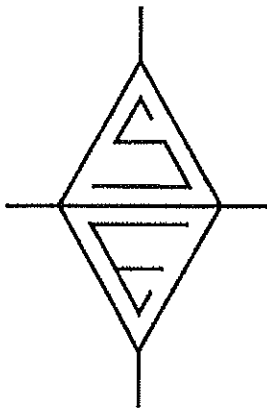


Town of Oriental

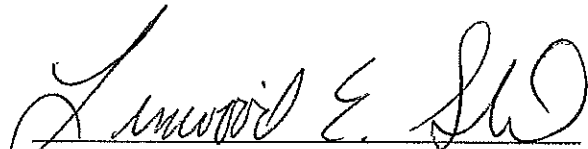
Raccoon Creek Flood Abatement Study

Owner:
Town of Oriental
P. O. Box 472
Oriental, NC 28571

Prepared by:



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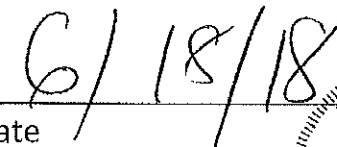

Date



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List of Exhibits:

- Exhibit A: Project Area Map
- Exhibit B1: Hodges Street - Existing Conditions
- Exhibit B2: Hodges Street - Existing Sections at Raccoon Creek
- Exhibits C1-C12: Neuse River Water Levels
- Exhibit D1: Hodges Street Proposed Conditions
- Exhibit D2: Hodges Street - Proposed Sections at Raccoon Creek
- Exhibit E: Funding Resources

Town Of Oriental

Raccoon Creek Flood Abatement Study

1. Background -

In June of 2017 The Town of Oriental was awarded a \$15,000 grant by the NC Division of Coastal Management for a Resilience Evaluation and Needs Assessment (RENA) Pilot Project for The Raccoon Creek Flood Abatement Study. Hodges Street crosses Raccoon Creek near its mouth at the Neuse River. Immediately North of Hodges Street is a series of three (3) shallow ponds known as Duck Ponds. The area around the Duck Ponds is a fully developed residential community. The area along Hodges Street between South Water Street and South Avenue is developed as commercial business. The entire area is very low lying and subject to frequent flooding even during minor storm events with prolonged winds out of the northeast. Water from the river backs up into the Duck Ponds and floods streets and yards throughout the area.

2. Purpose

The purpose of this engineering study is to determine mitigation measures for reduction of frequency and level of flooding within the area around the Duck Ponds upstream from the mouth of Raccoon Creek. This is a low lying coastal area which floods frequently during hurricanes, nor'easters, or just during periods of sustained winds out of the northeast. The 2015 NC Sea-Level Rise Assessment Report Update predicts that sea levels in this area will continue to rise over the next 30 years from a minimum of approximately 4 inches to a maximum of approximately 10 inches. Oriental is located on the Neuse River near the mouth at Pamlico Sound. Sea level rises will result in higher water levels in the sound as well as the lower Neuse River. Since flooding in this area is predominantly wind driven; the higher water levels will cause an increase in both the frequency and depth of flooding unless mitigation measures are implemented. Typically wind driven waters from the river back up across Hodges Street at the mouth of Raccoon Creek flooding approximately 40 acres of the town (see Project Location Map, Exhibit A). This project will evaluate the feasibility of raising the grade of Hodges Street to create a dyke and installing backwater valves to prevent tidal water from backing up through the culverts. The study will also evaluate improvements needed to the existing in line ponds on Raccoon Creek to achieve nutrient reduction prior to discharge to the Neuse River.

3. Flooding Analysis

The base flood elevation in this area is 7.0 feet according to FIRM Map No. 372064800J. The ground elevations in the area range between 1 and 6 feet; so the elevation of the entire area is below the base flood elevation. The entire area is fully developed; therefore protection against flooding during the 100 year storm event is not considered economically feasible and is beyond the scope of this study. Rather, this study investigates the feasibility of protection against nuisance flooding which occurs several times per year during periods of sustained winds out of the northeast which push water in the Pamlico Sound and the Neuse River back up into Raccoon Creek and Duck Pond. Water backs up into Raccoon Creek via an 18" concrete culvert under Hodges Street and often rise above and overtop Hodges Street. To determine the frequency of these events, Stroud Engineering performed a field survey to determine the

surface elevation of Hodges Street between South Street and Factory Street. The low level in the street at the location of the Raccoon Creek culvert was determined to be 0.77 ft. The elevation rose gradually to 2.99 ft. at the South Street intersection and rose to 3.00 ft. at the Factory Street intersection. (See Exhibits B1 and B2) This data was then compared to river gauge readings for the Neuse River at Oriental. The river gauge data is managed and maintained by the NC Department of Public Safety, Division of Emergency Management, Risk Management Section. It is located near the southern end of Freemason Street as shown on Exhibit A. The gauge records the river level at 5 minute intervals 24/7. The water level data is depicted graphically over a one year period beginning in May 2017 and continuing through April 2018. (Exhibit C1-C12). The red lines on Exhibit C1-C12 represent the low point on Hodges Street. Anytime the water level rises above this level, Hodges Street is flooded. The data indicates that Hodges Street was flooded at the low point 59 days during the one year period with the water level frequently approaching or exceeding 2 ft. There were only 2 months of the year when flooding did not occur at some time during the month. This level is sufficient to produce shallow flooding of all of the residential properties surrounding Duck Pond and to impede travel to businesses located on Hodges Street.

4. Water Quality Issues

The surface water classification for the Neuse River at Oriental is SA;HQW,NSW. The 2016 Integrated Report (303(d)) lists Shellfish Growing Area (Fecal, SH, SA) as a Parameter of Interest. The businesses and residences in the area are served by a gravity sewer system. The elevation of the manhole tops are all below the base flood elevations and many are flooded frequently. During these flooding events raw sewage becomes mixed with surface water which is a major source of fecal coliform contamination. The sewer system is owned and operated by Bay River Metropolitan Sewer District (BRMSD). BRMSD recently completed a sewer collection system rehabilitation project which included raising the manhole tops to above the base flood elevation where feasible; and placing sealed covers on manhole tops where raising was not feasible. The project was funded by a State Revolving Fund loan/grant. The completion of this project significantly reduces the export of fecal coliform to the surface waters.

A major water quality issue in the Neuse River since the 1980's has been nutrient related pollution. Excess nitrogen and phosphorus have caused problems including low oxygen levels, extensive fish kills and algal blooms. As a result, in 1997 the NC Environmental Management Commission adopted the Neuse River Nutrient Sensitive Waters Management Strategy. The rules seek to reduce nitrogen levels in the Neuse estuary by 30% from a 1991-1995 baseline. The sewage pollution discussed above was a source of nitrogen export the river at the mouth of Raccoon Creek. This source has been minimized by the sewer rehabilitation project. Another source of nitrogen export is storm water runoff. Within this project area, storm water runoff flows either by sheet flow or direct point discharge to the Duck Ponds. Riparian buffers around the Duck pond are marginal to non-existent in some areas.

5. Flood Abatement Feasibility Evaluation

To prevent the nuisance flooding it will be necessary to both prevent water from the river from backing up into the Duck Ponds by reverse flow through the culvert under Hodges Street and to

raise the grade of Hodges Street to prevent overflow from the river into Duck Ponds. Stopping the backflow through the culvert is best achieved by the installation of a tideflex valve on the outlet end of the culvert. The tideflex valve is a check valve constructed of elastomer material which will not corrode. It would allow water to flow from the pond to the river but prevent flow in the reverse direction. To prevent overflow of Hodges Street into Duck Pond we concluded from our analysis that the grade can be raised to an elevation of approximately 3.0 ft.; about 2.2 ft. higher than the current low point. The effect of raising the grade to that elevation is sufficient to have eliminated all 59 days of nuisance flooding during the one year period from May 2017 through April 2017. This elevation is depicted by the green line on Exhibit C1-C12. However, during time periods when high wind tides coincide with significant rainfall events, the low lying areas would flood anyway because the storm water runoff has nowhere to go. The only option to prevent the flooding is to install a storm water pump station to pump the water from Duck Pond to the river. The pumps would be controlled by level sensors which would cause the pumps to come on when the pond surface elevation reaches a pre-determined level. Our hydraulic analysis indicates that 2-12 inch 10 HP pumps would be required. A plan view of the proposed reconstruction of Hodges Street is attached, (Exhibit D1). The proposed street section at Raccoon Creek crossing is also attached (Exhibit D2).

6. Water Quality Enhancement Evaluation

To enhance the quality of storm water discharge to the Neuse River we evaluated the geometry of Duck Pond in relation to the river water levels in the river to determine if there are Best Management Practices (BMP's) which could be implemented to reduce export of nutrients and fecal coliform to the river. Of all of the BMP's listed in the NCDEQ BMP Manual, the Duck Ponds most closely resemble a constructed wetland. NCDEQ credit's wetlands for 44% nitrogen removal when constructed according to criteria contained in the BMP Manual. As such the wetland should include forebays at the inlet, 10%-15% of surface area; shallow water zones containing herbaceous plants, 35%-40% of surface area; temporary inundation zones containing herbaceous plants, shrubs and trees, 30%-45% of surface area; and deep pools, 5%-15% of surface area. Forebays are typically 24-40 inches deep; deep pools are 18 inches or more deep below permanent pool; shallow water zones are 0-9 inches deep, and areas of temporary inundation are 0-15 inches above permanent pool. Areas of temporary inundation are prevalent around the ponds; however, some of these areas are deficient in vegetation. The greatest deficiency is that the area of shallow water zone, as defined above, is minimal. Filling to create shallow zones is problematic and could create more environmental problems than it would solve. As an alternative, a floating treatment wetland (FTW) is considered. A floating treatment wetland is a manmade system that mimics a natural wetland. FTW's are created using floating rafts that support plants grown hydroponically as shown in Figure A below. These are effective in breaking down pollutants including nutrients, sediment, and metals.

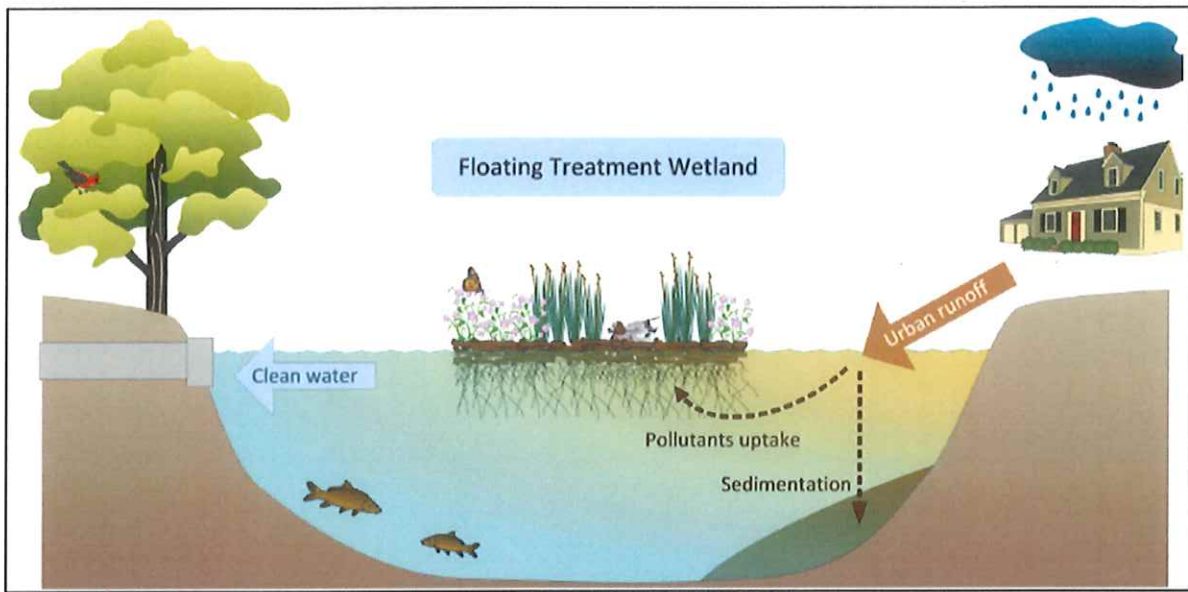


Figure A

7. Cost Estimate

The project costs include planning, design, construction and easement acquisition. We assume that the easement requirements will be minimum. The estimated cost is \$769,327 as itemized in Table A below.

Table A					
Preliminary Cost Estimate					
Raccoon Creek Flood Abatement					
Item	Description	Quantity	Unit	Unit Price	Price
CONSTRUCTION COSTS:					
1	Remove Existing Guard Rail	230	LF	\$ 4.00	\$ 920.00
2	Remove Existing Concrete Curb	700	LF	\$9.00	\$6,300.00
3	Remove Existing Sidewalk	450	LF	\$8.00	\$3,600.00
4	Remove Existing Concrete Pavement	1100	SY	\$16.00	\$17,600.00
5	Remove Existing Asphalt Pavement	1900	SY	\$6.00	\$ 11,400.00
6	Plug and Fill Existing Conc. Pipe	1	LS	\$3,500.00	\$3,500.00
7	New Vinyl Bulkhead	330	LF	\$200.00	\$66,000.00
8	Select Fill	1800	CY	\$16.00	\$28,800.00

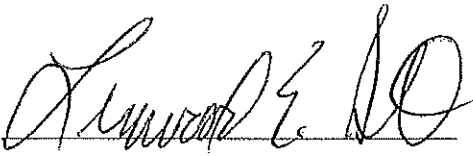
9	6" ABC Stone Base	1600	SY	\$15.00	\$24,000.00
10	Concrete Curb and Gutter	700	LF	\$18.00	\$12,600.00
11	2" Asphalt Pavement	1600	SY	\$12.00	\$19,200.00
12	Concrete Sidewalk	800	LF	\$35.00	\$28,000.00
13	New Guard Rail	330	LF	\$100.00	\$33,000.00
14	15" Concrete Pipe	54	LF	\$40.00	\$2,160.00
15	18" Concrete Pipe	320	LF	\$50.00	\$16,000.00
16	18" Flared End Section	3	Ea	\$1,000.00	\$3,000.00
17	Catch Basin	4	Ea	\$1,600.00	\$6,400.00
18	Yard Inlet	2	Ea	\$1,500.00	\$3,000.00
19	18" Tide Check Valve	1	Ea	\$7,500.00	\$7,500.00
20	Storm water Pump Station; 2-12" Pumps	1	Ea	\$125,000.00	\$125,000.00
21	Electrical Service - 3 phase	2	LS	\$25,000.00	\$50,000.00
22	Vegetated Swale	100	LF	\$10.00	\$1,000.00
23	Floating Wetland Budget	5,000	SF	\$12.00	\$60,000.00
24	Erosion and Sedimentation Control	1	LS	\$10,000.00	\$10,000.00
Construction Sub-total					\$538,980.00
TECHNICAL SERVICES:					
25	Engineering Planning and Design				\$50,000.00
26	Surveying				\$5,000.00
27	Testing				\$5,000.00
28	Construction Administration and Inspection				\$50,000.00
Technical Services Sub-total					\$110,000.00
Easement Acquisition					\$20,000.00
Project Subtotal					\$668,980.00
Contingency			15%		\$100,347.00
PROJECT TOTAL					\$769,327.00

8. Funding Sources

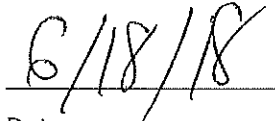
Possible funding sources are listed in The Town of Oriental, Resilience Evaluation and Needs Assessment Final Report date April 2018, pages 16-19 attached hereto. (Exhibit E)

9. Conclusions and Recommendations

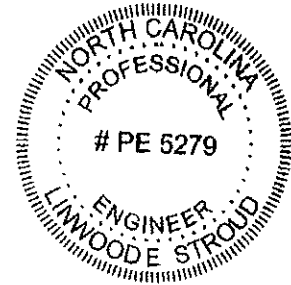
The nuisance flooding of the properties surrounding the Duck Ponds can be significantly reduced by reconstruction of Hodges Street at a higher elevation of approximately 3 ft. which is about 2.2 ft. higher than the current elevation. The construction would also require the installation of a tideflex check valve on the outlet of the culvert at Raccoon Creek crossing and the construction of a pumping station for discharge of storm water runoff during periods of high wind tides coupled with significant rainfall events. Water quality can also be enhanced by installation of a floating wetland. Total estimated project cost is \$769,327. The Town should seek grant funding for this project.



Linwood E. Stroud



Date

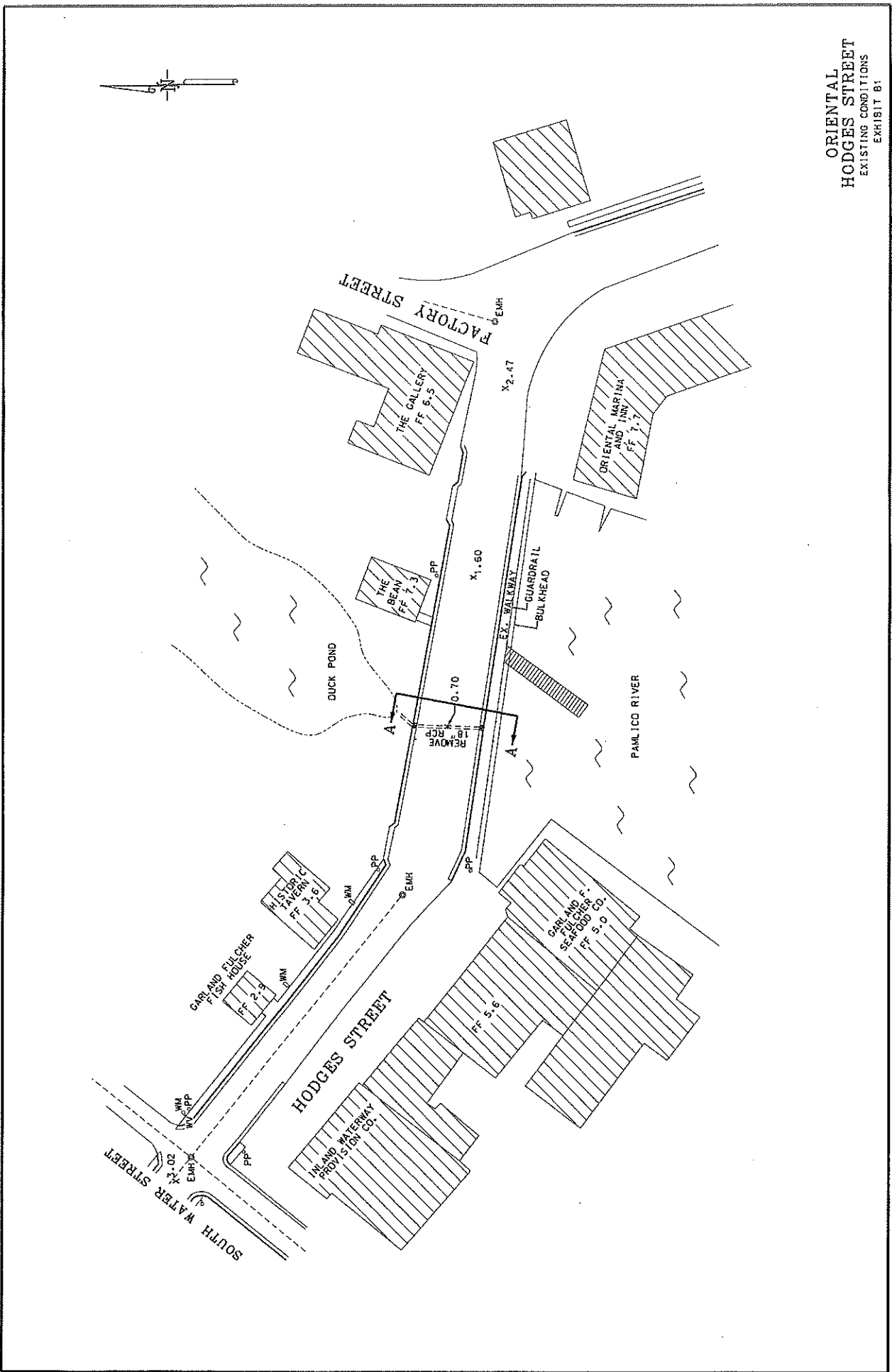
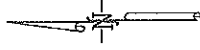


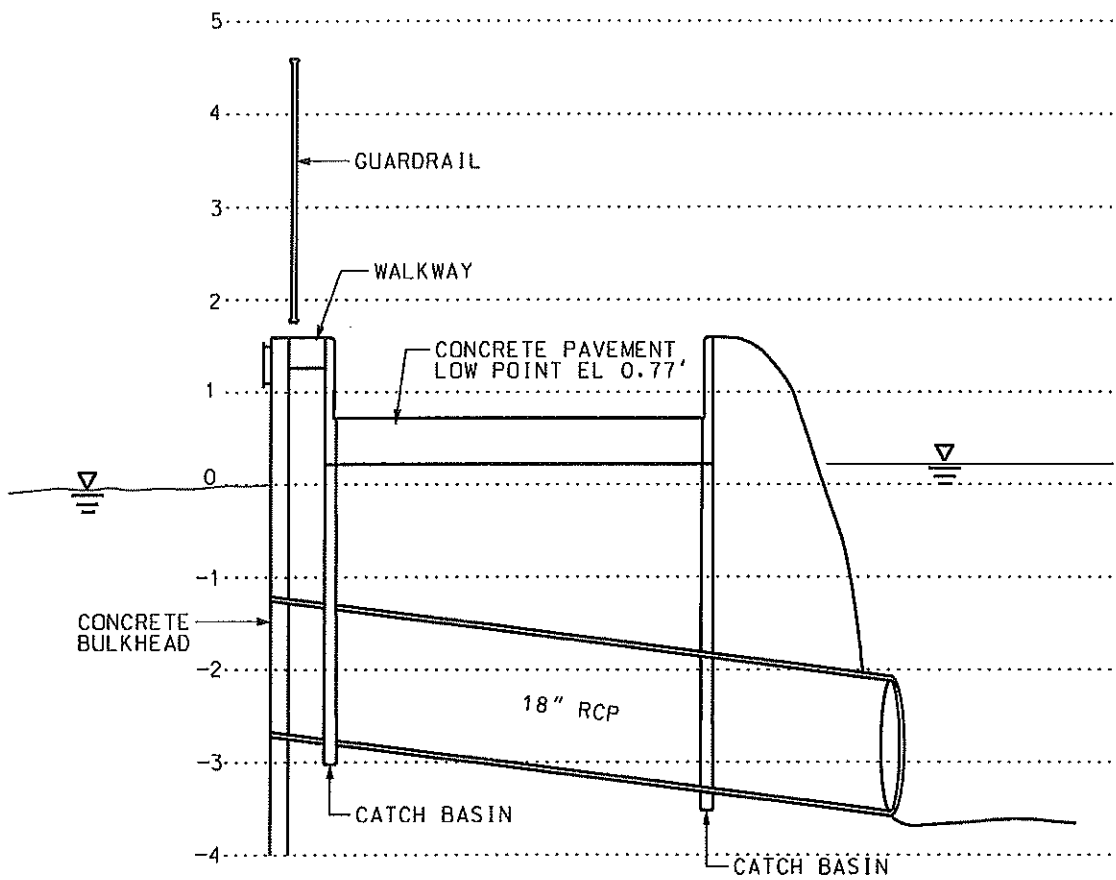


— PROJECT AREA

PROJECT AREA MAP
RACON CREEK
FLOOD ABATEMENT
SCALE: 1"=300'
EXHIBIT A

ORIENTAL
HODGES STREET
EXISTING CONDITIONS
EXHIBIT B1

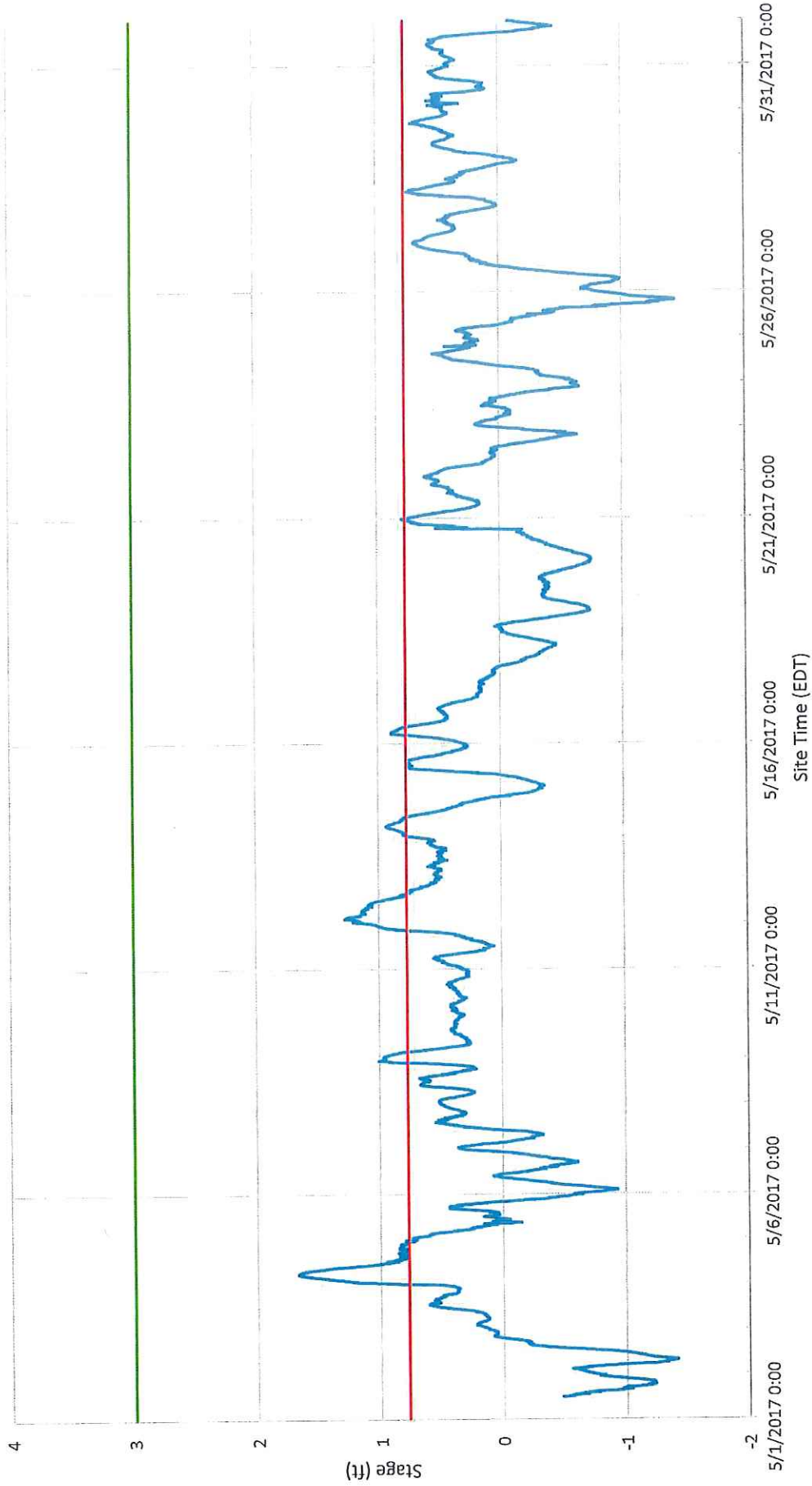




SECTION A-A

**HODGES STREET
 @ RACCOON CREEK
 EXISTING SECTION
 EXHIBIT B2**

Oriental, NC
Neuse River Water Levels
May 2017



Oriental, NC
Neuse River Water Levels
June 2017

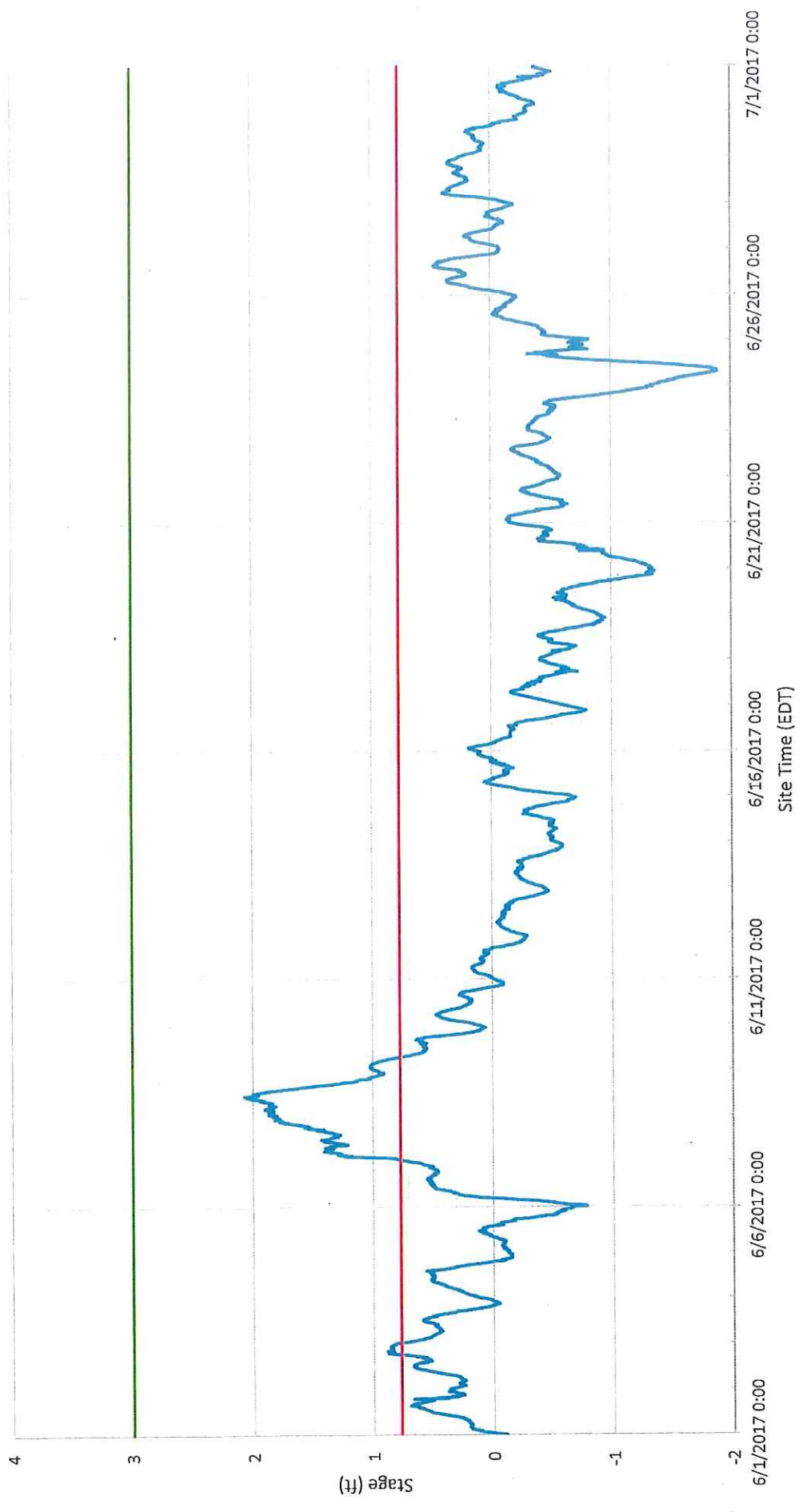


Exhibit C2

Oriental, NC
Neuse River Water Levels
July 2017

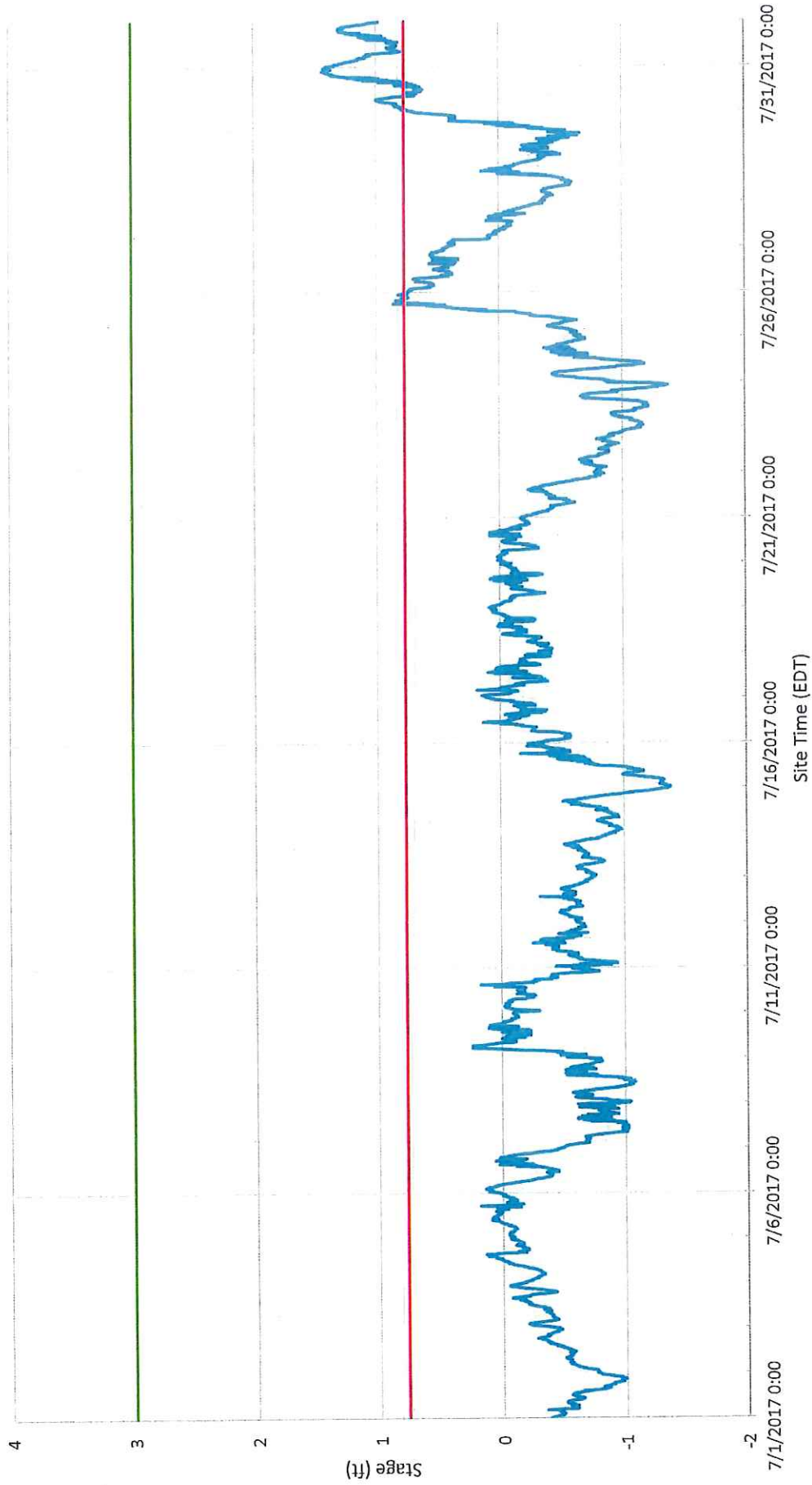
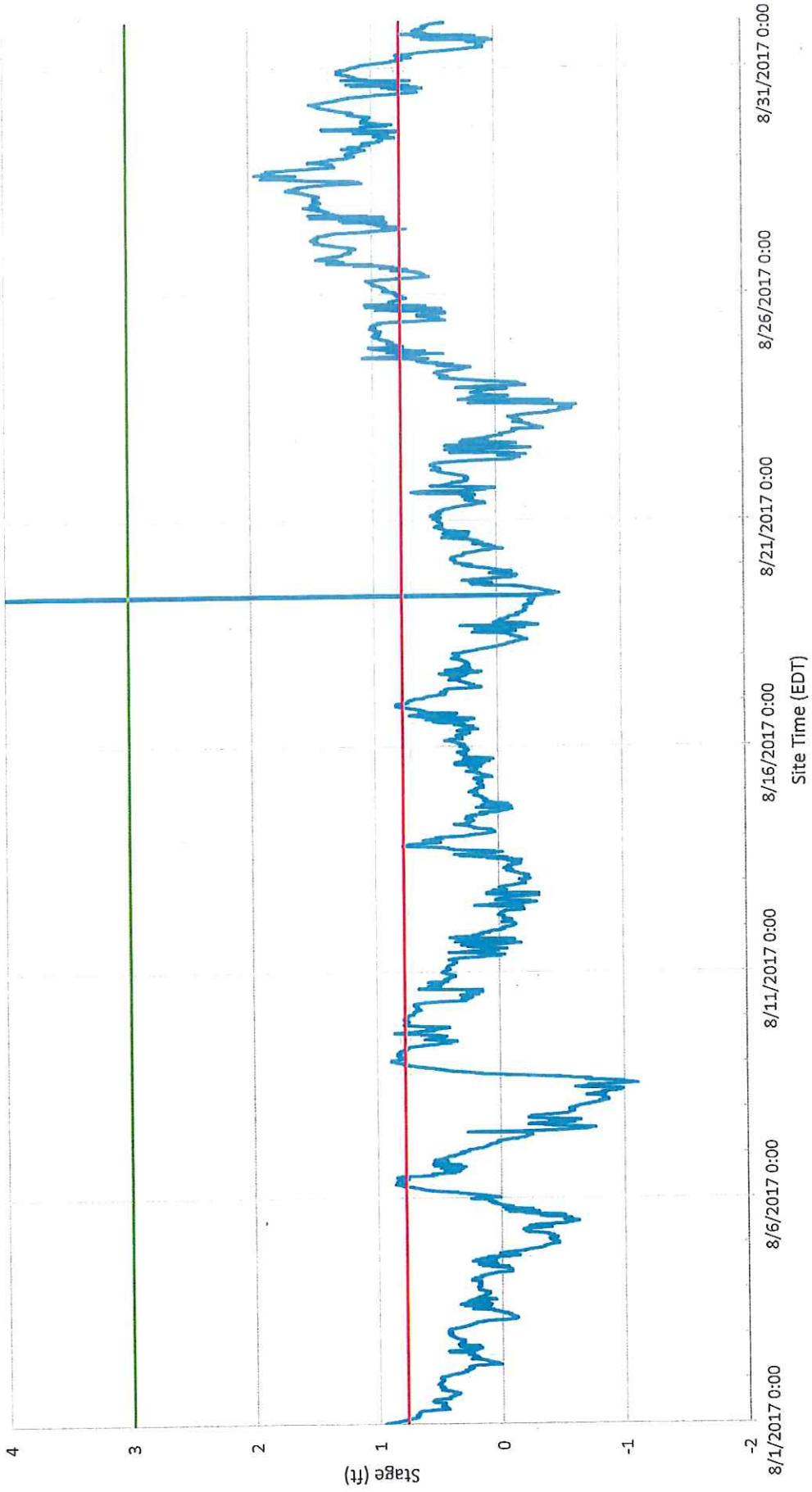


Exhibit C3

Oriental, NC
Neuse River Water Levels
August 2017



Oriental, NC
Neuse River Water Levels
September 2017

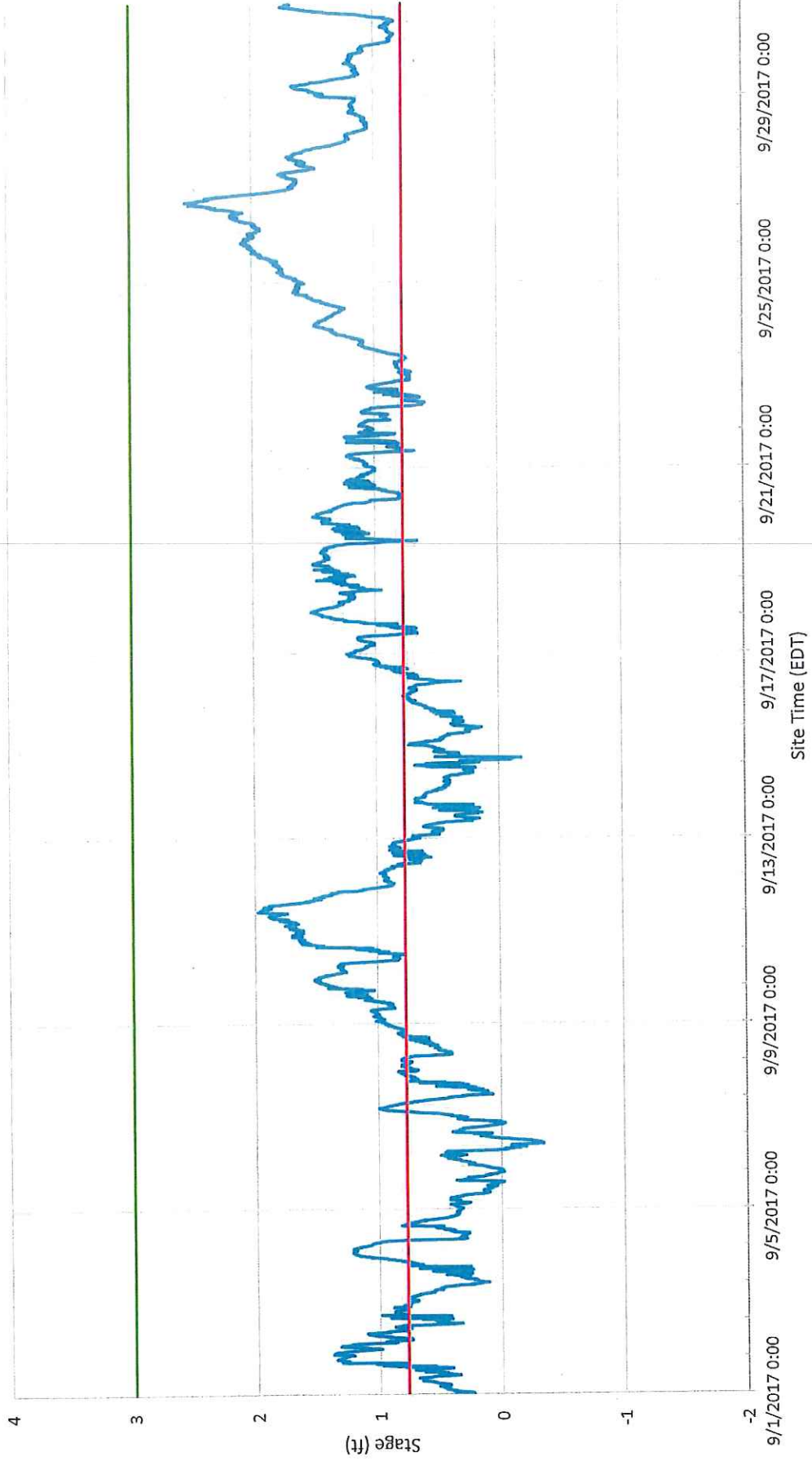
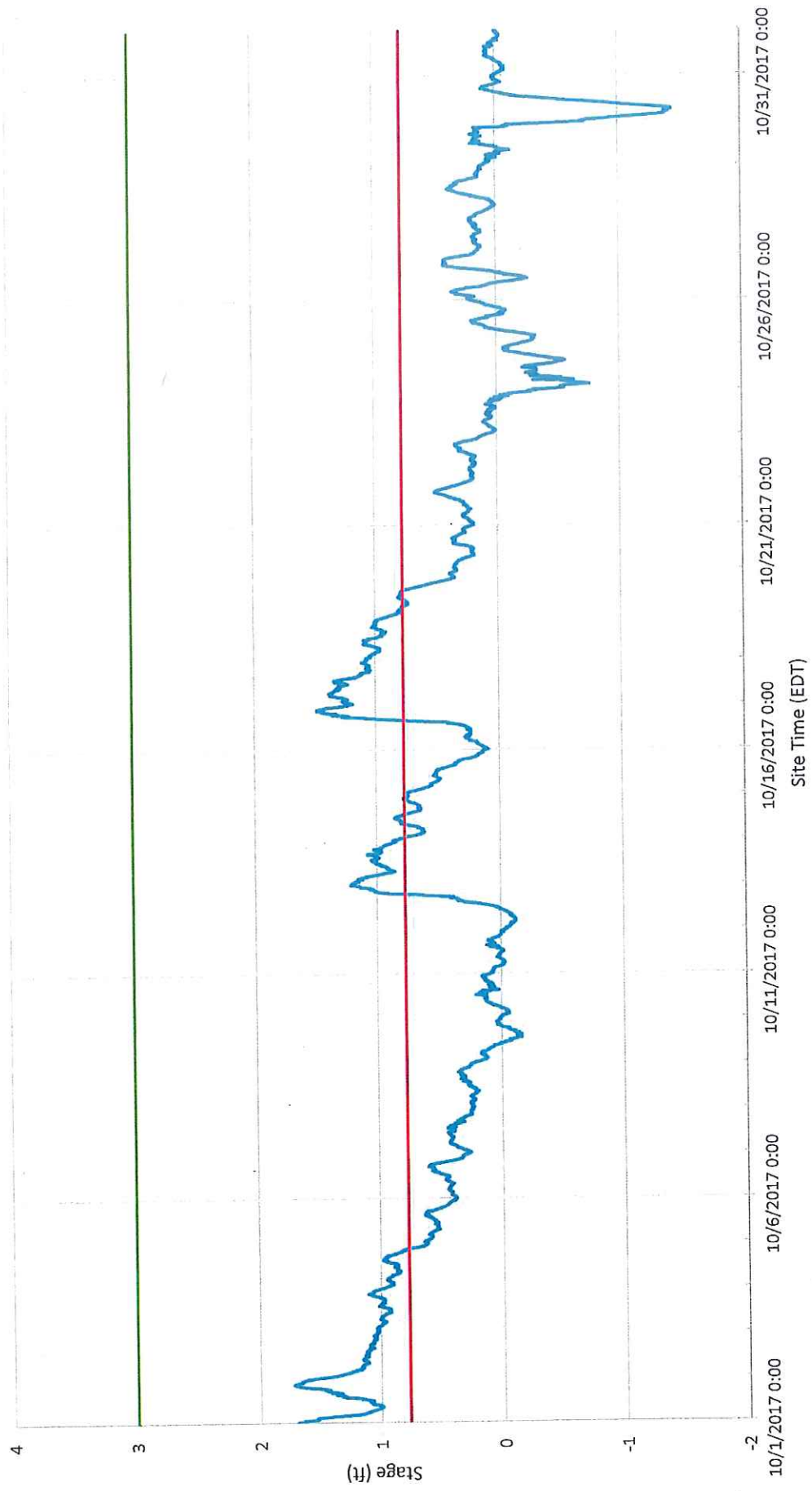
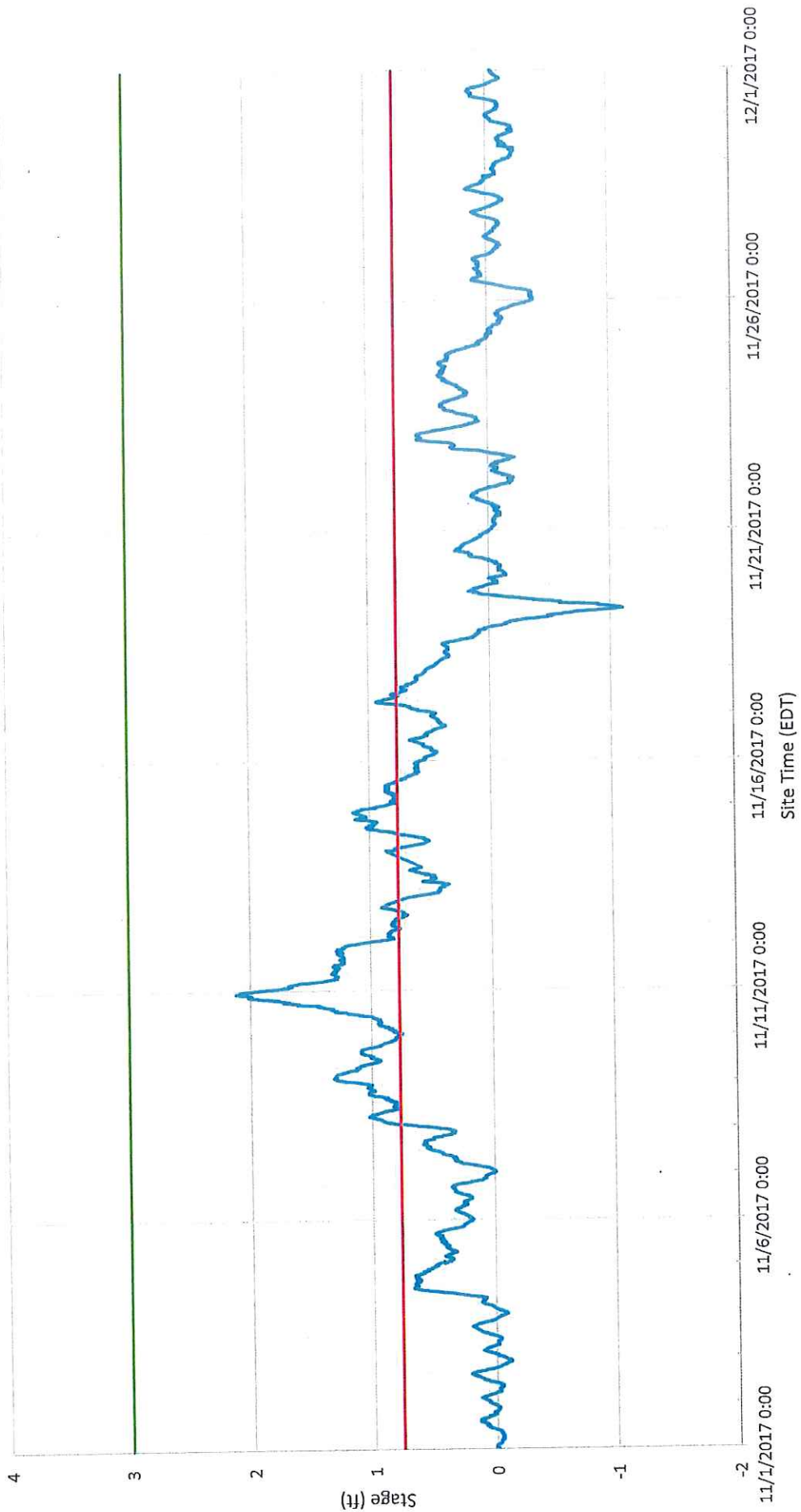


Exhibit C5

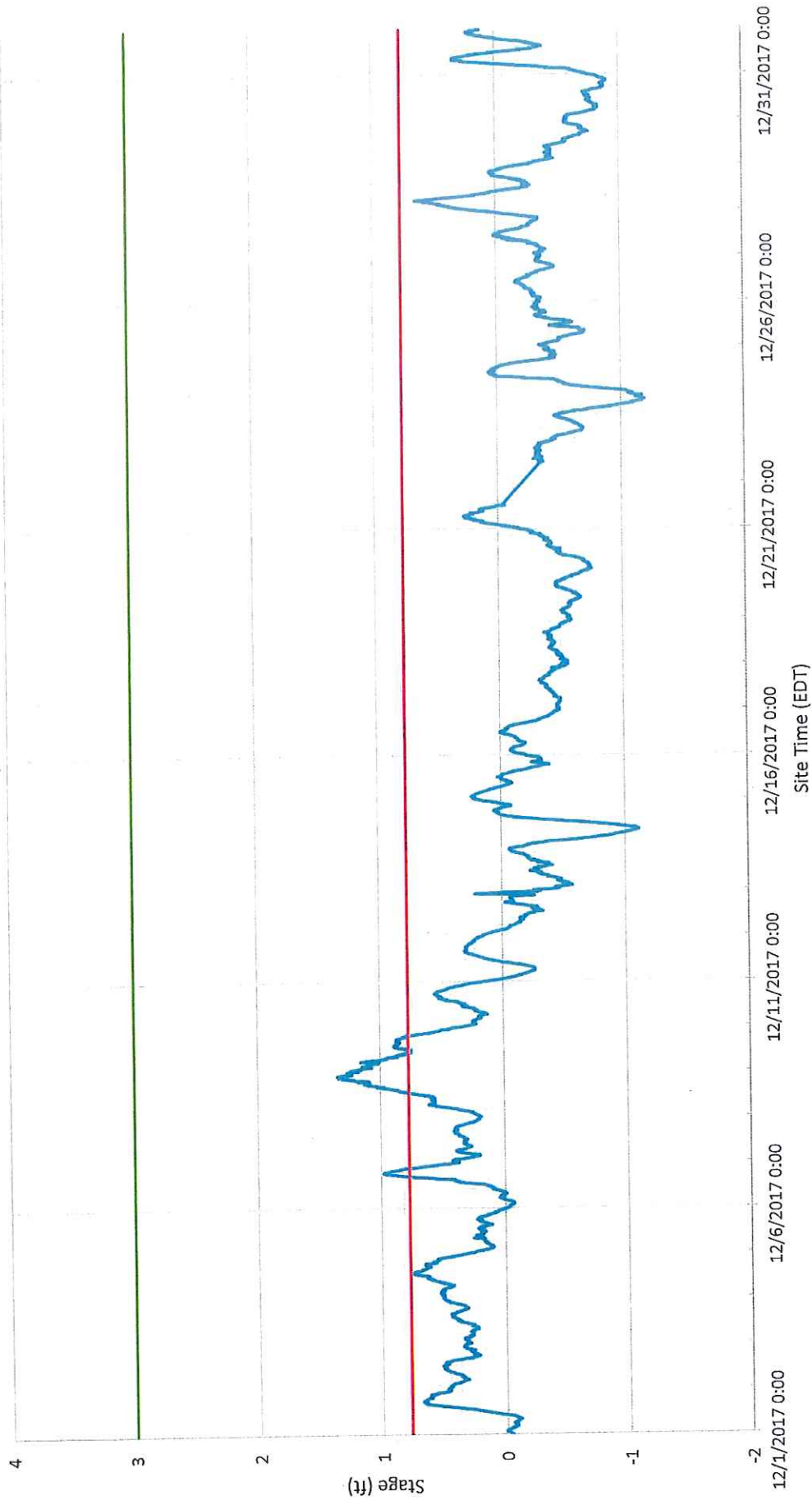
Oriental, NC
Neuse River Water Levels
October 2017



Oriental, NC
Neuse River Water Levels
November 2017



Oriental, NC
Neuse River Water Levels
December 2017



Oriental, NC
Neuse River Water Levels
January 2018

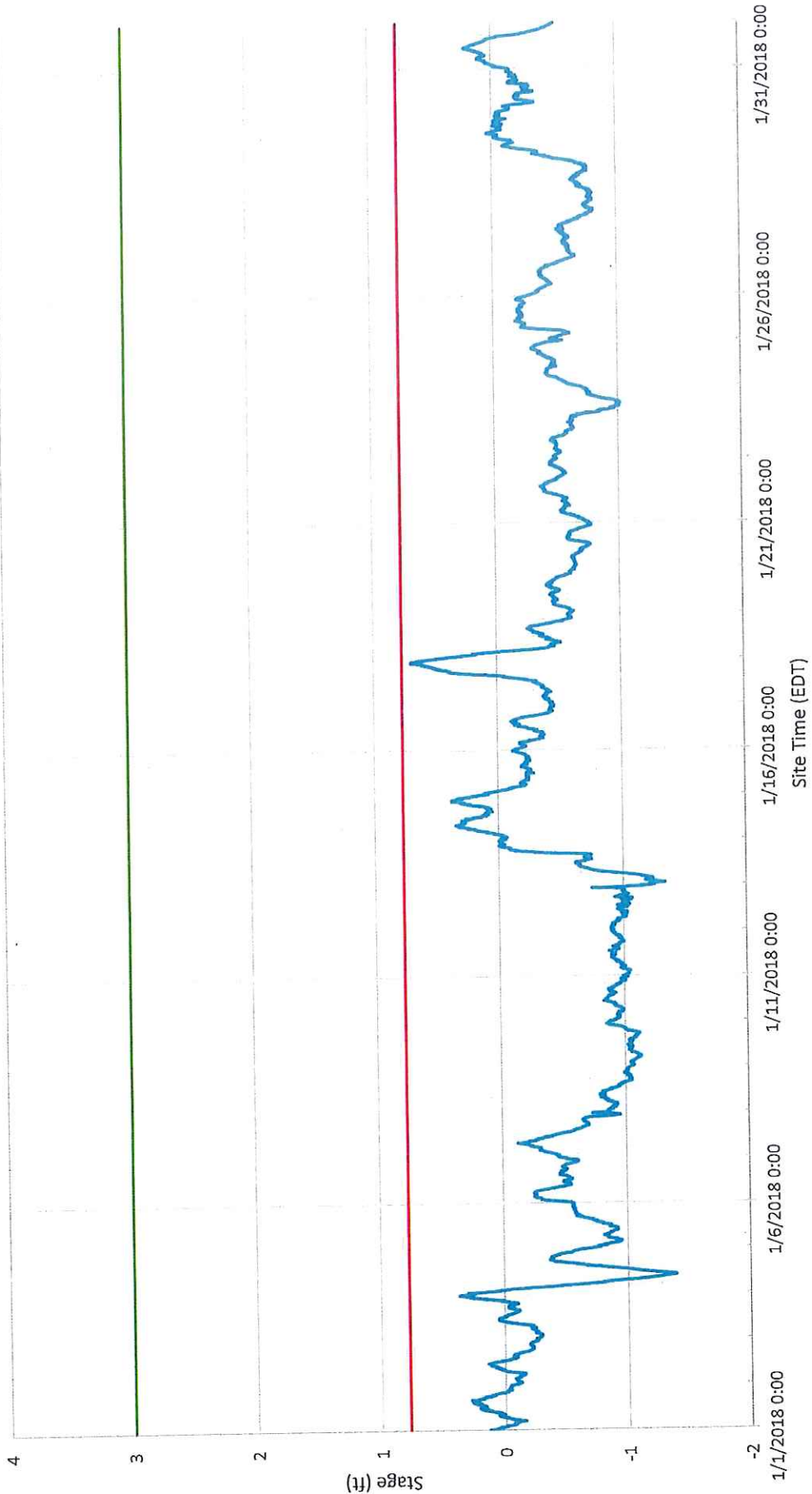


Exhibit C9

Oriental, NC
Neuse River Water Levels
February 2018

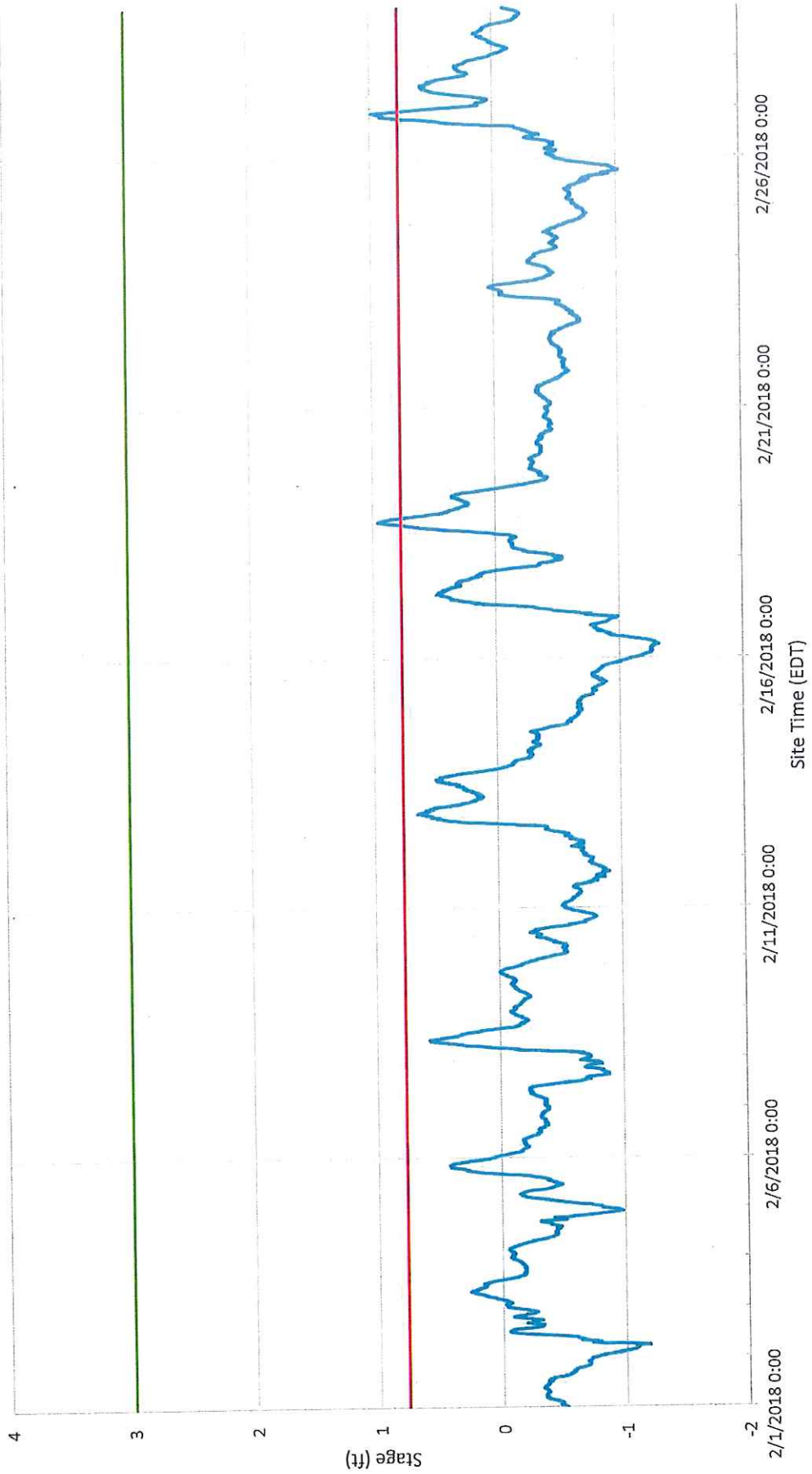
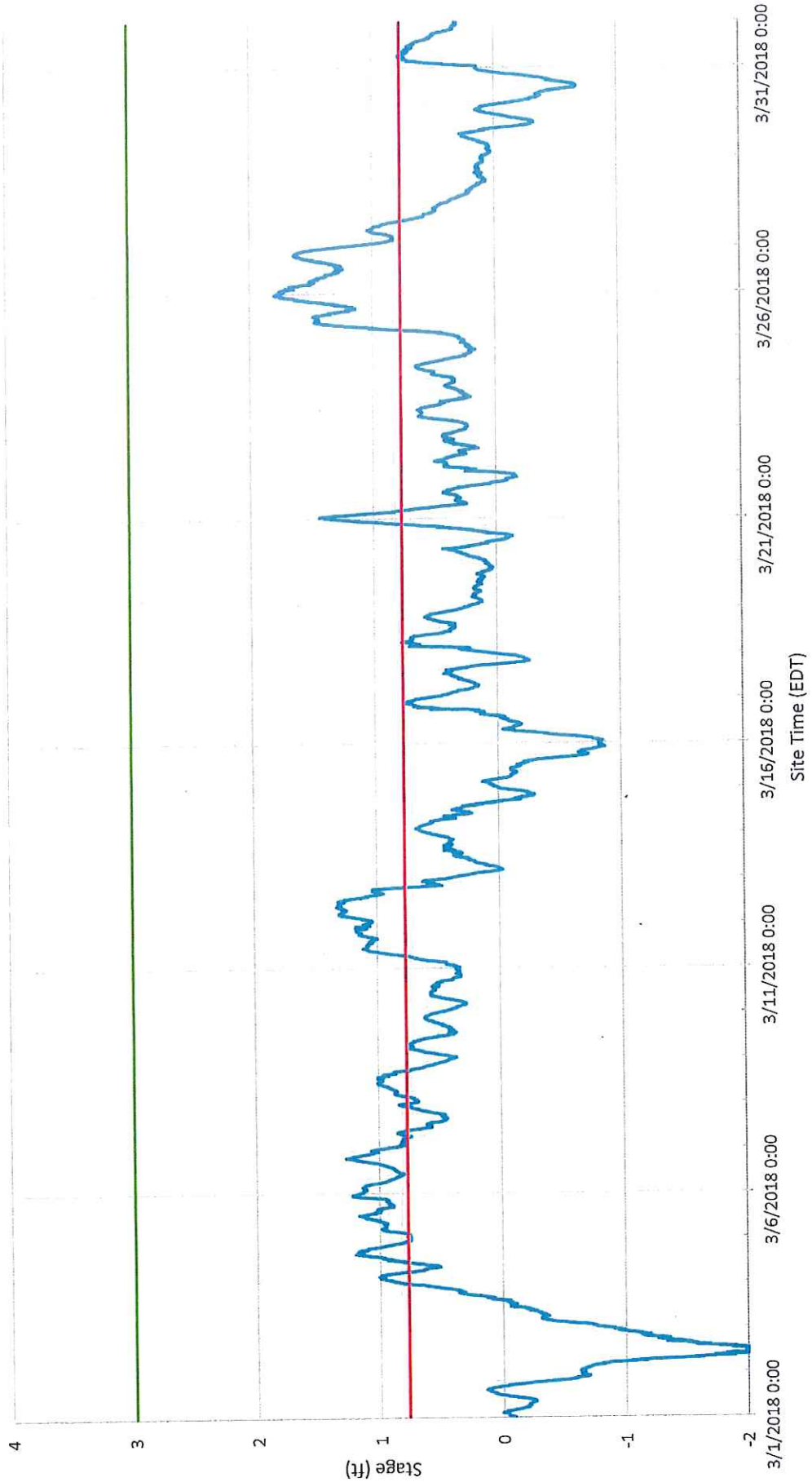
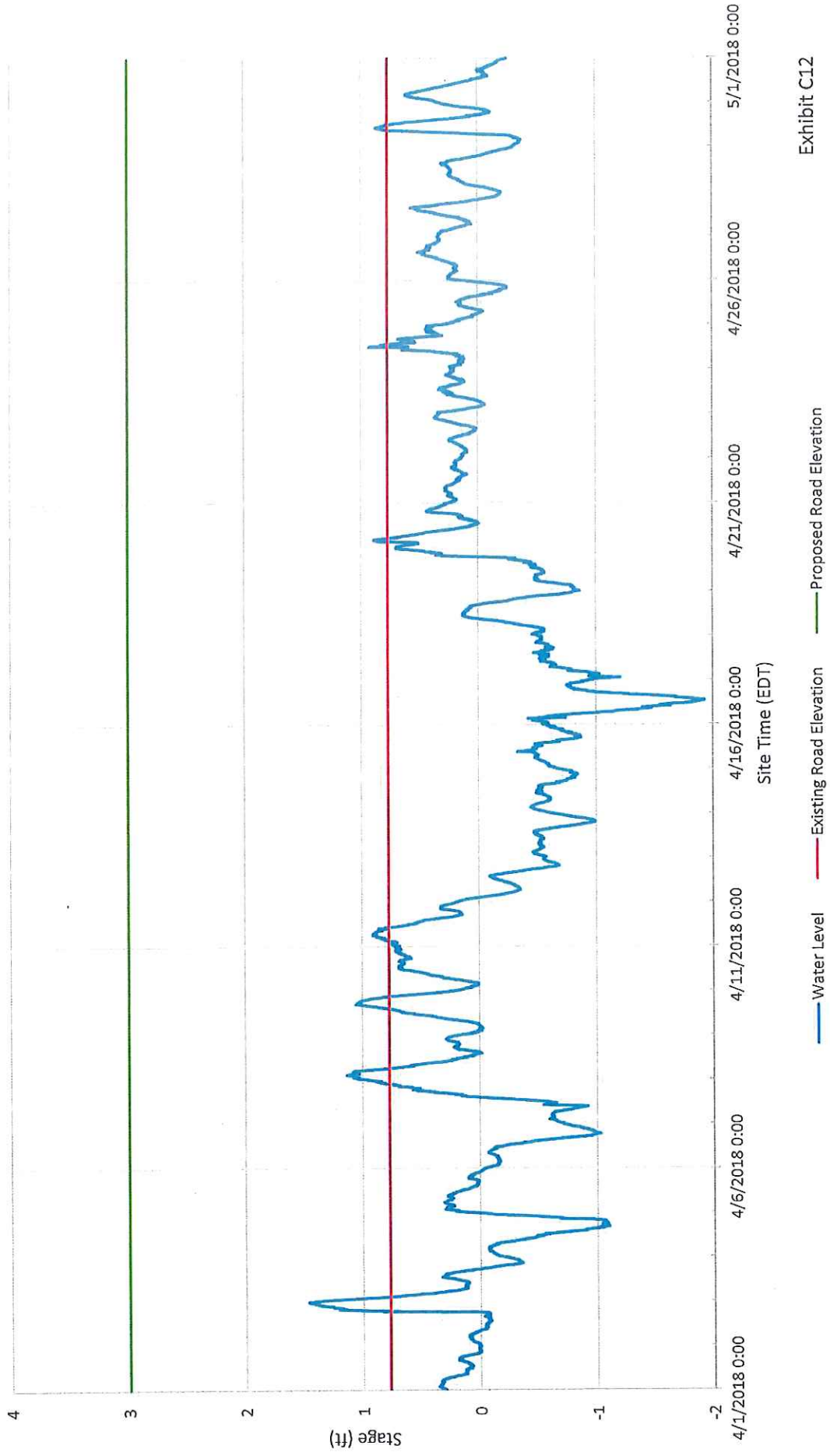


Exhibit C10

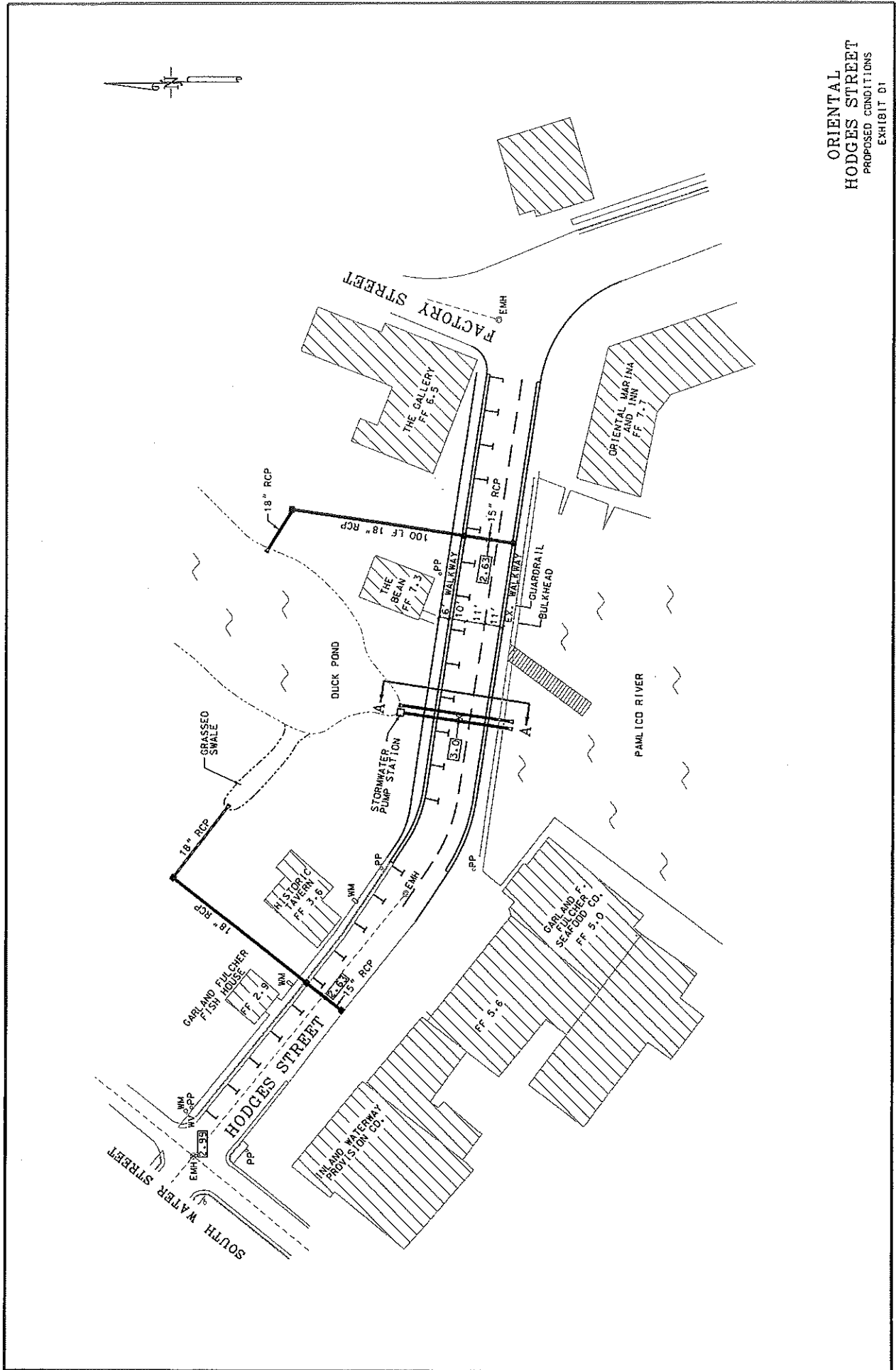
Oriental, NC
Neuse River Water Levels
March 2018

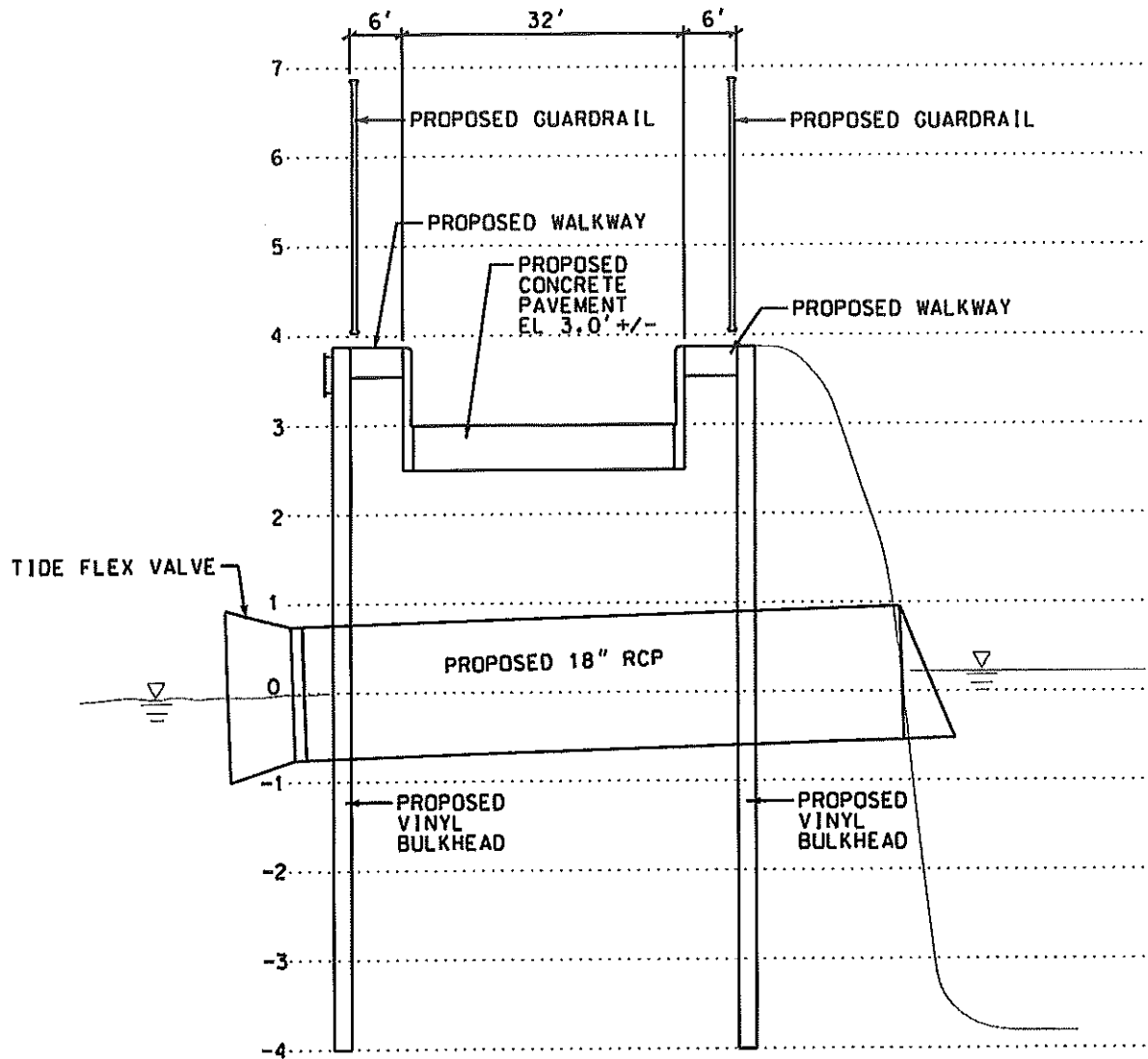


Oriental, NC
Neuse River Water Levels
April 2018



ORIENTAL
HODGES STREET
PROPOSED CONDITIONS
EXHIBIT 01





SECTION A-A

**HODGES STREET
 @ RACCOON CREEK
 PROPOSED SECTION
 EXHIBIT 02**

Funding Resources

The following short-list compiles information on local and national grant programs, information on nonprofits and agencies focused on funding resiliency-related projects, and existing lists of funding sources from other organizations. This list is not comprehensive.

Grants

1. **State Grant Program - North Carolina's Department of Environmental Quality, Division of Coastal Management (DEQ-DCM) Planning and Management Grants**
 - a. Funding frequency: Periodic; As funding allows
 - b. Description: DEQ-DCM's Planning and Management grants help local governments in the 20 coastal counties fund local planning and management projects. Funding is prioritized by issue. During the 2017-2018 cycle, Natural Hazards and Storm Recovery projects were encouraged.
 - c. For more information: <https://deq.nc.gov/about/divisions/coastal-management/coastal-management-land-use-planning/grants>

2. **State Grant Program: Clean Water Management Trust Fund (CWMTF)**
 - a. Funding frequency: Annually
 - b. Description: The CWMTF grants are available to non-profit and governmental organizations to protect land for natural, historical and cultural benefit, limit encroachment on military installations, restore degraded streams, and develop and improve stormwater treatment technology.
 - c. For more information: <https://cwmtf.nc.gov/>

3. **State Grant Program: Water Resources Development Grant Program**
 - a. Funding frequency: Bi-annually
 - b. Description: The purpose of this program is to provide cost-share grants and technical assistance to local governments throughout the state. Applications for grants are accepted for seven purposes: General Navigation, Recreational Navigation, Water Management, Stream Restoration, Land Acquisition and Facility Development for Water-Based Recreation, NRCS Environmental Quality Incentives Program (EQIP) stream restoration projects and Feasibility/Engineering Studies.
 - c. For more information: <http://deq.nc.gov/about/divisions/water-resources/water-resources-grants/financial-assistance>

4. **Federal Grants: U.S. Climate Resilience Toolkit List**
 - a. Funding frequency: Dependent on grant
 - b. Description: The U.S. Climate Resilience Toolkit is a website designed to help people find and use tools, information, and subject matter expertise to build climate

resilience. The Toolkit offers information from all across the U.S. federal government in one easy-to-use location. In the United States, a range of government entities and private foundations offer financial and technical resources to advance local adaptation and mitigation efforts. For convenience, the Toolkit has compiled a list of some of those funding resources.

- c. For more information: <https://toolkit.climate.gov/content/funding-opportunities>

5. Federal Grants: Resilience AmeriCorps VISTAs Funding List

- a. Funding frequency: Dependent on grant
- b. Description: Resilience AmeriCorps VISTA builds capacity in vulnerable, low-income communities to develop plans and implement projects that increase the community's resilience to shocks and stressors. The document was created for Resilience AmeriCorps VISTA members and lists a variety of grants for resilience-building.
- c. For more information: <http://www.regions.noaa.gov/secar/wp-content/uploads/2013/06/Federal-Funding-for-Resilience-Projects.pdf> [PDF Download]

6. Federal Grants: National Oceanic and Atmospheric Administration (NOAA), Office of Coastal Management (OCM)

- a. Funding frequency: Dependent on grant
- b. Description: NOAA is an agency that enriches life through science. Our reach goes from the surface of the sun to the depths of the ocean floor as we work to keep citizens informed of the changing environment around them. NOAA's OCM manages a competitive grant program that funds projects that are helping coastal communities and ecosystems prepare for and recover from extreme weather events, climate hazards, and changing ocean conditions. All project proposals undergo a rigorous merit review and selection process by a panel of subject matter experts from across the United States that include representatives of government, academia, and private industry.
- c. For more Information: <https://coast.noaa.gov/resilience-grant/>

7. National Non-Profit Grants: The Kresge Foundation

- a. Funding frequency: Dependent on grant
- b. Description: The Kresge Foundation is a \$3.6 billion private, national foundation that works to expand opportunities in America's cities through grant-making and social investing in arts and culture, education, environment, health, human services and community development.
- c. For more information: <https://kresge.org/opportunities>

8. National Non-Profit Grants: Model Forest Policy Program (MFPP)

- a. Funding frequency: Dependent on grant
- b. Description: The Model Forest Policy Program is a national nonprofit that builds the capacity of communities to be climate resilient by sustaining water resources, productive forests, citizens' wellbeing, and thriving economies. Our team compiled a Climate Resilience Funding Guide to help communities identify financial support for climate adaptation projects. MFPP's will help communities learn about established funding programs that have evolved to provide funding for climate adaptation activities, and to match those funding sources with local adaptation goals.
- c. For more information: <http://www.mfpp.org/climate-resilience-funding-guide/>
[Guide available to download for free]

Organizations

9. Local Non-Profit Organization: Coastal Federation

- a. Description: The North Carolina Coastal Federation is a member-supported 501(c)3 that focuses on protecting and restoring the North Carolina coast. Since 1982, the federation has been in the field restoring miles of coastline; training and educating students, adults and communities to take actions that result in cleaner coastal waters and advocating for an accessible, healthy, productive coast. The Coastal Federation has worked in communities across North Carolina to assist with grant-writing and to implement on-the-ground projects.
- b. For more information: <https://www.nccoast.org/about-us/>

10. Local Non-Profit Organization: North Carolina Land of Water (NC LOW)

- a. Description: NC LOW is a 501(c)3 non-profit formed around 2016 that may be able to assist with identifying funding sources for local projects in North Carolina. Counties included in NC LOW's region include CAMA counties covered in NC LOW's region include: Bertie, Beaufort, Camden, Carteret, Chowan, Craven, Currituck, Dare, Gates, Hertford, Hyde, Pamlico, Pasquotank, Perquimans, Tyrrell, and Washington.
- b. For more information: <http://www.nclandofwater.org/>

11. National Non-Profit Organization (local chapter): The Nature Conservancy, North Carolina

- a. Description: The mission of The Nature Conservancy is to conserve the lands and waters on which all life depends. For 41 years, TNC has been working in North Carolina. Staff in Kill Devil Hills, North Carolina, worked extensively with the CMF to host asset maps created by DCM and local governments. TNC has tools, resources, and staff expertise to assist communities to build resilience.

b. For more information:

<https://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/northcarolina/index.htm>