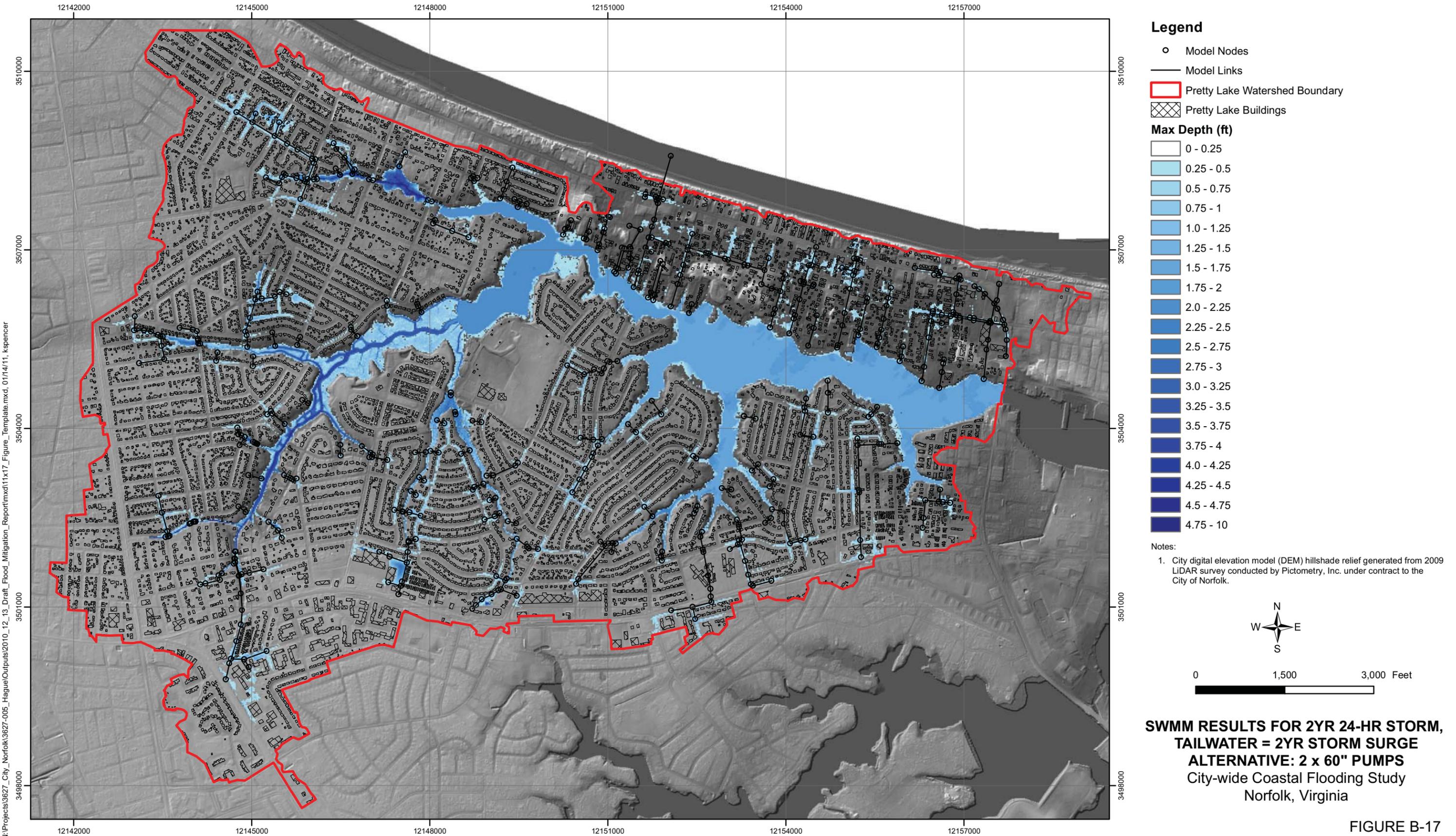


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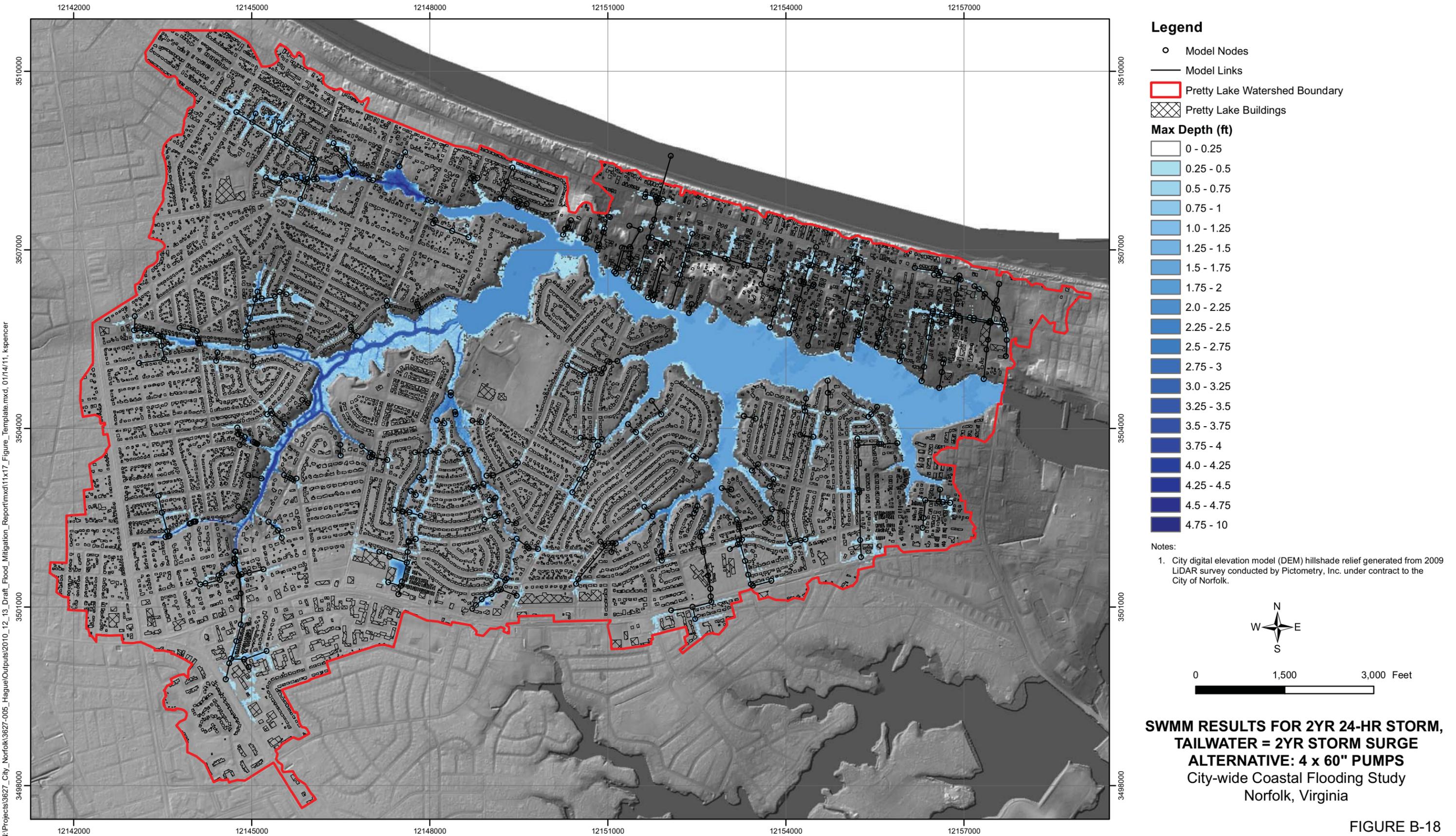


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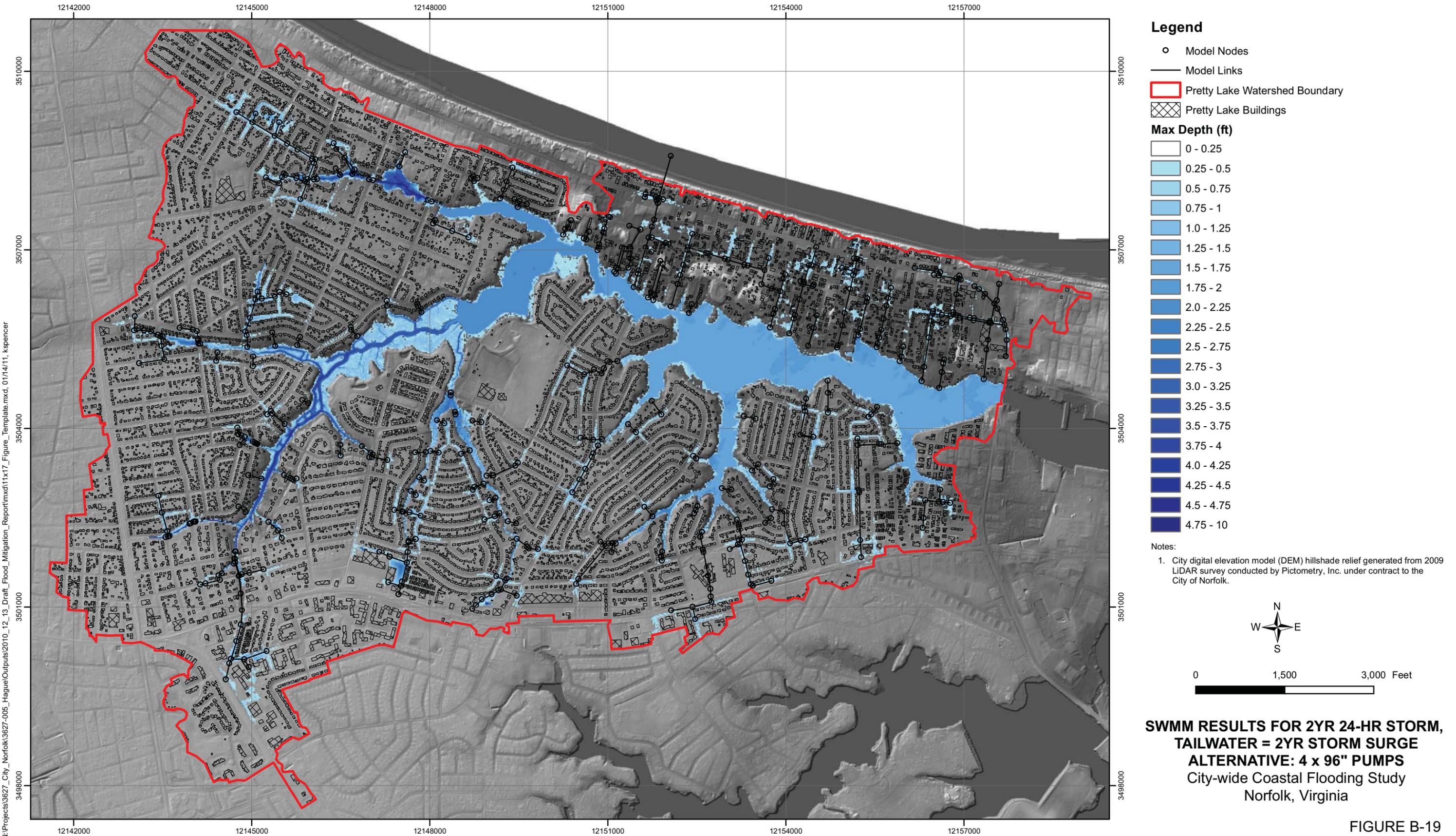


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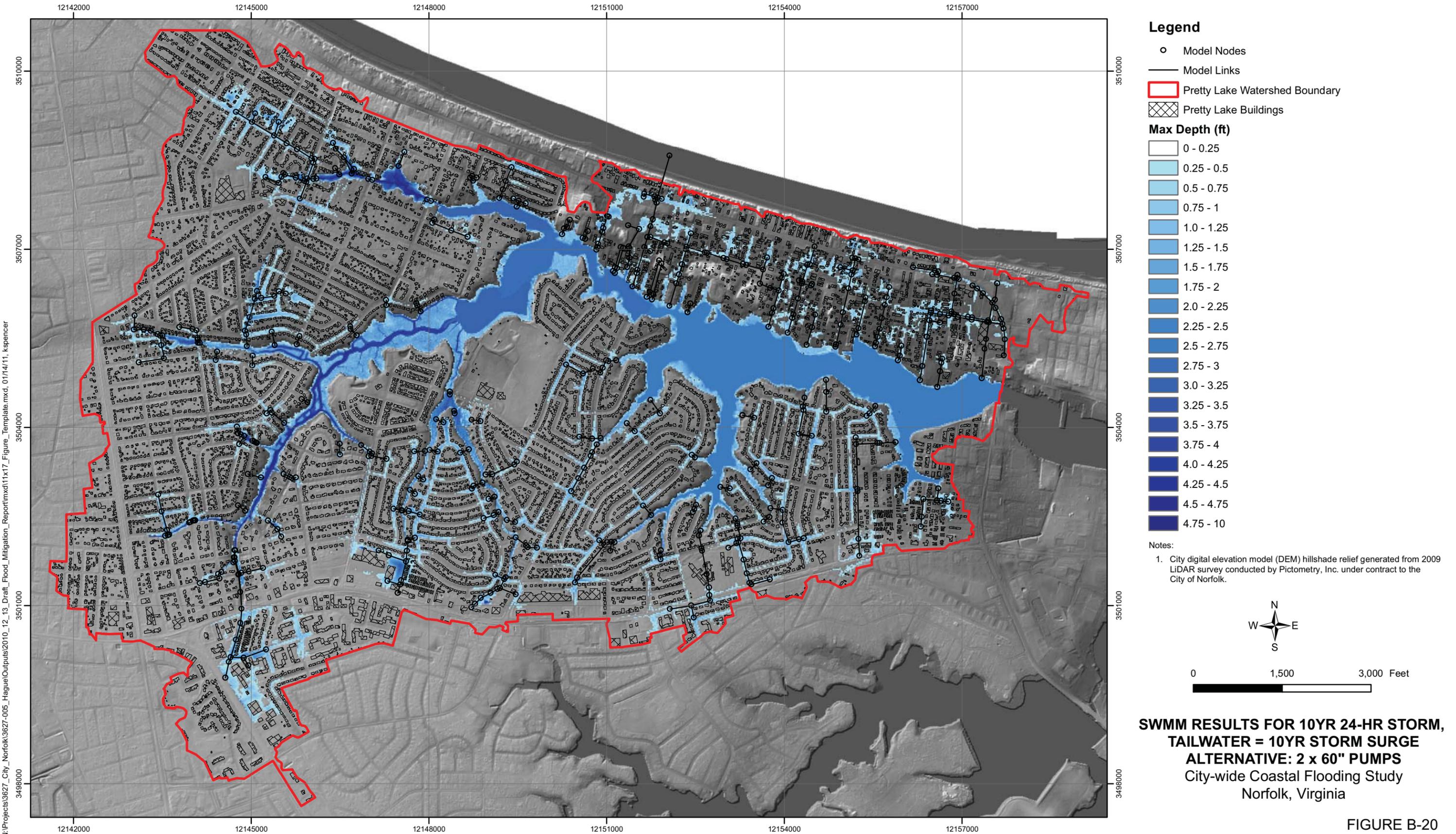


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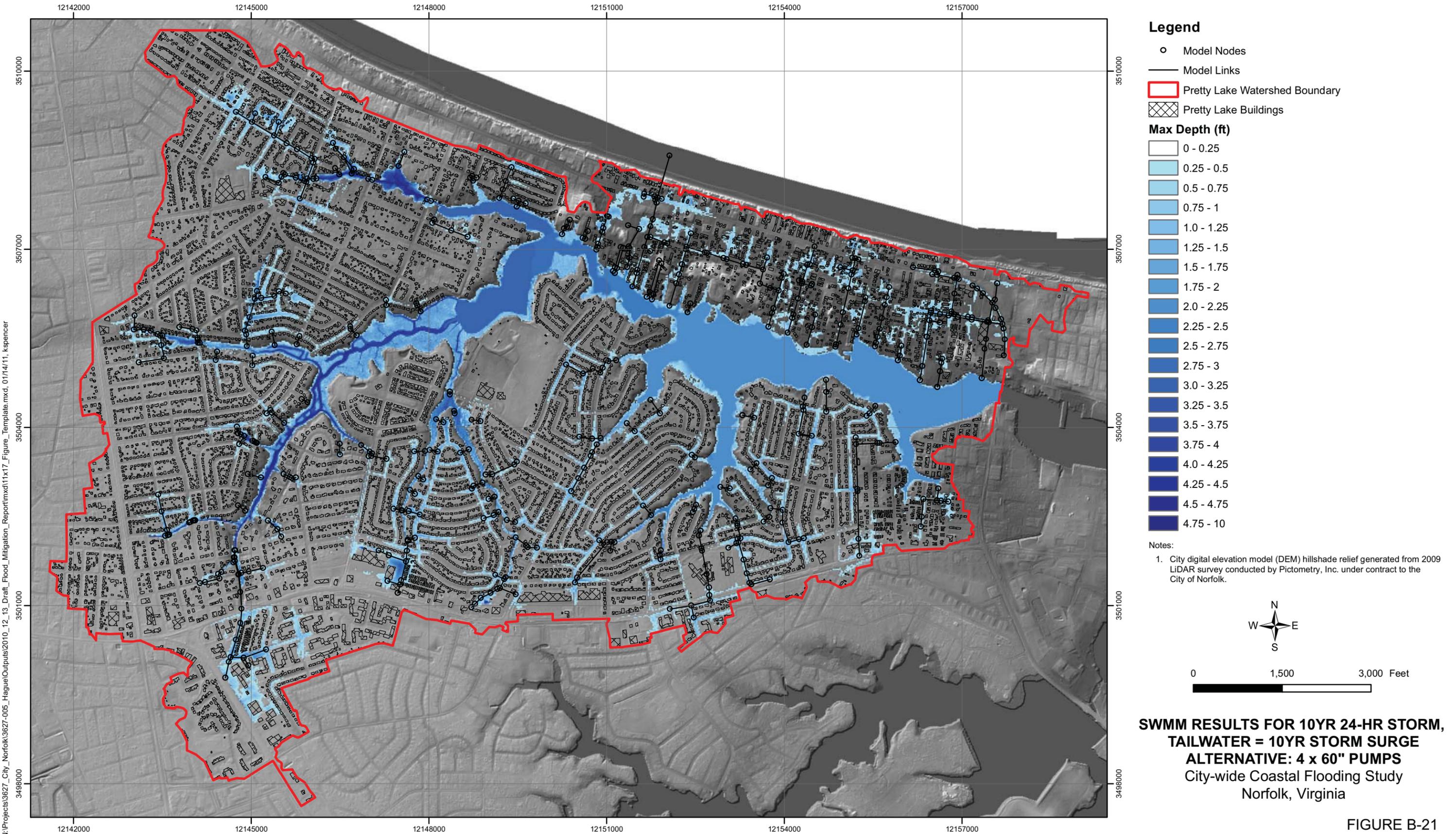


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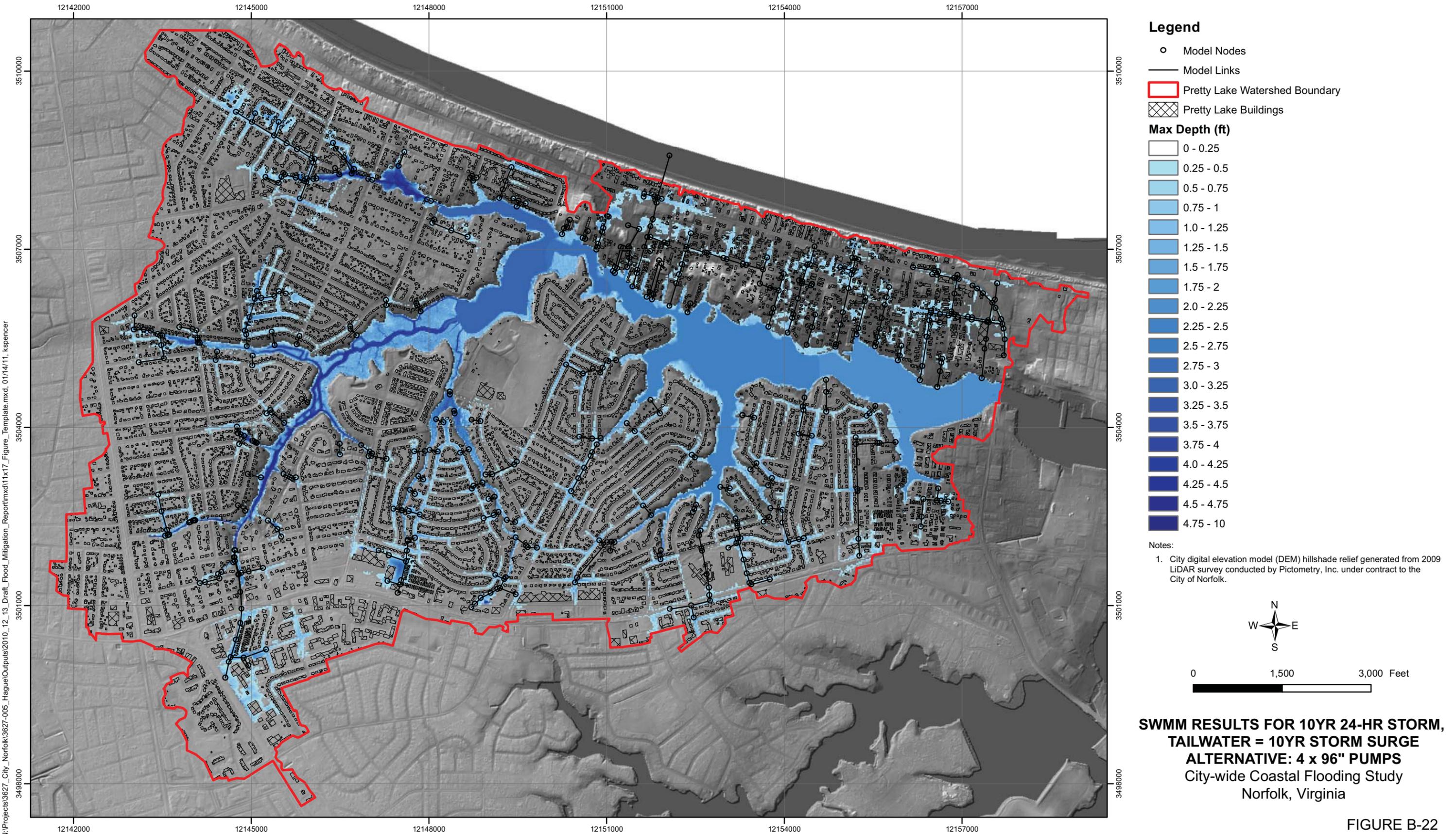


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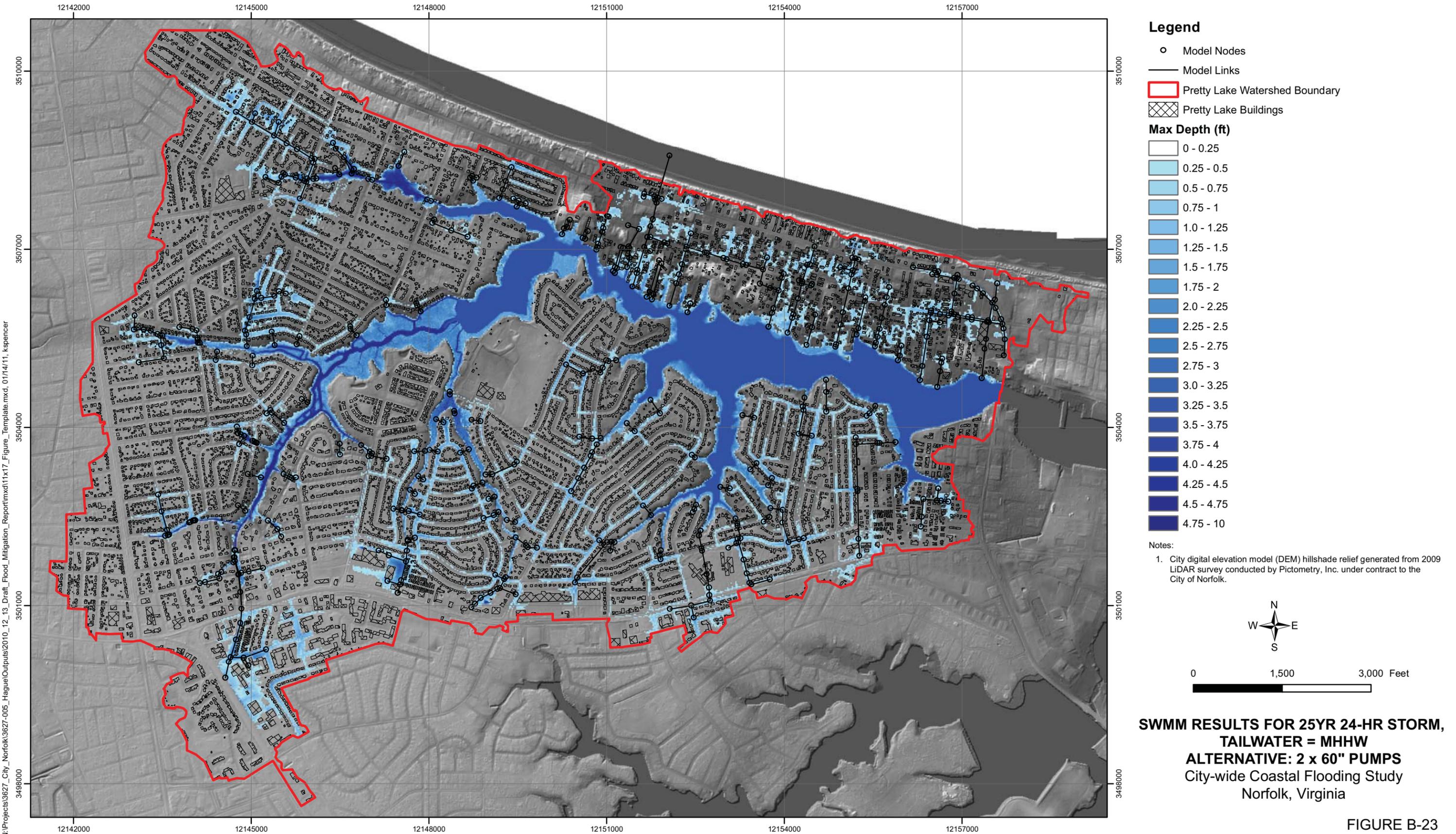


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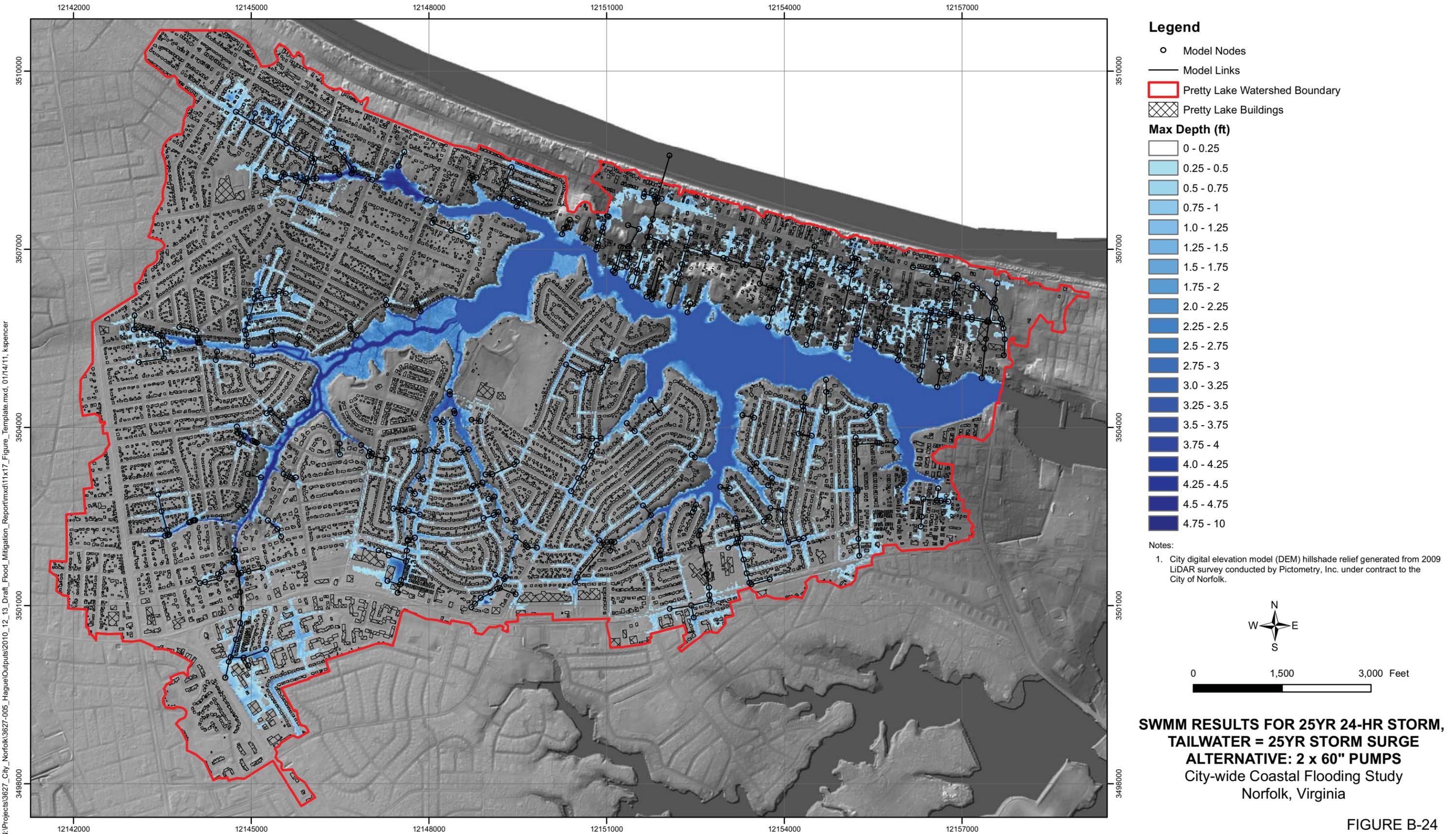


FIGURE B-24

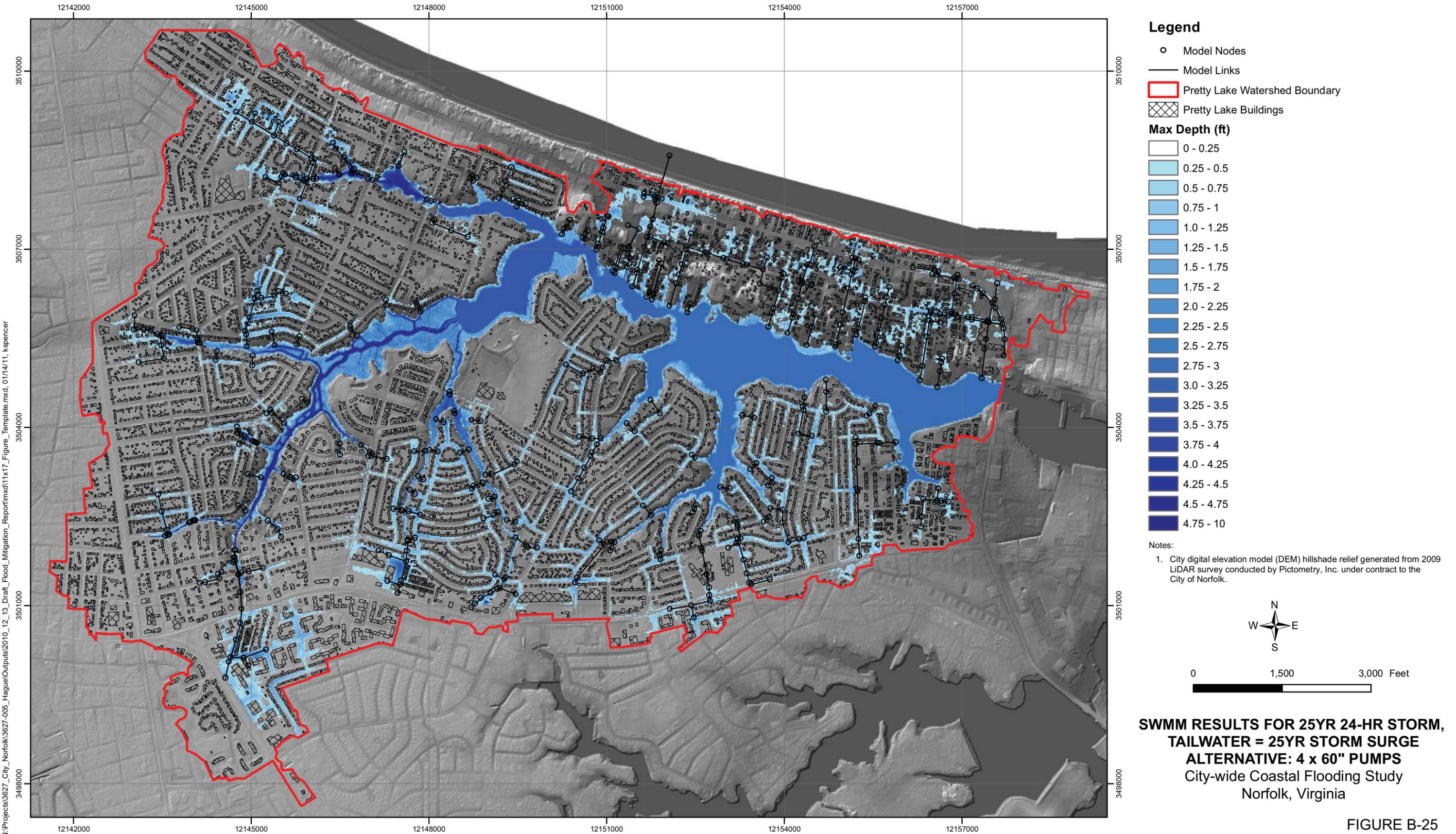


FIGURE B-25

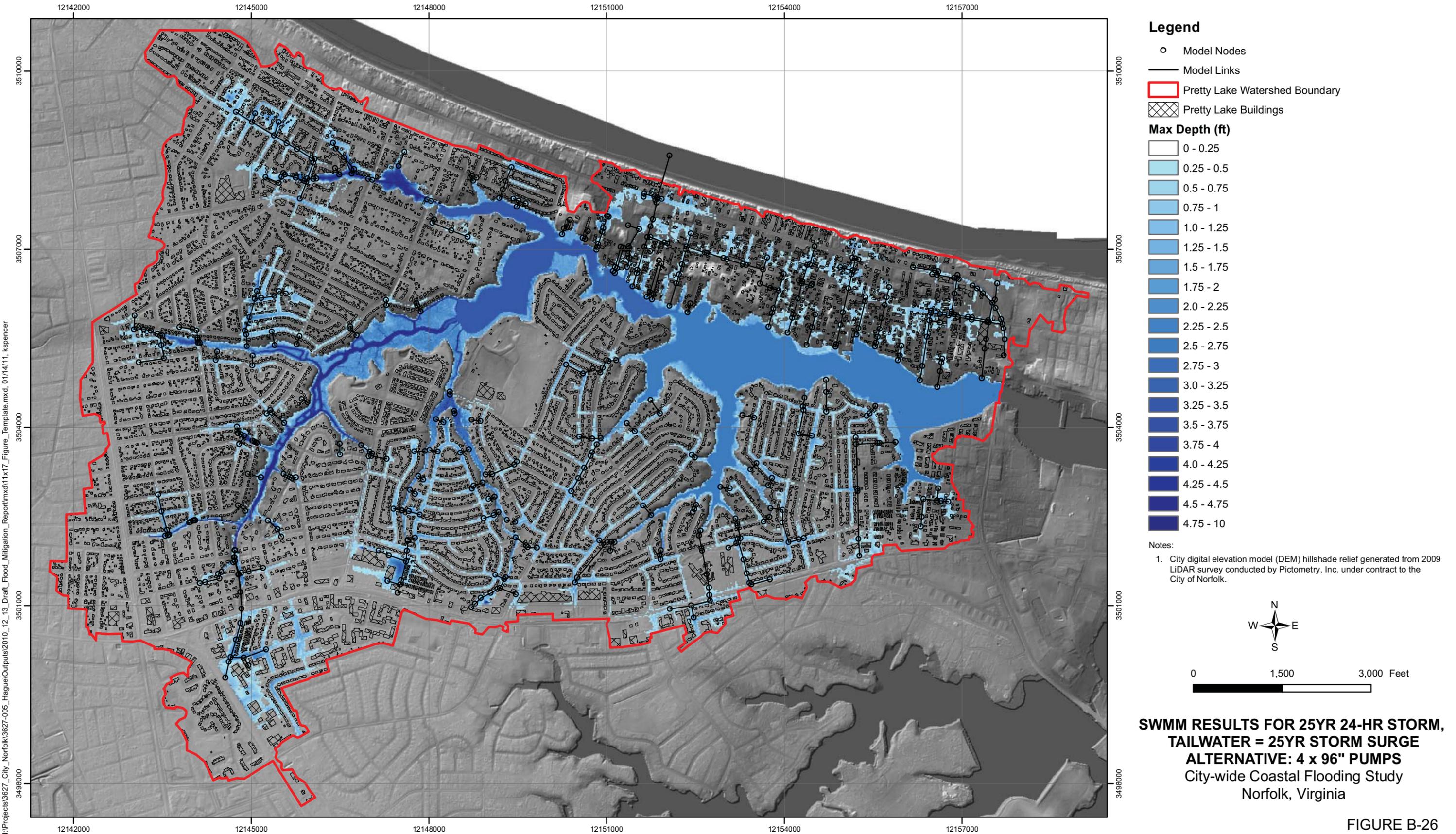


FIGURE B-26

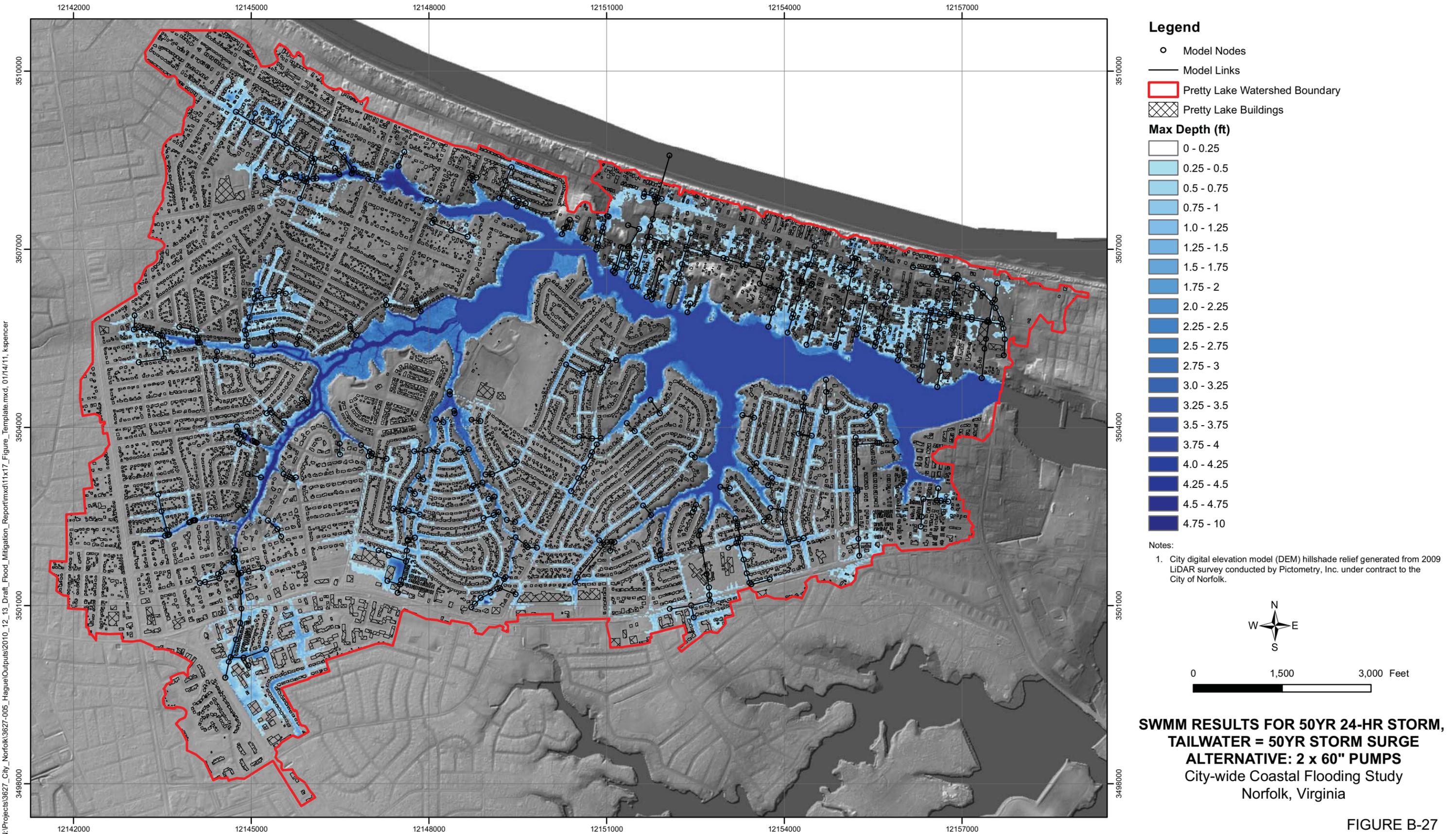


FIGURE B-27

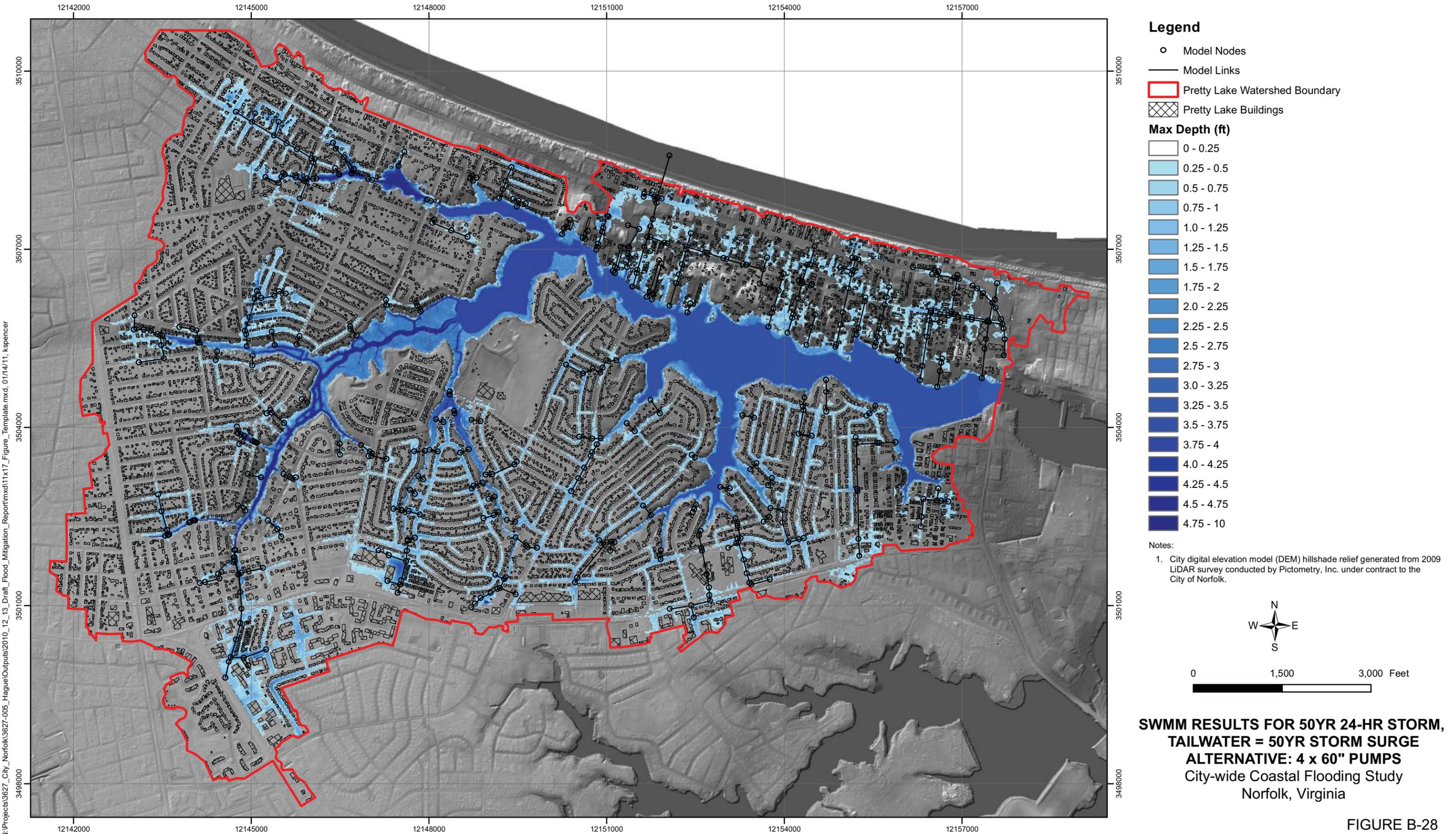


FIGURE B-28

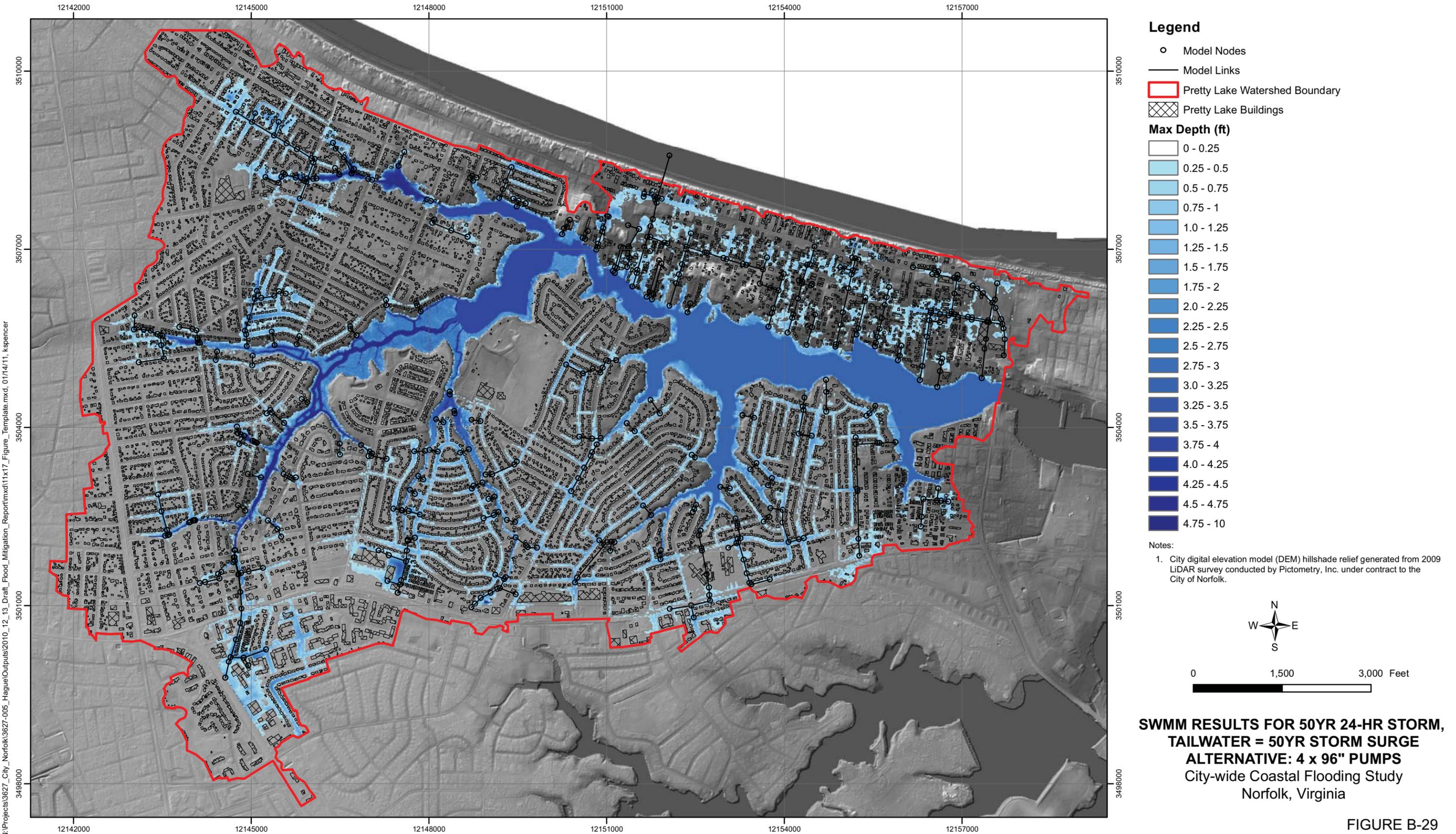


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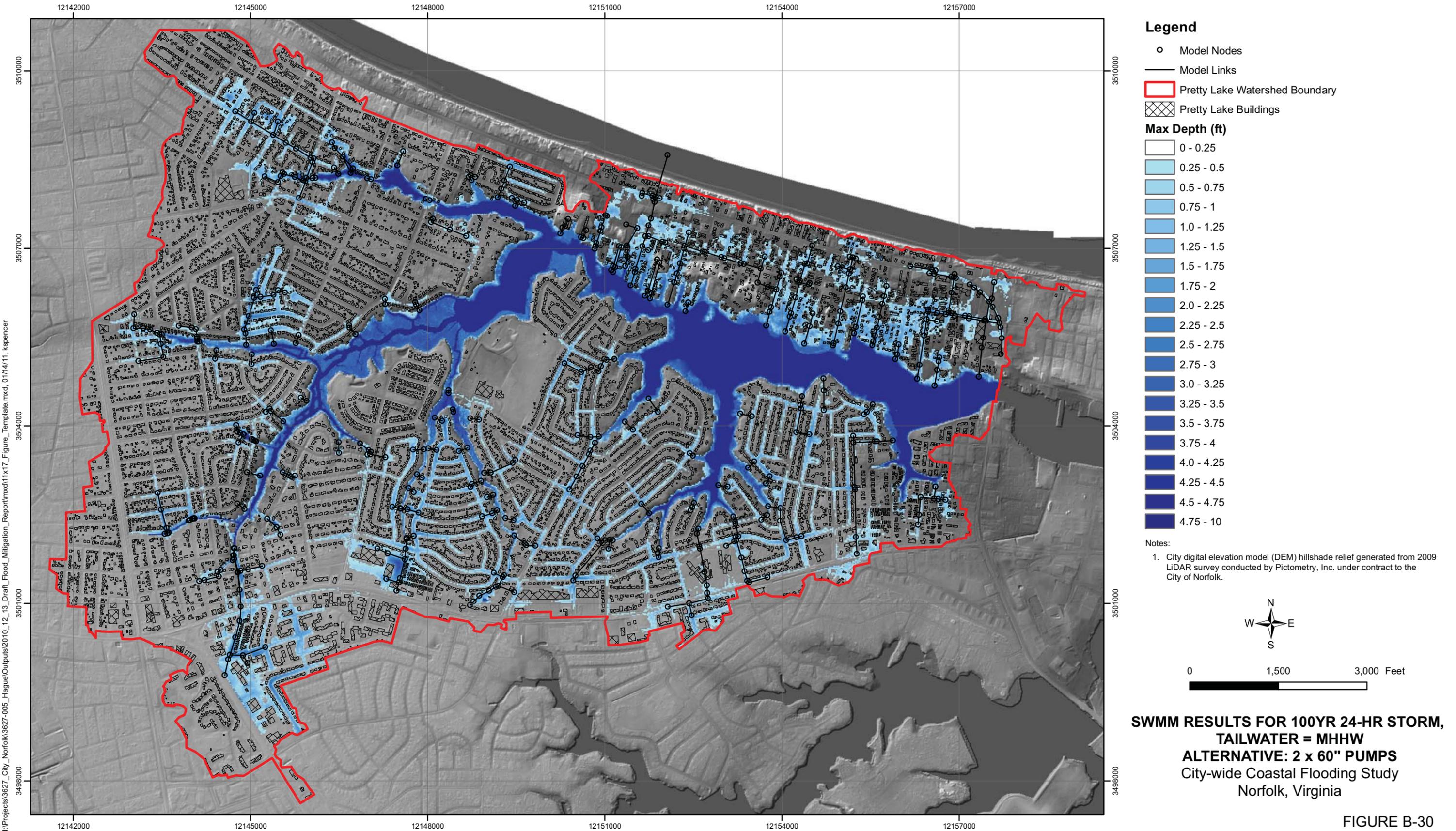


FIGURE B-30



FIGURE B-31



FIGURE B-32

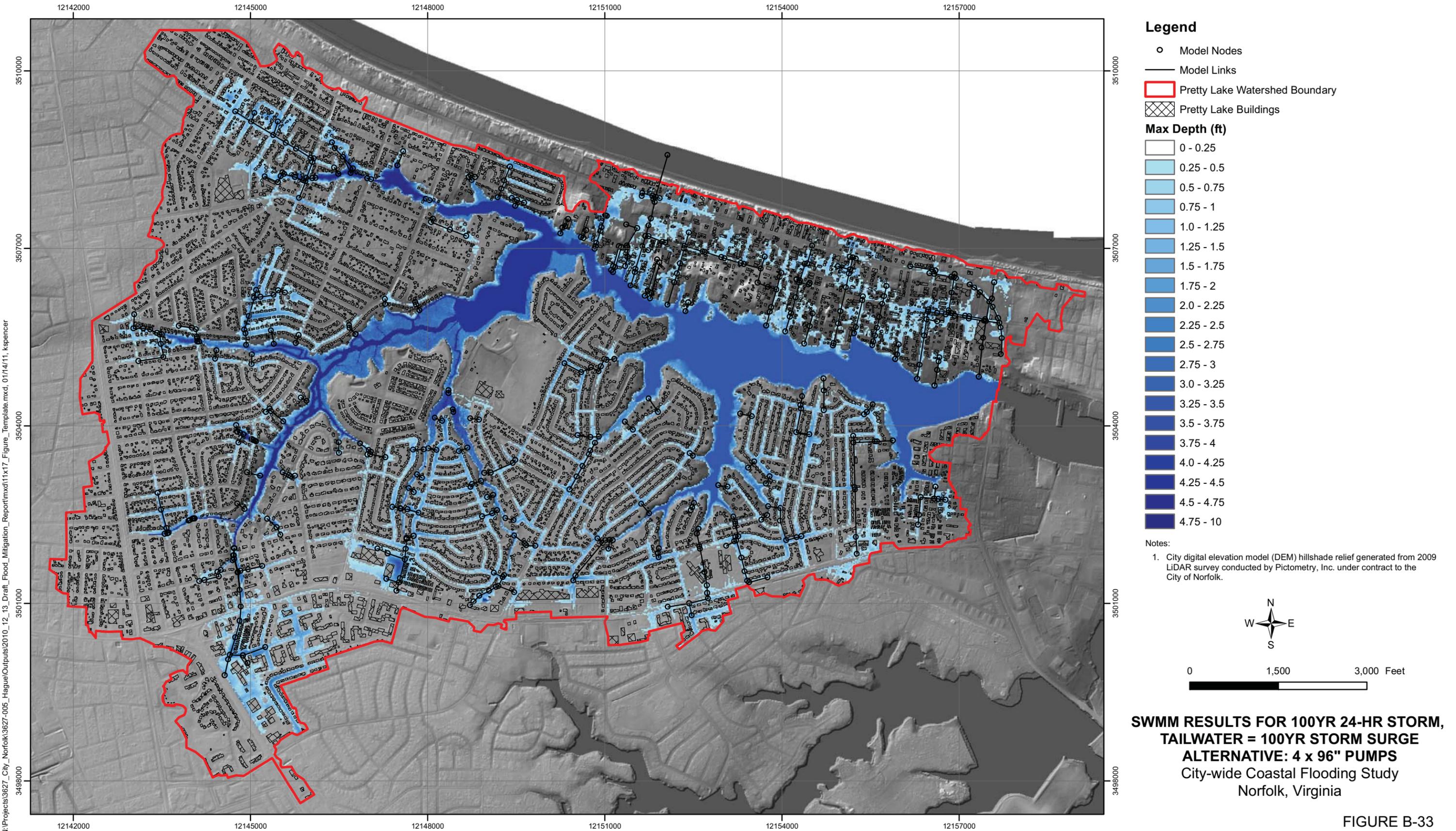


FIGURE B-33

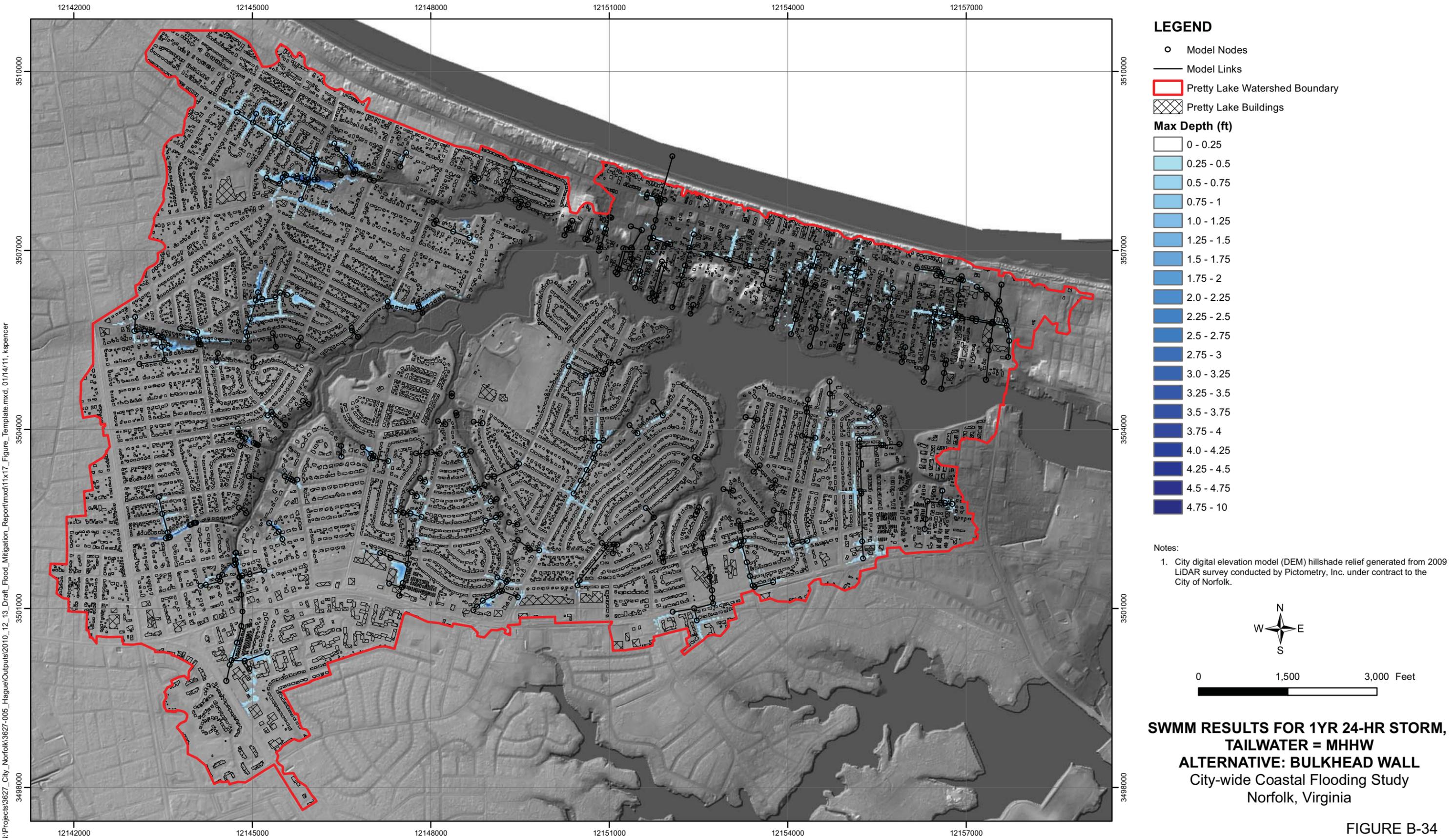


FIGURE B-34

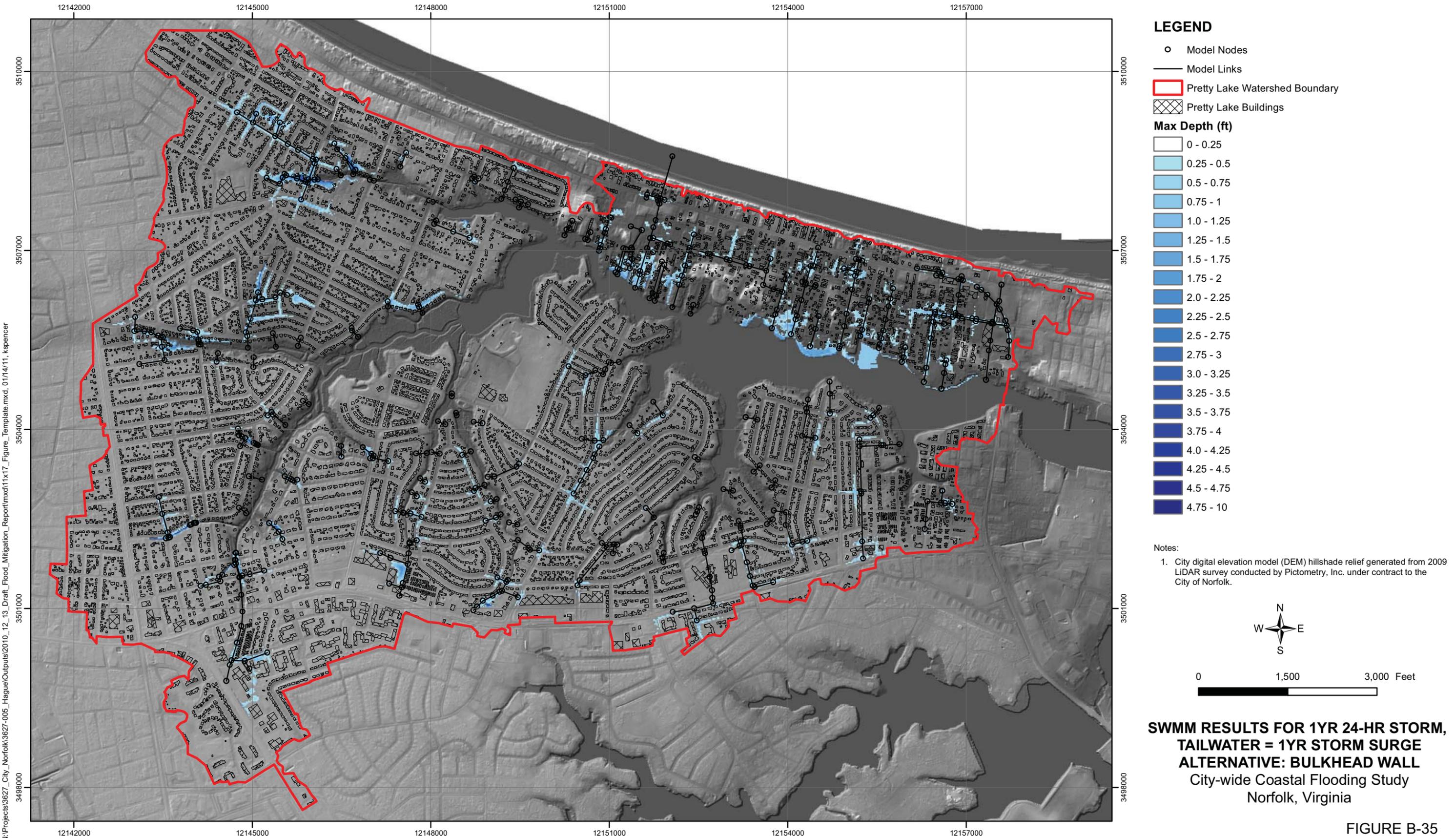


FIGURE B-35

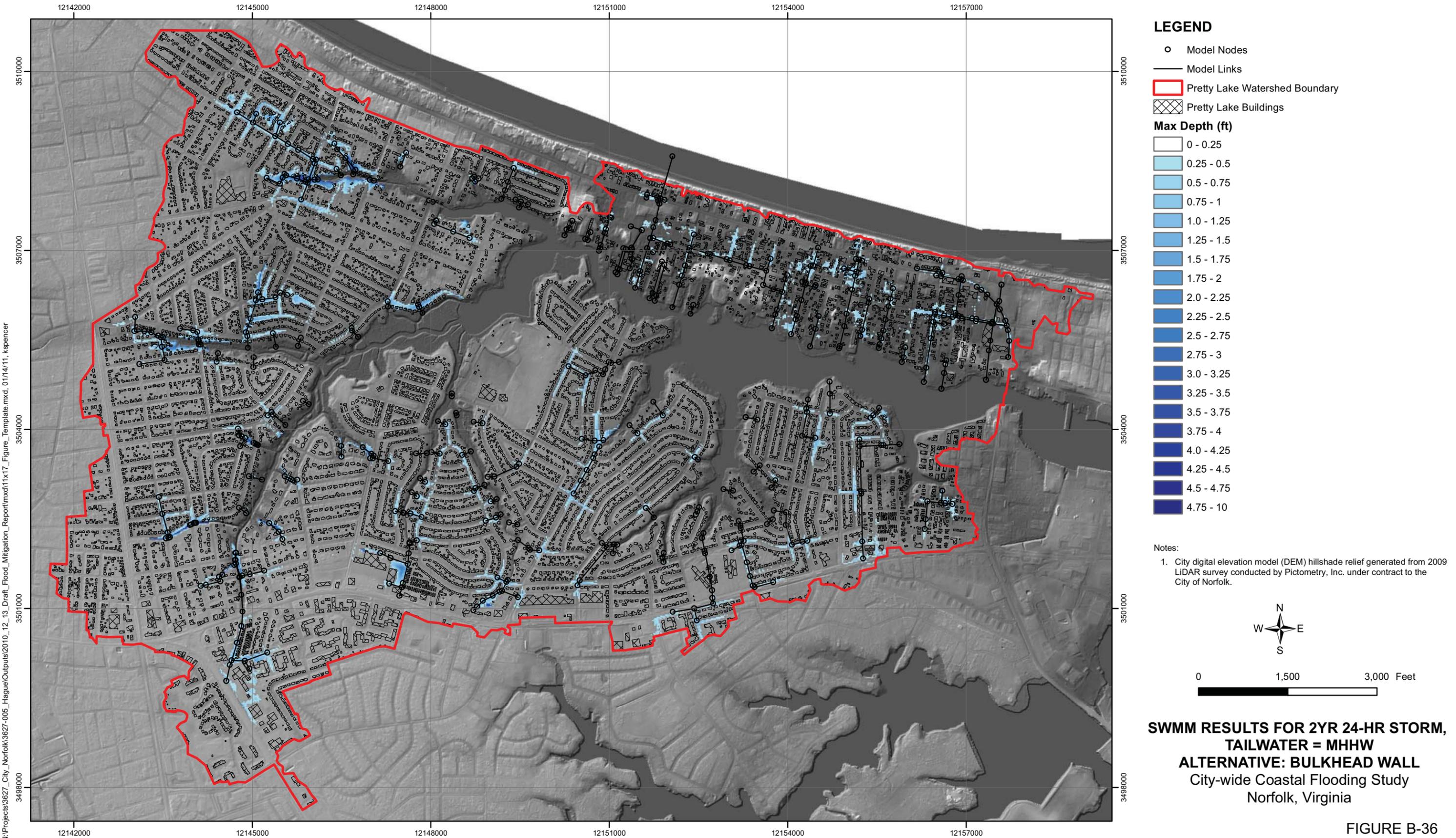


FIGURE B-36

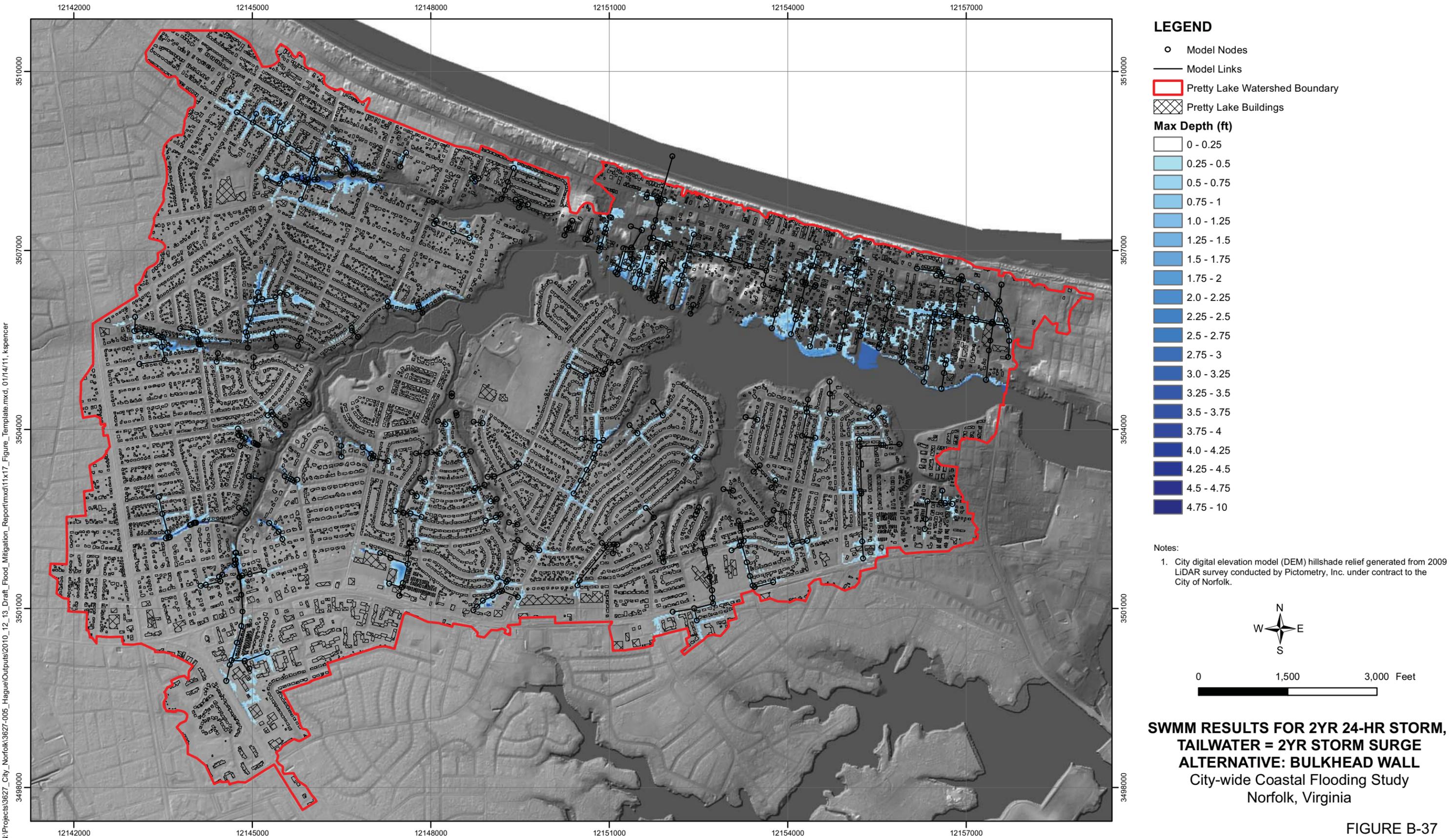
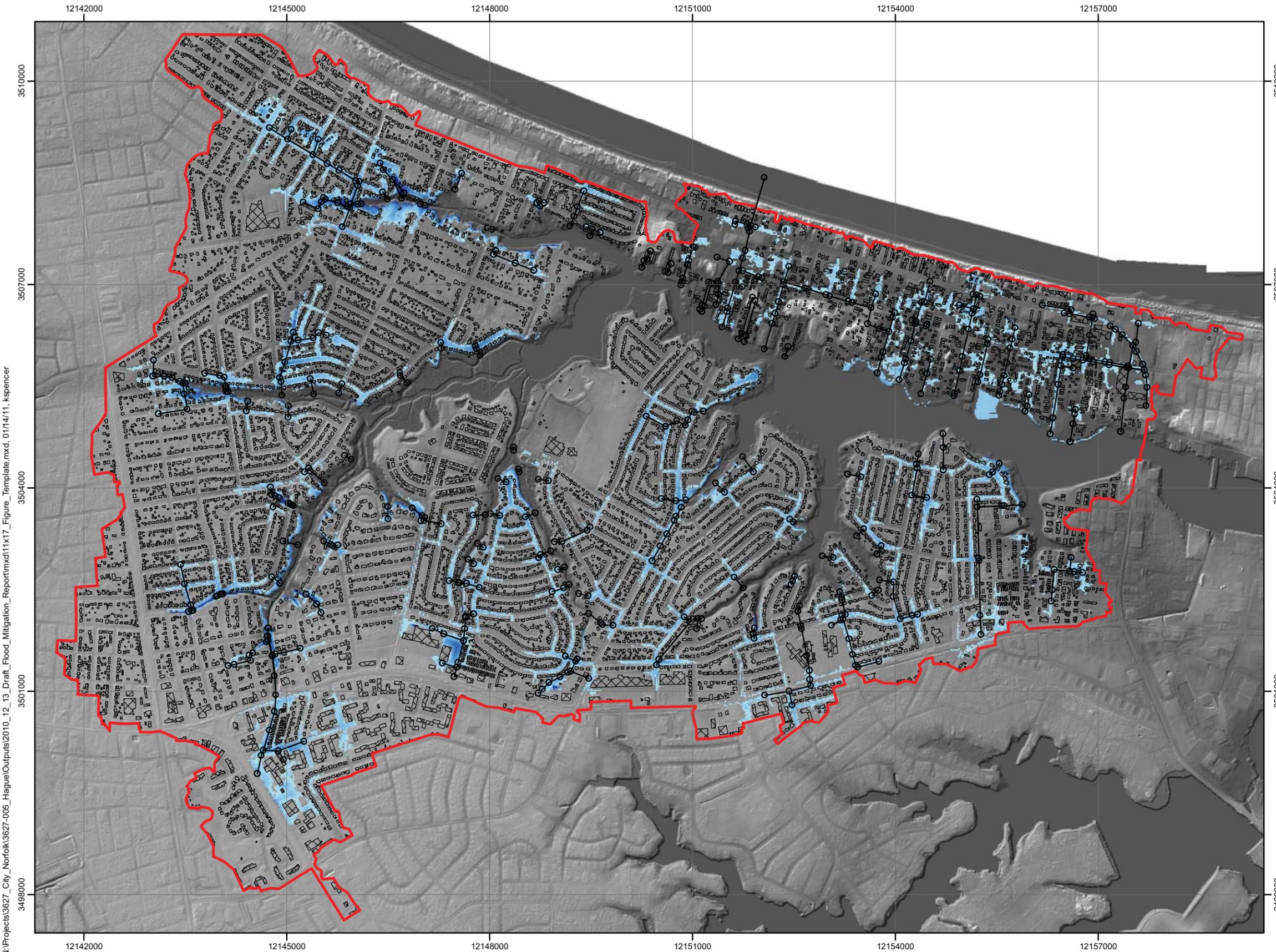


FIGURE B-37



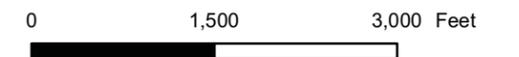
**LEGEND**

- Model Nodes
- Model Links
- ▭ Pretty Lake Watershed Boundary
- ▨ Pretty Lake Buildings

**Max Depth (ft)**

- 0 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1.0 - 1.25
- 1.25 - 1.5
- 1.5 - 1.75
- 1.75 - 2
- 2.0 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3.0 - 3.25
- 3.25 - 3.5
- 3.5 - 3.75
- 3.75 - 4
- 4.0 - 4.25
- 4.25 - 4.5
- 4.5 - 4.75
- 4.75 - 10

Notes:  
 1. City digital elevation model (DEM) hillshade relief generated from 2009 LIDAR survey conducted by Pictometry, Inc. under contract to the City of Norfolk.



**SWMM RESULTS FOR 10YR 24-HR STORM,  
 TAILWATER = MHHW  
 ALTERNATIVE: BULKHEAD WALL**  
 City-wide Coastal Flooding Study  
 Norfolk, Virginia

FIGURE B-38

N:\Projects\3627\_City\_Norfolk\3627-005\_Hague\Outputs\2010\_12\_13\_Draft\_Flood\_Mitigation\_Report\mxd\11x17\_Figure\_Template.mxd, 01/14/11, kspencer



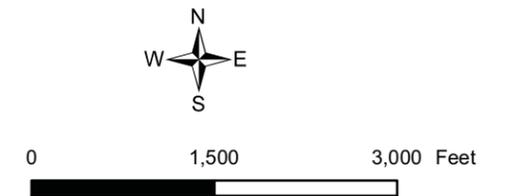
**LEGEND**

- Model Nodes
- Model Links
- ▭ Pretty Lake Watershed Boundary
- ▨ Pretty Lake Buildings

**Max Depth (ft)**

- 0 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1.0 - 1.25
- 1.25 - 1.5
- 1.5 - 1.75
- 1.75 - 2
- 2.0 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3
- 3.0 - 3.25
- 3.25 - 3.5
- 3.5 - 3.75
- 3.75 - 4
- 4.0 - 4.25
- 4.25 - 4.5
- 4.5 - 4.75
- 4.75 - 10

Notes:  
1. City digital elevation model (DEM) hillshade relief generated from 2009 LIDAR survey conducted by Pictometry, Inc. under contract to the City of Norfolk.



**SWMM RESULTS FOR 10YR 24-HR STORM,  
TAILWATER = 10YR STORM SURGE  
ALTERNATIVE: BULKHEAD WALL**  
City-wide Coastal Flooding Study  
Norfolk, Virginia

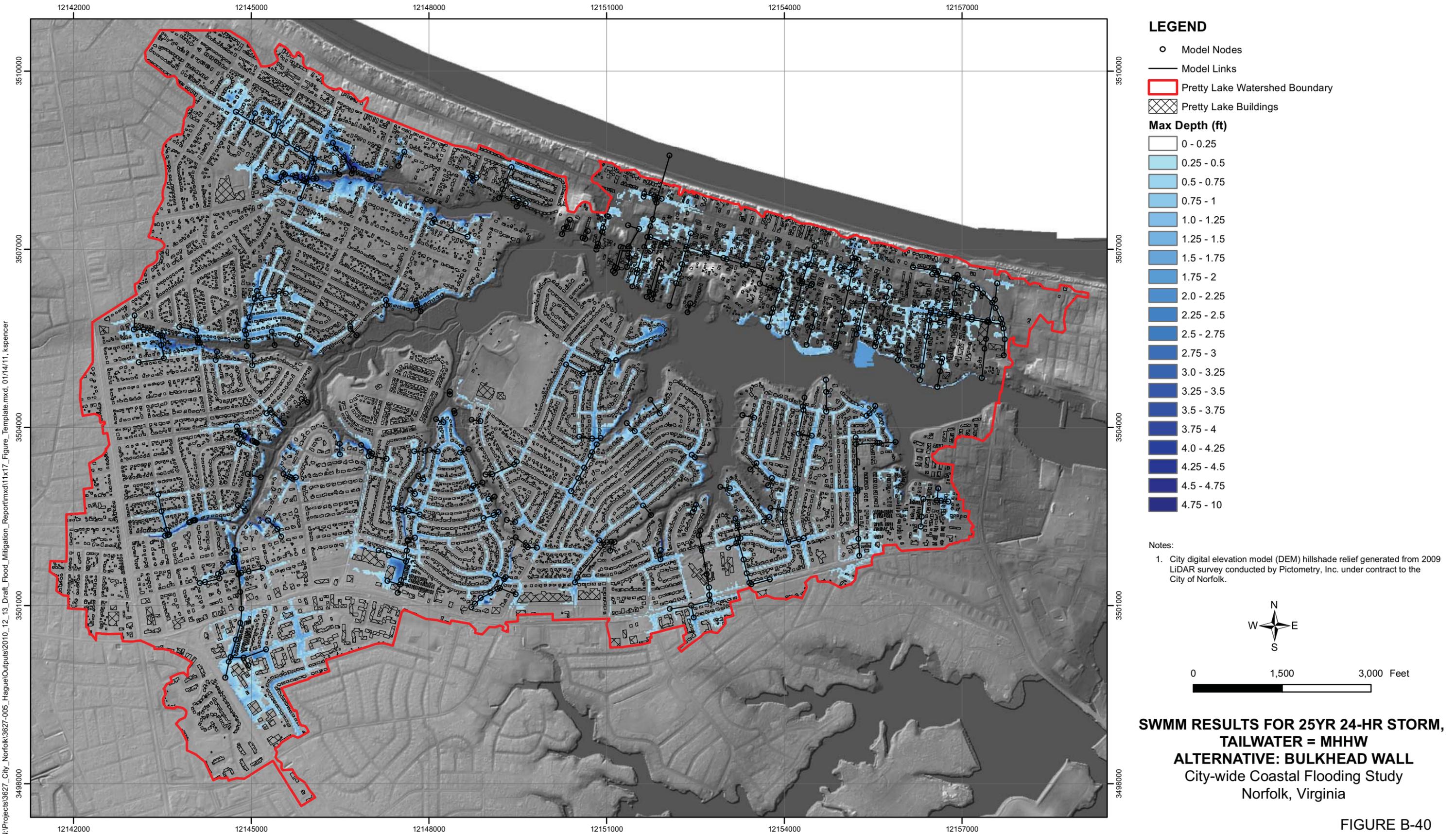


FIGURE B-40

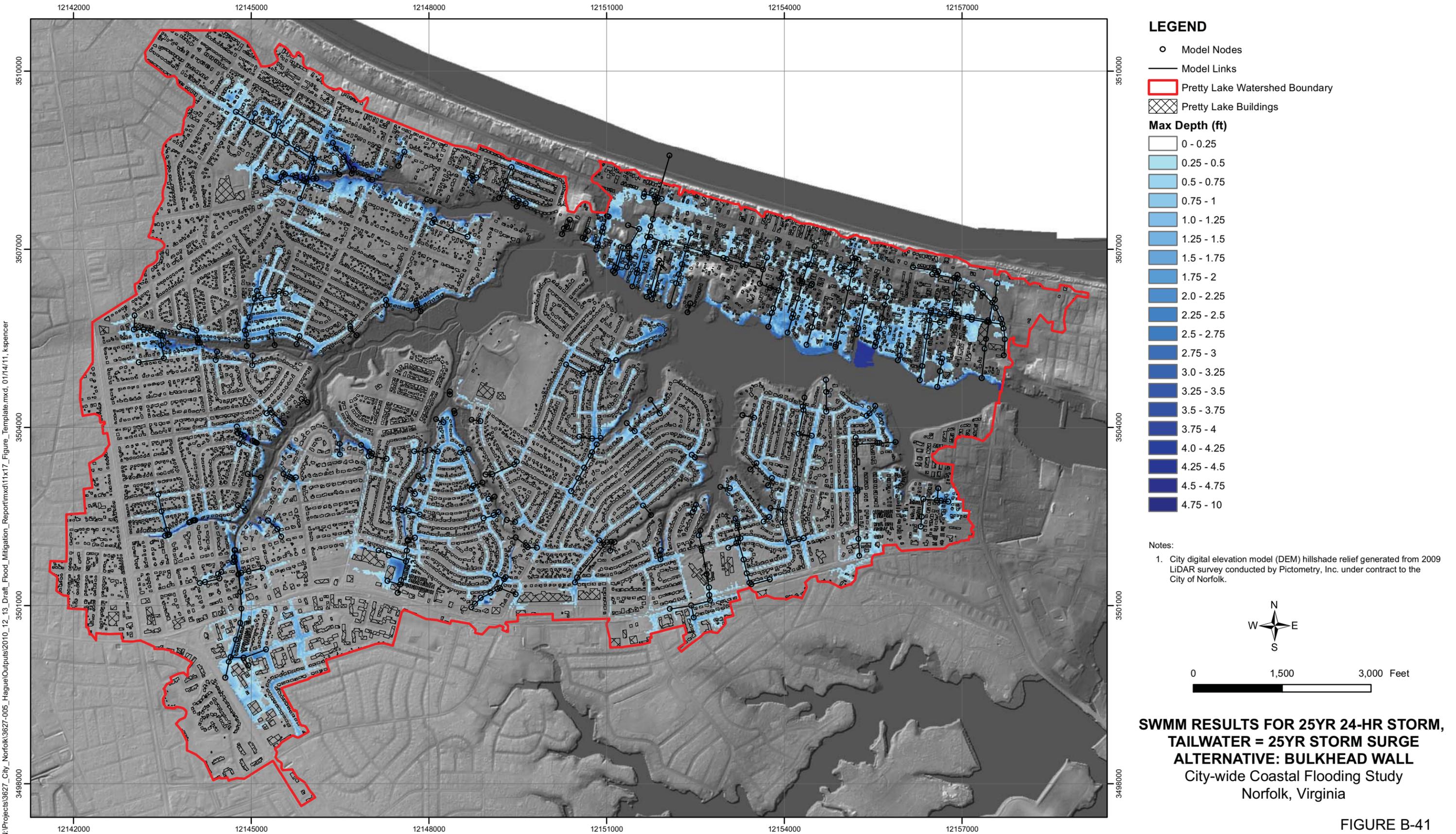


FIGURE B-41

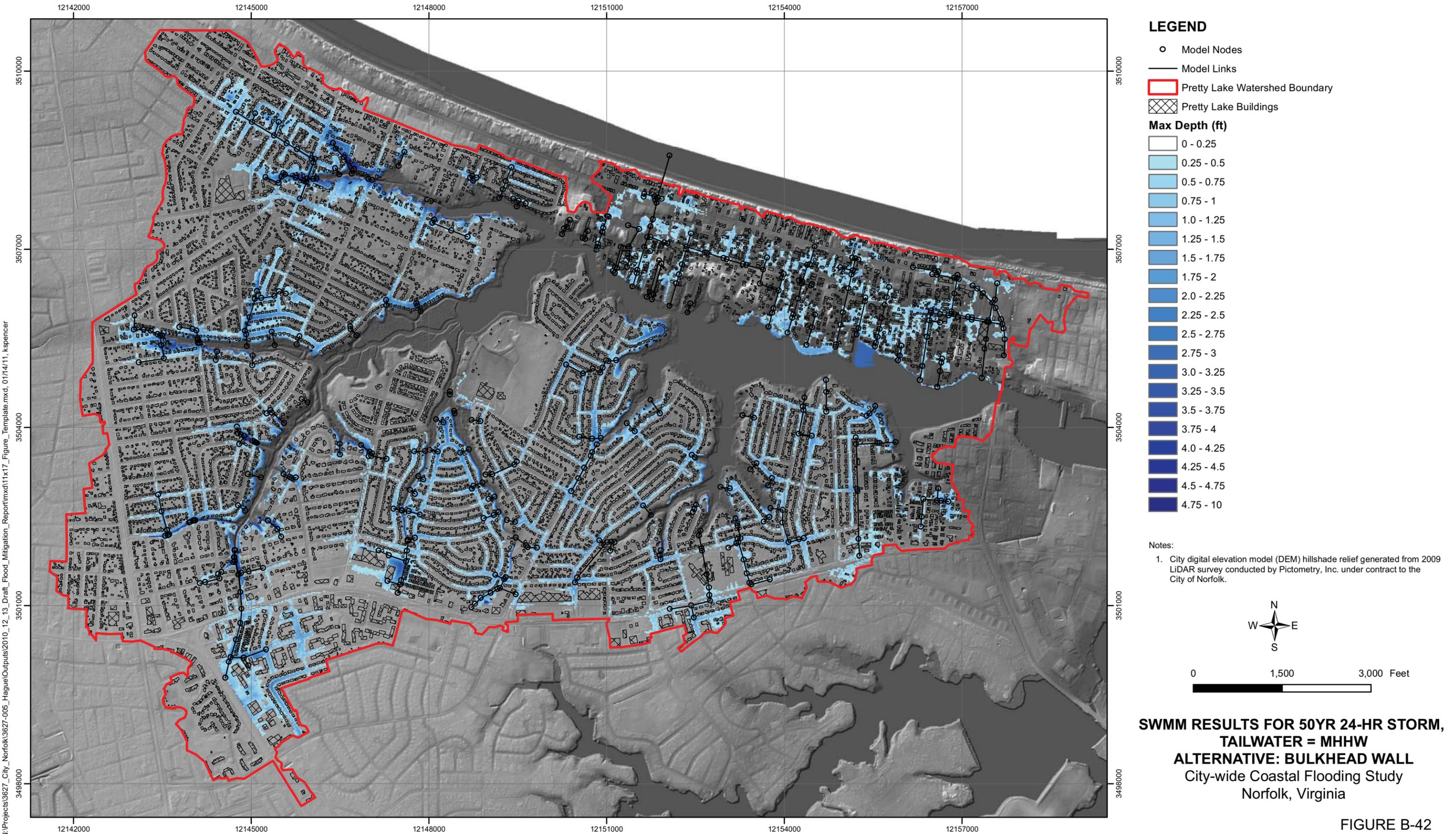


FIGURE B-42

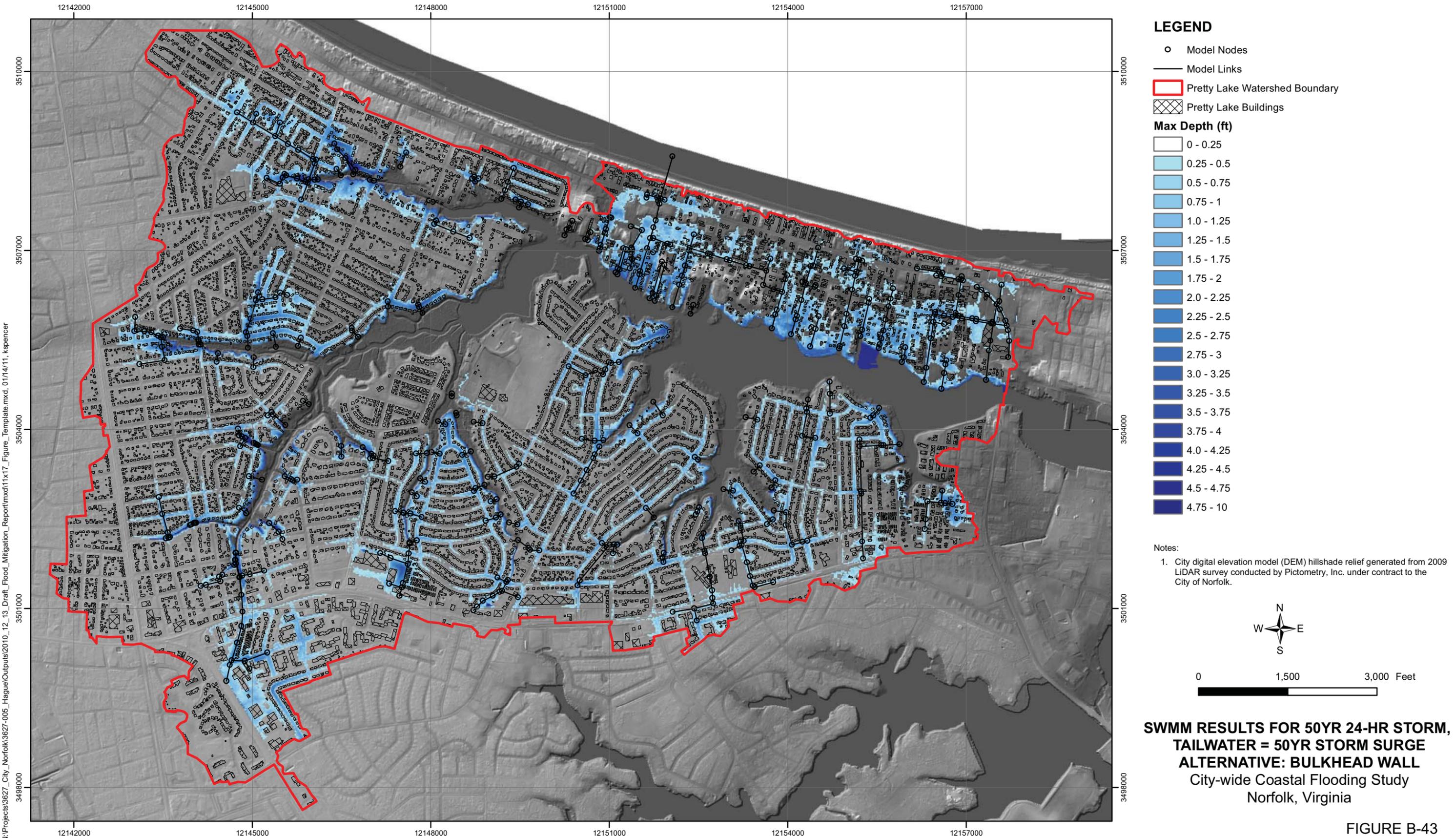


FIGURE B-43

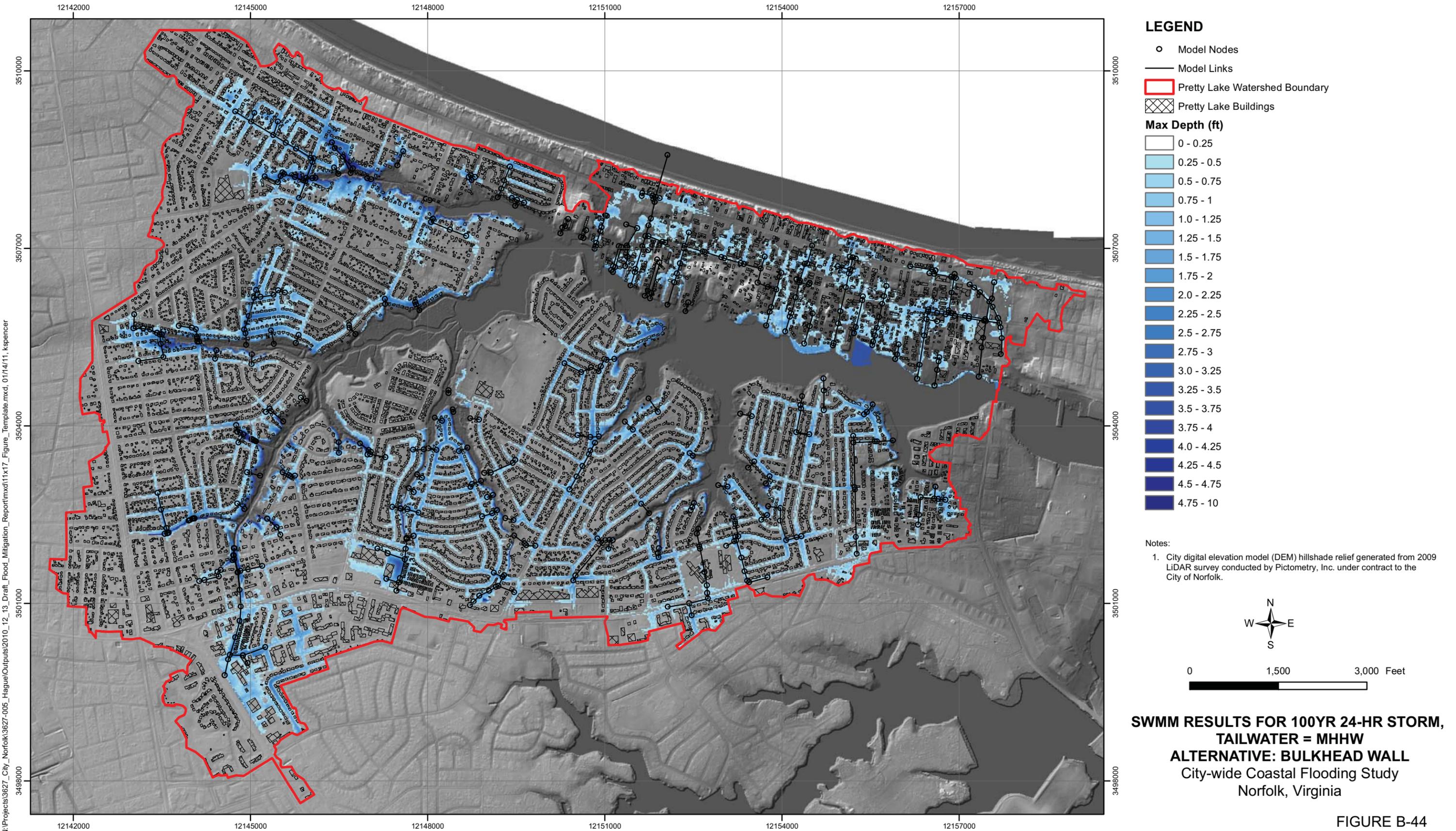


FIGURE B-44

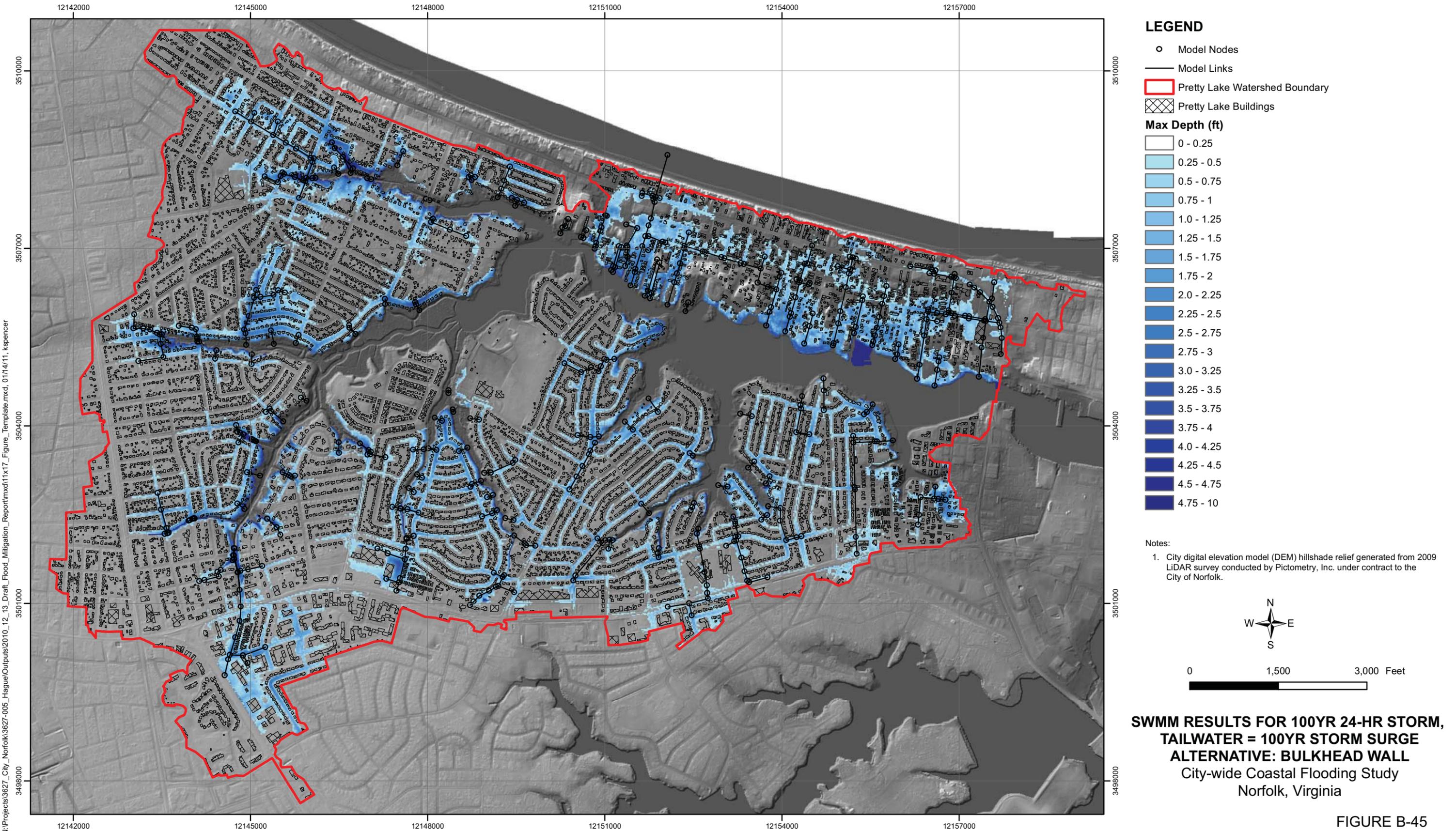


FIGURE B-45

**APPENDIX C**

**OPINION OF PROBABLE COST AND OPERATIONAL COST**



Opinion of Probable Cost

DATE PREPARED  
17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO. IDENTIFICATION NUMBER
PROJECT TITLE <b>Pretty Lake - Alternative 1a Tidal Barrier with Steel Gate, 2 - 60" Dia. Pumps, and Road Raise</b>	ESTIMATED BY Moffatt & Nichol
	CATEGORY CODE NUMBER STATUS OF DESIGN JOB ORDER NUMBER 6822-06

Summary	
Scenario	Opinion of Probable Cost
2 Year Surge with Rain	\$27,700,000
10 Year Surge with Rain	\$34,900,000
25 Year Surge with Rain	\$36,200,000
50 Year Surge with Rain	\$37,400,000
100 Year Surge with Rain	\$38,400,000



Opinion of Probable Cost

DATE PREPARED  
17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
PROJECT TITLE <b>Alt. 1a - Tidal Barrier with Steel Gate, 2 - 60" Dia. Pumps, and Road Raise For 2 Year Event @ ELEV +4.2'</b>	ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER
	STATUS OF DESIGN	JOB ORDER NUMBER 6822-06

ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL

<b>Site Civil</b>				
Road Raise (2-Lane Road)	0.00	LF/VLF	\$250.00	\$0
Road Raise (4-Lane Road)	0.00	LF/VLF	\$450.00	\$0
Utility Relocation	0	LF	\$300.00	\$0
Elevating Homes along North Side of Dunning Ave	0	EA	\$70,000.00	\$0

<b>Sliding Gate</b>				
<u>Piling: Steel</u>				
Install AZ 14 Steel Sheet Piles	56,400	SF	\$28.50	\$1,607,400
Treat Embedded Interlocks	13,000	LF	\$7.25	\$94,250
30" DIA Steel Pipe End Piles	320	LF	\$363.00	\$116,160
Special Sheet Fabrication	480	LF	\$42.50	\$20,400

<u>Site Work: Excavation &amp; Fill</u>				
Gravel Base	38,000	CY	\$32.25	\$1,225,500

<u>Concrete: Gate Base Slab</u>				
Precast Concrete Gate Base	50	CY	\$1,832.50	\$91,625
Tremie Concrete Base	150	CY	\$985.00	\$147,750

<u>Gate Assembly</u>				
Framed Steel Gate	65	Tons	\$10,125.00	\$658,125
Flanged Steel Wheel Assembly	6	EA	\$3,120.00	\$18,720
Rail	150	LF	\$298.00	\$44,700
Capstan & Cabling	1	LS	\$193,500.00	\$193,500
UHMW Rollers	12	EA	\$2,587.00	\$31,044
Pocket Seal	35	LF	\$4,650.00	\$162,750

<u>Finish Work</u>				
Concrete Fascia	8,100	SF	\$85.00	\$688,500
Top Slab	180	CY	\$630.00	\$113,400
Handrail	830	LF	\$178.00	\$147,740

<b>Pump Stations</b>				
60" pumps	3	EA	\$1,380,000.00	\$4,140,000
Support Structure - piles,header,rods, etc.	1	EA	\$28,000.00	\$28,000
Misc 60" Pipe Sections	3	EA	\$8,000.00	\$24,000
Concrete Headwall	1	EA	\$80,000.00	\$80,000
Flapgates	3	EA	\$19,200.00	\$57,600
Brick Enclosure for Generator	1	EA	\$450,000.00	\$450,000
Aesthetic Features of Pump Station	1	LS	\$150,000.00	\$150,000



Opinion of Probable Cost

DATE PREPARED  
17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
PROJECT TITLE <b>Alt. 1a - Tidal Barrier with Steel Gate, 2 - 60" Dia. Pumps, and Road Raise For 2 Year Event @ ELEV +4.2'</b>	ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER
	STATUS OF DESIGN	JOB ORDER NUMBER 6822-06

ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL

<b>Electrical</b>				
Dominion Power Installation Costs	1	LS	\$100,000.00	\$100,000
<i>Common Costs</i>				
Line Truck	20	DY	\$283.25	\$5,665
Backhoe	10	DY	\$395.52	\$3,955
Scissors Lift	40	DY	\$265.20	\$10,608
<i>Site Work</i>				
Trench & Backfill	400	LF	\$1.96	\$784
Pole, Foundation & Flood It	6	EA	\$1,223.02	\$7,338
Quasite Handhole	3	EA	\$607.04	\$1,821
<i>Power</i>				
Switchboard	1	LS	\$74,231.00	\$74,231
400A 208V service panel W/MCB	1	EA	\$4,475.00	\$4,475
100A 30ckt 208v 3 phase panel	6	EA	\$2,090.00	\$12,540
225A 42 ckt 208v 3 phase panel	2	EA	\$3,400.00	\$6,800
100-225A 3P 208v CB	4	EA	\$998.00	\$3,992
20A 1P 120v Circuit Breaker	42	EA	\$53.30	\$2,239
Surge Arrestor (SPD) 208V 10-Mode NEMA 4x box	2	EA	\$9,849.00	\$19,698
4" GRS Conduit	1500	LF	\$49.80	\$74,700
3/4" GRS Conduit	2500	LF	\$7.93	\$19,825
1/2" GRS Conduit	5000	LF	\$7.14	\$35,700
4" GRS Fittings	100	EA	\$455.00	\$45,500
3/4" GRS Fittings	200	EA	\$42.95	\$8,590
1/2" GRS Fittings	200	EA	\$35.45	\$7,090
# 500 kcmil XHHW	7500	LF	\$14.10	\$105,750
#4/0 AWG THWN	1500	LF	\$6.86	\$10,290
#8 THWN Copper	1500	LF	\$0.91	\$1,365
#12 THWN Copper	25000	LF	\$0.50	\$12,500
# 500 kcmil cable connector	18	EA	\$160.00	\$2,880
GFI Receptacle W/ Box & Cover	25	EA	\$107.09	\$2,677
Duplex Receptacle W/Box & Cover	80	EA	\$60.82	\$4,866
Motor Connection	3	EA	\$9,203.13	\$27,609
VFD Drive	3	EA	\$150,000.00	\$450,000
2500 KW Standby Generator - natural gas	2	EA	\$1,245,875.00	\$2,491,750
Paralleling Switchgear	1	LS	\$429,800.00	\$429,800
150 KVA Dry Transformer	1	EA	\$15,452.00	\$15,452
30kVA UPS owner purchase (including commissioning)	1	EA	\$40,000.00	\$40,000
Annunciator	1	LS	\$14,200.00	\$14,200
Insurance & Taxes for Electrical	1	LS	\$159,404.00	\$159,404



Opinion of Probable Cost

DATE PREPARED  
17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia		CONSTRUCTION CONTRACT NO.		IDENTIFICATION NUMBER	
PROJECT TITLE <b>Alt. 1a - Tidal Barrier with Steel Gate, 2 - 60" Dia. Pumps, and Road Raise For 2 Year Event @ ELEV +4.2'</b>		ESTIMATED BY Moffatt & Nichol		CATEGORY CODE NUMBER	
		STATUS OF DESIGN		JOB ORDER NUMBER 6822-06	
		QUANTITY		ENGINEERING ESTIMATE	
ITEM DESCRIPTION		NUMBER	UNIT	UNIT COST	TOTAL
Sales Tax for Electrical		1	LS	\$173,859.00	\$173,859
<b>SUBTOTAL</b>					<b>\$14,679,117</b>
Overhead & Profit		15%			\$2,201,868
Mobilization/Demobilization		10%			\$1,467,912
Difficult Waterside Conditions		est - lump sum			\$1,000,000
Erosion/Sediment Control		5%			\$733,956
Traffic Control		2%			\$293,582
Surveying/Engineering/Construction Observation		12%			\$1,761,494
<b>Subtotal with Mark-ups</b>					<b>\$22,137,929</b>
Contingency		25%			\$5,534,482
<b>Subtotal</b>					<b>\$27,672,411</b>
<b>TOTAL</b>					<b>\$27,672,411</b>
				<b>SAY</b>	<b>\$27,700,000</b>



Opinion of Probable Cost

DATE PREPARED  
17-Jan-11

ACTIVITY AND LOCATION	CONSTRUCTION CONTRACT NO.		IDENTIFICATION NUMBER	
	ESTIMATED BY		CATEGORY CODE NUMBER	
PROJECT TITLE	Moffatt & Nichol			
	STATUS OF DESIGN		JOB ORDER NUMBER	
			6822-06	
	QUANTITY		ENGINEERING ESTIMATE	
ITEM DESCRIPTION	NUMBER	UNIT	UNIT COST	TOTAL
<b>Site Civil</b>				
Road Raise (2-Lane Road)	1,650.00	LF/VLF	\$250.00	\$412,500
Road Raise (4-Lane Road)	1,100.00	LF/VLF	\$450.00	\$495,000
Utility Relocation	2,750	LF	\$300.00	\$825,000
Elevating Homes along North Side of Dunning Ave	30	EA	\$70,000.00	\$2,100,000
<b>Sliding Gate</b>				
<u>Piling: Steel</u>				
Install AZ 14 Steel Sheet Piles	61,100	SF	\$28.50	\$1,741,350
Treat Embedded Interlocks	14,000	LF	\$7.25	\$101,500
30" DIA Steel Pipe End Piles	340	LF	\$363.00	\$123,420
Special Sheet Fabrication	520	LF	\$42.50	\$22,100
<u>Site Work: Excavation &amp; Fill</u>				
Gravel Base	38,000	CY	\$32.25	\$1,225,500
<u>Concrete: Gate Base Slab</u>				
Precast Concrete Gate Base	50	CY	\$1,832.50	\$91,625
Tremie Concrete Base	150	CY	\$985.00	\$147,750
<u>Gate Assembly</u>				
Framed Steel Gate	65	Tons	\$10,125.00	\$658,125
Flanged Steel Wheel Assembly	6	EA	\$3,120.00	\$18,720
Rail	150	LF	\$298.00	\$44,700
Capstan & Cabling	1	LS	\$193,500.00	\$193,500
UHMW Rollers	12	EA	\$2,587.00	\$31,044
Pocket Seal	35	LF	\$4,650.00	\$162,750
<u>Finish Work</u>				
Concrete Fascia	8,100	SF	\$85.00	\$688,500
Top Slab	180	CY	\$630.00	\$113,400
Handrail	830	LF	\$178.00	\$147,740
<b>Pump Stations</b>				
60" pumps	3	EA	\$1,380,000.00	\$4,140,000
Support Structure - piles,header,rods, etc.	1	EA	\$28,000.00	\$28,000
Misc 60" Pipe Sections	3	EA	\$8,000.00	\$24,000
Concrete Headwall	1	EA	\$80,000.00	\$80,000
Flapgates	3	EA	\$19,200.00	\$57,600
Brick Enclosure for Generator	1	EA	\$450,000.00	\$450,000
Aesthetic Features of Pump Station	1	LS	\$150,000.00	\$150,000



Opinion of Probable Cost

DATE PREPARED  
17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
PROJECT TITLE <b>Alt. 1a - Tidal Barrier with Steel Gate, 2 - 60" Dia. Pumps, and Road Raise For 10 Year Event @ ELEV +5.6'</b>	ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER
	STATUS OF DESIGN	JOB ORDER NUMBER 6822-06

ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL

<b>Electrical</b>				
Dominion Power Installation Costs	1	LS	\$100,000.00	\$100,000
<i>Common Costs</i>				
Line Truck	20	DY	\$283.25	\$5,665
Backhoe	10	DY	\$395.52	\$3,955
Scissors Lift	40	DY	\$265.20	\$10,608
<i>Site Work</i>				
Trench & Backfill	400	LF	\$1.96	\$784
Pole, Foundation & Flood It	6	EA	\$1,223.02	\$7,338
Quasite Handhole	3	EA	\$607.04	\$1,821
<i>Power</i>				
Switchboard	1	LS	\$74,231.00	\$74,231
400A 208V service panel W/MCB	1	EA	\$4,475.00	\$4,475
100A 30ckt 208v 3 phase panel	6	EA	\$2,090.00	\$12,540
225A 42 ckt 208v 3 phase panel	2	EA	\$3,400.00	\$6,800
100-225A 3P 208v CB	4	EA	\$998.00	\$3,992
20A 1P 120v Circuit Breaker	42	EA	\$53.30	\$2,239
Surge Arrestor (SPD) 208V 10-Mode NEMA 4x box	2	EA	\$9,849.00	\$19,698
4" GRS Conduit	1500	LF	\$49.80	\$74,700
3/4" GRS Conduit	2500	LF	\$7.93	\$19,825
1/2" GRS Conduit	5000	LF	\$7.14	\$35,700
4" GRS Fittings	100	EA	\$455.00	\$45,500
3/4" GRS Fittings	200	EA	\$42.95	\$8,590
1/2" GRS Fittings	200	EA	\$35.45	\$7,090
# 500 kcmil XHHW	7500	LF	\$14.10	\$105,750
#4/0 AWG THWN	1500	LF	\$6.86	\$10,290
#8 THWN Copper	1500	LF	\$0.91	\$1,365
#12 THWN Copper	25000	LF	\$0.50	\$12,500
# 500 kcmil cable connector	18	EA	\$160.00	\$2,880
GFI Receptacle W/ Box & Cover	25	EA	\$107.09	\$2,677
Duplex Receptacle W/Box & Cover	80	EA	\$60.82	\$4,866
Motor Connection	3	EA	\$9,203.13	\$27,609
VFD Drive	3	EA	\$150,000.00	\$450,000
2500 KW Standby Generator - natural gas	2	EA	\$1,245,875.00	\$2,491,750
Paralleling Switchgear	1	LS	\$429,800.00	\$429,800
150 KVA Dry Transformer	1	EA	\$15,452.00	\$15,452
30kVA UPS owner purchase (including commissioning)	1	EA	\$40,000.00	\$40,000
Annunciator	1	LS	\$14,200.00	\$14,200
Insurance & Taxes for Electrical	1	LS	\$159,404.00	\$159,404



Opinion of Probable Cost

DATE PREPARED  
17-Jan-11

ACTIVITY AND LOCATION		CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER	
PROJECT TITLE		ESTIMATED BY	CATEGORY CODE NUMBER	
ITEM DESCRIPTION		QUANTITY		ENGINEERING ESTIMATE
		NUMBER	UNIT	TOTAL
City of Norfolk Norfolk, Virginia				
Alt. 1a - Tidal Barrier with Steel Gate, 2 - 60" Dia. Pumps, and Road Raise For 10 Year Event @ ELEV +5.6'		Moffatt & Nichol		
			JOB ORDER NUMBER	
			6822-06	
Sales Tax for Electrical		1	LS	\$173,859.00
<b>SUBTOTAL</b>				\$173,859
Overhead & Profit		15%		\$2,799,267
Mobilization/Demobilization		10%		\$1,866,178
Difficult Waterside Conditions		est - lump sum		\$1,000,000
Erosion/Sediment Control		5%		\$933,089
Traffic Control		2%		\$373,236
Surveying/Engineering/Construction Observation		12%		\$2,239,413
<b>Subtotal with Mark-ups</b>				<b>\$27,872,959</b>
Contingency		25%		\$6,968,240
<b>Subtotal</b>				<b>\$34,841,199</b>
<b>TOTAL</b>				<b>\$34,841,199</b>
				<b>SAY \$34,900,000</b>



Opinion of Probable Cost

DATE PREPARED

17-Jan-11

ACTIVITY AND LOCATION		CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER	
City of Norfolk Norfolk, Virginia				
PROJECT TITLE		ESTIMATED BY	CATEGORY CODE NUMBER	
<b>Alt. 1a - Tidal Barrier with Steel Gate, 2 - 60" Dia. Pumps, and Road Raise For 25 Year Event @ ELEV +6.4'</b>		Moffatt & Nichol		
		STATUS OF DESIGN	JOB ORDER NUMBER	
			6822-06	
ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL
<b>Site Civil</b>				
Road Raise (2-Lane Road)	2,970.00	LF/VLF	\$250.00	\$742,500
Road Raise (4-Lane Road)	1,980.00	LF/VLF	\$450.00	\$891,000
Utility Relocation	2,750	LF	\$300.00	\$825,000
Elevating Homes along North Side of Dunning Ave	30	EA	\$70,000.00	\$2,100,000
<b>Sliding Gate</b>				
<u>Piling: Steel</u>				
Install AZ 14 Steel Sheet Piles	61,100	SF	\$28.50	\$1,741,350
Treat Embedded Interlocks	14,000	LF	\$7.25	\$101,500
30" DIA Steel Pipe End Piles	340	LF	\$363.00	\$123,420
Special Sheet Fabrication	520	LF	\$42.50	\$22,100
<u>Site Work: Excavation &amp; Fill</u>				
Gravel Base	38,000	CY	\$32.25	\$1,225,500
<u>Concrete: Gate Base Slab</u>				
Precast Concrete Gate Base	50	CY	\$1,832.50	\$91,625
Tremie Concrete Base	150	CY	\$985.00	\$147,750
<u>Gate Assembly</u>				
Framed Steel Gate	65	Tons	\$10,125.00	\$658,125
Flanged Steel Wheel Assembly	6	EA	\$3,120.00	\$18,720
Rail	150	LF	\$298.00	\$44,700
Capstan & Cabling	1	LS	\$193,500.00	\$193,500
UHMW Rollers	12	EA	\$2,587.00	\$31,044
Pocket Seal	35	LF	\$4,650.00	\$162,750
<u>Finish Work</u>				
Concrete Fascia	8,100	SF	\$85.00	\$688,500
Top Slab	180	CY	\$630.00	\$113,400
Handrail	830	LF	\$178.00	\$147,740
<b>Pump Stations</b>				
60" pumps	3	EA	\$1,380,000.00	\$4,140,000
Support Structure - piles,header,rods, etc.	1	EA	\$28,000.00	\$28,000
Misc 60" Pipe Sections	3	EA	\$8,000.00	\$24,000
Concrete Headwall	1	EA	\$80,000.00	\$80,000
Flapgates	3	EA	\$19,200.00	\$57,600
Brick Enclosure for Generator	1	EA	\$450,000.00	\$450,000
Aesthetic Features of Pump Station	1	LS	\$150,000.00	\$150,000



Opinion of Probable Cost

DATE PREPARED

17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
PROJECT TITLE <b>Alt. 1a - Tidal Barrier with Steel Gate, 2 - 60" Dia. Pumps, and Road Raise For 25 Year Event @ ELEV +6.4'</b>	ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER
	STATUS OF DESIGN	JOB ORDER NUMBER 6822-06

ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL

<b>Electrical</b>				
Dominion Power Installation Costs	1	LS	\$100,000.00	\$100,000
<i>Common Costs</i>				
Line Truck	20	DY	\$283.25	\$5,665
Backhoe	10	DY	\$395.52	\$3,955
Scissors Lift	40	DY	\$265.20	\$10,608
<i>Site Work</i>				
Trench & Backfill	400	LF	\$1.96	\$784
Pole, Foundation & Flood It	6	EA	\$1,223.02	\$7,338
Quasite Handhole	3	EA	\$607.04	\$1,821
<i>Power</i>				
Switchboard	1	LS	\$74,231.00	\$74,231
400A 208V service panel W/MCB	1	EA	\$4,475.00	\$4,475
100A 30ckt 208v 3 phase panel	6	EA	\$2,090.00	\$12,540
225A 42 ckt 208v 3 phase panel	2	EA	\$3,400.00	\$6,800
100-225A 3P 208v CB	4	EA	\$998.00	\$3,992
20A 1P 120v Circuit Breaker	42	EA	\$53.30	\$2,239
Surge Arrestor (SPD) 208V 10-Mode NEMA 4x box	2	EA	\$9,849.00	\$19,698
4" GRS Conduit	1500	LF	\$49.80	\$74,700
3/4" GRS Conduit	2500	LF	\$7.93	\$19,825
1/2" GRS Conduit	5000	LF	\$7.14	\$35,700
4" GRS Fittings	100	EA	\$455.00	\$45,500
3/4" GRS Fittings	200	EA	\$42.95	\$8,590
1/2" GRS Fittings	200	EA	\$35.45	\$7,090
# 500 kcmil XHHW	7500	LF	\$14.10	\$105,750
#4/0 AWG THWN	1500	LF	\$6.86	\$10,290
#8 THWN Copper	1500	LF	\$0.91	\$1,365
#12 THWN Copper	25000	LF	\$0.50	\$12,500
# 500 kcmil cable connector	18	EA	\$160.00	\$2,880
GFI Receptacle W/ Box & Cover	25	EA	\$107.09	\$2,677
Duplex Receptacle W/Box & Cover	80	EA	\$60.82	\$4,866
Motor Connection	3	EA	\$9,203.13	\$27,609
VFD Drive	3	EA	\$150,000.00	\$450,000
2500 KW Standby Generator - natural gas	2	EA	\$1,245,875.00	\$2,491,750
Paralleling Switchgear	1	LS	\$429,800.00	\$429,800
150 KVA Dry Transformer	1	EA	\$15,452.00	\$15,452
30kVA UPS owner purchase (including commissioning)	1	EA	\$40,000.00	\$40,000
Annunciator	1	LS	\$14,200.00	\$14,200
Insurance & Taxes for Electrical	1	LS	\$159,404.00	\$159,404



Opinion of Probable Cost

DATE PREPARED

17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia		CONSTRUCTION CONTRACT NO.		IDENTIFICATION NUMBER	
PROJECT TITLE <b>Alt. 1a - Tidal Barrier with Steel Gate, 2 - 60" Dia. Pumps, and Road Raise For 25 Year Event @ ELEV +6.4'</b>		ESTIMATED BY Moffatt & Nichol		CATEGORY CODE NUMBER	
		STATUS OF DESIGN		JOB ORDER NUMBER 6822-06	
		QUANTITY		ENGINEERING ESTIMATE	
ITEM DESCRIPTION		NUMBER	UNIT	UNIT COST	TOTAL
Sales Tax for Electrical		1	LS	\$173,859.00	\$173,859
<b>SUBTOTAL</b>					<b>\$19,387,777</b>
Overhead & Profit		15%			\$2,908,167
Mobilization/Demobilization		10%			\$1,938,778
Difficult Waterside Conditions		est - lump sum			\$1,000,000
Erosion/Sediment Control		5%			\$969,389
Traffic Control		2%			\$387,756
Surveying/Engineering/Construction Observation		12%			\$2,326,533
<b>Subtotal with Mark-ups</b>					<b>\$28,918,399</b>
Contingency		25%			\$7,229,600
<b>Subtotal</b>					<b>\$36,147,999</b>
<b>TOTAL</b>					<b>\$36,147,999</b>
				<b>SAY</b>	<b>\$36,200,000</b>



Opinion of Probable Cost

DATE PREPARED  
17-Jan-11

ACTIVITY AND LOCATION		CONSTRUCTION CONTRACT NO.		IDENTIFICATION NUMBER	
City of Norfolk Norfolk, Virginia					
PROJECT TITLE		ESTIMATED BY		CATEGORY CODE NUMBER	
<b>Alt. 1a - Tidal Barrier with Steel Gate, 2 - 60" Dia. Pumps, and Road Raise For 50 Year Event @ ELEV +7.0'</b>		Moffatt & Nichol			
		STATUS OF DESIGN		JOB ORDER NUMBER	
				6822-06	
ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE		
	NUMBER	UNIT	UNIT COST	TOTAL	
<b>Site Civil</b>					
Road Raise (2-Lane Road)	3,960.00	LF/VLF	\$250.00	\$990,000	
Road Raise (4-Lane Road)	2,640.00	LF/VLF	\$450.00	\$1,188,000	
Utility Relocation	2,750	LF	\$300.00	\$825,000	
Elevating Homes along North Side of Dunning Ave	30	EA	\$70,000.00	\$2,100,000	
<b>Sliding Gate</b>					
<u>Piling: Steel</u>					
Install AZ 14 Steel Sheet Piles	65,800	SF	\$28.50	\$1,875,300	
Treat Embedded Interlocks	15,000	LF	\$7.25	\$108,750	
30" DIA Steel Pipe End Piles	360	LF	\$363.00	\$130,680	
Special Sheet Fabrication	560	LF	\$42.50	\$23,800	
<u>Site Work: Excavation &amp; Fill</u>					
Gravel Base	38,000	CY	\$32.25	\$1,225,500	
<u>Concrete: Gate Base Slab</u>					
Precast Concrete Gate Base	50	CY	\$1,832.50	\$91,625	
Tremie Concrete Base	150	CY	\$985.00	\$147,750	
<u>Gate Assembly</u>					
Framed Steel Gate	65	Tons	\$10,125.00	\$658,125	
Flanged Steel Wheel Assembly	6	EA	\$3,120.00	\$18,720	
Rail	150	LF	\$298.00	\$44,700	
Capstan & Cabling	1	LS	\$193,500.00	\$193,500	
UHMW Rollers	12	EA	\$2,587.00	\$31,044	
Pocket Seal	35	LF	\$4,650.00	\$162,750	
<u>Finish Work</u>					
Concrete Fascia	8,100	SF	\$85.00	\$688,500	
Top Slab	180	CY	\$630.00	\$113,400	
Handrail	830	LF	\$178.00	\$147,740	
<b>Pump Stations</b>					
60" pumps	3	EA	\$1,380,000.00	\$4,140,000	
Support Structure - piles,header,rods, etc.	1	EA	\$28,000.00	\$28,000	
Misc 60" Pipe Sections	3	EA	\$8,000.00	\$24,000	
Concrete Headwall	1	EA	\$80,000.00	\$80,000	
Flapgates	3	EA	\$19,200.00	\$57,600	
Brick Enclosure for Generator	1	EA	\$450,000.00	\$450,000	
Aesthetic Features of Pump Station	1	LS	\$150,000.00	\$150,000	



Opinion of Probable Cost

DATE PREPARED

17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
PROJECT TITLE <b>Alt. 1a - Tidal Barrier with Steel Gate, 2 - 60" Dia. Pumps, and Road Raise For 50 Year Event @ ELEV +7.0'</b>	ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER
	STATUS OF DESIGN	JOB ORDER NUMBER 6822-06

ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL

<b>Electrical</b>				
Dominion Power Installation Costs	1	LS	\$100,000.00	\$100,000
<i>Common Costs</i>				
Line Truck	20	DY	\$283.25	\$5,665
Backhoe	10	DY	\$395.52	\$3,955
Scissors Lift	40	DY	\$265.20	\$10,608
<i>Site Work</i>				
Trench & Backfill	400	LF	\$1.96	\$784
Pole, Foundation & Flood It	6	EA	\$1,223.02	\$7,338
Quasite Handhole	3	EA	\$607.04	\$1,821
<i>Power</i>				
Switchboard	1	LS	\$74,231.00	\$74,231
400A 208V service panel W/MCB	1	EA	\$4,475.00	\$4,475
100A 30ckt 208v 3 phase panel	6	EA	\$2,090.00	\$12,540
225A 42 ckt 208v 3 phase panel	2	EA	\$3,400.00	\$6,800
100-225A 3P 208v CB	4	EA	\$998.00	\$3,992
20A 1P 120v Circuit Breaker	42	EA	\$53.30	\$2,239
Surge Arrestor (SPD) 208V 10-Mode NEMA 4x box	2	EA	\$9,849.00	\$19,698
4" GRS Conduit	1500	LF	\$49.80	\$74,700
3/4" GRS Conduit	2500	LF	\$7.93	\$19,825
1/2" GRS Conduit	5000	LF	\$7.14	\$35,700
4" GRS Fittings	100	EA	\$455.00	\$45,500
3/4" GRS Fittings	200	EA	\$42.95	\$8,590
1/2" GRS Fittings	200	EA	\$35.45	\$7,090
# 500 kcmil XHHW	7500	LF	\$14.10	\$105,750
#4/0 AWG THWN	1500	LF	\$6.86	\$10,290
#8 THWN Copper	1500	LF	\$0.91	\$1,365
#12 THWN Copper	25000	LF	\$0.50	\$12,500
# 500 kcmil cable connector	18	EA	\$160.00	\$2,880
GFI Receptacle W/ Box & Cover	25	EA	\$107.09	\$2,677
Duplex Receptacle W/Box & Cover	80	EA	\$60.82	\$4,866
Motor Connection	3	EA	\$9,203.13	\$27,609
VFD Drive	3	EA	\$150,000.00	\$450,000
2500 KW Standby Generator - natural gas	2	EA	\$1,245,875.00	\$2,491,750
Paralleling Switchgear	1	LS	\$429,800.00	\$429,800
150 KVA Dry Transformer	1	EA	\$15,452.00	\$15,452
30kVA UPS owner purchase (including commissioning)	1	EA	\$40,000.00	\$40,000
Annunciator	1	LS	\$14,200.00	\$14,200
Insurance & Taxes for Electrical	1	LS	\$159,404.00	\$159,404



Opinion of Probable Cost

DATE PREPARED

17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia		CONSTRUCTION CONTRACT NO.		IDENTIFICATION NUMBER	
PROJECT TITLE <b>Alt. 1a - Tidal Barrier with Steel Gate, 2 - 60" Dia. Pumps, and Road Raise For 50 Year Event @ ELEV +7.0'</b>		ESTIMATED BY Moffatt & Nichol		CATEGORY CODE NUMBER	
		STATUS OF DESIGN		JOB ORDER NUMBER 6822-06	
		QUANTITY		ENGINEERING ESTIMATE	
ITEM DESCRIPTION		NUMBER	UNIT	UNIT COST	TOTAL
Sales Tax for Electrical		1	LS	\$173,859.00	\$173,859
<b>SUBTOTAL</b>					<b>\$20,082,437</b>
Overhead & Profit		15%			\$3,012,366
Mobilization/Demobilization		10%			\$2,008,244
Difficult Waterside Conditions		est - lump sum			\$1,000,000
Erosion/Sediment Control		5%			\$1,004,122
Traffic Control		2%			\$401,649
Surveying/Engineering/Construction Observation		12%			\$2,409,892
<b>Subtotal with Mark-ups</b>					<b>\$29,918,710</b>
Contingency		25%			\$7,479,677
<b>Subtotal</b>					<b>\$37,398,387</b>
<b>TOTAL</b>					<b>\$37,398,387</b>
				<b>SAY</b>	<b>\$37,400,000</b>



Opinion of Probable Cost

DATE PREPARED

17-Jan-11

ACTIVITY AND LOCATION		CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER	
City of Norfolk Norfolk, Virginia				
PROJECT TITLE		ESTIMATED BY	CATEGORY CODE NUMBER	
<b>Alt. 1a - Tidal Barrier with Steel Gate, 2 - 60" Dia. Pumps, and Road Raise For 100 Year Event @ ELEV +7.6'</b>		Moffatt & Nichol		
		STATUS OF DESIGN	JOB ORDER NUMBER	
			6822-06	
ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL
<b>Site Civil</b>				
Road Raise (2-Lane Road)	4,950.00	LF/VLF	\$250.00	\$1,237,500
Road Raise (4-Lane Road)	3,300.00	LF/VLF	\$450.00	\$1,485,000
Utility Relocation	2,750	LF	\$300.00	\$825,000
Elevating Homes along North Side of Dunning Ave	30	EA	\$70,000.00	\$2,100,000
<b>Sliding Gate</b>				
<u>Piling: Steel</u>				
Install AZ 14 Steel Sheet Piles	65,800	SF	\$28.50	\$1,875,300
Treat Embedded Interlocks	15,000	LF	\$7.25	\$108,750
30" DIA Steel Pipe End Piles	360	LF	\$363.00	\$130,680
Special Sheet Fabrication	560	LF	\$42.50	\$23,800
<u>Site Work: Excavation &amp; Fill</u>				
Gravel Base	38,000	CY	\$32.25	\$1,225,500
<u>Concrete: Gate Base Slab</u>				
Precast Concrete Gate Base	50	CY	\$1,832.50	\$91,625
Tremie Concrete Base	150	CY	\$985.00	\$147,750
<u>Gate Assembly</u>				
Framed Steel Gate	65	Tons	\$10,125.00	\$658,125
Flanged Steel Wheel Assembly	6	EA	\$3,120.00	\$18,720
Rail	150	LF	\$298.00	\$44,700
Capstan & Cabling	1	LS	\$193,500.00	\$193,500
UHMW Rollers	12	EA	\$2,587.00	\$31,044
Pocket Seal	35	LF	\$4,650.00	\$162,750
<u>Finish Work</u>				
Concrete Fascia	8,100	SF	\$85.00	\$688,500
Top Slab	180	CY	\$630.00	\$113,400
Handrail	830	LF	\$178.00	\$147,740
<b>Pump Stations</b>				
60" pumps	3	EA	\$1,380,000.00	\$4,140,000
Support Structure - piles,header,rods, etc.	1	EA	\$28,000.00	\$28,000
Misc 60" Pipe Sections	3	EA	\$8,000.00	\$24,000
Concrete Headwall	1	EA	\$80,000.00	\$80,000
Flapgates	3	EA	\$19,200.00	\$57,600
Brick Enclosure for Generator	1	EA	\$450,000.00	\$450,000
Aesthetic Features of Pump Station	1	LS	\$150,000.00	\$150,000



Opinion of Probable Cost

DATE PREPARED

17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
PROJECT TITLE <b>Alt. 1a - Tidal Barrier with Steel Gate, 2 - 60" Dia. Pumps, and Road Raise For 100 Year Event @ ELEV +7.6'</b>	ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER
	STATUS OF DESIGN	JOB ORDER NUMBER 6822-06

ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL

<b>Electrical</b>				
Dominion Power Installation Costs	1	LS	\$100,000.00	\$100,000
<i>Common Costs</i>				
Line Truck	20	DY	\$283.25	\$5,665
Backhoe	10	DY	\$395.52	\$3,955
Scissors Lift	40	DY	\$265.20	\$10,608
<i>Site Work</i>				
Trench & Backfill	400	LF	\$1.96	\$784
Pole, Foundation & Flood It	6	EA	\$1,223.02	\$7,338
Quasite Handhole	3	EA	\$607.04	\$1,821
<i>Power</i>				
Switchboard	1	LS	\$74,231.00	\$74,231
400A 208V service panel W/MCB	1	EA	\$4,475.00	\$4,475
100A 30ckt 208v 3 phase panel	6	EA	\$2,090.00	\$12,540
225A 42 ckt 208v 3 phase panel	2	EA	\$3,400.00	\$6,800
100-225A 3P 208v CB	4	EA	\$998.00	\$3,992
20A 1P 120v Circuit Breaker	42	EA	\$53.30	\$2,239
Surge Arrestor (SPD) 208V 10-Mode NEMA 4x box	2	EA	\$9,849.00	\$19,698
4" GRS Conduit	1500	LF	\$49.80	\$74,700
3/4" GRS Conduit	2500	LF	\$7.93	\$19,825
1/2" GRS Conduit	5000	LF	\$7.14	\$35,700
4" GRS Fittings	100	EA	\$455.00	\$45,500
3/4" GRS Fittings	200	EA	\$42.95	\$8,590
1/2" GRS Fittings	200	EA	\$35.45	\$7,090
# 500 kcmil XHHW	7500	LF	\$14.10	\$105,750
#4/0 AWG THWN	1500	LF	\$6.86	\$10,290
#8 THWN Copper	1500	LF	\$0.91	\$1,365
#12 THWN Copper	25000	LF	\$0.50	\$12,500
# 500 kcmil cable connector	18	EA	\$160.00	\$2,880
GFI Receptacle W/ Box & Cover	25	EA	\$107.09	\$2,677
Duplex Receptacle W/Box & Cover	80	EA	\$60.82	\$4,866
Motor Connection	3	EA	\$9,203.13	\$27,609
VFD Drive	3	EA	\$150,000.00	\$450,000
2500 KW Standby Generator - natural gas	2	EA	\$1,245,875.00	\$2,491,750
Paralleling Switchgear	1	LS	\$429,800.00	\$429,800
150 KVA Dry Transformer	1	EA	\$15,452.00	\$15,452
30kVA UPS owner purchase (including commissioning)	1	EA	\$40,000.00	\$40,000
Annunciator	1	LS	\$14,200.00	\$14,200
Insurance & Taxes for Electrical	1	LS	\$159,404.00	\$159,404



Opinion of Probable Cost

DATE PREPARED

17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia		CONSTRUCTION CONTRACT NO.		IDENTIFICATION NUMBER	
PROJECT TITLE <b>Alt. 1a - Tidal Barrier with Steel Gate, 2 - 60" Dia. Pumps, and Road Raise For 100 Year Event @ ELEV +7.6'</b>		ESTIMATED BY Moffatt & Nichol		CATEGORY CODE NUMBER	
		STATUS OF DESIGN		JOB ORDER NUMBER 6822-06	
		QUANTITY		ENGINEERING ESTIMATE	
ITEM DESCRIPTION		NUMBER	UNIT	UNIT COST	TOTAL
Sales Tax for Electrical		1	LS	\$173,859.00	\$173,859
<b>SUBTOTAL</b>					<b>\$20,626,937</b>
Overhead & Profit		15%			\$3,094,041
Mobilization/Demobilization		10%			\$2,062,694
Difficult Waterside Conditions		est - lump sum			\$1,000,000
Erosion/Sediment Control		5%			\$1,031,347
Traffic Control		2%			\$412,539
Surveying/Engineering/Construction Observation		12%			\$2,475,232
<b>Subtotal with Mark-ups</b>					<b>\$30,702,790</b>
Contingency		25%			\$7,675,697
<b>Subtotal</b>					<b>\$38,378,487</b>
<b>TOTAL</b>					<b>\$38,378,487</b>
				<b>SAY</b>	<b>\$38,400,000</b>



Opinion of Probable Cost

DATE PREPARED  
17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
	ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER
PROJECT TITLE <b>Pretty Lake - Alternative 1b Tidal Barrier with Obermeyer Gate, 2 - 60" Dia. Pumps, and Road Raise</b>	STATUS OF DESIGN	JOB ORDER NUMBER 6822-06

**Summary**

Scenario	Opinion of Probable Cost
2 Year Surge with Rain	\$29,900,000
10 Year Surge with Rain	\$37,600,000
25 Year Surge with Rain	\$39,200,000
50 Year Surge with Rain	\$40,600,000
100 Year Surge with Rain	\$41,900,000



Opinion of Probable Cost

DATE PREPARED

17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
PROJECT TITLE <b>Alt. 1b - Tidal Barrier with Obermeyer Gate, 2 - 60" Dia. Pumps, and Road Raise For 2 Year Event @ ELEV +4.2'</b>	ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER
	STATUS OF DESIGN	JOB ORDER NUMBER 6822-06

ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL

<b>Site Civil</b>				
Road Raise (2-Lane Road)	0.00	LF/VLF	\$250.00	\$0
Road Raise (4-Lane Road)	0.00	LF/VLF	\$450.00	\$0
Utility Relocation	0	LF	\$300.00	\$0
Elevating Homes along North Side of Dunning Ave	0	EA	\$70,000.00	\$0
<b>Obermeyer Gate w/ Bulkhead (Pretty Lake is 475 LF )</b>				
<u>Piling: Steel</u>				
Install AZ 14 Steel Sheet Piles	51,700	SF	\$28.50	\$1,473,450
Treat Embedded Interlocks	12,000	LF	\$7.25	\$87,000
30" DIA Steel Pipe End Piles	300	LF	\$363.00	\$108,900
Special Sheet Fabrication	600	LF	\$42.50	\$25,500
<u>Site Work: Excavation &amp; Fill</u>				
Gravel Base	38,000	CY	\$32.25	\$1,225,500
<u>Concrete: Gate Base Slab</u>				
Precast Concrete Gate Base	50	CY	\$1,832.50	\$91,625
Tremie Concrete Base	150	CY	\$985.00	\$147,750
<u>Dam Assembly</u>				
Gate with Operating System - 12.3' High x 50 LF	615	SF	\$4,000.00	\$2,460,000
<u>Finish Work</u>				
Concrete Fascia	8,100	SF	\$85.00	\$688,500
Top Slab	180	CY	\$630.00	\$113,400
Handrail	830	LF	\$178.00	\$147,740
<b>Pump Stations</b>				
60" pumps	3	EA	\$1,380,000.00	\$4,140,000
Support Structure - piles,header,rods, etc.	1	EA	\$28,000.00	\$28,000
Misc 60" Pipe Sections	3	EA	\$8,000.00	\$24,000
Concrete Headwall	1	EA	\$80,000.00	\$80,000
Flapgates	3	EA	\$19,200.00	\$57,600
Brick Enclosure for Generator	1	EA	\$450,000.00	\$450,000
Aesthetic Features of Pump Station	1	LS	\$150,000.00	\$150,000



Opinion of Probable Cost

DATE PREPARED

17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
PROJECT TITLE <b>Alt. 1b - Tidal Barrier with Obermeyer Gate, 2 - 60" Dia. Pumps, and Road Raise For 2 Year Event @ ELEV +4.2'</b>	ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER
	STATUS OF DESIGN	JOB ORDER NUMBER 6822-06

ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL

<b>Electrical</b>				
Dominion Power Installation Costs	1	LS	\$100,000.00	\$100,000
<i>Common Costs</i>				
Line Truck	20	DY	\$283.25	\$5,665
Backhoe	10	DY	\$395.52	\$3,955
Scissors Lift	40	DY	\$265.20	\$10,608
<i>Site Work</i>				
Trench & Backfill	400	LF	\$1.96	\$784
Pole, Foundation & Flood It	6	EA	\$1,223.02	\$7,338
Quasite Handhole	3	EA	\$607.04	\$1,821
<i>Power</i>				
Switchboard	1	LS	\$74,231.00	\$74,231
400A 208V service panel W/MCB	1	EA	\$4,475.00	\$4,475
100A 30ckt 208v 3 phase panel	6	EA	\$2,090.00	\$12,540
225A 42 ckt 208v 3 phase panel	2	EA	\$3,400.00	\$6,800
100-225A 3P 208v CB	4	EA	\$998.00	\$3,992
20A 1P 120v Circuit Breaker	42	EA	\$53.30	\$2,239
Surge Arrestor (SPD) 208V 10-Mode NEMA 4x box	2	EA	\$9,849.00	\$19,698
4" GRS Conduit	1500	LF	\$49.80	\$74,700
3/4" GRS Conduit	2500	LF	\$7.93	\$19,825
1/2" GRS Conduit	5000	LF	\$7.14	\$35,700
4" GRS Fittings	100	EA	\$455.00	\$45,500
3/4" GRS Fittings	200	EA	\$42.95	\$8,590
1/2" GRS Fittings	200	EA	\$35.45	\$7,090
# 500 kcmil XHHW	7500	LF	\$14.10	\$105,750
#4/0 AWG THWN	1500	LF	\$6.86	\$10,290
#8 THWN Copper	1500	LF	\$0.91	\$1,365
#12 THWN Copper	25000	LF	\$0.50	\$12,500
# 500 kcmil cable connector	18	EA	\$160.00	\$2,880
GFI Receptacle W/ Box & Cover	25	EA	\$107.09	\$2,677
Duplex Receptacle W/Box & Cover	80	EA	\$60.82	\$4,866
Motor Connection	3	EA	\$9,203.13	\$27,609
VFD Drive	3	EA	\$150,000.00	\$450,000
2500 KW Standby Generator - natural gas	2	EA	\$1,245,875.00	\$2,491,750
Paralleling Switchgear	1	LS	\$429,800.00	\$429,800
150 KVA Dry Transformer	1	EA	\$15,452.00	\$15,452
30kVA UPS owner purchase (including commissioning)	1	EA	\$40,000.00	\$40,000
Annunciator	1	LS	\$14,200.00	\$14,200
Insurance & Taxes for Electrical	1	LS	\$159,404.00	\$159,404



Opinion of Probable Cost

DATE PREPARED

17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
PROJECT TITLE <b>Alt. 1b - Tidal Barrier with Obermeyer Gate, 2 - 60" Dia. Pumps, and Road Raise For 2 Year Event @ ELEV +4.2'</b>	ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER
	STATUS OF DESIGN	JOB ORDER NUMBER 6822-06

ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL
Sales Tax for Electrical	1	LS	\$173,859.00	\$173,859
<b>SUBTOTAL</b>				<b>\$15,886,918</b>
Overhead & Profit	15%			\$2,383,038
Mobilization/Demobilization	10%			\$1,588,692
Difficult Waterside Conditions	est - lump sum			\$1,000,000
Erosion/Sediment Control	5%			\$794,346
Traffic Control	2%			\$317,738
Surveying/Engineering/Construction Observation	12%			\$1,906,430
<b>Subtotal with Mark-ups</b>				<b>\$23,877,162</b>
Contingency	25%			\$5,969,291
<b>Subtotal</b>				<b>\$29,846,453</b>
<b>TOTAL</b>				<b>\$29,846,453</b>
			<b>SAY</b>	<b>\$29,900,000</b>



Opinion of Probable Cost

DATE PREPARED  
17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
PROJECT TITLE <b>Alt. 1b - Tidal Barrier with Obermeyer Gate, 2 - 60" Dia. Pumps, and Road Raise For 10 Year Event @ ELEV +5.6'</b>	ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER
	STATUS OF DESIGN	JOB ORDER NUMBER 6822-06

ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL

<b>Site Civil</b>				
Road Raise (2-Lane Road)	1,650.00	LF/VLF	\$250.00	\$412,500
Road Raise (4-Lane Road)	1,100.00	LF/VLF	\$450.00	\$495,000
Utility Relocation	2,750	LF	\$300.00	\$825,000
Elevating Homes along North Side of Dunning Ave	30	EA	\$70,000.00	\$2,100,000
<b>Obermeyer Gate w/ Bulkhead (Pretty Lake is 475 LF) -</b>				
<u>Piling: Steel</u>				
Install AZ 14 Steel Sheet Piles	56,400	SF	\$28.50	\$1,607,400
Treat Embedded Interlocks	13,000	LF	\$7.25	\$94,250
30" DIA Steel Pipe End Piles	320	LF	\$363.00	\$116,160
Special Sheet Fabrication	520	LF	\$42.50	\$22,100
<u>Site Work: Excavation &amp; Fill</u>				
Gravel Base	38,000	CY	\$32.25	\$1,225,500
<u>Concrete: Gate Base Slab</u>				
Precast Concrete Gate Base	50	CY	\$1,832.50	\$91,625
Tremie Concrete Base	150	CY	\$985.00	\$147,750
<u>Dam Assembly</u>				
Gate with Operating System - 13.7' High x 50 LF	685	SF	\$4,000.00	\$2,740,000
<u>Finish Work</u>				
Concrete Fascia	8,100	SF	\$85.00	\$688,500
Top Slab	180	CY	\$630.00	\$113,400
Handrail	830	LF	\$178.00	\$147,740
<b>Pump Stations</b>				
60" pumps	3	EA	\$1,380,000.00	\$4,140,000
Support Structure - piles,header,rods, etc.	1	EA	\$28,000.00	\$28,000
Misc 60" Pipe Sections	3	EA	\$8,000.00	\$24,000
Concrete Headwall	1	EA	\$80,000.00	\$80,000
Flapgates	3	EA	\$19,200.00	\$57,600
Brick Enclosure for Generator	1	EA	\$450,000.00	\$450,000
Aesthetic Features of Pump Station	1	LS	\$150,000.00	\$150,000



Opinion of Probable Cost

DATE PREPARED  
17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
PROJECT TITLE <b>Alt. 1b - Tidal Barrier with Obermeyer Gate, 2 - 60" Dia. Pumps, and Road Raise For 10 Year Event @ ELEV +5.6'</b>	ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER
	STATUS OF DESIGN	JOB ORDER NUMBER 6822-06

ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL

<b>Electrical</b>				
Dominion Power Installation Costs	1	LS	\$100,000.00	\$100,000
<i>Common Costs</i>				
Line Truck	20	DY	\$283.25	\$5,665
Backhoe	10	DY	\$395.52	\$3,955
Scissors Lift	40	DY	\$265.20	\$10,608
<i>Site Work</i>				
Trench & Backfill	400	LF	\$1.96	\$784
Pole, Foundation & Flood It	6	EA	\$1,223.02	\$7,338
Quasite Handhole	3	EA	\$607.04	\$1,821
<i>Power</i>				
Switchboard	1	LS	\$74,231.00	\$74,231
400A 208V service panel W/MCB	1	EA	\$4,475.00	\$4,475
100A 30ckt 208v 3 phase panel	6	EA	\$2,090.00	\$12,540
225A 42 ckt 208v 3 phase panel	2	EA	\$3,400.00	\$6,800
100-225A 3P 208v CB	4	EA	\$998.00	\$3,992
20A 1P 120v Circuit Breaker	42	EA	\$53.30	\$2,239
Surge Arrestor (SPD) 208V 10-Mode NEMA 4x box	2	EA	\$9,849.00	\$19,698
4" GRS Conduit	1500	LF	\$49.80	\$74,700
3/4" GRS Conduit	2500	LF	\$7.93	\$19,825
1/2" GRS Conduit	5000	LF	\$7.14	\$35,700
4" GRS Fittings	100	EA	\$455.00	\$45,500
3/4" GRS Fittings	200	EA	\$42.95	\$8,590
1/2" GRS Fittings	200	EA	\$35.45	\$7,090
# 500 kcmil XHHW	7500	LF	\$14.10	\$105,750
#4/0 AWG THWN	1500	LF	\$6.86	\$10,290
#8 THWN Copper	1500	LF	\$0.91	\$1,365
#12 THWN Copper	25000	LF	\$0.50	\$12,500
# 500 kcmil cable connector	18	EA	\$160.00	\$2,880
GFI Receptacle W/ Box & Cover	25	EA	\$107.09	\$2,677
Duplex Receptacle W/Box & Cover	80	EA	\$60.82	\$4,866
Motor Connection	3	EA	\$9,203.13	\$27,609
VFD Drive	3	EA	\$150,000.00	\$450,000
2500 KW Standby Generator - natural gas	2	EA	\$1,245,875.00	\$2,491,750
Paralleling Switchgear	1	LS	\$429,800.00	\$429,800
150 KVA Dry Transformer	1	EA	\$15,452.00	\$15,452
30kVA UPS owner purchase (including commissioning)	1	EA	\$40,000.00	\$40,000
Annunciator	1	LS	\$14,200.00	\$14,200
Insurance & Taxes for Electrical	1	LS	\$159,404.00	\$159,404



Opinion of Probable Cost

DATE PREPARED  
17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
	ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER
PROJECT TITLE <b>Alt. 1b - Tidal Barrier with Obermeyer Gate, 2 - 60" Dia. Pumps, and Road Raise For 10 Year Event @ ELEV +5.6'</b>	STATUS OF DESIGN	JOB ORDER NUMBER 6822-06

ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL
Sales Tax for Electrical	1	LS	\$173,859.00	\$173,859
<b>SUBTOTAL</b>				<b>\$20,144,478</b>
Overhead & Profit	15%			\$3,021,672
Mobilization/Demobilization	10%			\$2,014,448
Difficult Waterside Conditions	est - lump sum			\$1,000,000
Erosion/Sediment Control	5%			\$1,007,224
Traffic Control	2%			\$402,890
Surveying/Engineering/Construction Observation	12%			\$2,417,337
<b>Subtotal with Mark-ups</b>				<b>\$30,008,049</b>
Contingency	25%			\$7,502,012
<b>Subtotal</b>				<b>\$37,510,061</b>
<b>TOTAL</b>				<b>\$37,510,061</b>
			<b>SAY</b>	<b>\$37,600,000</b>



Opinion of Probable Cost

DATE PREPARED

17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
PROJECT TITLE <b>Alt. 1b - Tidal Barrier with Obermeyer Gate, 2 - 60" Dia. Pumps, and Road Raise For 25 Year Event @ ELEV +6.4'</b>	ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER
	STATUS OF DESIGN	JOB ORDER NUMBER 6822-06

ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL

<b>Site Civil</b>				
Road Raise (2-Lane Road)	2,970.00	LF/VLF	\$250.00	\$742,500
Road Raise (4-Lane Road)	1,980.00	LF/VLF	\$450.00	\$891,000
Utility Relocation	2,750	LF	\$300.00	\$825,000
Elevating Homes along North Side of Dunning Ave	30	EA	\$70,000.00	\$2,100,000
<b>Obermeyer Gate w/ Bulkhead (Pretty Lake is 475 LF )</b>				
<u>Piling: Steel</u>				
Install AZ 14 Steel Sheet Piles	56,400	SF	\$28.50	\$1,607,400
Treat Embedded Interlocks	13,000	LF	\$7.25	\$94,250
30" DIA Steel Pipe End Piles	320	LF	\$363.00	\$116,160
Special Sheet Fabrication	520	LF	\$42.50	\$22,100
<u>Site Work: Excavation &amp; Fill</u>				
Gravel Base	38,000	CY	\$32.25	\$1,225,500
<u>Concrete: Gate Base Slab</u>				
Precast Concrete Gate Base	50	CY	\$1,832.50	\$91,625
Tremie Concrete Base	150	CY	\$985.00	\$147,750
<u>Dam Assembly</u>				
Gate with Operating System - 15.1' High x 50 LF	725	SF	\$4,000.00	\$2,900,000
<u>Finish Work</u>				
Concrete Fascia	8,100	SF	\$85.00	\$688,500
Top Slab	180	CY	\$630.00	\$113,400
Handrail	830	LF	\$178.00	\$147,740
<b>Pump Stations</b>				
60" pumps	3	EA	\$1,380,000.00	\$4,140,000
Support Structure - piles,header,rods, etc.	1	EA	\$28,000.00	\$28,000
Misc 60" Pipe Sections	3	EA	\$8,000.00	\$24,000
Concrete Headwall	1	EA	\$80,000.00	\$80,000
Flapgates	3	EA	\$19,200.00	\$57,600
Brick Enclosure for Generator	1	EA	\$450,000.00	\$450,000
Aesthetic Features of Pump Station	1	LS	\$150,000.00	\$150,000



Opinion of Probable Cost

DATE PREPARED

17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
PROJECT TITLE <b>Alt. 1b - Tidal Barrier with Obermeyer Gate, 2 - 60" Dia. Pumps, and Road Raise For 25 Year Event @ ELEV +6.4'</b>	ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER
	STATUS OF DESIGN	JOB ORDER NUMBER 6822-06

ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL

<b>Electrical</b>				
Dominion Power Installation Costs	1	LS	\$100,000.00	\$100,000
<i>Common Costs</i>				
Line Truck	20	DY	\$283.25	\$5,665
Backhoe	10	DY	\$395.52	\$3,955
Scissors Lift	40	DY	\$265.20	\$10,608
<i>Site Work</i>				
Trench & Backfill	400	LF	\$1.96	\$784
Pole, Foundation & Flood It	6	EA	\$1,223.02	\$7,338
Quasite Handhole	3	EA	\$607.04	\$1,821
<i>Power</i>				
Switchboard	1	LS	\$74,231.00	\$74,231
400A 208V service panel W/MCB	1	EA	\$4,475.00	\$4,475
100A 30ckt 208v 3 phase panel	6	EA	\$2,090.00	\$12,540
225A 42 ckt 208v 3 phase panel	2	EA	\$3,400.00	\$6,800
100-225A 3P 208v CB	4	EA	\$998.00	\$3,992
20A 1P 120v Circuit Breaker	42	EA	\$53.30	\$2,239
Surge Arrestor (SPD) 208V 10-Mode NEMA 4x box	2	EA	\$9,849.00	\$19,698
4" GRS Conduit	1500	LF	\$49.80	\$74,700
3/4" GRS Conduit	2500	LF	\$7.93	\$19,825
1/2" GRS Conduit	5000	LF	\$7.14	\$35,700
4" GRS Fittings	100	EA	\$455.00	\$45,500
3/4" GRS Fittings	200	EA	\$42.95	\$8,590
1/2" GRS Fittings	200	EA	\$35.45	\$7,090
# 500 kcmil XHHW	7500	LF	\$14.10	\$105,750
#4/0 AWG THWN	1500	LF	\$6.86	\$10,290
#8 THWN Copper	1500	LF	\$0.91	\$1,365
#12 THWN Copper	25000	LF	\$0.50	\$12,500
# 500 kcmil cable connector	18	EA	\$160.00	\$2,880
GFI Receptacle W/ Box & Cover	25	EA	\$107.09	\$2,677
Duplex Receptacle W/Box & Cover	80	EA	\$60.82	\$4,866
Motor Connection	3	EA	\$9,203.13	\$27,609
VFD Drive	3	EA	\$150,000.00	\$450,000
2500 KW Standby Generator - natural gas	2	EA	\$1,245,875.00	\$2,491,750
Paralleling Switchgear	1	LS	\$429,800.00	\$429,800
150 KVA Dry Transformer	1	EA	\$15,452.00	\$15,452
30kVA UPS owner purchase (including commissioning)	1	EA	\$40,000.00	\$40,000
Annunciator	1	LS	\$14,200.00	\$14,200
Insurance & Taxes for Electrical	1	LS	\$159,404.00	\$159,404



Opinion of Probable Cost

DATE PREPARED

17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia		CONSTRUCTION CONTRACT NO.		IDENTIFICATION NUMBER	
PROJECT TITLE <b>Alt. 1b - Tidal Barrier with Obermeyer Gate, 2 - 60" Dia. Pumps, and Road Raise For 25 Year Event @ ELEV +6.4'</b>		ESTIMATED BY Moffatt & Nichol		CATEGORY CODE NUMBER	
		STATUS OF DESIGN		JOB ORDER NUMBER 6822-06	
ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE		
	NUMBER	UNIT	UNIT COST	TOTAL	
Sales Tax for Electrical	1	LS	\$173,859.00	\$173,859	
<b>SUBTOTAL</b>				<b>\$21,030,478</b>	
Overhead & Profit	15%			\$3,154,572	
Mobilization/Demobilization	10%			\$2,103,048	
Difficult Waterside Conditions	est - lump sum			\$1,000,000	
Erosion/Sediment Control	5%			\$1,051,524	
Traffic Control	2%			\$420,610	
Surveying/Engineering/Construction Observation	12%			\$2,523,657	
<b>Subtotal with Mark-ups</b>				<b>\$31,283,889</b>	
Contingency	25%			\$7,820,972	
<b>Subtotal</b>				<b>\$39,104,861</b>	
<b>TOTAL</b>				<b>\$39,104,861</b>	
				<b>SAY \$39,200,000</b>	



Opinion of Probable Cost

DATE PREPARED

17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
PROJECT TITLE <b>Alt. 1b - Tidal Barrier with Obermeyer Gate, 2 - 60" Dia. Pumps, and Road Raise For 50 Year Event @ ELEV +7.0'</b>	ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER
	STATUS OF DESIGN	JOB ORDER NUMBER 6822-06

ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL

<b>Site Civil</b>				
Road Raise (2-Lane Road)	3,960.00	LF/VLF	\$250.00	\$990,000
Road Raise (4-Lane Road)	2,640.00	LF/VLF	\$450.00	\$1,188,000
Utility Relocation	2,750	LF	\$300.00	\$825,000
Elevating Homes along North Side of Dunning Ave	30	EA	\$70,000.00	\$2,100,000
<b>Obermeyer Gate w/ Bulkhead (Pretty Lake is 475 LF )</b>				
<u>Piling: Steel</u>				
Install AZ 14 Steel Sheet Piles	61,100	SF	\$28.50	\$1,741,350
Treat Embedded Interlocks	14,000	LF	\$7.25	\$101,500
30" DIA Steel Pipe End Piles	340	LF	\$363.00	\$123,420
Special Sheet Fabrication	520	LF	\$42.50	\$22,100
<u>Site Work: Excavation &amp; Fill</u>				
Gravel Base	38,000	CY	\$32.25	\$1,225,500
<u>Concrete: Gate Base Slab</u>				
Precast Concrete Gate Base	50	CY	\$1,832.50	\$91,625
Tremie Concrete Base	150	CY	\$985.00	\$147,750
<u>Dam Assembly</u>				
Gate with Operating System - 15.1' High x 50 LF	755	SF	\$4,000.00	\$3,020,000
<u>Finish Work</u>				
Concrete Fascia	8,100	SF	\$85.00	\$688,500
Top Slab	180	CY	\$630.00	\$113,400
Handrail	830	LF	\$178.00	\$147,740
<b>Pump Stations</b>				
60" pumps	3	EA	\$1,380,000.00	\$4,140,000
Support Structure - piles,header,rods, etc.	1	EA	\$28,000.00	\$28,000
Misc 60" Pipe Sections	3	EA	\$8,000.00	\$24,000
Concrete Headwall	1	EA	\$80,000.00	\$80,000
Flapgates	3	EA	\$19,200.00	\$57,600
Brick Enclosure for Generator	1	EA	\$450,000.00	\$450,000
Aesthetic Features of Pump Station	1	LS	\$150,000.00	\$150,000



Opinion of Probable Cost

DATE PREPARED

17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
PROJECT TITLE <b>Alt. 1b - Tidal Barrier with Obermeyer Gate, 2 - 60" Dia. Pumps, and Road Raise For 50 Year Event @ ELEV +7.0'</b>	ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER
	STATUS OF DESIGN	JOB ORDER NUMBER 6822-06

ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL

<b>Electrical</b>				
Dominion Power Installation Costs	1	LS	\$100,000.00	\$100,000
<i>Common Costs</i>				
Line Truck	20	DY	\$283.25	\$5,665
Backhoe	10	DY	\$395.52	\$3,955
Scissors Lift	40	DY	\$265.20	\$10,608
<i>Site Work</i>				
Trench & Backfill	400	LF	\$1.96	\$784
Pole, Foundation & Flood It	6	EA	\$1,223.02	\$7,338
Quasite Handhole	3	EA	\$607.04	\$1,821
<i>Power</i>				
Switchboard	1	LS	\$74,231.00	\$74,231
400A 208V service panel W/MCB	1	EA	\$4,475.00	\$4,475
100A 30ckt 208v 3 phase panel	6	EA	\$2,090.00	\$12,540
225A 42 ckt 208v 3 phase panel	2	EA	\$3,400.00	\$6,800
100-225A 3P 208v CB	4	EA	\$998.00	\$3,992
20A 1P 120v Circuit Breaker	42	EA	\$53.30	\$2,239
Surge Arrestor (SPD) 208V 10-Mode NEMA 4x box	2	EA	\$9,849.00	\$19,698
4" GRS Conduit	1500	LF	\$49.80	\$74,700
3/4" GRS Conduit	2500	LF	\$7.93	\$19,825
1/2" GRS Conduit	5000	LF	\$7.14	\$35,700
4" GRS Fittings	100	EA	\$455.00	\$45,500
3/4" GRS Fittings	200	EA	\$42.95	\$8,590
1/2" GRS Fittings	200	EA	\$35.45	\$7,090
# 500 kcmil XHHW	7500	LF	\$14.10	\$105,750
#4/0 AWG THWN	1500	LF	\$6.86	\$10,290
#8 THWN Copper	1500	LF	\$0.91	\$1,365
#12 THWN Copper	25000	LF	\$0.50	\$12,500
# 500 kcmil cable connector	18	EA	\$160.00	\$2,880
GFI Receptacle W/ Box & Cover	25	EA	\$107.09	\$2,677
Duplex Receptacle W/Box & Cover	80	EA	\$60.82	\$4,866
Motor Connection	3	EA	\$9,203.13	\$27,609
VFD Drive	3	EA	\$150,000.00	\$450,000
2500 KW Standby Generator - natural gas	2	EA	\$1,245,875.00	\$2,491,750
Paralleling Switchgear	1	LS	\$429,800.00	\$429,800
150 KVA Dry Transformer	1	EA	\$15,452.00	\$15,452
30kVA UPS owner purchase (including commissioning)	1	EA	\$40,000.00	\$40,000
Annunciator	1	LS	\$14,200.00	\$14,200
Insurance & Taxes for Electrical	1	LS	\$159,404.00	\$159,404



Opinion of Probable Cost

DATE PREPARED

17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia		CONSTRUCTION CONTRACT NO.		IDENTIFICATION NUMBER	
PROJECT TITLE <b>Alt. 1b - Tidal Barrier with Obermeyer Gate, 2 - 60" Dia. Pumps, and Road Raise For 50 Year Event @ ELEV +7.0'</b>		ESTIMATED BY Moffatt & Nichol		CATEGORY CODE NUMBER	
		STATUS OF DESIGN		JOB ORDER NUMBER 6822-06	
ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE		
	NUMBER	UNIT	UNIT COST	TOTAL	
Sales Tax for Electrical	1	LS	\$173,859.00	\$173,859	
<b>SUBTOTAL</b>				<b>\$21,843,438</b>	
Overhead & Profit	15%			\$3,276,516	
Mobilization/Demobilization	10%			\$2,184,344	
Difficult Waterside Conditions	est - lump sum			\$1,000,000	
Erosion/Sediment Control	5%			\$1,092,172	
Traffic Control	2%			\$436,869	
Surveying/Engineering/Construction Observation	12%			\$2,621,213	
<b>Subtotal with Mark-ups</b>				<b>\$32,454,551</b>	
Contingency	25%			\$8,113,638	
<b>Subtotal</b>				<b>\$40,568,189</b>	
<b>TOTAL</b>				<b>\$40,568,189</b>	
				<b>SAY \$40,600,000</b>	



Opinion of Probable Cost

DATE PREPARED

17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
PROJECT TITLE <b>Alt. 1b - Tidal Barrier with Obermeyer Gate, 2 - 60" Dia. Pumps, and Road Raise For 100 Year Event @ ELEV +7.6'</b>	ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER
	STATUS OF DESIGN	JOB ORDER NUMBER 6822-06

ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL

<b>Site Civil</b>				
Road Raise (2-Lane Road)	4,950.00	LF/VLF	\$250.00	\$1,237,500
Road Raise (4-Lane Road)	3,300.00	LF/VLF	\$450.00	\$1,485,000
Utility Relocation	2,750	LF	\$300.00	\$825,000
Elevating Homes along North Side of Dunning Ave	30	EA	\$70,000.00	\$2,100,000
<b>Obermeyer Gate w/ Bulkhead (Pretty Lake is 475 LF )</b>				
<u>Piling: Steel</u>				
Install AZ 14 Steel Sheet Piles	61,100	SF	\$28.50	\$1,741,350
Treat Embedded Interlocks	14,000	LF	\$7.25	\$101,500
30" DIA Steel Pipe End Piles	340	LF	\$363.00	\$123,420
Special Sheet Fabrication	520	LF	\$42.50	\$22,100
<u>Site Work: Excavation &amp; Fill</u>				
Gravel Base	38,000	CY	\$32.25	\$1,225,500
<u>Concrete: Gate Base Slab</u>				
Precast Concrete Gate Base	50	CY	\$1,832.50	\$91,625
Tremie Concrete Base	150	CY	\$985.00	\$147,750
<u>Dam Assembly</u>				
Gate with Operating System - 15.7' High x 50 LF	795	SF	\$4,000.00	\$3,180,000
<u>Finish Work</u>				
Concrete Fascia	8,100	SF	\$85.00	\$688,500
Top Slab	180	CY	\$630.00	\$113,400
Handrail	830	LF	\$178.00	\$147,740
<b>Pump Stations</b>				
60" pumps	3	EA	\$1,380,000.00	\$4,140,000
Support Structure - piles,header,rods, etc.	1	EA	\$28,000.00	\$28,000
Misc 60" Pipe Sections	3	EA	\$8,000.00	\$24,000
Concrete Headwall	1	EA	\$80,000.00	\$80,000
Flapgates	3	EA	\$19,200.00	\$57,600
Brick Enclosure for Generator	1	EA	\$450,000.00	\$450,000
Aesthetic Features of Pump Station	1	LS	\$150,000.00	\$150,000



Opinion of Probable Cost

DATE PREPARED

17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
PROJECT TITLE <b>Alt. 1b - Tidal Barrier with Obermeyer Gate, 2 - 60" Dia. Pumps, and Road Raise For 100 Year Event @ ELEV +7.6'</b>	ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER
	STATUS OF DESIGN	JOB ORDER NUMBER 6822-06

ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL

<b>Electrical</b>				
Dominion Power Installation Costs	1	LS	\$100,000.00	\$100,000
<i>Common Costs</i>				
Line Truck	20	DY	\$283.25	\$5,665
Backhoe	10	DY	\$395.52	\$3,955
Scissors Lift	40	DY	\$265.20	\$10,608
<i>Site Work</i>				
Trench & Backfill	400	LF	\$1.96	\$784
Pole, Foundation & Flood It	6	EA	\$1,223.02	\$7,338
Quasite Handhole	3	EA	\$607.04	\$1,821
<i>Power</i>				
Switchboard	1	LS	\$74,231.00	\$74,231
400A 208V service panel W/MCB	1	EA	\$4,475.00	\$4,475
100A 30ckt 208v 3 phase panel	6	EA	\$2,090.00	\$12,540
225A 42 ckt 208v 3 phase panel	2	EA	\$3,400.00	\$6,800
100-225A 3P 208v CB	4	EA	\$998.00	\$3,992
20A 1P 120v Circuit Breaker	42	EA	\$53.30	\$2,239
Surge Arrestor (SPD) 208V 10-Mode NEMA 4x box	2	EA	\$9,849.00	\$19,698
4" GRS Conduit	1500	LF	\$49.80	\$74,700
3/4" GRS Conduit	2500	LF	\$7.93	\$19,825
1/2" GRS Conduit	5000	LF	\$7.14	\$35,700
4" GRS Fittings	100	EA	\$455.00	\$45,500
3/4" GRS Fittings	200	EA	\$42.95	\$8,590
1/2" GRS Fittings	200	EA	\$35.45	\$7,090
# 500 kcmil XHHW	7500	LF	\$14.10	\$105,750
#4/0 AWG THWN	1500	LF	\$6.86	\$10,290
#8 THWN Copper	1500	LF	\$0.91	\$1,365
#12 THWN Copper	25000	LF	\$0.50	\$12,500
# 500 kcmil cable connector	18	EA	\$160.00	\$2,880
GFI Receptacle W/ Box & Cover	25	EA	\$107.09	\$2,677
Duplex Receptacle W/Box & Cover	80	EA	\$60.82	\$4,866
Motor Connection	3	EA	\$9,203.13	\$27,609
VFD Drive	3	EA	\$150,000.00	\$450,000
2500 KW Standby Generator - natural gas	2	EA	\$1,245,875.00	\$2,491,750
Paralleling Switchgear	1	LS	\$429,800.00	\$429,800
150 KVA Dry Transformer	1	EA	\$15,452.00	\$15,452
30kVA UPS owner purchase (including commissioning)	1	EA	\$40,000.00	\$40,000
Annunciator	1	LS	\$14,200.00	\$14,200
Insurance & Taxes for Electrical	1	LS	\$159,404.00	\$159,404



Opinion of Probable Cost

DATE PREPARED

17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia		CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER	
PROJECT TITLE <b>Alt. 1b - Tidal Barrier with Obermeyer Gate, 2 - 60" Dia. Pumps, and Road Raise For 100 Year Event @ ELEV +7.6'</b>		ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER	
		STATUS OF DESIGN	JOB ORDER NUMBER 6822-06	
ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL
Sales Tax for Electrical	1	LS	\$173,859.00	\$173,859
<b>SUBTOTAL</b>				<b>\$22,547,938</b>
Overhead & Profit	15%			\$3,382,191
Mobilization/Demobilization	10%			\$2,254,794
Difficult Waterside Conditions	est - lump sum			\$1,000,000
Erosion/Sediment Control	5%			\$1,127,397
Traffic Control	2%			\$450,959
Surveying/Engineering/Construction Observation	12%			\$2,705,753
<b>Subtotal with Mark-ups</b>				<b>\$33,469,031</b>
Contingency	25%			\$8,367,258
<b>Subtotal</b>				<b>\$41,836,289</b>
<b>TOTAL</b>				<b>\$41,836,289</b>
			<b>SAY</b>	<b>\$41,900,000</b>



Opinion of Probable Cost

DATE PREPARED  
17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO. IDENTIFICATION NUMBER
PROJECT TITLE <b>Alt. 1c - Tidal Barrier with Inflatable Dam, 2 - 60" Dia. Pumps, and Road Raise For 100 Year Event @ ELEV +7.6'</b>	ESTIMATED BY Moffatt & Nichol
	CATEGORY CODE NUMBER
	STATUS OF DESIGN
	JOB ORDER NUMBER 6822-06

ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL

<b>Site Civil</b>				
Road Raise (2-Lane Road)	4,950.00	F/VL	\$250.00	\$1,237,500
Road Raise (4-Lane Road)	3,300.00	F/VL	\$450.00	\$1,485,000
Utility Relocation	2,750	LF	\$300.00	\$825,000
Elevating Homes along North Side of Dunning Ave	30	EA	\$70,000.00	\$2,100,000
<b>Inflatable Dam w/ Bulkhead (Pretty Lake is 475 LF )</b>				
<u>Piling: Steel</u>				
Install AZ 14 Steel Sheet Piles	61,100	SF	\$28.50	\$1,741,350
Treat Embedded Interlocks	14,000	LF	\$7.25	\$101,500
30" DIA Steel Pipe End Piles	340	LF	\$363.00	\$123,420
Special Sheet Fabrication	520	LF	\$42.50	\$22,100
<u>Site Work: Excavation &amp; Fill</u>				
Gravel Base	38,000	CY	\$32.25	\$1,225,500
<u>Concrete: Gate Base Slab</u>				
Precast Concrete Gate Base	50	CY	\$1,832.50	\$91,625
Tremie Concrete Base	150	CY	\$985.00	\$147,750
<u>Dam Assembly</u>				
Rubber Dam - 15.7' High x 111 LF	1,765	SF	\$3,000.00	\$5,294,700
Dam Operating System	1	LS	\$248,000.00	\$248,000
<u>Finish Work</u>				
Concrete Fascia	8,100	SF	\$85.00	\$688,500
Top Slab	180	CY	\$630.00	\$113,400
Handrail	830	LF	\$178.00	\$147,740
<b>Pump Stations</b>				
60" pumps	3	EA	\$1,380,000.00	\$4,140,000
Support Structure - piles,header,rods, etc.	1	EA	\$28,000.00	\$28,000
Misc 60" Pipe Sections	3	EA	\$8,000.00	\$24,000
Concrete Headwall	1	EA	\$80,000.00	\$80,000
Flapgates	3	EA	\$19,200.00	\$57,600
Brick Enclosure for Generator	1	EA	\$450,000.00	\$450,000
Aesthetic Features of Pump Station	1	LS	\$150,000.00	\$150,000



Opinion of Probable Cost

DATE PREPARED  
17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO. IDENTIFICATION NUMBER
PROJECT TITLE <b>Alt. 1c - Tidal Barrier with Inflatable Dam, 2 - 60" Dia. Pumps, and Road Raise For 100 Year Event @ ELEV +7.6'</b>	ESTIMATED BY Moffatt & Nichol
	CATEGORY CODE NUMBER
	STATUS OF DESIGN JOB ORDER NUMBER 6822-06

ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL

<b>Electrical</b>				
Dominion Power Installation Costs	1	LS	\$100,000.00	\$100,000
<i>Common Costs</i>				
Line Truck	20	DY	\$283.25	\$5,665
Backhoe	10	DY	\$395.52	\$3,955
Scissors Lift	40	DY	\$265.20	\$10,608
<i>Site Work</i>				
Trench & Backfill	400	LF	\$1.96	\$784
Pole, Foundation & Flood It	6	EA	\$1,223.02	\$7,338
Quasite Handhole	3	EA	\$607.04	\$1,821
<i>Power</i>				
Switchboard	1	LS	\$74,231.00	\$74,231
400A 208V service panel W/MCB	1	EA	\$4,475.00	\$4,475
100A 30ckt 208v 3 phase panel	6	EA	\$2,090.00	\$12,540
225A 42 ckt 208v 3 phase panel	2	EA	\$3,400.00	\$6,800
100-225A 3P 208v CB	4	EA	\$998.00	\$3,992
20A 1P 120v Circuit Breaker	42	EA	\$53.30	\$2,239
Surge Arrestor (SPD) 208V 10-Mode NEMA 4x box	2	EA	\$9,849.00	\$19,698
4" GRS Conduit	1500	LF	\$49.80	\$74,700
3/4" GRS Conduit	2500	LF	\$7.93	\$19,825
1/2" GRS Conduit	5000	LF	\$7.14	\$35,700
4" GRS Fittings	100	EA	\$455.00	\$45,500
3/4" GRS Fittings	200	EA	\$42.95	\$8,590
1/2" GRS Fittings	200	EA	\$35.45	\$7,090
# 500 kcmil XHHW	7500	LF	\$14.10	\$105,750
#4/0 AWG THWN	1500	LF	\$6.86	\$10,290
#8 THWN Copper	1500	LF	\$0.91	\$1,365
#12 THWN Copper	25000	LF	\$0.50	\$12,500
# 500 kcmil cable connector	18	EA	\$160.00	\$2,880
GFI Receptacle W/ Box & Cover	25	EA	\$107.09	\$2,677
Duplex Receptacle W/Box & Cover	80	EA	\$60.82	\$4,866
Motor Connection	3	EA	\$9,203.13	\$27,609
VFD Drive	3	EA	\$150,000.00	\$450,000
2500 KW Standby Generator - natural gas	2	EA	\$1,245,875.00	\$2,491,750
Paralleling Switchgear	1	LS	\$429,800.00	\$429,800
150 KVA Dry Transformer	1	EA	\$15,452.00	\$15,452
30kVA UPS owner purchase (including commissioning)	1	EA	\$40,000.00	\$40,000
Annunciator	1	LS	\$14,200.00	\$14,200
Insurance & Taxes for Electrical	1	LS	\$159,404.00	\$159,404



Opinion of Probable Cost

DATE PREPARED  
17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia		CONSTRUCTION CONTRACT NO. IDENTIFICATION NUMBER		
PROJECT TITLE <b>Alt. 1c - Tidal Barrier with Inflatable Dam, 2 - 60" Dia. Pumps, and Road Raise For 100 Year Event @ ELEV +7.6'</b>		ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER	
		STATUS OF DESIGN	JOB ORDER NUMBER 6822-06	
ITEM DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE	
	NUMBER	UNIT	UNIT COST	TOTAL
Sales Tax for Electrical	1	LS	\$173,859.00	\$173,859
<b>SUBTOTAL</b>				<b>\$24,910,638</b>
Overhead & Profit		15%		\$3,736,596
Mobilization/Demobilization		10%		\$2,491,064
Difficult Waterside Conditions		est - lump sum		\$1,000,000
Erosion/Sediment Control		5%		\$1,245,532
Traffic Control		2%		\$498,213
Surveying/Engineering/Construction Observation		12%		\$2,989,277
<b>Subtotal with Mark-ups</b>				<b>\$36,871,319</b>
Contingency		25%		\$9,217,830
<b>Subtotal</b>				<b>\$46,089,149</b>
<b>TOTAL</b>				<b>\$46,089,149</b>
			<b>SAY</b>	<b>\$46,100,000</b>



Opinion of Probable Cost

DATE PREPARED  
17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO. IDENTIFICATION NUMBER
PROJECT TITLE <b>Pretty Lake - Alternative 2a Tidal Barrier with Steel Gate, 4 - 60" Dia. Pumps, and Road Raise</b>	ESTIMATED BY Moffatt & Nichol
	CATEGORY CODE NUMBER STATUS OF DESIGN JOB ORDER NUMBER 6822-06

Summary	
Scenario	Opinion of Probable Cost
2 Year Surge with Rain	\$39,800,000
10 Year Surge with Rain	\$46,900,000
25 Year Surge with Rain	\$48,200,000
50 Year Surge with Rain	\$49,500,000
100 Year Surge with Rain	\$50,500,000



Opinion of Probable Cost

DATE PREPARED  
17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
	ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER
PROJECT TITLE <b>Pretty Lake - Alternative 2b Tidal Barrier with Obermeyer Gate, 4 - 60" Dia. Pumps, and Road Raise</b>	STATUS OF DESIGN	JOB ORDER NUMBER 6822-06

**Summary**

Scenario	Opinion of Probable Cost
2 Year Surge with Rain	\$41,800,000
10 Year Surge with Rain	\$49,400,000
25 Year Surge with Rain	\$51,000,000
50 Year Surge with Rain	\$52,500,000
100 Year Surge with Rain	\$53,800,000



Opinion of Probable Cost

DATE PREPARED  
17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
	ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER
PROJECT TITLE <b>Pretty Lake - Alternative 2c Tidal Barrier with Inflatable Dam, 4 - 60" Dia. Pumps, and Road Raise</b>	STATUS OF DESIGN	JOB ORDER NUMBER 6822-06

Summary

Scenario	Opinion of Probable Cost
2 Year Surge with Rain	\$45,300,000
10 Year Surge with Rain	\$53,300,000
25 Year Surge with Rain	\$55,100,000
50 Year Surge with Rain	\$56,700,000
100 Year Surge with Rain	\$57,600,000



Opinion of Probable Cost

DATE PREPARED  
17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO. IDENTIFICATION NUMBER
PROJECT TITLE <b>Pretty Lake - Alternative 3a Tidal Barrier with Steel Gate, 4 - 96" Dia. Pumps, and Road Raise</b>	ESTIMATED BY Moffatt & Nichol
	CATEGORY CODE NUMBER STATUS OF DESIGN JOB ORDER NUMBER 6822-03

Summary	
Scenario	Opinion of Probable Cost
2 Year Surge with Rain	\$74,300,000
10 Year Surge with Rain	\$81,500,000
25 Year Surge with Rain	\$82,800,000
50 Year Surge with Rain	\$84,000,000
100 Year Surge with Rain	\$85,000,000



Opinion of Probable Cost

DATE PREPARED  
17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
	ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER
PROJECT TITLE <b>Pretty Lake - Alternative 3b Tidal Barrier with Obermeyer Gate, 4 - 96" Dia. Pumps, and Road Raise</b>	STATUS OF DESIGN	JOB ORDER NUMBER 6822-06

Summary

Scenario	Opinion of Probable Cost
2 Year Surge with Rain	\$76,500,000
10 Year Surge with Rain	\$84,100,000
25 Year Surge with Rain	\$85,700,000
50 Year Surge with Rain	\$87,200,000
100 Year Surge with Rain	\$88,500,000



Opinion of Probable Cost

DATE PREPARED  
17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
	ESTIMATED BY Moffatt & Nichol	CATEGORY CODE NUMBER
PROJECT TITLE <b>Pretty Lake - Alternative 3c Tidal Barrier with Inflatable Dam, 4 - 96" Dia. Pumps, and Road Raise</b>	STATUS OF DESIGN	JOB ORDER NUMBER 6822-06

Summary	
Scenario	Opinion of Probable Cost
2 Year Surge with Rain	\$79,900,000
10 Year Surge with Rain	\$90,400,000
25 Year Surge with Rain	\$92,200,000
50 Year Surge with Rain	\$93,800,000
100 Year Surge with Rain	\$94,100,000



Opinion of Probable Cost

DATE PREPARED  
17-Jan-11

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO. IDENTIFICATION NUMBER
PROJECT TITLE <b>Pretty Lake - Alternative 4 Bulkhead Wall, Earthen Berm and Road Raise</b>	ESTIMATED BY Moffatt & Nichol
	CATEGORY CODE NUMBER STATUS OF DESIGN JOB ORDER NUMBER 6822-06

Summary	
Scenario	Opinion of Probable Cost
2 Year Surge with Rain	\$55,500,000
10 Year Surge with Rain	\$94,700,000
25 Year Surge with Rain	\$117,400,000
50 Year Surge with Rain	\$154,500,000
100 Year Surge with Rain	\$189,700,000



Opinion of Probable Cost

DATE PREPARED  
20-Dec-10

ACTIVITY AND LOCATION City of Norfolk Norfolk, Virginia	CONSTRUCTION CONTRACT NO.	IDENTIFICATION NUMBER
	ESTIMATED BY	CATEGORY CODE NUMBER
PROJECT TITLE <b>Pretty Lake - Alternative 5</b> <b>Buyout 20% Damage Level</b>	Moffatt & Nichol	
	STATUS OF DESIGN	JOB ORDER NUMBER
	Conceptual	6822-06

**Summary**

Scenario	Opinion of Probable Cost
2 - Year Storm Event	\$50,366,925
10 - Year Storm Event	\$174,241,900
25 - Year Storm Event	\$265,390,650
50 - Year Storm Event	\$356,736,888
100 - Year Storm Event	\$473,696,563



moffatt & nichol

Opinion of Probable Cost

DATE PREPARED  
7-Dec-10

ACTIVITY AND LOCATION	CONSTRUCTION CONTRACT IDENTIFICATION NUMBER
	ESTIMATED BY      CATEGORY CODE NUMBER
PROJECT TITLE <b>Pretty Lake - Steel Gate with Steel Bulkhead &amp; Pumpstation with 2 - 60" Pumps Operational &amp; Maintenance Costs (Anticipated Service Life of 50 Years)</b>	<b>Moffatt &amp; Nichol</b>
	STATUS OF DESIGN      JOB ORDER NUMBER

	Quantities	Price	Unit	Total Price
<b>Bulkhead &amp; Gate</b>				
Inspections (Completed Every 5 Years)	10	\$75,000	EACH	\$750,000.00
Minor Repairs (Years 15, 35, 45)	3	\$400,000	EACH	\$1,200,000.00
Major Repairs (Years 25 & 40)	2	\$1,250,000	EACH	\$2,500,000.00
Operational Cost per Event (8 Events per Year)	400	\$500	EACH	\$200,000.00
<b>Pump Station</b>				
Maintenance Cost Per Generator Per Year (2 Gen Sets)	100	\$2,000	EACH	\$200,000.00
Operational Cost for Generator Per Event (Once Every 5 Yr)	20	\$40,000	EACH	\$800,000.00
Maintenance Cost Per Pump (Per Year Per Pump)	100	\$40,000	EACH	\$4,000,000.00
Replacement of Pumps (Year 30)	2	\$690,000	EACH	\$1,380,000.00
Operational Cost per Pump Per Event Per Pump Per Year	100	\$785	EACH	\$78,500.00
Operation Cost (City Employees - 2 Employees per Event)	19200	\$25	HOUR	\$480,000.00
<b>Total</b>				<b>\$11,588,500.00</b>



Opinion of Probable Cost

DATE PREPARED  
7-Dec-10

ACTIVITY AND LOCATION	CONSTRUCTION CONTRACT IDENTIFICATION NUMBER
PROJECT TITLE	ESTIMATED BY
<b>Pretty Lake - Obermeyer Gate with Steel Bulkhead &amp; Pumpstation with 2 - 60" Pumps Operational &amp; Maintenance Costs (Anticipated Service Life of 50 Years)</b>	Moffatt & Nichol
	CATEGORY CODE NUMBER
	STATUS OF DESIGN
	JOB ORDER NUMBER

	Quantities	Price	Unit	Total Price
<b>Bulkhead &amp; Gate</b>				
Inspections (Completed Every 5 Years)	10	\$75,000	EACH	\$750,000.00
Minor Repairs (Years 15, 35, 45)	3	\$300,000	EACH	\$900,000.00
Major Repairs (Years 25 & 40)	2	\$1,000,000	EACH	\$2,000,000.00
Replacement of Rubber Dam (Year 30)	1	\$984,000	EACH	\$984,000.00
Operational Cost per Event (8 Events per Year)	400	\$500	EACH	\$200,000.00
<b>Pump Station</b>				
Maintenance Cost Per Generator Per Year (2 Gen Sets)	100	\$2,000	EACH	\$200,000.00
Operational Cost for Generator Per Event (Once Every 5 Yr)	20	\$40,000	EACH	\$800,000.00
Maintenance Cost Per Pump (Per Year Per Pump)	100	\$40,000	EACH	\$4,000,000.00
Replacement of Pumps (Year 30)	2	\$690,000	EACH	\$1,380,000.00
Operational Cost per Pump Per Event Per Pump Per Year	100	\$785	EACH	\$78,500.00
Operation Cost (City Employees - 2 Employees per Event)	19200	\$25	HOUR	\$480,000.00
<b>Total</b>				<b>\$11,772,500.00</b>



Opinion of Probable Cost

DATE PREPARED  
7-Dec-10

ACTIVITY AND LOCATION	CONSTRUCTION CONTRACT IDENTIFICATION NUMBER
PROJECT TITLE	ESTIMATED BY Moffatt & Nichol
<b>Pretty Lake - Inflatable Gate with Steel Bulkhead &amp; Pumpstation with 2 - 60" Pumps Operational &amp; Maintenance Costs (Anticipated Service Life of 50 Years)</b>	CATEGORY CODE NUMBER
	STATUS OF DESIGN      JOB ORDER NUMBER

	Quantities	Price	Unit	Total Price
<b>Bulkhead &amp; Gate</b>				
Inspections (Completed Every 5 Years)	10	\$75,000	EACH	\$750,000.00
Minor Repairs (Years 15, 35, 45)	3	\$300,000	EACH	\$900,000.00
Major Repairs (Years 25 & 40)	2	\$1,000,000	EACH	\$2,000,000.00
Replacement of Rubber Dam (Year 30)	1	\$2,200,000	EACH	\$2,200,000.00
Operational Cost per Event (8 Events per Year)	400	\$500	EACH	\$200,000.00
<b>Pump Station</b>				
Maintenance Cost Per Generator Per Year (2 Gen Sets)	100	\$2,000	EACH	\$200,000.00
Operational Cost for Generator Per Event (Once Every 5 Yr)	20	\$40,000	EACH	\$800,000.00
Maintenance Cost Per Pump (Per Year Per Pump)	100	\$40,000	EACH	\$4,000,000.00
Replacement of Pumps (Year 30)	2	\$690,000	EACH	\$1,380,000.00
Operational Cost per Pump Per Event Per Pump Per Year	100	\$785	EACH	\$78,500.00
Operation Cost (City Employees - 2 Employees per Event)	19200	\$25	HOUR	\$480,000.00
<b>Total</b>				<b>\$12,988,500.00</b>



Opinion of Probable Cost

DATE PREPARED  
7-Dec-10

ACTIVITY AND LOCATION	CONSTRUCTION CONTRACT IDENTIFICATION NUMBER
PROJECT TITLE	ESTIMATED BY
<b>Pretty Lake - Steel Gate with Steel Bulkhead &amp; Pumpstation with 4 - 60" Pumps Operational &amp; Maintenance Costs (Anticipated Service Life of 50 Years)</b>	Moffatt & Nichol
	CATEGORY CODE NUMBER
	STATUS OF DESIGN
	JOB ORDER NUMBER

	Quantities	Price	Unit	Total Price
<b>Bulkhead &amp; Gate</b>				
Inspections (Completed Every 5 Years)	10	\$75,000	EACH	\$750,000.00
Minor Repairs (Years 15, 35, 45)	3	\$400,000	EACH	\$1,200,000.00
Major Repairs (Years 25 & 40)	2	\$1,250,000	EACH	\$2,500,000.00
Operational Cost per Event (8 Events per Year)	400	\$500	EACH	\$200,000.00
<b>Pump Station</b>				
Maintenance Cost Per Generator Per Year (4 Gen Sets)	200	\$2,000	EACH	\$400,000.00
Operational Cost for Generator Per Event (Once Every 5 Yr)	40	\$40,000	EACH	\$1,600,000.00
Maintenance Cost Per Pump (Per Year Per Pump)	200	\$40,000	EACH	\$8,000,000.00
Replacement of Pumps (Year 30)	4	\$690,000	EACH	\$2,760,000.00
Operational Cost per Pump Per Event (8 Events per Year)	200	\$785	EACH	\$157,000.00
Operation Cost (City Employees - 2 Employees per Event)	19200	\$25	Hour	\$480,000.00
<b>Total</b>				<b>\$18,047,000.00</b>



Opinion of Probable Cost

DATE PREPARED  
7-Dec-10

ACTIVITY AND LOCATION	CONSTRUCTION CONTRACT IDENTIFICATION NUMBER
PROJECT TITLE	ESTIMATED BY Moffatt & Nichol
<b>Pretty Lake - Obermeyer Gate with Steel Bulkhead &amp; Pumpstation with 4 - 60" Pumps Operational &amp; Maintenance Costs (Anticipated Service Life of 50 Years)</b>	CATEGORY CODE NUMBER
	STATUS OF DESIGN      JOB ORDER NUMBER

	Quantities	Price	Unit	Total Price
<b>Bulkhead &amp; Gate</b>				
Inspections (Completed Every 5 Years)	10	\$75,000	EACH	\$750,000.00
Minor Repairs (Years 15, 35, 45)	3	\$300,000	EACH	\$900,000.00
Major Repairs (Years 25 & 40)	2	\$1,000,000	EACH	\$2,000,000.00
Replacement of Rubber Dam (Year 30)	1	\$984,000	EACH	\$984,000.00
Operational Cost per Event (8 Events per Year)	400	\$500	EACH	\$200,000.00
<b>Pump Station</b>				
Maintenance Cost Per Generator Per Year (4 Gen Sets)	200	\$2,000	EACH	\$400,000.00
Operational Cost for Generator Per Event (Once Every 5 Yr)	40	\$40,000	EACH	\$1,600,000.00
Maintenance Cost Per Pump (Per Year Per Pump)	200	\$40,000	EACH	\$8,000,000.00
Replacement of Pumps (Year 30)	4	\$690,000	EACH	\$2,760,000.00
Operational Cost per Pump Per Event (8 Events per Year)	200	\$785	EACH	\$157,000.00
Operation Cost (City Employees - 2 Employees per Event)	19200	\$25	Hour	\$480,000.00
<b>Total</b>				<b>\$18,231,000.00</b>



Opinion of Probable Cost

DATE PREPARED  
7-Dec-10

ACTIVITY AND LOCATION	CONSTRUCTION CONTRACT IDENTIFICATION NUMBER
PROJECT TITLE	ESTIMATED BY <b>Moffatt &amp; Nichol</b>
<b>Pretty Lake - Inflatable Gate with Steel Bulkhead &amp; Pumpstation with 4 - 60" Pumps Operational &amp; Maintenance Costs (Anticipated Service Life of 50 Years)</b>	CATEGORY CODE NUMBER
	STATUS OF DESIGN      JOB ORDER NUMBER

	Quantities	Price	Unit	Total Price
<b>Bulkhead &amp; Gate</b>				
Inspections (Completed Every 5 Years)	10	\$75,000	EACH	\$750,000.00
Minor Repairs (Years 15, 35, 45)	3	\$300,000	EACH	\$900,000.00
Major Repairs (Years 25 & 40)	2	\$1,000,000	EACH	\$2,000,000.00
Replacement of Rubber Dam (Year 30)	1	\$2,200,000	EACH	\$2,200,000.00
Operational Cost per Event (8 Events per Year)	400	\$500	EACH	\$200,000.00
<b>Pump Station</b>				
Maintenance Cost Per Generator Per Year (4 Gen Sets)	200	\$2,000	EACH	\$400,000.00
Operational Cost for Generator Per Event (Once Every 5 Yr)	40	\$40,000	EACH	\$1,600,000.00
Maintenance Cost Per Pump (Per Year Per Pump)	200	\$40,000	EACH	\$8,000,000.00
Replacement of Pumps (Year 30)	4	\$690,000	EACH	\$2,760,000.00
Operational Cost per Pump Per Event (8 Events per Year)	200	\$785	EACH	\$157,000.00
Operation Cost (City Employees - 2 Employees per Event)	19200	\$25	Hour	\$480,000.00
<b>Total</b>				<b>\$19,447,000.00</b>



Opinion of Probable Cost

DATE PREPARED  
7-Dec-10

ACTIVITY AND LOCATION	CONSTRUCTION CONTRACT IDENTIFICATION NUMBER
PROJECT TITLE	ESTIMATED BY <b>Moffatt &amp; Nichol</b>
<b>Pretty Lake - Inflatable Gate with Steel Bulkhead &amp; Pumpstation with 4 - 96" Pumps Operational &amp; Maintenance Costs (Anticipated Service Life of 50 Years)</b>	CATEGORY CODE NUMBER STATUS OF DESIGN JOB ORDER NUMBER

	Quantities	Price	Unit	Total Price
<b>Bulkhead &amp; Gate</b>				
Inspections (Completed Every 5 Years)	10	\$75,000	EACH	\$750,000.00
Minor Repairs (Years 15, 35, 45)	3	\$300,000	EACH	\$900,000.00
Major Repairs (Years 25 & 40)	2	\$1,000,000	EACH	\$2,000,000.00
Operational Cost per Event (8 Events per Year)	400	\$500	EACH	\$200,000.00
<b>Pump Station</b>				
Maintenance Cost Per Generator Per Year (4 Gen Sets)	200	\$2,000	EACH	\$400,000.00
Operational Cost for Generator Per Event (Once Every 5 Yr)	40	\$40,000	EACH	\$1,600,000.00
Maintenance Cost Per Pump (Per Year Per Pump)	200	\$40,000	EACH	\$8,000,000.00
Replacement of Pumps (Year 30)	4	\$1,975,000	EACH	\$7,900,000.00
Operational Cost per Pump Per Event (8 Events per Year)	200	\$1,245	EACH	\$249,000.00
Operation Cost (City Employees - 2 Employees per Event)	19200	\$25	Hour	\$480,000.00
<b>Total</b>				<b>\$22,479,000.00</b>



Opinion of Probable Cost

DATE PREPARED  
7-Dec-10

ACTIVITY AND LOCATION	CONSTRUCTION CONTRACT IDENTIFICATION NUMBER
	ESTIMATED BY: Moffatt & Nichol CATEGORY CODE NUMBER
PROJECT TITLE <b>Pretty Lake - Inflatable Gate with Steel Bulkhead &amp; Pumpstation with 4 - 96" Pumps Operational &amp; Maintenance Costs (Anticipated Service Life of 50 Years)</b>	STATUS OF DESIGN
	JOB ORDER NUMBER

	Quantities	Price	Unit	Total Price
<b>Bulkhead &amp; Gate</b>				
Inspections (Completed Every 5 Years)	10	\$75,000	EACH	\$750,000.00
Minor Repairs (Years 15, 35, 45)	3	\$300,000	EACH	\$900,000.00
Major Repairs (Years 25 & 40)	2	\$1,000,000	EACH	\$2,000,000.00
Replacement of Rubber Dam (Year 30)	1	\$984,000	EACH	\$984,000.00
Operational Cost per Event (8 Events per Year)	400	\$500	EACH	\$200,000.00
<b>Pump Station</b>				
Maintenance Cost Per Generator Per Year (4 Gen Sets)	200	\$2,000	EACH	\$400,000.00
Operational Cost for Generator Per Event (Once Every 5 Yr)	40	\$40,000	EACH	\$1,600,000.00
Maintenance Cost Per Pump (Per Year Per Pump)	200	\$40,000	EACH	\$8,000,000.00
Replacement of Pumps (Year 30)	4	\$1,975,000	EACH	\$7,900,000.00
Operational Cost per Pump Per Event (8 Events per Year)	200	\$1,245	EACH	\$249,000.00
Operation Cost (City Employees - 2 Employees per Event)	19200	\$25	Hour	\$480,000.00
<b>Total</b>				<b>\$23,463,000.00</b>



Opinion of Probable Cost

DATE PREPARED  
7-Dec-10

ACTIVITY AND LOCATION	CONSTRUCTION CONTRACT IDENTIFICATION NUMBER
	ESTIMATED BY: Moffatt & Nichol CATEGORY CODE NUMBER
PROJECT TITLE <b>Pretty Lake - Inflatable Gate with Steel Bulkhead &amp; Pumpstation with 4 - 96" Pumps Operational &amp; Maintenance Costs (Anticipated Service Life of 50 Years)</b>	STATUS OF DESIGN
	JOB ORDER NUMBER

	Quantities	Price	Unit	Total Price
<b>Bulkhead &amp; Gate</b>				
Inspections (Completed Every 5 Years)	10	\$75,000	EACH	\$750,000.00
Minor Repairs (Years 15, 35, 45)	3	\$300,000	EACH	\$900,000.00
Major Repairs (Years 25 & 40)	2	\$1,000,000	EACH	\$2,000,000.00
Replacement of Rubber Dam (Year 30)	1	\$2,200,000	EACH	\$2,200,000.00
Operational Cost per Event (8 Events per Year)	400	\$500	EACH	\$200,000.00
<b>Pump Station</b>				
Maintenance Cost Per Generator Per Year (4 Gen Sets)	200	\$2,000	EACH	\$400,000.00
Operational Cost for Generator Per Event (Once Every 5 Yr)	40	\$40,000	EACH	\$1,600,000.00
Maintenance Cost Per Pump (Per Year Per Pump)	200	\$40,000	EACH	\$8,000,000.00
Replacement of Pumps (Year 30)	4	\$1,975,000	EACH	\$7,900,000.00
Operational Cost per Pump Per Event (8 Events per Year)	200	\$1,245	EACH	\$249,000.00
Operation Cost (City Employees - 2 Employees per Event)	19200	\$25	Hour	\$480,000.00
<b>Total</b>				<b>\$24,679,000.00</b>

**APPENDIX D**

**BENEFIT/COST RATIO CALCULATIONS**

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 2-60" PUMPS - 2yr SURGE							
PROJ NO: DESIGNER: JDM DATE: 27-Apr-11							
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$5,972,256				
		0.50	\$7,991,008	\$6,981,632	\$3,490,118	\$3,490,118	
0.500	2	0.40	\$22,364,184	\$15,177,596	\$6,071,038	\$9,561,156	
0.100	10	0.06	\$33,481,476	\$27,922,830	\$1,675,370	\$11,236,526	
0.040	25	0.02	\$47,289,764	\$40,385,620	\$807,712	\$12,044,239	7.00% INTEREST RATE
0.020	50	0.01	\$63,169,593	\$55,229,679	\$552,297	\$12,596,535	50 YEARS
0.010	100						\$173,841,588 PRESENT WORTH
0.99							

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 2-60" PUMPS - 2yr SURGE							
PROJ NO: DESIGNER: JDM DATE: 27-Apr-11							
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$3,531,323				
		0.50	\$4,573,605	\$4,052,464	\$2,025,827	\$2,025,827	
0.500	2	0.4	\$22,364,184	\$13,468,894	\$5,387,558	\$7,413,384	
0.100	10	0.06	\$33,481,476	\$27,922,830	\$1,675,370	\$9,088,754	
0.040	25	0.02	\$47,289,764	\$40,385,620	\$807,712	\$9,896,467	7.00% INTEREST RATE
0.020	50	0.01	\$63,169,593	\$55,229,679	\$552,297	\$10,448,763	50 YEARS
0.010	100						\$144,200,733 PRESENT WORTH
0.99							

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 2-60" PUMPS - 2yr SURGE							
PROJ NO: DESIGNER: JDM DATE: 27-Apr-11							
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS INTERVAL	EXPECTED ANNUAL BENEFITS SUMMATION	
0.990	1		\$2,440,933				
		0.49	\$3,417,403	\$2,929,168	\$1,435,582	\$1,435,582	
0.500	2	0.4	\$0	\$1,708,702	\$683,481	\$2,119,063	
0.100	10	0.06	\$0	\$0	\$0	\$2,119,063	
0.040	25	0.02	\$0	\$0	\$0	\$2,119,063	7.00% INTEREST RATE
0.020	50	0.01	\$0	\$0	\$0	\$2,119,063	50 YEARS
0.010	100						\$29,244,652 PRESENT WORTH

**2 - 60" Pumps and Inflatable Dam**

\$33,300,000	PRESENT WORTH PROJECT COST	\$260,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$3,588,194	PRESENT WORTH O&M COSTS	\$36,888,194	PRESENT WORTH TOTAL PROJECT COST
<b>0.79 B/C RATIO</b>			

**2 - 60" Pumps and Obermeyer Gate**

\$29,900,000	PRESENT WORTH PROJECT COST	\$236,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$3,256,976	PRESENT WORTH O&M COSTS	\$33,156,976	PRESENT WORTH TOTAL PROJECT COST
<b>0.88 B/C RATIO</b>			

**2 - 60" Pumps and Steel Gate**

\$27,700,000	PRESENT WORTH PROJECT COST	\$232,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$3,201,773	PRESENT WORTH O&M COSTS	\$30,901,773	PRESENT WORTH TOTAL PROJECT COST
<b>0.95 B/C RATIO</b>			

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 2-60" PUMPS - 10yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$5,972,256				
0.500	2	0.50	\$7,991,008	\$6,981,632	\$3,490,118	\$3,490,118	
0.100	10	0.40	\$22,364,184	\$15,177,596	\$6,071,038	\$9,561,156	
0.040	25	0.06	\$33,481,476	\$27,922,830	\$1,675,370	\$11,236,526	
0.020	50	0.02	\$47,289,764	\$40,385,620	\$807,712	\$12,044,239	7.00% INTEREST RATE
0.010	100	0.01	\$63,169,593	\$55,229,679	\$552,297	\$12,596,535	50 YEARS
							\$173,841,588 PRESENT WORTH
0.99							

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 2-60" PUMPS - 10yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$3,531,323				
0.500	2	0.50	\$4,573,605	\$4,052,464	\$2,025,827	\$2,025,827	
0.100	10	0.4	\$10,020,918	\$7,297,261	\$2,918,905	\$4,944,731	
0.040	25	0.06	\$33,481,476	\$21,751,197	\$1,305,072	\$6,249,803	
0.020	50	0.02	\$47,289,764	\$40,385,620	\$807,712	\$7,057,515	7.00% INTEREST RATE
0.010	100	0.01	\$63,169,593	\$55,229,679	\$552,297	\$7,609,812	50 YEARS
							\$105,021,089 PRESENT WORTH
0.99							

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 2-60" PUMPS - 10yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS INTERVAL	EXPECTED ANNUAL BENEFITS SUMMATION	
0.990	1		\$2,440,933				
0.500	2	0.49	\$3,417,403	\$2,929,168	\$1,435,582	\$1,435,582	
0.100	10	0.4	\$12,343,266	\$7,880,335	\$3,152,134	\$4,587,716	
0.040	25	0.06	\$0	\$6,171,633	\$370,298	\$4,958,014	
0.020	50	0.02	\$0	\$0	\$0	\$4,958,014	7.00% INTEREST RATE
0.010	100	0.01	\$0	\$0	\$0	\$4,958,014	50 YEARS
							\$68,424,297 PRESENT WORTH

2 - 60" Pumps and Inflatable Dam			
\$41,300,000	PRESENT WORTH PROJECT COST	\$260,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$3,588,194	PRESENT WORTH O&M COSTS	\$44,888,194	PRESENT WORTH TOTAL PROJECT COST
1.52 B/C RATIO			

2 - 60" Pumps and Obermeyer Gate			
\$37,600,000	PRESENT WORTH PROJECT COST	\$236,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$3,256,976	PRESENT WORTH O&M COSTS	\$40,856,976	PRESENT WORTH TOTAL PROJECT COST
1.67 B/C RATIO			

2 - 60" Pumps and Steel Gate			
\$34,900,000	PRESENT WORTH PROJECT COST	\$232,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$3,201,773	PRESENT WORTH O&M COSTS	\$38,101,773	PRESENT WORTH TOTAL PROJECT COST
1.80 B/C RATIO			

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 2-60" PUMPS - 25yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$5,972,256				
0.500	2	0.50	\$7,991,008	\$6,981,632	\$3,490,118	\$3,490,118	
0.100	10	0.40	\$22,364,184	\$15,177,596	\$6,071,038	\$9,561,156	
0.040	25	0.06	\$33,481,476	\$27,922,830	\$1,675,370	\$11,236,526	
0.020	50	0.02	\$47,289,764	\$40,385,620	\$807,712	\$12,044,239	7.00% INTEREST RATE
0.010	100	0.01	\$63,169,593	\$55,229,679	\$552,297	\$12,596,535	50 YEARS
							\$173,841,588 PRESENT WORTH
0.99							

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 2-60" PUMPS - 25yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$3,531,323				
0.500	2	0.50	\$4,573,605	\$4,052,464	\$2,025,827	\$2,025,827	
0.100	10	0.4	\$10,020,918	\$7,297,261	\$2,918,905	\$4,944,731	
0.040	25	0.06	\$12,936,003	\$11,478,461	\$688,708	\$5,633,439	
0.020	50	0.02	\$47,289,764	\$30,112,884	\$602,258	\$6,235,697	7.00% INTEREST RATE
0.010	100	0.01	\$63,169,593	\$55,229,679	\$552,297	\$6,787,993	50 YEARS
							\$93,679,374 PRESENT WORTH
0.99							

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 2-60" PUMPS - 25yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS INTERVAL	EXPECTED ANNUAL BENEFITS SUMMATION	
0.990	1		\$2,440,933				
0.500	2	0.49	\$3,417,403	\$2,929,168	\$1,435,582	\$1,435,582	
0.100	10	0.4	\$12,343,266	\$7,880,335	\$3,152,134	\$4,587,716	
0.040	25	0.06	\$20,545,473	\$16,444,369	\$986,662	\$5,574,378	
0.020	50	0.02	\$0	\$10,272,736	\$205,455	\$5,779,833	7.00% INTEREST RATE
0.010	100	0.01	\$0	\$0	\$0	\$5,779,833	50 YEARS
							\$79,766,011 PRESENT WORTH

2 - 60" Pumps and Inflatable Dam			
\$43,100,000	PRESENT WORTH PROJECT COST	\$260,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$3,588,194	PRESENT WORTH O&M COSTS	\$46,688,194	PRESENT WORTH TOTAL PROJECT COST
		1.71	B/C RATIO

2 - 60" Pumps and Obermeyer Gate			
\$39,200,000	PRESENT WORTH PROJECT COST	\$236,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$3,256,976	PRESENT WORTH O&M COSTS	\$42,456,976	PRESENT WORTH TOTAL PROJECT COST
		1.88	B/C RATIO

2 - 60" Pumps and Steel Gate			
\$36,200,000	PRESENT WORTH PROJECT COST	\$232,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$3,201,773	PRESENT WORTH O&M COSTS	\$39,401,773	PRESENT WORTH TOTAL PROJECT COST
		2.02	B/C RATIO

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 2-60" PUMPS - 50yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$5,972,256				
0.500	2	0.50	\$7,991,008	\$6,981,632	\$3,490,118	\$3,490,118	
0.100	10	0.40	\$22,364,184	\$15,177,596	\$6,071,038	\$9,561,156	
0.040	25	0.06	\$33,481,476	\$27,922,830	\$1,675,370	\$11,236,526	
0.020	50	0.02	\$47,289,764	\$40,385,620	\$807,712	\$12,044,239	7.00% INTEREST RATE
0.010	100	0.01	\$63,169,593	\$55,229,679	\$552,297	\$12,596,535	50 YEARS
							\$173,841,588 PRESENT WORTH
0.99							

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 2-60" PUMPS - 50yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$3,531,323				
0.500	2	0.50	\$4,573,605	\$4,052,464	\$2,025,827	\$2,025,827	
0.100	10	0.4	\$10,020,918	\$7,297,261	\$2,918,905	\$4,944,731	
0.040	25	0.06	\$12,936,003	\$11,478,461	\$688,708	\$5,633,439	
0.020	50	0.02	\$16,050,214	\$14,493,109	\$289,862	\$5,923,301	7.00% INTEREST RATE
0.010	100	0.01	\$63,169,593	\$39,609,904	\$396,099	\$6,319,400	50 YEARS
							\$87,212,438 PRESENT WORTH
0.99							

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 2-60" PUMPS - 50yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS INTERVAL	EXPECTED ANNUAL BENEFITS SUMMATION	
0.990	1		\$2,440,933				
0.500	2	0.49	\$3,417,403	\$2,929,168	\$1,435,582	\$1,435,582	
0.100	10	0.4	\$12,343,266	\$7,880,335	\$3,152,134	\$4,587,716	
0.040	25	0.06	\$20,545,473	\$16,444,369	\$986,662	\$5,574,378	
0.020	50	0.02	\$31,239,550	\$25,892,511	\$517,850	\$6,092,229	7.00% INTEREST RATE
0.010	100	0.01	\$0	\$15,619,775	\$156,198	\$6,248,426	50 YEARS
							\$86,232,947 PRESENT WORTH

**2 - 60" Pumps and Inflatable Dam**

\$44,100,000	PRESENT WORTH PROJECT COST	\$260,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$3,588,194	PRESENT WORTH O&M COSTS	\$47,688,194	PRESENT WORTH TOTAL PROJECT COST
1.81 B/C RATIO			

**2 - 60" Pumps and Obermeyer Gate**

\$39,200,000	PRESENT WORTH PROJECT COST	\$236,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$3,256,976	PRESENT WORTH O&M COSTS	\$42,456,976	PRESENT WORTH TOTAL PROJECT COST
2.03 B/C RATIO			

**2 - 60" Pumps and Steel Gate**

\$37,400,000	PRESENT WORTH PROJECT COST	\$232,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$3,201,773	PRESENT WORTH O&M COSTS	\$40,601,773	PRESENT WORTH TOTAL PROJECT COST
2.12 B/C RATIO			

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 2-60" PUMPS - 100 yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$5,972,256				
0.500	2	0.50	\$7,991,008	\$6,981,632	\$3,490,118	\$3,490,118	
0.100	10	0.40	\$22,364,184	\$15,177,596	\$6,071,038	\$9,561,156	
0.040	25	0.06	\$33,481,476	\$27,922,830	\$1,675,370	\$11,236,526	
0.020	50	0.02	\$47,289,764	\$40,385,620	\$807,712	\$12,044,239	7.00% INTEREST RATE
0.010	100	0.01	\$55,229,679	\$55,229,679	\$552,297	\$12,596,535	50 YEARS
							\$173,841,588 PRESENT WORTH
0.99							

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 2-60" PUMPS - 100 yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$3,531,323				
0.500	2	0.50	\$4,573,605	\$4,052,464	\$2,025,827	\$2,025,827	
0.100	10	0.4	\$10,020,918	\$7,297,261	\$2,918,905	\$4,944,731	
0.040	25	0.06	\$12,936,003	\$11,478,461	\$688,708	\$5,633,439	
0.020	50	0.02	\$16,050,214	\$14,493,109	\$289,862	\$5,923,301	7.00% INTEREST RATE
0.010	100	0.01	\$21,497,001	\$18,773,607	\$187,736	\$6,111,037	50 YEARS
							\$84,336,873 PRESENT WORTH
0.99							

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 2-60" PUMPS - 100 yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS INTERVAL	EXPECTED ANNUAL BENEFITS SUMMATION	
0.990	1		\$2,440,933				
0.500	2	0.49	\$3,417,403	\$2,929,168	\$1,435,582	\$1,435,582	
0.100	10	0.4	\$12,343,266	\$7,880,335	\$3,152,134	\$4,587,716	
0.040	25	0.06	\$20,545,473	\$16,444,369	\$986,662	\$5,574,378	
0.020	50	0.02	\$31,239,550	\$25,892,511	\$517,850	\$6,092,229	7.00% INTEREST RATE
0.010	100	0.01	\$41,672,592	\$36,456,071	\$364,561	\$6,456,789	50 YEARS
							\$89,108,512 PRESENT WORTH

**2 - 60" Pumps and Inflatable Dam**

\$46,100,000	PRESENT WORTH PROJECT COST	\$260,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$3,588,194	PRESENT WORTH O&M COSTS	\$49,688,194	PRESENT WORTH TOTAL PROJECT COST
1.79 B/C RATIO			

**2 - 60" Pumps and Obermeyer Gate**

\$41,900,000	PRESENT WORTH PROJECT COST	\$236,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$3,256,976	PRESENT WORTH O&M COSTS	\$45,156,976	PRESENT WORTH TOTAL PROJECT COST
1.97 B/C RATIO			

**2 - 60" Pumps and Steel Gate**

\$38,400,000	PRESENT WORTH PROJECT COST	\$232,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$3,201,773	PRESENT WORTH O&M COSTS	\$41,601,773	PRESENT WORTH TOTAL PROJECT COST
2.14 B/C RATIO			

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-60" PUMPS - 2yr SURGE							
PROJ NO: DESIGNER: JDM DATE: 27-Apr-11							
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$5,972,256				
0.500	2	0.50	\$7,991,008	\$6,981,632	\$3,490,118	\$3,490,118	
0.100	10	0.40	\$22,364,184	\$15,177,596	\$6,071,038	\$9,561,156	
0.040	25	0.06	\$33,481,476	\$27,922,830	\$1,675,370	\$11,236,526	
0.020	50	0.02	\$47,289,764	\$40,385,620	\$807,712	\$12,044,239	7.00% INTEREST RATE
0.010	100	0.01	\$55,229,679	\$55,229,679	\$552,297	\$12,596,535	50 YEARS
			\$63,169,593				\$173,841,588 PRESENT WORTH
		0.99					

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-60" PUMPS - 2yr SURGE							
PROJ NO: DESIGNER: JDM DATE: 27-Apr-11							
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$3,531,866				
0.500	2	0.50	\$4,573,605	\$4,052,736	\$2,025,963	\$2,025,963	
0.100	10	0.4	\$22,364,184	\$13,468,894	\$5,387,558	\$7,413,520	
0.040	25	0.06	\$33,481,476	\$27,922,830	\$1,675,370	\$9,088,890	
0.020	50	0.02	\$47,289,764	\$40,385,620	\$807,712	\$9,896,602	7.00% INTEREST RATE
0.010	100	0.01	\$55,229,679	\$55,229,679	\$552,297	\$10,448,899	50 YEARS
			\$63,169,593				\$144,202,608 PRESENT WORTH
		0.99					

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-60" PUMPS - 2yr SURGE							
PROJ NO: DESIGNER: JDM DATE: 27-Apr-11							
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS INTERVAL	EXPECTED ANNUAL BENEFITS SUMMATION	
0.990	1		\$2,440,390				
0.500	2	0.49	\$3,417,403	\$2,928,896	\$1,435,449	\$1,435,449	
0.100	10	0.4	\$0	\$1,708,702	\$683,481	\$2,118,930	
0.040	25	0.06	\$0	\$0	\$0	\$2,118,930	
0.020	50	0.02	\$0	\$0	\$0	\$2,118,930	7.00% INTEREST RATE
0.010	100	0.01	\$0	\$0	\$0	\$2,118,930	50 YEARS
			\$0				\$29,242,814 PRESENT WORTH

**4 - 60" Pumps and Inflatable Dam**

\$45,300,000	PRESENT WORTH PROJECT COST	\$389,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$5,368,490	PRESENT WORTH O&M COSTS	\$50,668,490	PRESENT WORTH TOTAL PROJECT COST
		0.58	B/C RATIO

**4 - 60" Pumps and Obermeyer Gate**

\$41,800,000	PRESENT WORTH PROJECT COST	\$365,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$5,037,272	PRESENT WORTH O&M COSTS	\$46,837,272	PRESENT WORTH TOTAL PROJECT COST
		0.62	B/C RATIO

**4 - 60" Pumps and Steel Gate**

\$39,800,000	PRESENT WORTH PROJECT COST	\$361,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$4,982,069	PRESENT WORTH O&M COSTS	\$44,782,069	PRESENT WORTH TOTAL PROJECT COST
		0.65	B/C RATIO

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-60" PUMPS - 10yr SURGE							
PROJ NO: DESIGNER: JDM DATE: 27-Apr-11							
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$5,972,256				
0.500	2	0.50	\$7,991,008	\$6,981,632	\$3,490,118	\$3,490,118	
0.100	10	0.40	\$22,364,184	\$15,177,596	\$6,071,038	\$9,561,156	
0.040	25	0.06	\$33,481,476	\$27,922,830	\$1,675,370	\$11,236,526	
0.020	50	0.02	\$47,289,764	\$40,385,620	\$807,712	\$12,044,239	7.00% INTEREST RATE
0.010	100	0.01	\$63,169,593	\$55,229,679	\$552,297	\$12,596,535	50 YEARS
							\$173,841,588 PRESENT WORTH
0.99							

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-60" PUMPS - 10yr SURGE							
PROJ NO: DESIGNER: JDM DATE: 27-Apr-11							
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$3,531,866				
0.500	2	0.50	\$4,573,605	\$4,052,736	\$2,025,963	\$2,025,963	
0.100	10	0.4	\$10,020,918	\$7,297,261	\$2,918,905	\$4,944,867	
0.040	25	0.06	\$33,481,476	\$21,751,197	\$1,305,072	\$6,249,939	
0.020	50	0.02	\$47,289,764	\$40,385,620	\$807,712	\$7,057,651	7.00% INTEREST RATE
0.010	100	0.01	\$63,169,593	\$55,229,679	\$552,297	\$7,609,948	50 YEARS
							\$105,022,963 PRESENT WORTH
0.99							

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-60" PUMPS - 10yr SURGE							
PROJ NO: DESIGNER: JDM DATE: 27-Apr-11							
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS INTERVAL	EXPECTED ANNUAL BENEFITS SUMMATION	
0.990	1		\$2,440,390				
0.500	2	0.49	\$3,417,403	\$2,928,896	\$1,435,449	\$1,435,449	
0.100	10	0.4	\$12,343,266	\$7,880,335	\$3,152,134	\$4,587,583	
0.040	25	0.06	\$0	\$6,171,633	\$370,298	\$4,957,881	
0.020	50	0.02	\$0	\$0	\$0	\$4,957,881	7.00% INTEREST RATE
0.010	100	0.01	\$0	\$0	\$0	\$4,957,881	50 YEARS
							\$68,422,459 PRESENT WORTH

4 - 60" Pumps and Inflatable Dam			
\$53,300,000	PRESENT WORTH PROJECT COST	\$389,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$5,368,490	PRESENT WORTH O&M COSTS	\$58,668,490	PRESENT WORTH TOTAL PROJECT COST
1.17 B/C RATIO			

4 - 60" Pumps and Obermeyer Gate			
\$49,400,000	PRESENT WORTH PROJECT COST	\$365,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$5,037,272	PRESENT WORTH O&M COSTS	\$54,437,272	PRESENT WORTH TOTAL PROJECT COST
1.26 B/C RATIO			

4 - 60" Pumps and Steel Gate			
\$46,900,000	PRESENT WORTH PROJECT COST	\$361,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$4,982,069	PRESENT WORTH O&M COSTS	\$51,882,069	PRESENT WORTH TOTAL PROJECT COST
1.32 B/C RATIO			

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-60" PUMPS - 25yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$5,972,256				
0.500	2	0.50	\$7,991,008	\$6,981,632	\$3,490,118	\$3,490,118	
0.100	10	0.40	\$22,364,184	\$15,177,596	\$6,071,038	\$9,561,156	
0.040	25	0.06	\$33,481,476	\$27,922,830	\$1,675,370	\$11,236,526	
0.020	50	0.02	\$47,289,764	\$40,385,620	\$807,712	\$12,044,239	7.00% INTEREST RATE
0.010	100	0.01	\$63,169,593	\$55,229,679	\$552,297	\$12,596,535	50 YEARS
							\$173,841,588 PRESENT WORTH
0.99							

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-60" PUMPS - 25yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$3,531,866				
0.500	2	0.50	\$4,573,605	\$4,052,736	\$2,025,963	\$2,025,963	
0.100	10	0.4	\$10,020,918	\$7,297,261	\$2,918,905	\$4,944,867	
0.040	25	0.06	\$12,936,003	\$11,478,461	\$688,708	\$5,633,575	
0.020	50	0.02	\$47,289,764	\$30,112,884	\$602,258	\$6,235,832	7.00% INTEREST RATE
0.010	100	0.01	\$63,169,593	\$55,229,679	\$552,297	\$6,788,129	50 YEARS
							\$93,681,249 PRESENT WORTH
0.99							

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-60" PUMPS - 25yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS INTERVAL	EXPECTED ANNUAL BENEFITS SUMMATION	
0.990	1		\$2,440,390				
0.500	2	0.49	\$3,417,403	\$2,928,896	\$1,435,449	\$1,435,449	
0.100	10	0.4	\$12,343,266	\$7,880,335	\$3,152,134	\$4,587,583	
0.040	25	0.06	\$20,545,473	\$16,444,369	\$986,662	\$5,574,245	
0.020	50	0.02	\$0	\$10,272,736	\$205,455	\$5,779,700	7.00% INTEREST RATE
0.010	100	0.01	\$0	\$0	\$0	\$5,779,700	50 YEARS
							\$79,764,173 PRESENT WORTH

4 - 60" Pumps and Inflatable Dam			
\$55,100,000	PRESENT WORTH PROJECT COST	\$389,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$5,368,490	PRESENT WORTH O&M COSTS	\$60,468,490	PRESENT WORTH TOTAL PROJECT COST
1.32 B/C RATIO			

4 - 60" Pumps and Obermeyer Gate			
\$51,000,000	PRESENT WORTH PROJECT COST	\$365,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$5,037,272	PRESENT WORTH O&M COSTS	\$56,037,272	PRESENT WORTH TOTAL PROJECT COST
1.42 B/C RATIO			

4 - 60" Pumps and Steel Gate			
\$48,200,000	PRESENT WORTH PROJECT COST	\$361,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$4,982,069	PRESENT WORTH O&M COSTS	\$53,182,069	PRESENT WORTH TOTAL PROJECT COST
1.50 B/C RATIO			

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-60" PUMPS - 50yr SURGE								
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11			
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION		
1.000	1		\$5,972,256					
	0.500	2	\$7,991,008	\$6,981,632	\$3,490,118	\$3,490,118		
	0.100	10	\$22,364,184	\$15,177,596	\$6,071,038	\$9,561,156		
	0.040	25	\$33,481,476	\$27,922,830	\$1,675,370	\$11,236,526		
	0.020	50	\$47,289,764	\$40,385,620	\$807,712	\$12,044,239	7.00% INTEREST RATE	
	0.010	100	\$63,169,593	\$55,229,679	\$552,297	\$12,596,535	50 YEARS	
							\$173,841,588	PRESENT WORTH
0.99								

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-60" PUMPS - 50yr SURGE								
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11			
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION		
1.000	1		\$3,531,866					
	0.500	2	\$4,573,605	\$4,052,736	\$2,025,963	\$2,025,963		
	0.100	10	\$10,020,918	\$7,297,261	\$2,918,905	\$4,944,867		
	0.040	25	\$12,936,003	\$11,478,461	\$688,708	\$5,633,575		
	0.020	50	\$16,050,214	\$14,493,109	\$289,862	\$5,923,437	7.00% INTEREST RATE	
	0.010	100	\$63,169,593	\$39,609,904	\$396,099	\$6,319,536	50 YEARS	
							\$87,214,313	PRESENT WORTH
0.99								

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-60" PUMPS - 50yr SURGE								
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11			
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS INTERVAL	EXPECTED ANNUAL BENEFITS SUMMATION		
0.990	1		\$2,440,390					
	0.500	2	\$3,417,403	\$2,928,896	\$1,435,449	\$1,435,449		
	0.100	10	\$12,343,266	\$7,880,335	\$3,152,134	\$4,587,583		
	0.040	25	\$20,545,473	\$16,444,369	\$986,662	\$5,574,245		
	0.020	50	\$31,239,550	\$25,892,511	\$517,850	\$6,092,095	7.00% INTEREST RATE	
	0.010	100	\$0	\$15,619,775	\$156,198	\$6,248,293	50 YEARS	
							\$86,231,109	PRESENT WORTH

4 - 60" Pumps and Inflatable Dam			
\$56,700,000	PRESENT WORTH PROJECT COST	\$389,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$5,368,490	PRESENT WORTH O&M COSTS	\$62,068,490	PRESENT WORTH TOTAL PROJECT COST
		1.39	B/C RATIO

4 - 60" Pumps and Obermeyer Gate			
\$52,500,000	PRESENT WORTH PROJECT COST	\$365,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$5,037,272	PRESENT WORTH O&M COSTS	\$57,537,272	PRESENT WORTH TOTAL PROJECT COST
		1.50	B/C RATIO

4 - 60" Pumps and Steel Gate			
\$49,500,000	PRESENT WORTH PROJECT COST	\$361,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$4,982,069	PRESENT WORTH O&M COSTS	\$54,482,069	PRESENT WORTH TOTAL PROJECT COST
		1.58	B/C RATIO

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-60" PUMPS - 100yr SURGE							
PROJ NO: DESIGNER: JDM DATE: 27-Apr-11							
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$5,972,256				
		0.50		\$6,981,632	\$3,490,118	\$3,490,118	
0.500	2		\$7,991,008				
		0.40		\$15,177,596	\$6,071,038	\$9,561,156	
0.100	10		\$22,364,184				
		0.06		\$27,922,830	\$1,675,370	\$11,236,526	
0.040	25		\$33,481,476				
		0.02		\$40,385,620	\$807,712	\$12,044,239	7.00% INTEREST RATE
0.020	50		\$47,289,764				50 YEARS
		0.01		\$55,229,679	\$552,297	\$12,596,535	\$173,841,588 PRESENT WORTH
0.010	100		\$63,169,593				
0.99							

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-60" PUMPS - 100yr SURGE							
PROJ NO: DESIGNER: JDM DATE: 27-Apr-11							
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$3,531,866				
		0.50		\$4,052,736	\$2,025,963	\$2,025,963	
0.500	2		\$4,573,605				
		0.4		\$7,297,261	\$2,918,905	\$4,944,867	
0.100	10		\$10,020,918				
		0.06		\$11,478,461	\$688,708	\$5,633,575	
0.040	25		\$12,936,003				
		0.02		\$14,493,109	\$289,862	\$5,923,437	7.00% INTEREST RATE
0.020	50		\$16,050,214				50 YEARS
		0.01		\$18,773,607	\$187,736	\$6,111,173	\$84,338,748 PRESENT WORTH
0.010	100		\$21,497,001				
0.99							

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-60" PUMPS - 100yr SURGE							
PROJ NO: DESIGNER: JDM DATE: 27-Apr-11							
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS INTERVAL	EXPECTED ANNUAL BENEFITS SUMMATION	
0.990	1		\$2,440,390				
		0.49		\$2,928,896	\$1,435,449	\$1,435,449	
0.500	2		\$3,417,403				
		0.4		\$7,880,335	\$3,152,134	\$4,587,583	
0.100	10		\$12,343,266				
		0.06		\$16,444,369	\$986,662	\$5,574,245	
0.040	25		\$20,545,473				
		0.02		\$25,892,511	\$517,850	\$6,092,095	7.00% INTEREST RATE
0.020	50		\$31,239,550				50 YEARS
		0.01		\$36,456,071	\$364,561	\$6,456,656	\$89,106,674 PRESENT WORTH
0.010	100		\$41,672,592				

4 - 60" Pumps and Inflatable Dam	
\$57,600,000 PRESENT WORTH PROJECT COST	\$389,000 ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$5,368,490 PRESENT WORTH O&M COSTS	\$62,968,490 PRESENT WORTH TOTAL PROJECT COST
1.42 B/C RATIO	

4 - 60" Pumps and Obermeyer Gate	
\$52,500,000 PRESENT WORTH PROJECT COST	\$365,000 ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$5,037,272 PRESENT WORTH O&M COSTS	\$57,537,272 PRESENT WORTH TOTAL PROJECT COST
1.55 B/C RATIO	

4 - 60" Pumps and Steel Gate	
\$50,500,000 PRESENT WORTH PROJECT COST	\$361,000 ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$4,982,069 PRESENT WORTH O&M COSTS	\$55,482,069 PRESENT WORTH TOTAL PROJECT COST
1.61 B/C RATIO	

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-96" PUMPS - 2yr SURGE							
PROJ NO: DESIGNER: JDM DATE: 27-Apr-11							
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$5,972,256				
		0.50	\$7,991,008	\$6,981,632	\$3,490,118	\$3,490,118	
	0.500	2	\$22,364,184	\$15,177,596	\$6,071,038	\$9,561,156	
	0.100	10	\$33,481,476	\$27,922,830	\$1,675,370	\$11,236,526	
	0.040	25	\$47,289,764	\$40,385,620	\$807,712	\$12,044,239	7.00% INTEREST RATE
	0.020	50	\$63,169,593	\$55,229,679	\$552,297	\$12,596,535	50 YEARS
	0.010	100					\$173,841,588 PRESENT WORTH
0.99							

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-96" PUMPS - 2yr SURGE							
PROJ NO: DESIGNER: JDM DATE: 27-Apr-11							
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$3,531,810				
		0.50	\$4,573,802	\$4,052,806	\$2,025,998	\$2,025,998	
	0.500	2	\$22,364,184	\$13,468,993	\$5,387,597	\$7,413,595	
	0.100	10	\$33,481,476	\$27,922,830	\$1,675,370	\$9,088,965	
	0.040	25	\$47,289,764	\$40,385,620	\$807,712	\$9,896,677	7.00% INTEREST RATE
	0.020	50	\$63,169,593	\$55,229,679	\$552,297	\$10,448,974	50 YEARS
	0.010	100					\$144,203,636 PRESENT WORTH
0.99							

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-96" PUMPS - 2yr SURGE							
PROJ NO: DESIGNER: JDM DATE: 27-Apr-11							
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS INTERVAL	EXPECTED ANNUAL BENEFITS SUMMATION	
0.990	1		\$2,440,446				
		0.49	\$3,417,206	\$2,928,826	\$1,435,415	\$1,435,415	
	0.500	2	\$0	\$1,708,603	\$683,441	\$2,118,856	
	0.100	10	\$0	\$0	\$0	\$2,118,856	
	0.040	25	\$0	\$0	\$0	\$2,118,856	7.00% INTEREST RATE
	0.020	50	\$0	\$0	\$0	\$2,118,856	50 YEARS
	0.010	100					\$29,241,795 PRESENT WORTH

4 - 96" Pumps and Inflatable Dam			
\$79,900,000	PRESENT WORTH PROJECT COST	\$494,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$6,817,569	PRESENT WORTH O&M COSTS	\$86,717,569	PRESENT WORTH TOTAL PROJECT COST
<b>0.34 B/C RATIO</b>			

4 - 96" Pumps and Obermeyer Gate			
\$76,500,000	PRESENT WORTH PROJECT COST	\$470,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$6,486,351	PRESENT WORTH O&M COSTS	\$82,986,351	PRESENT WORTH TOTAL PROJECT COST
<b>0.35 B/C RATIO</b>			

4 - 96" Pumps and Steel Gate			
\$74,300,000	PRESENT WORTH PROJECT COST	\$450,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$6,210,336	PRESENT WORTH O&M COSTS	\$80,510,336	PRESENT WORTH TOTAL PROJECT COST
<b>0.36 B/C RATIO</b>			

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-96" PUMPS - 10yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$5,972,256				
0.500	2	0.50	\$7,991,008	\$6,981,632	\$3,490,118	\$3,490,118	
0.100	10	0.40	\$22,364,184	\$15,177,596	\$6,071,038	\$9,561,156	
0.040	25	0.06	\$33,481,476	\$27,922,830	\$1,675,370	\$11,236,526	
0.020	50	0.02	\$47,289,764	\$40,385,620	\$807,712	\$12,044,239	7.00% INTEREST RATE
0.010	100	0.01	\$55,229,679	\$55,229,679	\$552,297	\$12,596,535	50 YEARS
							\$173,841,588 PRESENT WORTH
0.99							

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-96" PUMPS - 10yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$3,531,810				
0.500	2	0.50	\$4,573,802	\$4,052,806	\$2,025,998	\$2,025,998	
0.100	10	0.4	\$10,020,418	\$7,297,110	\$2,918,844	\$4,944,842	
0.040	25	0.06	\$33,481,476	\$21,750,947	\$1,305,057	\$6,249,899	
0.020	50	0.02	\$47,289,764	\$40,385,620	\$807,712	\$7,057,611	7.00% INTEREST RATE
0.010	100	0.01	\$55,229,679	\$55,229,679	\$552,297	\$7,609,908	50 YEARS
							\$105,022,406 PRESENT WORTH
0.99							

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-96" PUMPS - 10yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS INTERVAL	EXPECTED ANNUAL BENEFITS SUMMATION	
0.990	1		\$2,440,446				
0.500	2	0.49	\$3,417,206	\$2,928,826	\$1,435,415	\$1,435,415	
0.100	10	0.4	\$12,343,766	\$7,880,486	\$3,152,194	\$4,587,609	
0.040	25	0.06	\$0	\$6,171,883	\$370,313	\$4,957,922	
0.020	50	0.02	\$0	\$0	\$0	\$4,957,922	7.00% INTEREST RATE
0.010	100	0.01	\$0	\$0	\$0	\$4,957,922	50 YEARS
							\$68,423,026 PRESENT WORTH

4 - 96" Pumps and Inflatable Dam			
\$90,400,000	PRESENT WORTH PROJECT COST	\$494,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$6,817,569	PRESENT WORTH O&M COSTS	\$97,217,569	PRESENT WORTH TOTAL PROJECT COST
		0.70	B/C RATIO

4 - 96" Pumps and Obermeyer Gate			
\$84,100,000	PRESENT WORTH PROJECT COST	\$470,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$6,486,351	PRESENT WORTH O&M COSTS	\$90,586,351	PRESENT WORTH TOTAL PROJECT COST
		0.76	B/C RATIO

4 - 96" Pumps and Steel Gate			
\$81,500,000	PRESENT WORTH PROJECT COST	\$450,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$6,210,336	PRESENT WORTH O&M COSTS	\$87,710,336	PRESENT WORTH TOTAL PROJECT COST
		0.78	B/C RATIO

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-96" PUMPS - 25yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$5,972,256				
0.500	2	0.50	\$7,991,008	\$6,981,632	\$3,490,118	\$3,490,118	
0.100	10	0.40	\$22,364,184	\$15,177,596	\$6,071,038	\$9,561,156	
0.040	25	0.06	\$33,481,476	\$27,922,830	\$1,675,370	\$11,236,526	
0.020	50	0.02	\$47,289,764	\$40,385,620	\$807,712	\$12,044,239	7.00% INTEREST RATE
0.010	100	0.01	\$63,169,593	\$55,229,679	\$552,297	\$12,596,535	50 YEARS
							\$173,841,588 PRESENT WORTH
0.99							

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-96" PUMPS - 25yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$3,531,810				
0.500	2	0.50	\$4,573,802	\$4,052,806	\$2,025,998	\$2,025,998	
0.100	10	0.4	\$10,020,418	\$7,297,110	\$2,918,844	\$4,944,842	
0.040	25	0.06	\$12,929,730	\$11,475,074	\$688,504	\$5,633,346	
0.020	50	0.02	\$47,289,764	\$30,109,747	\$602,195	\$6,235,541	7.00% INTEREST RATE
0.010	100	0.01	\$63,169,593	\$55,229,679	\$552,297	\$6,787,838	50 YEARS
							\$93,677,228 PRESENT WORTH
0.99							

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-96" PUMPS - 25yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS INTERVAL	EXPECTED ANNUAL BENEFITS SUMMATION	
0.990	1		\$2,440,446				
0.500	2	0.49	\$3,417,206	\$2,928,826	\$1,435,415	\$1,435,415	
0.100	10	0.4	\$12,343,766	\$7,880,486	\$3,152,194	\$4,587,609	
0.040	25	0.06	\$20,551,746	\$16,447,756	\$986,865	\$5,574,475	
0.020	50	0.02	\$0	\$10,275,873	\$205,517	\$5,779,992	7.00% INTEREST RATE
0.010	100	0.01	\$0	\$0	\$0	\$5,779,992	50 YEARS
							\$79,768,203 PRESENT WORTH

4 - 96" Pumps and Inflatable Dam			
\$92,200,000	PRESENT WORTH PROJECT COST	\$494,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$6,817,569	PRESENT WORTH O&M COSTS	\$99,017,569	PRESENT WORTH TOTAL PROJECT COST
		0.81	B/C RATIO

4 - 96" Pumps and Obermeyer Gate			
\$85,700,000	PRESENT WORTH PROJECT COST	\$470,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$6,486,351	PRESENT WORTH O&M COSTS	\$92,186,351	PRESENT WORTH TOTAL PROJECT COST
		0.87	B/C RATIO

4 - 96" Pumps and Steel Gate			
\$84,000,000	PRESENT WORTH PROJECT COST	\$450,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$6,210,336	PRESENT WORTH O&M COSTS	\$90,210,336	PRESENT WORTH TOTAL PROJECT COST
		0.88	B/C RATIO

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-96" PUMPS - 50yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$5,972,256				
0.500	2	0.50	\$7,991,008	\$6,981,632	\$3,490,118	\$3,490,118	
0.100	10	0.40	\$22,364,184	\$15,177,596	\$6,071,038	\$9,561,156	
0.040	25	0.06	\$33,481,476	\$27,922,830	\$1,675,370	\$11,236,526	
0.020	50	0.02	\$47,289,764	\$40,385,620	\$807,712	\$12,044,239	7.00% INTEREST RATE
0.010	100	0.01	\$63,169,593	\$55,229,679	\$552,297	\$12,596,535	50 YEARS
							\$173,841,588 PRESENT WORTH
0.99							

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-96" PUMPS - 50yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$3,531,810				
0.500	2	0.50	\$4,573,802	\$4,052,806	\$2,025,998	\$2,025,998	
0.100	10	0.4	\$10,020,418	\$7,297,110	\$2,918,844	\$4,944,842	
0.040	25	0.06	\$12,929,730	\$11,475,074	\$688,504	\$5,633,346	
0.020	50	0.02	\$15,981,365	\$14,455,547	\$289,111	\$5,922,457	7.00% INTEREST RATE
0.010	100	0.01	\$63,169,593	\$39,575,479	\$395,755	\$6,318,212	50 YEARS
							\$87,196,039 PRESENT WORTH
0.99							

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-96" PUMPS - 50yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS INTERVAL	EXPECTED ANNUAL BENEFITS SUMMATION	
0.990	1		\$2,440,446				
0.500	2	0.49	\$3,417,206	\$2,928,826	\$1,435,415	\$1,435,415	
0.100	10	0.4	\$12,343,766	\$7,880,486	\$3,152,194	\$4,587,609	
0.040	25	0.06	\$20,551,746	\$16,447,756	\$986,865	\$5,574,475	
0.020	50	0.02	\$31,308,399	\$25,930,073	\$518,601	\$6,093,076	7.00% INTEREST RATE
0.010	100	0.01	\$0	\$15,654,199	\$156,542	\$6,249,618	50 YEARS
							\$86,249,392 PRESENT WORTH

4 - 96" Pumps and Inflatable Dam			
\$93,800,000	PRESENT WORTH PROJECT COST	\$494,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$6,817,569	PRESENT WORTH O&M COSTS	\$100,617,569	PRESENT WORTH TOTAL PROJECT COST
0.86 B/C RATIO			

4 - 96" Pumps and Obermeyer Gate			
\$87,200,000	PRESENT WORTH PROJECT COST	\$470,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$6,486,351	PRESENT WORTH O&M COSTS	\$93,686,351	PRESENT WORTH TOTAL PROJECT COST
0.92 B/C RATIO			

4 - 96" Pumps and Steel Gate			
\$84,000,000	PRESENT WORTH PROJECT COST	\$450,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$6,210,336	PRESENT WORTH O&M COSTS	\$90,210,336	PRESENT WORTH TOTAL PROJECT COST
0.96 B/C RATIO			

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-96" PUMPS - 100yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$5,972,256				
		0.50		\$6,981,632	\$3,490,118	\$3,490,118	
0.500	2		\$7,991,008				
		0.40		\$15,177,596	\$6,071,038	\$9,561,156	
0.100	10		\$22,364,184				
		0.06		\$27,922,830	\$1,675,370	\$11,236,526	
0.040	25		\$33,481,476				
		0.02		\$40,385,620	\$807,712	\$12,044,239	7.00% INTEREST RATE
0.020	50		\$47,289,764				50 YEARS
		0.01		\$55,229,679	\$552,297	\$12,596,535	\$173,841,588 PRESENT WORTH
0.010	100		\$63,169,593				
0.99							

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-96" PUMPS - 100yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION	
1.000	1		\$3,531,810				
		0.50		\$4,052,806	\$2,025,998	\$2,025,998	
0.500	2		\$4,573,802				
		0.4		\$7,297,110	\$2,918,844	\$4,944,842	
0.100	10		\$10,020,418				
		0.06		\$11,475,074	\$688,504	\$5,633,346	
0.040	25		\$12,929,730				
		0.02		\$14,455,547	\$289,111	\$5,922,457	7.00% INTEREST RATE
0.020	50		\$15,981,365				50 YEARS
		0.01		\$18,528,329	\$185,283	\$6,107,740	\$84,291,376 PRESENT WORTH
0.010	100		\$21,075,294				
0.99							

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 4-96" PUMPS - 100yr SURGE							
PROJ NO:		DESIGNER: JDM			DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS INTERVAL	EXPECTED ANNUAL BENEFITS SUMMATION	
0.990	1		\$2,440,446				
		0.49		\$2,928,826	\$1,435,415	\$1,435,415	
0.500	2		\$3,417,206				
		0.4		\$7,880,486	\$3,152,194	\$4,587,609	
0.100	10		\$12,343,766				
		0.06		\$16,447,756	\$986,865	\$5,574,475	
0.040	25		\$20,551,746				
		0.02		\$25,930,073	\$518,601	\$6,093,076	7.00% INTEREST RATE
0.020	50		\$31,308,399				50 YEARS
		0.01		\$36,701,349	\$367,013	\$6,460,089	\$89,154,056 PRESENT WORTH
0.010	100		\$42,094,299				

4 - 96" Pumps and Inflatable Dam			
\$94,100,000	PRESENT WORTH PROJECT COST	\$494,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$6,817,569	PRESENT WORTH O&M COSTS	\$100,917,569	PRESENT WORTH TOTAL PROJECT COST
<b>0.88 B/C RATIO</b>			

4 - 96" Pumps and Obermeyer Gate			
\$88,500,000	PRESENT WORTH PROJECT COST	\$470,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$6,486,351	PRESENT WORTH O&M COSTS	\$94,986,351	PRESENT WORTH TOTAL PROJECT COST
<b>0.94 B/C RATIO</b>			

4 - 96" Pumps and Steel Gate			
\$85,000,000	PRESENT WORTH PROJECT COST	\$450,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$6,210,336	PRESENT WORTH O&M COSTS	\$91,210,336	PRESENT WORTH TOTAL PROJECT COST
<b>0.98 B/C RATIO</b>			

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT:		CITY OF NORFOLK - PRETTY LAKE - 2-yr Bulkhead - SURGE				DATE:		27-Apr-11
PROJ NO:		DESIGNER: JDM						
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION		
1.000	1		\$5,435,078					
		0.50		\$6,713,043	\$3,355,850	\$3,355,850		
0.500	2		\$7,991,008					
		0.40		\$15,177,596	\$6,071,038	\$9,426,889		
0.100	10		\$22,364,184					
		0.06		\$27,922,830	\$1,675,370	\$11,102,259		
0.040	25		\$33,481,476					
		0.02		\$40,385,620	\$807,712	\$11,909,971		
0.020	50		\$47,289,764					
		0.01		\$55,229,679	\$552,297	\$12,462,268		
0.010	100		\$63,169,593					
		0.99						

7.00% INTEREST RATE  
50 YEARS  
PRESENT WOI  
\$171,988,595

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT:		CITY OF NORFOLK - PRETTY LAKE - 2-yr Bulkhead - SURGE				DATE:		27-Apr-11
PROJ NO:		DESIGNER: JDM						
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION		
1.000	1		\$4,763,445					
		0.50		\$5,529,936	\$2,764,415	\$2,764,415		
0.500	2		\$6,296,428					
		0.4		\$14,330,306	\$5,732,122	\$8,496,538		
0.100	10		\$22,364,184					
		0.06		\$27,922,830	\$1,675,370	\$10,171,907		
0.040	25		\$33,481,476					
		0.02		\$40,385,620	\$807,712	\$10,979,620		
0.020	50		\$47,289,764					
		0.01		\$55,229,679	\$552,297	\$11,531,917		
0.010	100		\$63,169,593					
		0.99						

7.00% INTEREST RATE  
50 YEARS  
PRESENT WOI  
\$159,149,055

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT:		CITY OF NORFOLK - PRETTY LAKE - 2-yr Bulkhead - SURGE				DATE:		27-Apr-11
PROJ NO:		DESIGNER: JDM						
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS INTERVAL	EXPECTED ANNUAL BENEFITS SUMMATION		
0.990	1		\$671,633					
		0.49		\$1,183,107	\$579,839	\$579,839		
0.500	2		\$1,694,580					
		0.4		\$847,290	\$338,916	\$918,756		
0.100	10		\$0					
		0.06		\$0	\$0	\$918,756		
0.040	25		\$0					
		0.02		\$0	\$0	\$918,756		
0.020	50		\$0					
		0.01		\$0	\$0	\$918,756		
0.010	100		\$0					

7.00% INTEREST RATE  
50 YEARS  
PRESENT WOI  
\$12,679,512

**Bulkhead/Berm Options**

\$55,500,000	PRESENT WORTH PROJECT COST	\$277,500	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$3,829,707	PRESENT WORTH O&M COSTS	\$59,329,707	PRESENT WORTH TOTAL PROJECT COST
		0.21	B/C RATIO

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 10-yr Bulkhead - SURGE		DESIGNER: JDM		DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION
1.000	1		\$5,435,078			
		0.50		\$6,713,043	\$3,355,850	\$3,355,850
0.500	2		\$7,991,008			
		0.40		\$15,177,596	\$6,071,038	\$9,426,889
0.100	10		\$22,364,184			
		0.06		\$27,922,830	\$1,675,370	\$11,102,259
0.040	25		\$33,481,476			
		0.02		\$40,385,620	\$807,712	\$11,909,971
0.020	50		\$47,289,764			
		0.01		\$55,229,679	\$552,297	\$12,462,268
0.010	100		\$63,169,593			
0.99						

7.00% INTEREST RATE  
50 YEARS  
PRESENT WORTH \$171,988,595

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 10-yr Bulkhead - SURGE		DESIGNER: JDM		DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION
1.000	1		\$4,763,445			
		0.50		\$5,529,936	\$2,764,415	\$2,764,415
0.500	2		\$6,296,428			
		0.4		\$10,248,966	\$4,099,587	\$6,864,002
0.100	10		\$14,201,505			
		0.06		\$23,841,491	\$1,430,489	\$8,294,491
0.040	25		\$33,481,476			
		0.02		\$40,385,620	\$807,712	\$9,102,204
0.020	50		\$47,289,764			
		0.01		\$55,229,679	\$552,297	\$9,654,500
0.010	100		\$63,169,593			
0.99						

7.00% INTEREST RATE  
50 YEARS  
PRESENT WORTH \$133,239,311

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE - 10-yr Bulkhead - SURGE		DESIGNER: JDM		DATE: 27-Apr-11		
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS INTERVAL	EXPECTED ANNUAL BENEFITS SUMMATION
0.990	1		\$671,633			
		0.49		\$1,183,107	\$579,839	\$579,839
0.500	2		\$1,694,580			
		0.4		\$4,928,630	\$1,971,452	\$2,551,291
0.100	10		\$8,162,679			
		0.06		\$4,081,339	\$244,880	\$2,796,172
0.040	25		\$0			
		0.02		\$0	\$0	\$2,796,172
0.020	50		\$0			
		0.01		\$0	\$0	\$2,796,172
0.010	100		\$0			

7.00% INTEREST RATE  
50 YEARS  
PRESENT WORTH \$38,589,256

**Bulkhead/Berm Options**

\$94,700,000	PRESENT WORTH PROJECT COST	\$473,500	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$6,534,653	PRESENT WORTH O&M COSTS	\$101,234,653	PRESENT WORTH TOTAL PROJECT COST
		0.38	B/C RATIO

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT:		CITY OF NORFOLK - PRETTY LAKE - 25-yr Bulkhead - SURGE				DATE:		27-Apr-11
PROJ NO:		DESIGNER: JDM						
FREQUENCY	RETURN	INTERVAL	DAMAGES	AVERAGE	EXPECTED ANNUAL DAMAGES			
%	PERIOD			DAMAGES	INTERVAL	SUMMATION		
1.000	1		\$5,435,078					
		0.50		\$6,713,043	\$3,355,850	\$3,355,850		
0.500	2		\$7,991,008					
		0.40		\$15,177,596	\$6,071,038	\$9,426,889		
0.100	10		\$22,364,184					
		0.06		\$27,922,830	\$1,675,370	\$11,102,259		
0.040	25		\$33,481,476					
		0.02		\$40,385,620	\$807,712	\$11,909,971	7.00% INTEREST RATE	
0.020	50		\$47,289,764				50 YEARS	
		0.01		\$55,229,679	\$552,297	\$12,462,268	\$171,988,595 PRESENT WORTH	
0.010	100		\$63,169,593					
0.99								

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT:		CITY OF NORFOLK - PRETTY LAKE - 25-yr Bulkhead - SURGE				DATE:		27-Apr-11
PROJ NO:		DESIGNER: JDM						
FREQUENCY	RETURN	INTERVAL	DAMAGES	AVERAGE	EXPECTED ANNUAL DAMAGES			
%	PERIOD			DAMAGES	INTERVAL	SUMMATION		
1.000	1		\$4,763,445					
		0.50		\$5,529,936	\$2,764,415	\$2,764,415		
0.500	2		\$6,296,428					
		0.4		\$10,248,966	\$4,099,587	\$6,864,002		
0.100	10		\$14,201,505					
		0.06		\$16,983,727	\$1,019,024	\$7,883,025		
0.040	25		\$19,765,950					
		0.02		\$33,527,857	\$670,557	\$8,553,583	7.00% INTEREST RATE	
0.020	50		\$47,289,764				50 YEARS	
		0.01		\$55,229,679	\$552,297	\$9,105,879	\$125,667,931 PRESENT WORTH	
0.010	100		\$63,169,593					
0.99								

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT:		CITY OF NORFOLK - PRETTY LAKE - 25-yr Bulkhead - SURGE				DATE:		27-Apr-11
PROJ NO:		DESIGNER: JDM						
FREQUENCY	RETURN	INTERVAL	BENEFITS	AVERAGE	EXPECTED ANNUAL BENEFITS			
%	PERIOD			BENEFITS	INTERVAL	SUMMATION		
0.990	1		\$671,633					
		0.49		\$1,183,107	\$579,839	\$579,839		
0.500	2		\$1,694,580					
		0.4		\$4,928,630	\$1,971,452	\$2,551,291		
0.100	10		\$8,162,679					
		0.06		\$10,939,103	\$656,346	\$3,207,637		
0.040	25		\$13,715,526					
		0.02		\$6,857,763	\$137,155	\$3,344,793	7.00% INTEREST RATE	
0.020	50		\$0				50 YEARS	
		0.01		\$0	\$0	\$3,344,793	\$46,160,635 PRESENT WORTH	
0.010	100		\$0					

**Bulkhead/Berm Options**

\$117,400,000	PRESENT WORTH PROJECT COST	\$587,000	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$8,101,038	PRESENT WORTH O&M COSTS	\$125,501,038	PRESENT WORTH TOTAL PROJECT COST
		0.37	B/C RATIO

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT:		CITY OF NORFOLK - PRETTY LAKE - 50-yr Bulkhead - SURGE				DATE:		27-Apr-11	
PROJ NO:		DESIGNER: JDM							
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION			
1.000	1		\$5,435,078						
		0.50		\$6,713,043	\$3,355,850	\$3,355,850			
0.500	2		\$7,991,008						
		0.40		\$15,177,596	\$6,071,038	\$9,426,889			
0.100	10		\$22,364,184						
		0.06		\$27,922,830	\$1,675,370	\$11,102,259			
0.040	25		\$33,481,476						
		0.02		\$40,385,620	\$807,712	\$11,909,971			7.00% INTEREST RATE
0.020	50		\$47,289,764						50 YEARS
		0.01		\$55,229,679	\$552,297	\$12,462,268			PRESENT WORTH
0.010	100		\$63,169,593						
0.99									

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT:		CITY OF NORFOLK - PRETTY LAKE - 50-yr Bulkhead - SURGE				DATE:		27-Apr-11	
PROJ NO:		DESIGNER: JDM							
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION			
1.000	1		\$4,763,445						
		0.50		\$5,529,936	\$2,764,415	\$2,764,415			
0.500	2		\$6,296,428						
		0.4		\$10,248,966	\$4,099,587	\$6,864,002			
0.100	10		\$14,201,505						
		0.06		\$16,983,727	\$1,019,024	\$7,883,025			
0.040	25		\$19,765,950						
		0.02		\$22,925,105	\$458,502	\$8,341,528			7.00% INTEREST RATE
0.020	50		\$26,084,259						50 YEARS
		0.01		\$44,626,926	\$446,269	\$8,787,797			PRESENT WORTH
0.010	100		\$63,169,593						
0.99									

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT:		CITY OF NORFOLK - PRETTY LAKE - 50-yr Bulkhead - SURGE				DATE:		27-Apr-11	
PROJ NO:		DESIGNER: JDM							
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS INTERVAL	EXPECTED ANNUAL BENEFITS SUMMATION			
0.990	1		\$671,633						
		0.49		\$1,183,107	\$579,839	\$579,839			
0.500	2		\$1,694,580						
		0.4		\$4,928,630	\$1,971,452	\$2,551,291			
0.100	10		\$8,162,679						
		0.06		\$10,939,103	\$656,346	\$3,207,637			
0.040	25		\$13,715,526						
		0.02		\$17,460,515	\$349,210	\$3,556,848			7.00% INTEREST RATE
0.020	50		\$21,205,505						50 YEARS
		0.01		\$10,602,752	\$106,028	\$3,662,875	\$50,550,412		PRESENT WORTH
0.010	100		\$0						

Bulkhead/Berm Options			
\$154,500,000	PRESENT WORTH PROJECT COST	\$772,500	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$10,661,077	PRESENT WORTH O&M COSTS	\$165,161,077	PRESENT WORTH TOTAL PROJECT COST
		0.31	B/C RATIO

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT:		CITY OF NORFOLK - PRETTY LAKE - 100-yr Bulkhead - SURGE				DATE:		27-Apr-11	
PROJ NO:		DESIGNER: JDM							
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION			
1.000	1		\$5,435,078						
		0.50		\$6,713,043	\$3,355,850	\$3,355,850			
0.500	2		\$7,991,008						
		0.40		\$15,177,596	\$6,071,038	\$9,426,889			
0.100	10		\$22,364,184						
		0.06		\$27,922,830	\$1,675,370	\$11,102,259			
0.040	25		\$33,481,476						
		0.02		\$40,385,620	\$807,712	\$11,909,971			7.00% INTEREST RATE
0.020	50		\$47,289,764						50 YEARS
		0.01		\$55,229,679	\$552,297	\$12,462,268			PRESENT WORTH
0.010	100		\$63,169,593						
0.99									

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT:		CITY OF NORFOLK - PRETTY LAKE - 100-yr Bulkhead - SURGE				DATE:		27-Apr-11	
PROJ NO:		DESIGNER: JDM							
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION			
1.000	1		\$4,763,445						
		0.50		\$5,529,936	\$2,764,415	\$2,764,415			
0.500	2		\$6,296,428						
		0.4		\$10,248,966	\$4,099,587	\$6,864,002			
0.100	10		\$14,201,505						
		0.06		\$16,983,727	\$1,019,024	\$7,883,025			
0.040	25		\$19,765,950						
		0.02		\$22,925,105	\$458,502	\$8,341,528			7.00% INTEREST RATE
0.020	50		\$26,084,259						50 YEARS
		0.01		\$29,542,036	\$295,420	\$8,636,948			PRESENT WORTH
0.010	100		\$32,999,812						
0.99									

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT:		CITY OF NORFOLK - PRETTY LAKE - 100-yr Bulkhead - SURGE				DATE:		27-Apr-11	
PROJ NO:		DESIGNER: JDM							
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS INTERVAL	EXPECTED ANNUAL BENEFITS SUMMATION			
0.990	1		\$671,633						
		0.49		\$1,183,107	\$579,839	\$579,839			
0.500	2		\$1,694,580						
		0.4		\$4,928,630	\$1,971,452	\$2,551,291			
0.100	10		\$8,162,679						
		0.06		\$10,939,103	\$656,346	\$3,207,637			
0.040	25		\$13,715,526						
		0.02		\$17,460,515	\$349,210	\$3,556,848			7.00% INTEREST RATE
0.020	50		\$21,205,505						50 YEARS
		0.01		\$25,687,643	\$256,876	\$3,813,724			PRESENT WORTH
0.010	100		\$30,169,781						

Bulkhead/Berm Options	
\$189,700,000	PRESENT WORTH PROJECT COST
\$948,500	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$13,090,008	PRESENT WORTH O&M COSTS
\$202,790,008	PRESENT WORTH TOTAL PROJECT COST
0.26	B/C RATIO

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE -20% Buyout - SURGE		DESIGNER: JDM		DATE: 27-Apr-11	
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES SUMMATION
1.000	1		\$5,435,078		
		0.50		\$6,713,043	\$3,355,850
0.500	2		\$7,991,008		
		0.40		\$15,177,596	\$6,071,038
0.100	10		\$22,364,184		
		0.06		\$27,922,830	\$1,675,370
0.040	25		\$33,481,476		
		0.02		\$40,385,620	\$807,712
0.020	50		\$47,289,764		
		0.01		\$55,229,679	\$552,297
0.010	100		\$63,169,593		
		0.99			

7.00% INTEREST RATE  
50 YEARS  
\$171,988,595 PRESENT WORTH

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT: CITY OF NORFOLK - PRETTY LAKE -20% Buyout - SURGE		DESIGNER: JDM		DATE: 27-Apr-11	
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES SUMMATION
1.000	1		\$2,924,079		
		0.50		\$3,748,376	\$1,873,813
0.500	2		\$4,572,673		
		0.4		\$10,869,581	\$4,347,832
0.100	10		\$17,166,489		
		0.06		\$22,276,316	\$1,336,579
0.040	25		\$27,386,144		
		0.02		\$33,947,024	\$678,940
0.020	50		\$40,507,904		
		0.01		\$48,157,487	\$481,575
0.010	100		\$55,807,070		
		0.99			

7.00% INTEREST RATE  
50 YEARS  
\$120,325,117 PRESENT WORTH

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE -20% Buyout - SURGE		DESIGNER: JDM		DATE: 27-Apr-11	
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS SUMMATION
0.990	1		\$2,510,999		
		0.49		\$2,964,667	\$1,452,981
0.500	2		\$3,418,335		
		0.4		\$4,308,015	\$1,723,206
0.100	10		\$5,197,695		
		0.06		\$5,646,514	\$338,791
0.040	25		\$6,095,332		
		0.02		\$6,438,596	\$128,772
0.020	50		\$6,781,860		
		0.01		\$7,072,192	\$70,722
0.010	100		\$7,362,523		

7.00% INTEREST RATE  
50 YEARS  
\$51,262,474 PRESENT WORTH

<b>Pretty Lake Buyout 20% Damage Level 2yr</b>	
\$50,366,925 PRESENT WORTH PROJECT COST	\$554,036 ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$7,646,113 PRESENT WORTH O&M COSTS	\$58,013,038 PRESENT WORTH TOTAL PROJECT COST
<b>0.88 B/C RATIO</b>	

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE -20% Buyout - SURGE		DESIGNER: JDM		DATE: 27-Apr-11	
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES SUMMATION
1.000	1		\$5,435,078		
		0.50		\$6,713,043	\$3,355,850
0.500	2		\$7,991,008		
		0.40		\$15,177,596	\$6,071,038
0.100	10		\$22,364,184		
		0.06		\$27,922,830	\$1,675,370
0.040	25		\$33,481,476		
		0.02		\$40,385,620	\$807,712
0.020	50		\$47,289,764		
		0.01		\$55,229,679	\$552,297
0.010	100		\$63,169,593		
		0.99			

7.00% INTEREST RATE  
50 YEARS  
\$171,988,595 PRESENT WORTH

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT: CITY OF NORFOLK - PRETTY LAKE -20% Buyout - SURGE		DESIGNER: JDM		DATE: 27-Apr-11	
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES SUMMATION
1.000	1		\$1,943,308		
		0.50		\$2,194,889	\$1,097,225
0.500	2		\$2,446,471		
		0.4		\$6,413,889	\$2,565,556
0.100	10		\$10,381,307		
		0.06		\$14,294,172	\$857,650
0.040	25		\$18,207,036		
		0.02		\$23,866,695	\$477,334
0.020	50		\$29,526,355		
		0.01		\$36,382,149	\$363,821
0.010	100		\$43,237,944		
		0.99			

7.00% INTEREST RATE  
50 YEARS  
\$73,993,895 PRESENT WORTH

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE -20% Buyout - SURGE		DESIGNER: JDM		DATE: 27-Apr-11	
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS SUMMATION
0.990	1		\$3,491,771		
		0.49		\$4,518,154	\$2,214,343
0.500	2		\$5,544,537		
		0.4		\$8,763,707	\$3,505,483
0.100	10		\$11,982,877		
		0.06		\$13,628,658	\$817,720
0.040	25		\$15,274,440		
		0.02		\$16,518,925	\$330,378
0.020	50		\$17,763,409		
		0.01		\$18,847,529	\$188,475
0.010	100		\$19,931,649		

7.00% INTEREST RATE  
50 YEARS  
\$97,383,570 PRESENT WORTH

**Pretty Lake Buyout 20% Damage Level 10yr**

**\$174,241,900** PRESENT WORTH PROJECT COST      **\$1,916,661** ANNUAL OPERATION & MAINTENANCE (O&M) COSTS

**\$26,451,351** PRESENT WORTH O&M COSTS      **\$200,693,251** PRESENT WORTH TOTAL PROJECT COST

**0.49 B/C RATIO**

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE -20% Buyout - SURGE						
PROJ NO:		DESIGNER: JDM			DATE:	27-Apr-11
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES	
					INTERVAL	SUMMATION
1.000	1		\$5,435,078			
		0.50		\$6,713,043	\$3,355,850	\$3,355,850
0.500	2		\$7,991,008			
		0.40		\$15,177,596	\$6,071,038	\$9,426,889
0.100	10		\$22,364,184			
		0.06		\$27,922,830	\$1,675,370	\$11,102,259
0.040	25		\$33,481,476			
		0.02		\$40,385,620	\$807,712	\$11,909,971
0.020	50		\$47,289,764			
		0.01		\$55,229,679	\$552,297	\$12,462,268
0.010	100		\$63,169,593			
		0.99				

7.00% INTEREST RATE  
50 YEARS  
PRESENT WOI

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT: CITY OF NORFOLK - PRETTY LAKE -20% Buyout - SURGE						
PROJ NO:		DESIGNER: JDM			DATE:	27-Apr-11
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES	
					INTERVAL	SUMMATION
1.000	1		\$1,652,770			
		0.50		\$1,805,826	\$902,733	\$902,733
0.500	2		\$1,958,883			
		0.4		\$4,572,395	\$1,828,958	\$2,731,691
0.100	10		\$7,185,908			
		0.06		\$9,812,117	\$588,727	\$3,320,418
0.040	25		\$12,438,327			
		0.02		\$17,244,843	\$344,897	\$3,665,315
0.020	50		\$22,051,358			
		0.01		\$28,140,275	\$281,403	\$3,946,717
0.010	100		\$34,229,192			
		0.99				

7.00% INTEREST RATE  
50 YEARS  
PRESENT WOI

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE -20% Buyout - SURGE						
PROJ NO:		DESIGNER: JDM			DATE:	27-Apr-11
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS	
					INTERVAL	SUMMATION
0.990	1		\$3,782,308			
		0.49		\$4,907,217	\$2,405,022	\$2,405,022
0.500	2		\$6,032,125			
		0.4		\$10,605,201	\$4,242,080	\$6,647,102
0.100	10		\$15,178,276			
		0.06		\$18,110,713	\$1,086,643	\$7,733,745
0.040	25		\$21,043,149			
		0.02		\$23,140,777	\$462,816	\$8,196,561
0.020	50		\$25,238,406			
		0.01		\$27,089,403	\$270,894	\$8,467,455
0.010	100		\$28,940,401			

7.00% INTEREST RATE  
50 YEARS  
PRESENT WOI

<b>Pretty Lake Buyout 20% Damage Level 25yr</b>			
\$265,390,650	PRESENT WORTH PROJECT COST	\$2,919,297	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$40,288,479	PRESENT WORTH O&M COSTS	\$305,679,129	PRESENT WORTH TOTAL PROJECT COST
		<b>0.38</b>	<b>B/C RATIO</b>

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE -20% Buyout - SURGE		DESIGNER: JDM		DATE: 27-Apr-11	
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES SUMMATION
1.000	1		\$5,435,078		
		0.50		\$6,713,043	\$3,355,850
0.500	2		\$7,991,008		
		0.40		\$15,177,596	\$6,071,038
0.100	10		\$22,364,184		
		0.06		\$27,922,830	\$1,675,370
0.040	25		\$33,481,476		
		0.02		\$40,385,620	\$807,712
0.020	50		\$47,289,764		
		0.01		\$55,229,679	\$552,297
0.010	100		\$63,169,593		
		0.99			

7.00% INTEREST RATE  
50 YEARS  
\$171,988,595 PRESENT WORTH

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT: CITY OF NORFOLK - PRETTY LAKE -20% Buyout - SURGE		DESIGNER: JDM		DATE: 27-Apr-11	
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES SUMMATION
1.000	1		\$1,539,669		
		0.50		\$1,667,008	\$833,338
0.500	2		\$1,794,347		
		0.4		\$3,627,275	\$1,450,910
0.100	10		\$5,460,202		
		0.06		\$7,065,767	\$423,946
0.040	25		\$8,671,331		
		0.02		\$12,448,830	\$248,977
0.020	50		\$16,226,329		
		0.01		\$21,438,017	\$214,380
0.010	100		\$26,649,704		
		0.99			

7.00% INTEREST RATE  
50 YEARS  
\$43,769,760 PRESENT WORTH

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT: CITY OF NORFOLK - PRETTY LAKE -20% Buyout - SURGE		DESIGNER: JDM		DATE: 27-Apr-11	
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS SUMMATION
0.990	1		\$3,895,409		
		0.49		\$5,046,035	\$2,473,057
0.500	2		\$6,196,661		
		0.4		\$11,550,321	\$4,620,128
0.100	10		\$16,903,982		
		0.06		\$20,857,063	\$1,251,424
0.040	25		\$24,810,145		
		0.02		\$27,936,790	\$558,736
0.020	50		\$31,063,435		
		0.01		\$33,791,662	\$337,917
0.010	100		\$36,519,889		

7.00% INTEREST RATE  
50 YEARS  
\$127,536,302 PRESENT WORTH

<b>Pretty Lake Buyout 20% Damage Level 50yr</b>	
\$356,736,888 PRESENT WORTH PROJECT COST	\$3,924,106 ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$54,155,588 PRESENT WORTH O&M COSTS	\$410,892,476 PRESENT WORTH TOTAL PROJECT COST
<b>0.31 B/C RATIO</b>	

**EXPECTED ANNUAL DAMAGES  
EXISTING CONDITIONS**

PROJECT:		CITY OF NORFOLK - PRETTY LAKE -20% Buyout - SURGE				DATE:		27-Apr-11
PROJ NO:		DESIGNER: JDM						
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION		
1.000	1		\$5,435,078					
		0.50		\$6,713,043	\$3,355,850	\$3,355,850		
0.500	2		\$7,991,008					
		0.40		\$15,177,596	\$6,071,038	\$9,426,889		
0.100	10		\$22,364,184					
		0.06		\$27,922,830	\$1,675,370	\$11,102,259		
0.040	25		\$33,481,476					
		0.02		\$40,385,620	\$807,712	\$11,909,971	7.00% INTEREST RATE	
0.020	50		\$47,289,764				50 YEARS	
		0.01		\$55,229,679	\$552,297	\$12,462,268	PRESENT WORTH	
0.010	100		\$63,169,593					
		0.99						

**EXPECTED ANNUAL DAMAGES  
RESIDUAL DAMAGES WITH PROJECT**

PROJECT:		CITY OF NORFOLK - PRETTY LAKE -20% Buyout - SURGE				DATE:		27-Apr-11
PROJ NO:		DESIGNER: JDM						
FREQUENCY %	RETURN PERIOD	INTERVAL	DAMAGES	AVERAGE DAMAGES	EXPECTED ANNUAL DAMAGES INTERVAL	EXPECTED ANNUAL DAMAGES SUMMATION		
1.000	1		\$1,109,896					
		0.50		\$1,201,163	\$600,461	\$600,461		
0.500	2		\$1,292,429					
		0.4		\$2,827,981	\$1,131,192	\$1,731,654		
0.100	10		\$4,363,533					
		0.06		\$5,508,522	\$330,511	\$2,062,165		
0.040	25		\$6,653,511					
		0.02		\$9,495,602	\$189,912	\$2,252,077	7.00% INTEREST RATE	
0.020	50		\$12,337,693				50 YEARS	
		0.01		\$16,418,100	\$164,181	\$2,416,258	PRESENT WORTH	
0.010	100		\$20,498,507					
		0.99						

**EXPECTED ANNUAL DAMAGES  
NET BENEFITS**

PROJECT:		CITY OF NORFOLK - PRETTY LAKE -20% Buyout - SURGE				DATE:		27-Apr-11
PROJ NO:		DESIGNER: JDM						
FREQUENCY %	RETURN PERIOD	INTERVAL	BENEFITS	AVERAGE BENEFITS	EXPECTED ANNUAL BENEFITS INTERVAL	EXPECTED ANNUAL BENEFITS SUMMATION		
0.990	1		\$4,325,182					
		0.49		\$5,511,880	\$2,701,367	\$2,701,367		
0.500	2		\$6,698,579					
		0.4		\$12,349,615	\$4,939,846	\$7,641,213		
0.100	10		\$18,000,651					
		0.06		\$22,414,308	\$1,344,858	\$8,986,072		
0.040	25		\$26,827,965					
		0.02		\$30,890,018	\$617,800	\$9,603,872	7.00% INTEREST RATE	
0.020	50		\$34,952,071				50 YEARS	
		0.01		\$38,811,578	\$388,116	\$9,991,988	PRESENT WORTH	
0.010	100		\$42,671,086					

**Pretty Lake Buyout 20% Damage Level 100yr**

\$473,696,563	PRESENT WORTH PROJECT COST	\$5,210,662	ANNUAL OPERATION & MAINTENANCE (O&M) COSTS
\$71,911,027	PRESENT WORTH O&M COSTS	\$545,607,589	PRESENT WORTH TOTAL PROJECT COST
		0.25	B/C RATIO