APPENDIX L:
Annex 3
Sensitivity Analysis

water resources / environmental consultants

ATCHAFALAYA FRESHWATER CONVEYANCE PROJECT HYDROLOGIC MODELING REPORT SENSITIVITY ANALYSIS

MAY 12, 2010

ATCHAFALAYA FRESHWATER CONVEYANCE PROJECT
HYDROLOGIC MODELING REPORT
SENSITIVITY ANALYSIS

Prepared for

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1.0 INTRODUCTION

The St. Louis District of the US Army Corps of Engineers (USACE) contracted with FTN Associates, Ltd. (FTN) (Contract No. W912P8-07-D-0060) to develop and calibrate a hydrodynamic model for the Atchafalaya Freshwater Conveyance Project for use in the selection of preferred project construction features to distribute existing Atchafalaya River freshwater flows into deteriorating portions of the Penchant and northern Terrebonne basins. The results of that study were documented in FTN's report to USACE entitled *Atchafalaya Freshwater Conveyance Project Hydrologic Modeling Report*, dated February 8, 2010. The St. Louis District modified FTN's contract to perform a sensitivity analysis on the calibrated model to analyze ranges of input coefficients in the calibrated RMA-2 and RMA-11 models. The three input coefficients investigated in the sensitivity analysis were Manning's *n* values, eddy coefficients, and diffusion coefficients. This report documents the methodology and findings of the sensitivity analysis. This report is intended as a supplement to the original report and does not repeat all of the pertinent information in the original report.

2.0 SENSITIVITY ANALYSIS SETUP

The St. Louis District provided a revised version of the model geometry FTN developed for the original project. This revised model geometry was used for all of the sensitivity analysis runs. The St. Louis District also provided hotstart files and model input files for both RMA-2 and RMA-11 that were used as the base conditions for the sensitivity analysis. The same time period (October through November of 2004) and boundary conditions were used for the base model simulations and the sensitivity analysis simulations.

The basic concept of the sensitivity analysis was to execute RMA-2 and RMA-11 model simulations using the base parameters provided by the St. Louis District, then change the input coefficients and perform additional simulations for comparison with the results of the base simulations. Each parameter of interest was varied with "high" and "low" values representing a reasonable range for the parameter. RMA-2 simulations were performed with high and low values for Manning's *n* and eddy coefficients. RMA-11 simulations using these RMA-2 results were executed using the base diffusion coefficients. Thus, any differences in RMA-11 results for the Manning's *n* and eddy coefficient sensitivity analysis would be due to differences in the depth and velocity fields computed by RMA-2. Similarly, the base conditions RMA-2 results were used to drive the RMA-11 simulations in the diffusion coefficient sensitivity analysis. Any differences in the RMA-11 results for the diffusion coefficient sensitivity analysis would be solely due to the effect of the diffusion coefficients.

2.1 Manning's *n* Values

A range of Manning's *n* values were used for different material types in the base model. The Manning's *n* values were used as a calibration parameter in the original model simulations, so the base conditions Manning's *n* values reflect the results of the calibration process. For the sensitivity analysis, the base Manning's *n* values were reduced by 25% for the "low" parameter values, and increased by 25% for the "high" parameter values. There was one exception to this model setup – the low Manning's *n* RMA-2 simulation crashed during week 1 at a weir connection to Grand Bayou, which is material type 86. The base Manning's *n* value for material type 86 was 0.045. The 25% reduction resulted in a Manning's *n* value of 0.034. To prevent RMA-2 instability, the low Manning's *n* value for material type 86 was increased to 0.040, representing an 11% reduction of the base value. The low Manning's *n* RMA-2 simulation was executed with this revised value with no further problems. Table 1 shows the base, low, and high values for Manning's *n* by material type.

2.2 Eddy Coefficients

According to *Users Guide to RMA2 WES Version 4.5*, turbulence exchange is fluid momentum transfer associated with the chaotic motion of fluid particles, and can be viewed as the temporal effects occurring at time scales smaller than the model time step. In RMA-2, eddy (turbulence exchange) coefficients are specified as eddy viscosities associated with all four combinations of direction and velocity components. The u-velocity is in the x-direction, and the v-velocity is in the y-direction. Thus, the four eddy coefficients are of the form E_{ij}, where i = direction and j = velocity component. The four eddy coefficients are E_{xu}, E_{yu}, E_{xv}, and E_{yv}. The eddy coefficients theoretically represent both molecular viscosity and the effects of turbulence from Reynold's stress; however, the Reynold's stress terms are orders of magnitude larger than the effects of molecular viscosity, so the molecular viscosity is ignored.

In RMA-2, there are two options available for specifying the eddy coefficients. The first option is the direct specification of the numerical eddy coefficients. The second option is the specification of a scale factor applied to a representative length of the element in the coordinate direction. As element sizes increase, the eddy coefficient should increase. Therefore, for eddy coefficients in the x-direction (E_{xu} and E_{xv}), the program calculates a representative length of the element in the x-direction and multiplies the representative length by the specified scale factor to compute the eddy coefficient for that element. The program does the same thing for eddy coefficients in the y-direction (E_{yu} and E_{yv}).

Table 1. Base, low, and high values for Manning's *n* by material type.

Material Type	Manning's n			Material Type	Manning's n		
	Base	Low	High		Base	Low	High
1	0.020	0.015	0.025	66	0.025	0.019	0.031
2	0.020	0.015	0.025	67	0.025	0.019	0.031
3	0.020	0.015	0.025	68	0.040	0.030	0.050
4	0.020	0.015	0.025	69	0.040	0.030	0.050
5	0.020	0.015	0.025	70	0.030	0.023	0.038
6	0.020	0.015	0.025	71	0.025	0.019	0.031
7	0.020	0.015	0.025	72	0.030	0.023	0.038
8	0.025	0.019	0.031	73	0.045	0.034	0.056
9	0.020	0.015	0.025	74	0.045	0.034	0.056
10	0.020	0.015	0.025	75	0.040	0.030	0.050
11	0.020	0.015	0.025	76	0.040	0.030	0.050
12	0.025	0.019	0.031	77	0.040	0.030	0.050
13	0.045	0.034	0.056	78	0.030	0.023	0.038
14	0.020	0.015	0.025	79	0.030	0.023	0.038
15	0.020	0.015	0.025	80	0.040	0.030	0.050
16	0.020	0.015	0.025	81	0.030	0.023	0.038
17	0.020	0.015	0.025	82	0.030	0.023	0.038
18	0.020	0.015	0.025	83	0.045	0.034	0.056
19	0.020	0.015	0.025	84	0.025	0.019	0.031
20	0.020	0.015	0.025	85	0.045	0.034	0.056
21	0.020	0.015	0.025	86	0.045	0.040	0.056
22	0.020	0.015	0.025	87	0.045	0.034	0.056
23	0.020	0.015	0.025	88	0.045	0.034	0.056
24	0.020	0.015	0.025	89	0.035	0.026	0.044
25	0.045	0.034	0.056	90	0.035	0.026	0.044
26	0.020	0.015	0.025	91	0.040	0.030	0.050
27	0.020	0.015	0.025	92	0.030	0.023	0.038
28	0.020	0.015	0.025	93	0.020	0.015	0.025
29	0.025	0.019	0.031	94	0.020	0.015	0.025
30	0.025	0.019	0.031	95	0.020	0.015	0.025
31	0.025	0.019	0.031	96	0.020	0.015	0.025
32	0.025	0.019	0.031	97	0.020	0.015	0.025
33	0.025	0.019	0.031	98	0.020	0.015	0.025
34	0.025	0.019	0.031	99	0.020	0.015	0.025
35	0.025	0.019	0.031	100	0.020	0.015	0.025
36	0.025	0.019	0.031	101	0.020	0.015	0.025
37	0.025	0.019	0.031	102	0.020	0.015	0.025
38	0.025	0.019	0.031	103	0.020	0.015	0.025

Table 1. Base, low, and high values for Manning’s *n* by material type (continued).

Material Type	Manning's n			Material Type	Manning's n		
	Base	Low	High		Base	Low	High
39	0.025	0.019	0.031	104	0.020	0.015	0.025
40	0.025	0.019	0.031	105	0.020	0.015	0.025
41	0.025	0.019	0.031	106	0.020	0.015	0.025
42	0.025	0.019	0.031	107	0.020	0.015	0.025
43	0.025	0.019	0.031	108	0.020	0.015	0.025
44	0.025	0.019	0.031	109	0.020	0.015	0.025
45	0.025	0.019	0.031	110	0.045	0.034	0.056
46	0.025	0.019	0.031	111	0.045	0.034	0.056
47	0.025	0.019	0.031	112	0.030	0.023	0.038
48	0.025	0.019	0.031	113	0.045	0.034	0.056
49	0.025	0.019	0.031	114	0.025	0.019	0.031
50	0.025	0.019	0.031	115	0.045	0.034	0.056
51	0.025	0.019	0.031	116	0.045	0.034	0.056
52	0.025	0.019	0.031	117	0.025	0.019	0.031
53	0.025	0.019	0.031	118	0.045	0.034	0.056
54	0.025	0.019	0.031	119	0.045	0.034	0.056
55	0.025	0.019	0.031	120	0.045	0.034	0.056
56	0.025	0.019	0.031	121	0.045	0.034	0.056
57	0.025	0.019	0.031	122	0.045	0.034	0.056
58	0.025	0.019	0.031	123	0.045	0.034	0.056
59	0.025	0.019	0.031	124	0.045	0.034	0.056
60	0.025	0.019	0.031	125	0.045	0.034	0.056
61	0.025	0.019	0.031	126	0.045	0.034	0.056
62	0.025	0.019	0.031	127	0.045	0.034	0.056
63	0.025	0.019	0.031	128	0.045	0.034	0.056
64	0.025	0.019	0.031	129	0.045	0.034	0.056
65	0.025	0.019	0.031	130	0.045	0.034	0.056

For the base model, eddy coefficients for one-dimensional (1-D) elements were specified as direct numerical values. For the sensitivity analysis, the 1-D eddy coefficients were reduced by 50% for the “low” values and increased by 100% for the “high” values. For 2-D elements, scale factors were specified in the base model. The base eddy scale factors were 0.2 for E_{xu} and 1.0 for E_{yv}, E_{xv}, and E_{yv}. For the “high” eddy scale factors, all scale factors were set equal to 1.0. This value was chosen because it is not reasonable to use a scale factor larger than the representative length of the element. For the “low” eddy scale factors, the base scale factors were initially reduced by 50%. This resulted in an unstable model that was unable to run the simulations. After considerable trial and error, the “low” eddy scale factors were set at 0.15 for E_{xu} and 0.5 for E_{yu}, E_{xv}, and E_{yv}. The only exception was that material type 113 had to be set to the original eddy scale factors to prevent model instability. Table 2 shows the base, low, and high values for eddy coefficients and scale factors by material type. Negative values in Table 2 indicate scale factors, as entered on the RMA-2 ED card.

Table 2. Base, low, and high values for eddy coefficients and scale factors by material type.

Material Type	Base				Low				High			
	E_{xu}	E_{yu}	E_{xv}	E_{yv}	E_{xu}	E_{yu}	E_{xv}	E_{yv}	E_{xu}	E_{yu}	E_{xv}	E_{yv}
1 – 67, 130	20	20	20	20	10	10	10	10	40	40	40	40
113	-0.2	-1	-1	-1	-0.2	-1	-1	-1	-1	-1	-1	-1
68 – 129	-0.2	-1	-1	-1	-0.15	-0.5	-0.5	-0.5	-1	-1	-1	-1

2.3 Diffusion Coefficients

The diffusion coefficients are specified in RMA-11. There are two required coefficients, one for the x-direction and one for the y-direction. Conceptually, the coefficients reflect the influence of turbulent behavior in the convective field. According to the *Users Guide to RMA4 WES Version 4.5*, convection is usually the dominant transport process, and mixing may have a relatively minor effect on the results. The diffusion coefficients have a somewhat arbitrary physical basis and are typically used as calibration parameters in water quality analyses.

In RMA-11, there are a number of options that affect how the diffusion coefficients are specified and applied. These are selected by the IDIFF field on the C1 card. The base model uses option 1, which has the following implications: horizontal diffusion coefficients are applied in the direction of flow. For the longitudinal direction, the diffusion coefficients are computed from the element size and velocity magnitude, and are scaled by the input value on the DF card. The transverse diffusion coefficients are calculated by a further scale factor times the longitudinal diffusion coefficient. Thus, there are two scale factors on the DF card corresponding with these definitions. In the base model, the same value is always specified for both scale factors, although the magnitude changes depending on material type as a result of the calibration process. There is also a minimum value for the lateral and longitudinal diffusion coefficients, which is always specified as 0.50 in both directions regardless of material type or the value of the scale factors.

The approach for the diffusion coefficient sensitivity analysis was to reduce the magnitude of the scale factors by 50% for the “low” values and increase the magnitude of the scale factors by 100% for the “high” values. Table 3 shows the base, low, and high values for the diffusion coefficient scale factors.

Table 3. Base, low, and high values for the diffusion coefficient scale factors.

Material Type	Base		Low		High		Material Type	Base		Low		High	
	Dx	Dy	Dx	Dy	Dx	Dy		Dx	Dy	Dx	Dy	Dx	Dy
1	1.0	1.0	0.5	0.5	2.0	2.0	67	25.0	25.0	12.5	12.5	50.0	50.0
2	1.0	1.0	0.5	0.5	2.0	2.0	68	1.0	1.0	0.5	0.5	2.0	2.0
3	1.0	1.0	0.5	0.5	2.0	2.0	69	3.0	3.0	1.5	1.5	6.0	6.0
4	1.0	1.0	0.5	0.5	2.0	2.0	70	1.0	1.0	0.5	0.5	2.0	2.0
5	1.0	1.0	0.5	0.5	2.0	2.0	71	500.0	500.0	250.0	250.0	1000.0	1000.0
6	3.0	3.0	1.5	1.5	6.0	6.0	72	10.0	10.0	5.0	5.0	20.0	20.0
7	1.0	1.0	0.5	0.5	2.0	2.0	73	1.0	1.0	0.5	0.5	2.0	2.0
8	1.0	1.0	0.5	0.5	2.0	2.0	74	5.0	5.0	2.5	2.5	10.0	10.0
9	10.0	10.0	5.0	5.0	20.0	20.0	75	1.0	1.0	0.5	0.5	2.0	2.0
10	5.0	5.0	2.5	2.5	10.0	10.0	76	1.0	1.0	0.5	0.5	2.0	2.0
11	1.0	1.0	0.5	0.5	2.0	2.0	77	10.0	10.0	5.0	5.0	20.0	20.0
12	50.0	50.0	25.0	25.0	100.0	100.0	78	75.0	75.0	37.5	37.5	150.0	150.0
13	1.0	1.0	0.5	0.5	2.0	2.0	79	10.0	10.0	5.0	5.0	20.0	20.0
14	1.0	1.0	0.5	0.5	2.0	2.0	80	1.0	1.0	0.5	0.5	2.0	2.0
15	1.0	1.0	0.5	0.5	2.0	2.0	81	100.0	100.0	50.0	50.0	200.0	200.0
16	1.0	1.0	0.5	0.5	2.0	2.0	82	2.0	2.0	1.0	1.0	4.0	4.0
17	3.0	3.0	1.5	1.5	6.0	6.0	83	1.0	1.0	0.5	0.5	2.0	2.0
18	10.0	10.0	5.0	5.0	20.0	20.0	84	1.0	1.0	0.5	0.5	2.0	2.0
19	1.0	1.0	0.5	0.5	2.0	2.0	85	25.0	25.0	12.5	12.5	50.0	50.0
20	1.0	1.0	0.5	0.5	2.0	2.0	86	10.0	10.0	5.0	5.0	20.0	20.0
21	1.0	1.0	0.5	0.5	2.0	2.0	87	10.0	10.0	5.0	5.0	20.0	20.0
22	1.0	1.0	0.5	0.5	2.0	2.0	88	10.0	10.0	5.0	5.0	20.0	20.0
23	1.0	1.0	0.5	0.5	2.0	2.0	89	5.0	5.0	2.5	2.5	10.0	10.0
24	25.0	25.0	12.5	12.5	50.0	50.0	90	25.0	25.0	12.5	12.5	50.0	50.0
25	25.0	25.0	12.5	12.5	50.0	50.0	91	3.0	3.0	1.5	1.5	6.0	6.0
26	10.0	10.0	5.0	5.0	20.0	20.0	92	5.0	5.0	2.5	2.5	10.0	10.0
27	1.0	1.0	0.5	0.5	2.0	2.0	93	50.0	50.0	25.0	25.0	100.0	100.0
28	25.0	25.0	12.5	12.5	50.0	50.0	94	10.0	10.0	5.0	5.0	20.0	20.0
29	25.0	25.0	12.5	12.5	50.0	50.0	95	100.0	100.0	50.0	50.0	200.0	200.0
30	1.0	1.0	0.5	0.5	2.0	2.0	96	50.0	50.0	25.0	25.0	100.0	100.0
31	1.0	1.0	0.5	0.5	2.0	2.0	97	50.0	50.0	25.0	25.0	100.0	100.0
32	1.0	1.0	0.5	0.5	2.0	2.0	98	100.0	100.0	50.0	50.0	200.0	200.0
33	1.0	1.0	0.5	0.5	2.0	2.0	99	100.0	100.0	50.0	50.0	200.0	200.0
34	1.0	1.0	0.5	0.5	2.0	2.0	100	100.0	100.0	50.0	50.0	200.0	200.0

Table 3. Base, low, and high values for the diffusion coefficient scale factors (continued).

Material Type	Base		Low		High		Material Type	Base		Low		High	
	Dx	Dy	Dx	Dy	Dx	Dy		Dx	Dy	Dx	Dy	Dx	Dy
35	1.0	1.0	0.5	0.5	2.0	2.0	101	100.0	100.0	50.0	50.0	200.0	200.0
36	1.0	1.0	0.5	0.5	2.0	2.0	102	100.0	100.0	50.0	50.0	200.0	200.0
37	1.0	1.0	0.5	0.5	2.0	2.0	103	100.0	100.0	50.0	50.0	200.0	200.0
38	1.0	1.0	0.5	0.5	2.0	2.0	104	100.0	100.0	50.0	50.0	200.0	200.0
39	1.0	1.0	0.5	0.5	2.0	2.0	105	10.0	10.0	5.0	5.0	20.0	20.0
40	1.0	1.0	0.5	0.5	2.0	2.0	106	10.0	10.0	5.0	5.0	20.0	20.0
41	1.0	1.0	0.5	0.5	2.0	2.0	107	2.0	2.0	1.0	1.0	4.0	4.0
42	1.0	1.0	0.5	0.5	2.0	2.0	108	100.0	100.0	50.0	50.0	200.0	200.0
43	1.0	1.0	0.5	0.5	2.0	2.0	109	50.0	50.0	25.0	25.0	100.0	100.0
44	1.0	1.0	0.5	0.5	2.0	2.0	110	25.0	25.0	12.5	12.5	50.0	50.0
45	1.0	1.0	0.5	0.5	2.0	2.0	111	10.0	10.0	5.0	5.0	20.0	20.0
46	1.0	1.0	0.5	0.5	2.0	2.0	112	50.0	50.0	25.0	25.0	100.0	100.0
47	1.0	1.0	0.5	0.5	2.0	2.0	113	10.0	10.0	5.0	5.0	20.0	20.0
48	1.0	1.0	0.5	0.5	2.0	2.0	114	10.0	10.0	5.0	5.0	20.0	20.0
49	1.0	1.0	0.5	0.5	2.0	2.0	115	75.0	75.0	37.5	37.5	150.0	150.0
50	1.0	1.0	0.5	0.5	2.0	2.0	116	10.0	10.0	5.0	5.0	20.0	20.0
51	1.0	1.0	0.5	0.5	2.0	2.0	117	10.0	10.0	5.0	5.0	20.0	20.0
52	1.0	1.0	0.5	0.5	2.0	2.0	118	10.0	10.0	5.0	5.0	20.0	20.0
53	1.0	1.0	0.5	0.5	2.0	2.0	119	10.0	10.0	5.0	5.0	20.0	20.0
54	1.0	1.0	0.5	0.5	2.0	2.0	120	10.0	10.0	5.0	5.0	20.0	20.0
55	1.0	1.0	0.5	0.5	2.0	2.0	121	10.0	10.0	5.0	5.0	20.0	20.0
56	1.0	1.0	0.5	0.5	2.0	2.0	122	10.0	10.0	5.0	5.0	20.0	20.0
57	1.0	1.0	0.5	0.5	2.0	2.0	123	10.0	10.0	5.0	5.0	20.0	20.0
58	1.0	1.0	0.5	0.5	2.0	2.0	124	10.0	10.0	5.0	5.0	20.0	20.0
59	1.0	1.0	0.5	0.5	2.0	2.0	125	10.0	10.0	5.0	5.0	20.0	20.0
60	1.0	1.0	0.5	0.5	2.0	2.0	126	10.0	10.0	5.0	5.0	20.0	20.0
61	1.0	1.0	0.5	0.5	2.0	2.0	127	10.0	10.0	5.0	5.0	20.0	20.0
62	25.0	25.0	12.5	12.5	50.0	50.0	128	10.0	10.0	5.0	5.0	20.0	20.0
63	25.0	25.0	12.5	12.5	50.0	50.0	129	10.0	10.0	5.0	5.0	20.0	20.0
64	25.0	25.0	12.5	12.5	50.0	50.0	130	10.0	10.0	5.0	5.0	20.0	20.0
65	15.0	15.0	7.5	7.5	30.0	30.0	999	10.0	10.0	5.0	5.0	20.0	20.0
66	25.0	25.0	12.5	12.5	50.0	50.0							

3.0 MODEL SIMULATIONS

A few RMA-2 model instabilities were encountered during the sensitivity analysis simulations that affected the selection of values for the parameters. As previously noted, the “low” Manning’s *n* simulation was unstable and diverged at a weir connection between Grand Bayou and the 2-D marsh, so the Manning’s *n* value for Grand Bayou was slightly increased. There were considerable RMA-2 model instabilities associated with the initial “low” eddy coefficients. At first, the eddy coefficients for individual material types where instabilities occurred were increased. This approach had to be abandoned because as one problem area was corrected, another one occurred in a different material type. Ultimately, the eddy scale factors were increased for all material types until model stability was achieved. These results demonstrate that model convergence is generally aided by higher Manning’s *n* values and eddy coefficients, resulting in a model system that is more damped.

Results from the model simulations were extracted at the same locations that were used as calibration points for the base model. The model results for water surface elevation and salinity at these locations were imported into a spreadsheet, and time-series plots were created to compare the sensitivity analysis results with the base model results. In addition, salinity isohalines comparing “high” and “low” parameter values were generated at a snapshot in time (November 3, 2004, 7:15 AM) to show the differences in salinity distribution for the sensitivity analysis. This date and time was chosen because the time-series plots at the calibration stations indicated relatively large differences in salinity at this point.

4.0 RESULTS

Time-series plots for the base conditions and sensitivity analysis simulations at the calibration stations are included as appendices to this report. Appendix A contains RMA-2 water surface elevation and RMA-11 salinity time-series plots for the Manning's *n* sensitivity analysis. Appendix B contains RMA-2 water surface elevation time-series plots and RMA-11 salinity time-series plots for the eddy coefficient sensitivity analysis. Appendix C contains RMA-11 salinity time-series plots for the diffusion coefficient sensitivity analysis results. All time-series plots in the appendices also include the observed data at the calibration stations so that the impact of the model coefficients on the calibration can be assessed. Isohalines generated for the sensitivity analysis are found in Appendix D. Table 4 shows the maximum and minimum differences in water surface elevation for the Manning's *n* and eddy coefficient sensitivity analyses. Table 5 shows the maximum and minimum differences in salinity for the Manning's *n*, eddy coefficient, and diffusion coefficient salinity analyses.

The results of the sensitivity analysis indicate that, in general, both RMA-2 and RMA-11 model results are more sensitive to Manning's *n* values than the eddy scale factors. The variation in eddy scale factors had very little effect on RMA-2 or RMA-11 model results as compared to the base conditions results. Although the variation in Manning's *n* values had more impact on the RMA-2 and RMA-11 results, the effects were not deemed significant enough to materially improve the model calibration for water surface elevation or salinity.

Table 4. Maximum and minimum differences in water surface elevations for the Manning's *n* and eddy coefficient sensitivity analyses.

Station	Node	Manning's *n* Sensitivity Analysis						Eddy Coefficient Sensitivity Analysis					
		Base – Low		Base – High		High – Low		Base – Low		Base – High		High – Low	
		Max (ft)	Min (ft)	Max (ft)	Min (ft)	Max (ft)	Min (ft)	Max (ft)	Min (ft)	Max (ft)	Min (ft)	Max (ft)	Min (ft)
1	435	0.185	-0.111	0.082	-0.146	0.329	-0.193	0.041	-0.021	0.005	-0.008	0.048	-0.024
2	15795	0.184	-0.113	0.085	-0.145	0.329	-0.197	0.041	-0.020	0.004	-0.008	0.048	-0.024
3	17403	0.184	-0.116	0.090	-0.145	0.327	-0.206	0.040	-0.021	0.005	-0.008	0.047	-0.025
4	21076	0.184	-0.114	0.088	-0.144	0.327	-0.201	0.053	-0.025	0.005	-0.010	0.060	-0.029
5	21057	0.183	-0.113	0.087	-0.144	0.200	-0.326	0.050	-0.025	0.005	-0.010	0.056	-0.029
6	15791	0.183	-0.115	0.089	-0.144	0.327	-0.203	0.049	-0.024	0.005	-0.010	0.056	-0.028
7	13805	0.164	-0.227	0.163	-0.114	0.275	-0.381	0.043	-0.037	0.012	-0.010	0.050	-0.045
8	2087	0.220	-0.232	0.200	-0.171	0.387	-0.412	0.030	-0.020	0.005	-0.006	0.034	-0.023
10	163	0.524	-0.022	-0.004	-0.518	1.037	0.013	0.037	-0.012	0.002	-0.007	0.044	-0.013
12	33388	0.207	-0.112	0.088	-0.158	0.363	-0.199	0.064	-0.038	0.010	-0.012	0.075	-0.047
13	33207	0.201	-0.108	0.084	-0.154	0.354	-0.191	0.061	-0.035	0.009	-0.010	0.071	-0.044
14	22757	0.039	-0.037	0.031	-0.031	0.069	-0.068	0.029	-0.026	0.011	-0.011	0.037	-0.035
15	11291	0.156	-0.164	0.125	-0.126	0.278	-0.274	0.022	-0.022	0.006	-0.009	0.029	-0.025
16	3534	0.194	-0.188	0.162	-0.157	0.346	-0.346	0.031	-0.026	0.008	-0.009	0.038	-0.032
17	14653	0.158	-0.083	0.071	-0.126	0.283	-0.153	0.029	-0.021	0.007	-0.006	0.034	-0.027
18	63877	0.126	-0.111	0.086	-0.109	0.235	-0.196	0.013	-0.028	0.014	-0.005	0.018	-0.040
19	64672	0.076	-0.078	0.066	-0.072	0.147	-0.142	0.010	-0.032	0.008	-0.006	0.016	-0.036

Table 5. Maximum and minimum differences in salinity for the Manning's *n*, eddy coefficient, and diffusion coefficient sensitivity analyses.

Station	Node	Manning's *n* Sensitivity Analysis						Eddy Coefficient Sensitivity Analysis						Diffusion Coefficient Sensitivity Analysis					
		Base - Low		Base - High		High - Low		Base - Low		Base - High		High - Low		Base - Low		Base - High		High - Low	
		Max (ppt)	Min (ppt)	Max (ppt)	Min (ppt)	Max (ppt)	Min (ppt)	Max (ppt)	Min (ppt)	Max (ppt)	Min (ppt)	Max (ppt)	Min (ppt)	Max (ppt)	Min (ppt)	Max (ppt)	Min (ppt)	Max (ppt)	Min (ppt)
1	435	0.0003	-0.0022	0.0022	-0.0001	0.0002	-0.0036	0.0010	-0.0012	0.0896	-0.0051	0.0083	0.0000	0.0032	0.0000	-0.0003	-0.1228	0.1257	0.0003
2	15795	0.0646	-0.2739	0.2881	-0.0490	0.1076	-0.3220	0.1361	-0.2064	0.0896	-0.0051	0.1127	-0.2323	0.0172	-0.0215	0.1924	-0.0533	0.0577	-0.2114
3	17403	0.0339	-0.0006	0.0013	-0.0119	0.0457	-0.0019	0.0064	0.0000	0.0000	-0.0019	0.0083	0.0000	0.0000	-0.0073	0.0431	0.0000	0.0000	-0.0450
4	21076	0.0558	-0.2923	0.0228	-0.0460	0.0891	-0.2926	0.0281	-0.0258	0.0292	-0.0087	0.0275	-0.0397	0.0238	-0.0113	0.0104	-1.3437	1.3563	-0.0144
5	21057	0.0566	-0.2666	0.0201	-0.0461	0.0906	-0.2498	0.0192	-0.0105	0.0189	-0.0090	0.0282	-0.0173	0.0258	-0.0115	0.0115	-0.4907	0.4924	-0.0161
6	15791	0.0729	-0.3903	0.0337	-0.0580	0.1112	-0.3793	0.0239	-0.0189	0.0613	-0.0110	0.0339	-0.0775	0.0446	-0.0128	0.0242	-0.2296	0.2350	-0.0253
7	13044	0.1735	-1.9837	1.4696	-0.1277	0.2477	-3.4010	0.2739	-0.5142	0.2008	-0.4126	0.3024	-0.7040	3.3401	-0.0975	0.0870	-6.8605	10.0380	-0.0713
8	2087	4.4705	-5.4048	3.2074	-2.9618	6.5897	-7.2326	0.2933	-0.8470	0.1951	-0.0355	0.2573	-1.0082	3.0583	-0.0151	0.0000	-11.5085	13.1495	0.0000
12	33388	0.0000	-0.1432	0.1010	0.0000	0.0000	-0.2416	0.0000	-0.0853	0.0286	0.0000	0.0000	-0.1138	0.1951	0.0000	0.0000	-4.1298	4.3240	0.0000
13	33207	0.0426	-0.0094	0.0051	-0.0347	0.0768	-0.0137	0.0198	-0.0064	0.0010	-0.0163	0.0349	-0.0067	0.0455	-0.0379	0.0887	-5.4168	5.4095	-0.0953
14	22757	2.5900	-1.3240	0.7790	-1.6990	4.2890	-1.6850	3.4650	-0.7260	1.0000	-0.7720	4.2370	-1.2210	2.2880	-4.6120	4.0360	-2.6710	4.0240	-7.5650
15	11291	1.5432	-2.1785	1.9969	-0.6200	1.7359	-3.8586	1.1468	-0.2327	0.1345	-0.3349	1.4817	-0.3102	3.4590	0.0022	-0.0156	-7.0399	8.4714	0.0177
16	3534	3.1100	-1.2110	1.0407	-1.4100	4.2230	-2.1601	0.1800	-1.2600	0.2770	-0.1320	0.2520	-1.3600	6.2194	-0.1770	-0.1910	-10.1740	15.8985	0.2960
17	14653	0.0847	-0.0222	0.0179	-0.0795	0.0951	-0.0283	0.0660	0.0000	0.0000	-0.0170	0.0732	0.0000	0.0174	-0.0006	0.0000	-0.7256	0.7332	0.0000

As could be expected, the diffusion coefficients had a significant effect on the salinity results. For some calibration stations on Company Canal (stations 1 and 2), the salinity calibration results were significantly improved for the “high” diffusion coefficients. At other stations (e.g., station 12 – Lake Cataouatche and station 13 – Lake Salvador) the salinity calibration results are significantly worse for the “high” diffusion coefficients. These results might imply that some improvement to the salinity calibration might be possible by selectively increasing the diffusion coefficients for some material types. However, considerable effort was expended in the base model salinity calibration, and it was found that the diffusion coefficients selected were optimum for balancing the overall calibration results. Some of the trends associated with higher and lower diffusion coefficients had already been observed during the salinity calibration of the base model. Therefore, it is not believed that the salinity calibration could be materially improved.

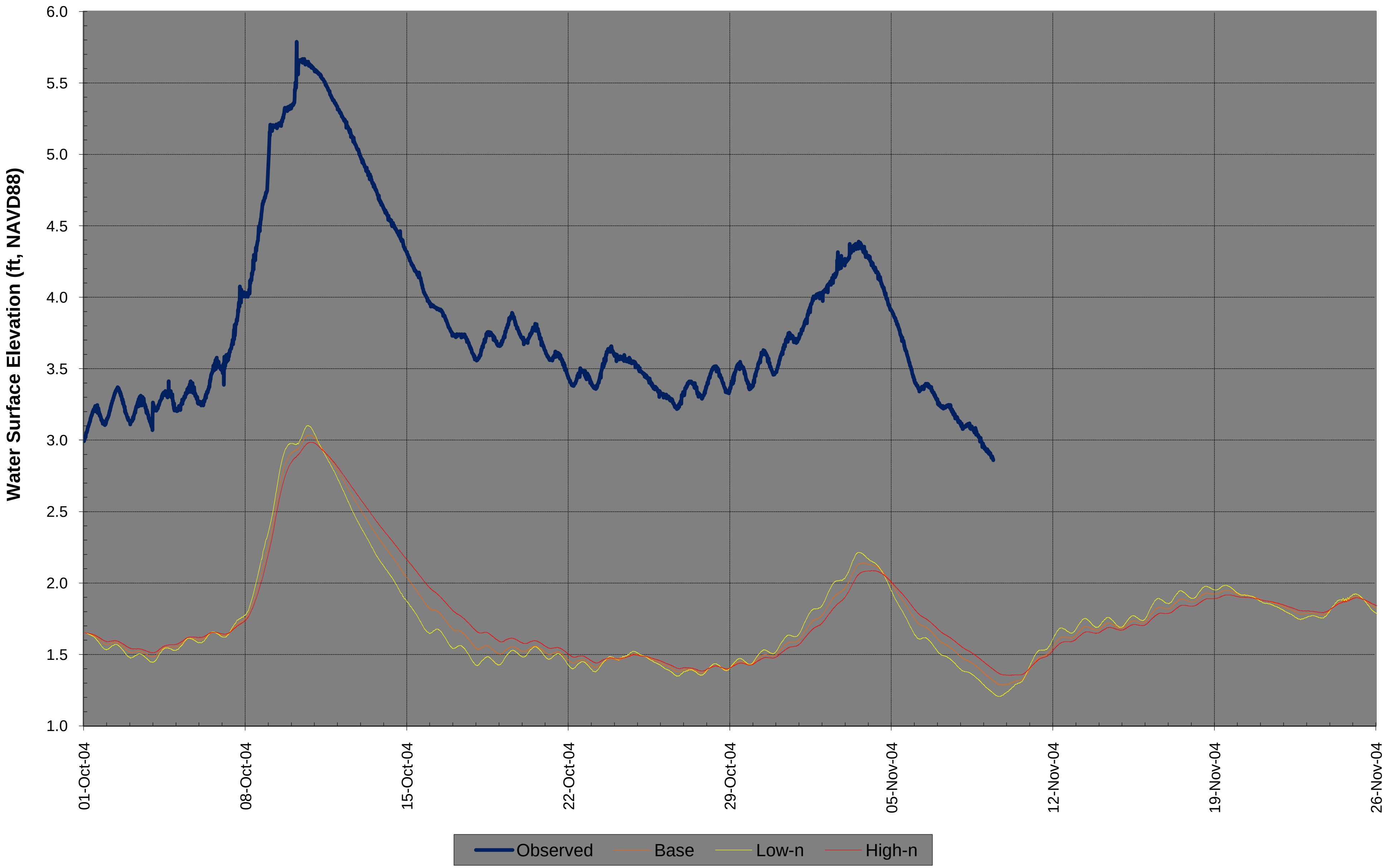
5.0 CONCLUSIONS

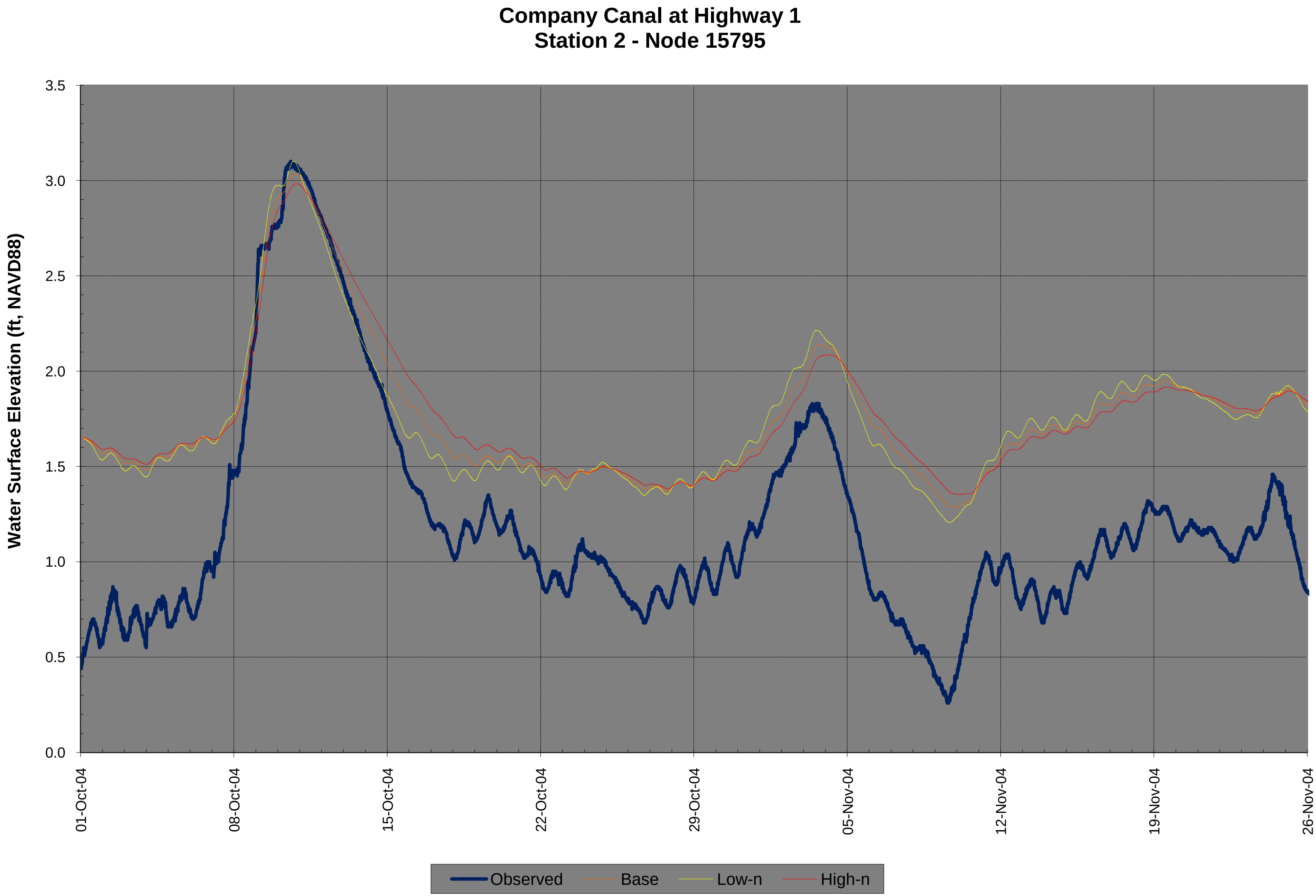
A sensitivity analysis was performed on the base conditions Atchafalaya Freshwater Conveyance Project RMA-2 and RMA-11 models that investigated the sensitivity of the model results to variations in Manning's *n*, eddy coefficients, and diffusion coefficients. The sensitivity analysis results were compared to the calibrated base model results. It was found that varying the parameters did not significantly improve the calibration of the base model.

APPENDIX A

Water Surface Elevation and Salinity Time-Series Plots for Manning's *n* Sensitivity Analysis

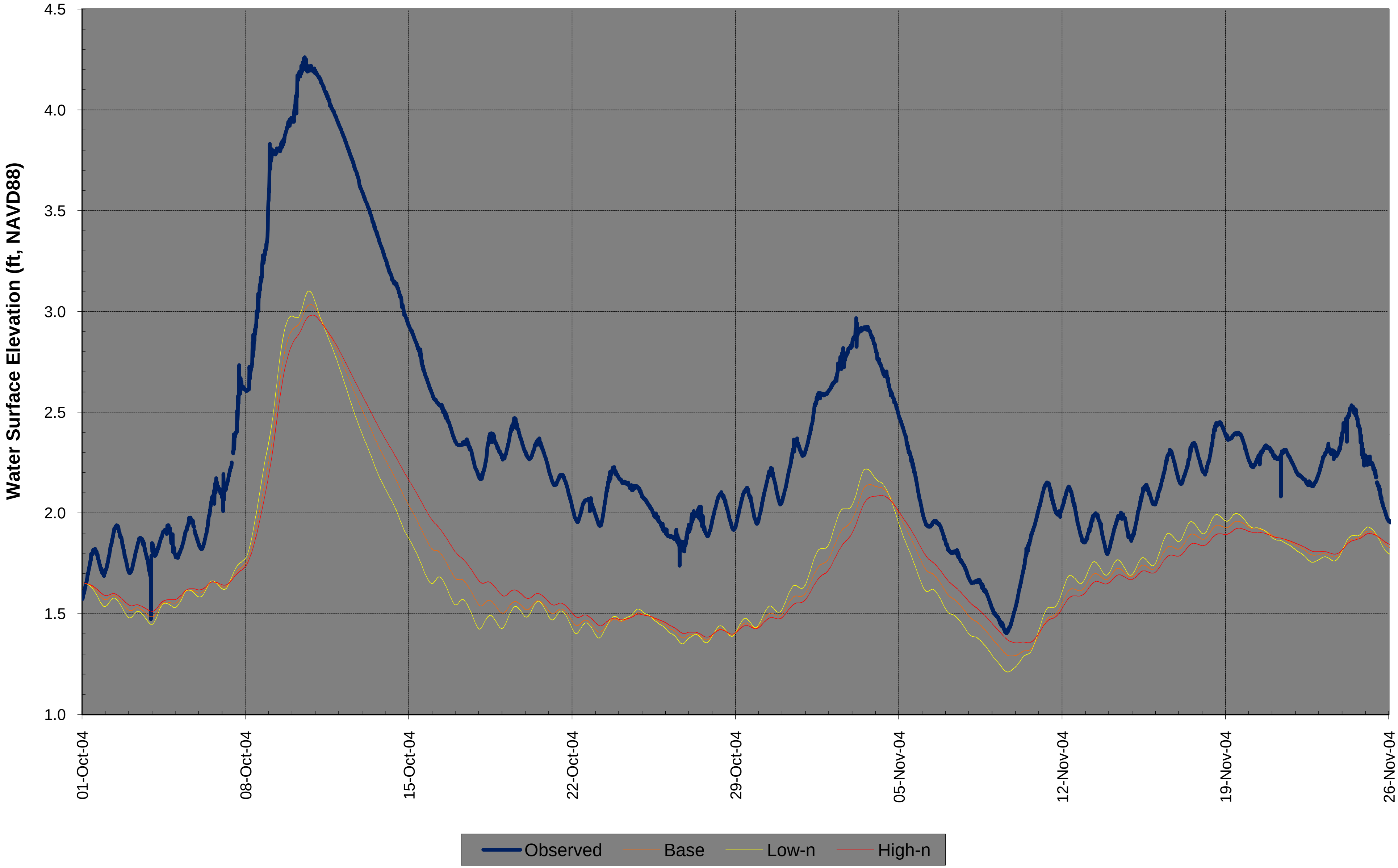
Bayou Lafourche North of Company Canal
Station 1 - Node 435

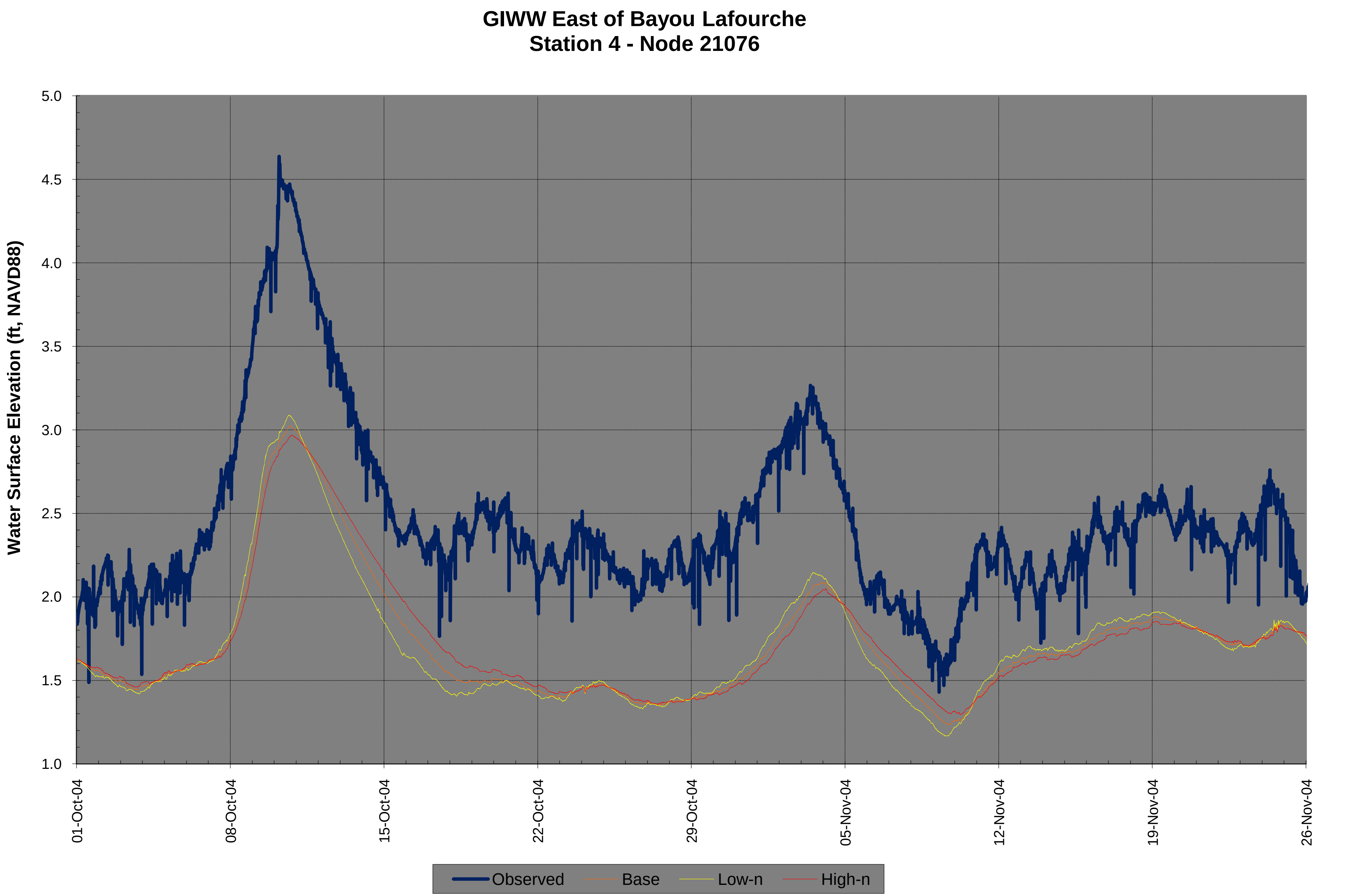


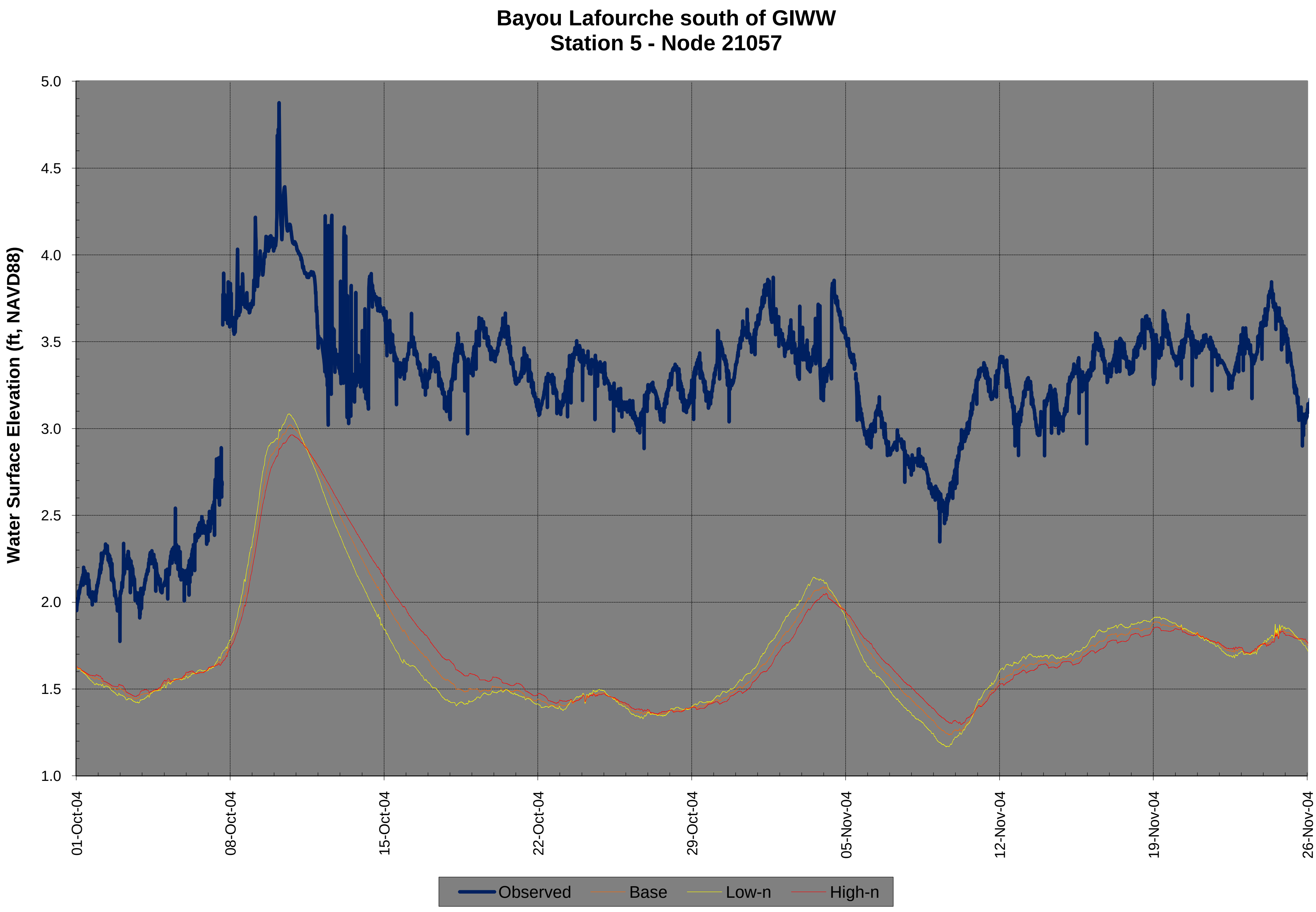


Company Canal at Highway 1
Station 2 - Node 15795
Water Surface Elevation (ft, NAVD88)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-n
High-n

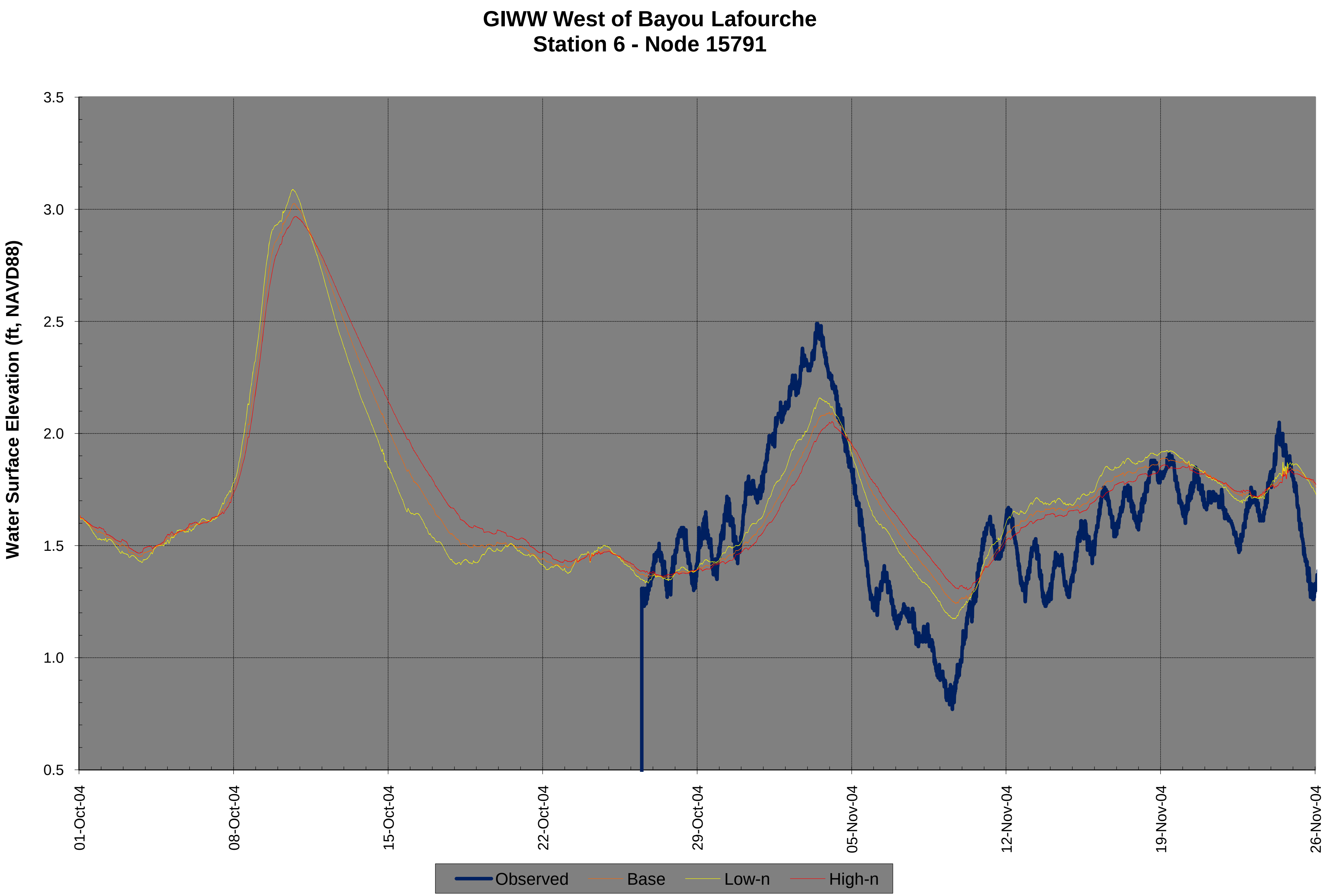
Lake Fields
Station 3 - Node 17403

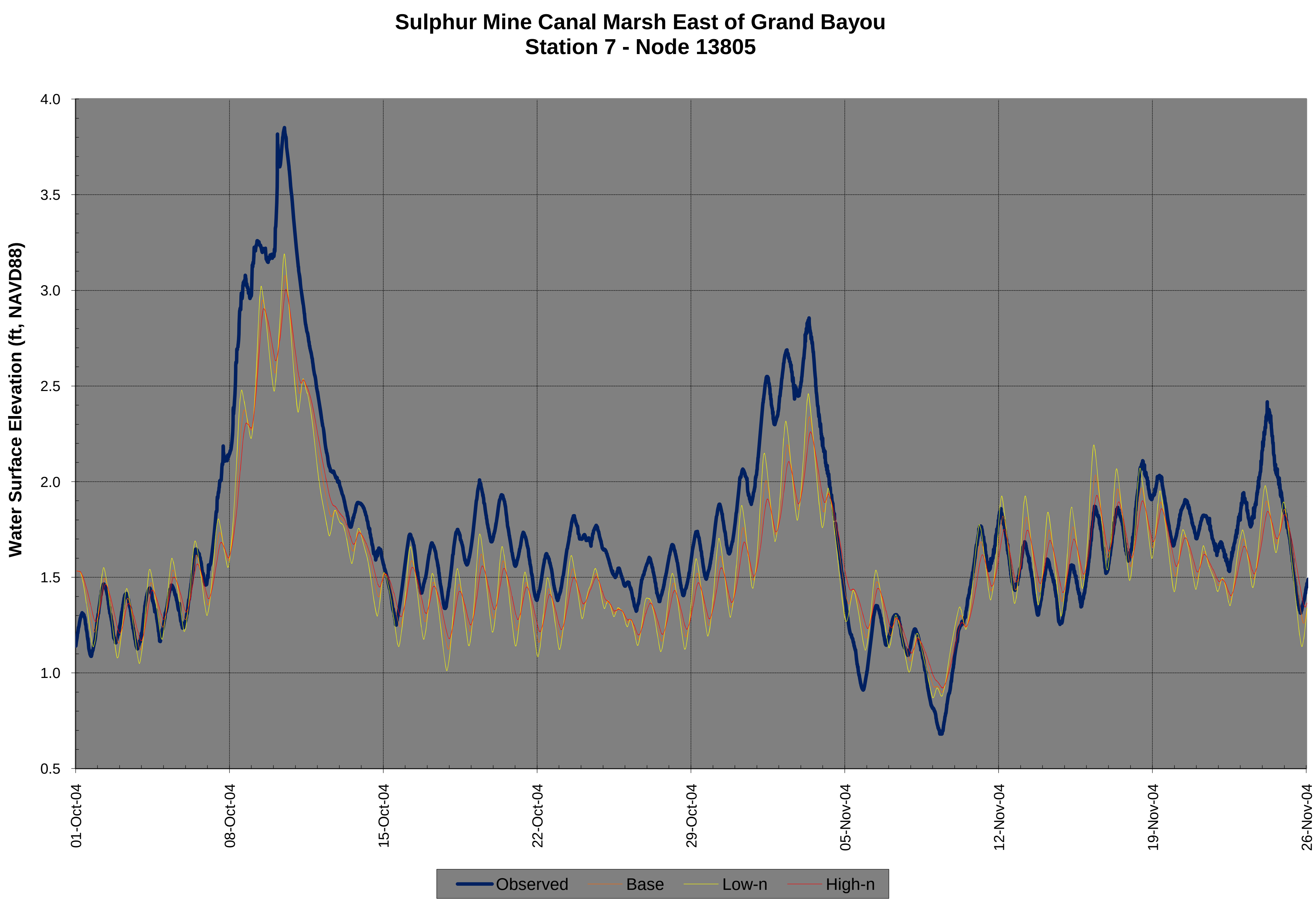


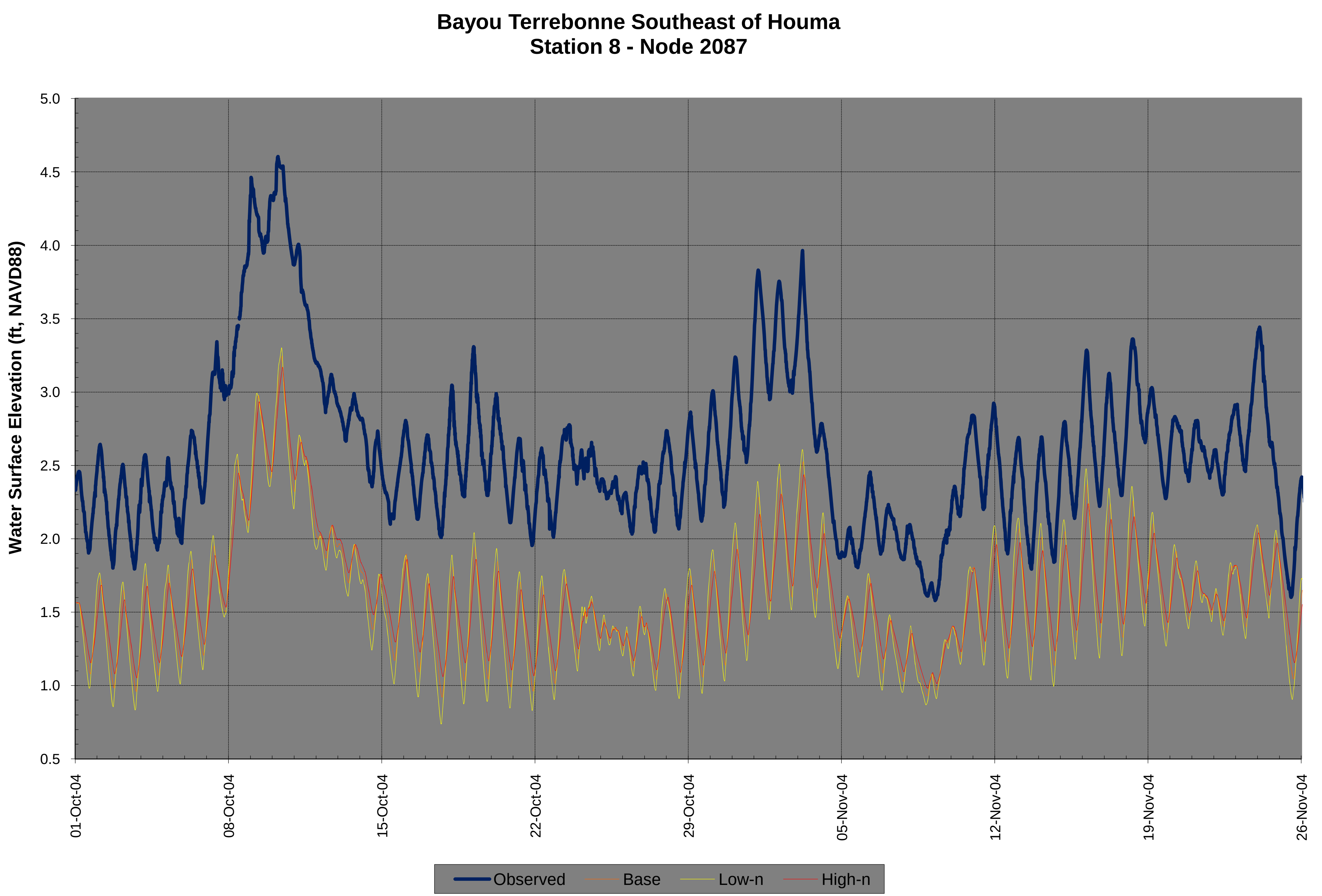

GIWW East of Bayou Lafourche
Station 4 - Node 21076
Water Surface Elevation (ft, NAVD88)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-n
High-n



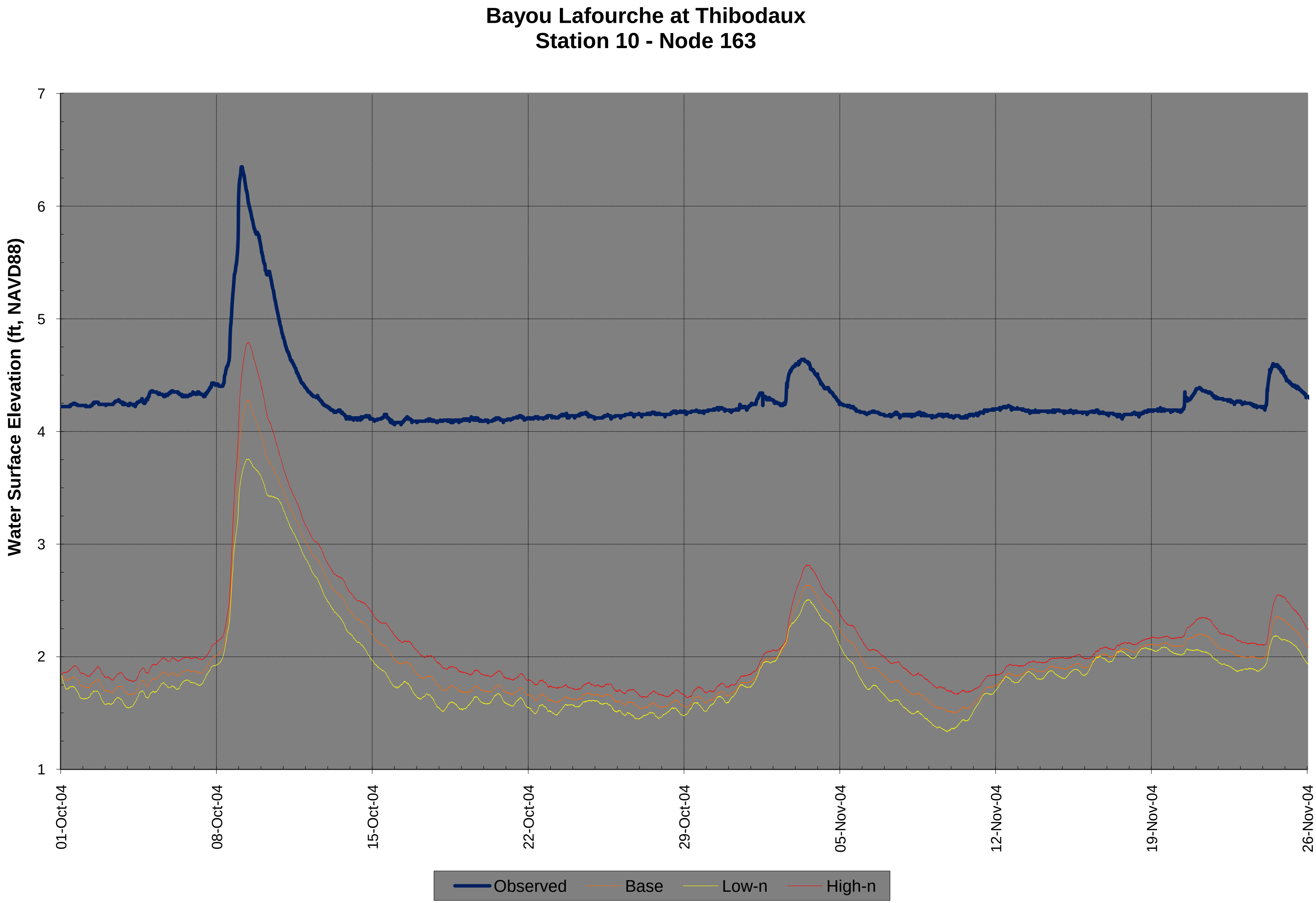
Bayou Lafourche south of GIWW
Station 5 - Node 21057
Water Surface Elevation (ft, NAVD88)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-n
High-n

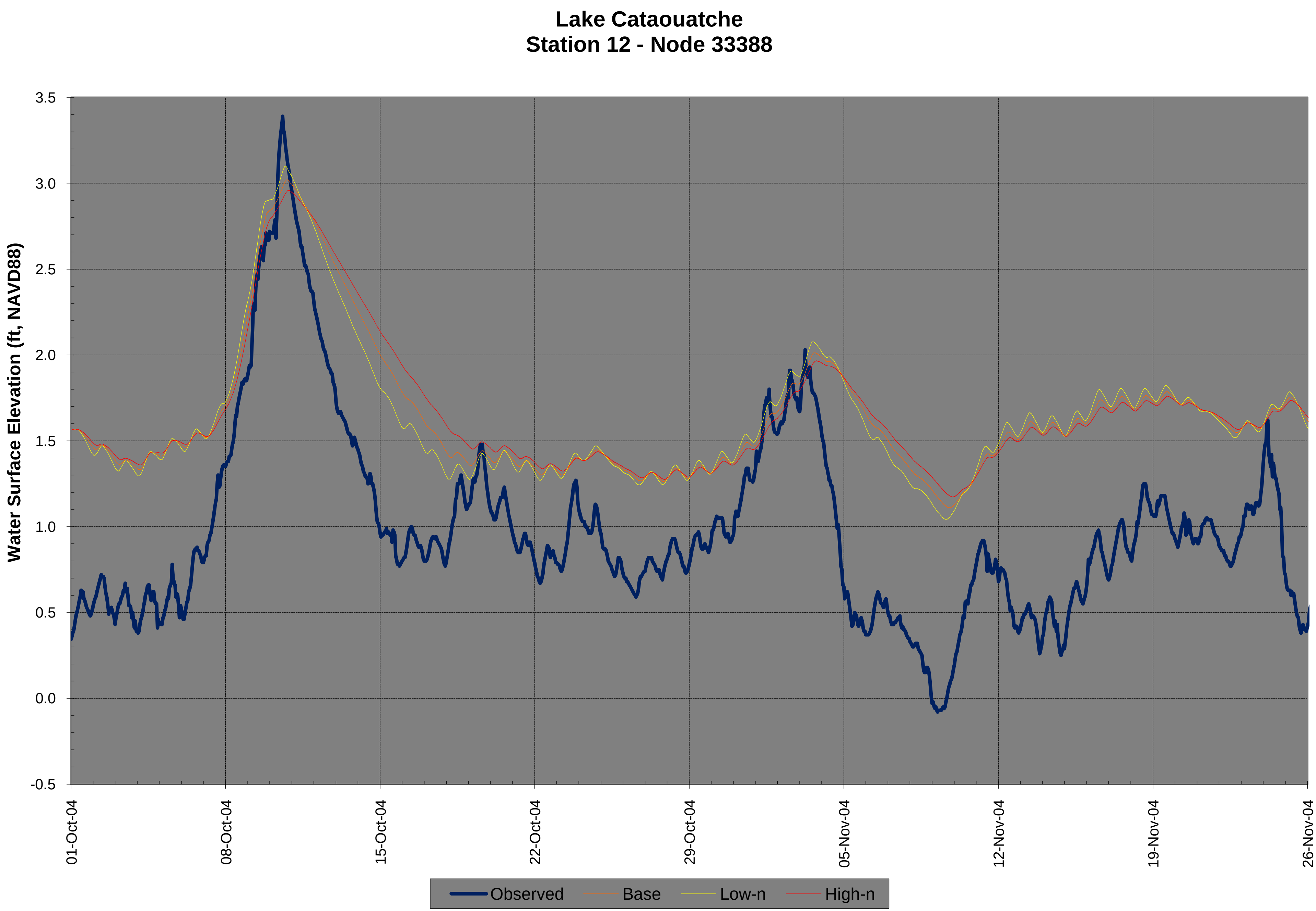

GIWW West of Bayou Lafourche
Station 6 - Node 15791
Water Surface Elevation (ft, NAVD88)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-n
High-n


Sulphur Mine Canal Marsh East of Grand Bayou
Station 7 - Node 13805
Water Surface Elevation (ft, NAVD88)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-n
High-n

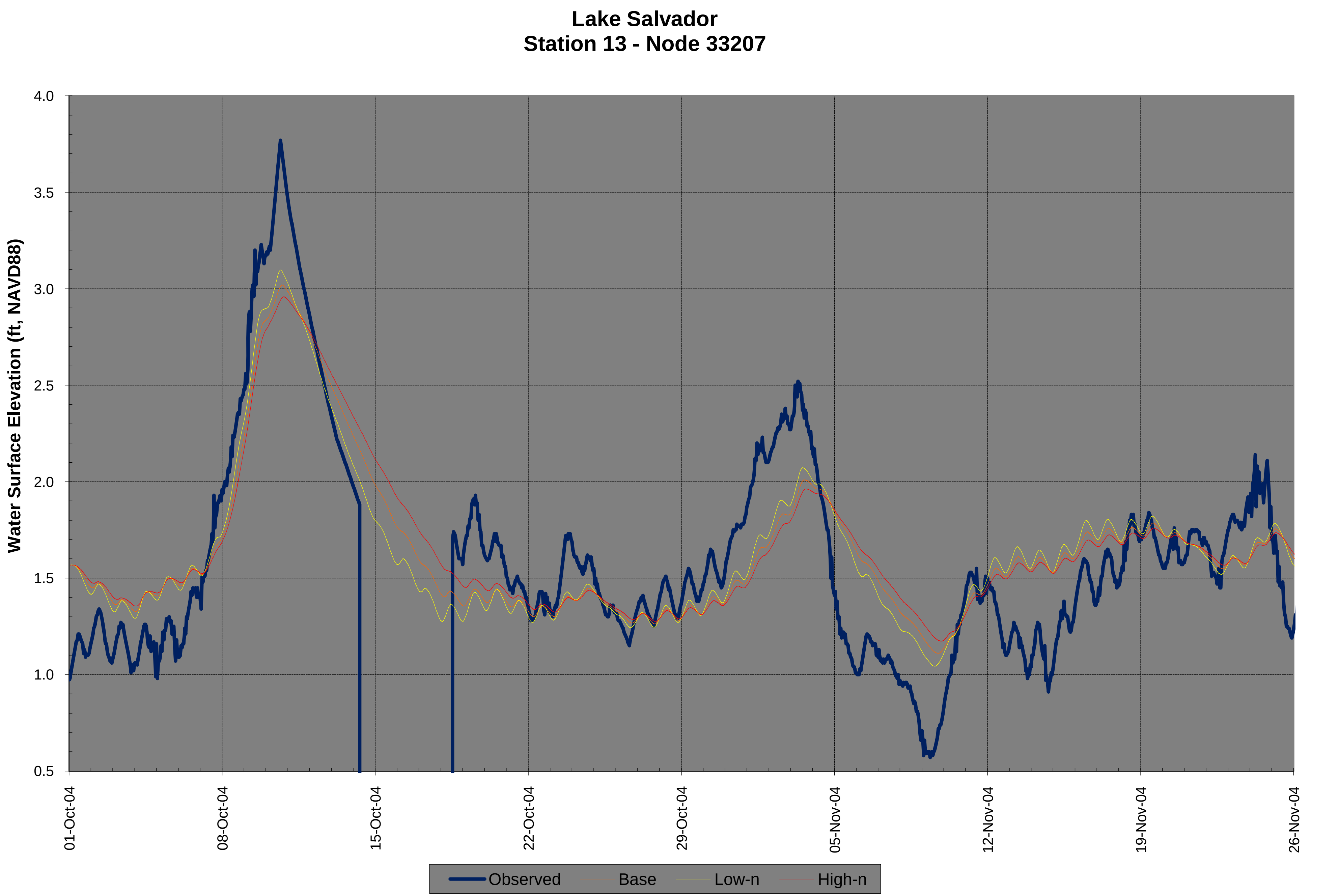


Bayou Terrebonne Southeast of Houma
Station 8 - Node 2087
Water Surface Elevation (ft, NAVD88)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-n
High-n


Bayou Lafourche at Thibodaux
Station 10 - Node 163
Water Surface Elevation (ft, NAVD88)
7
6
5
4
3
2
1
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-n
High-n

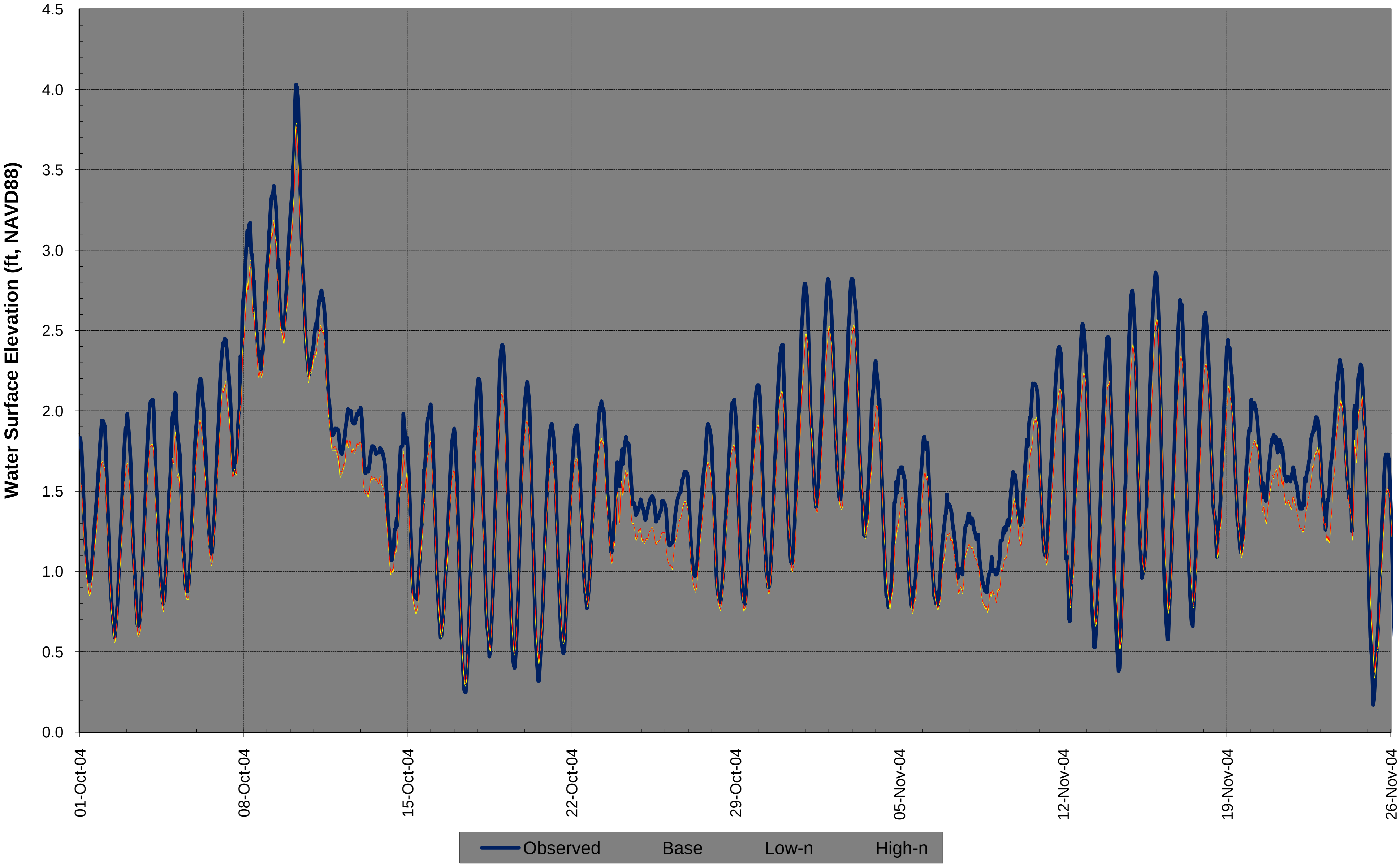


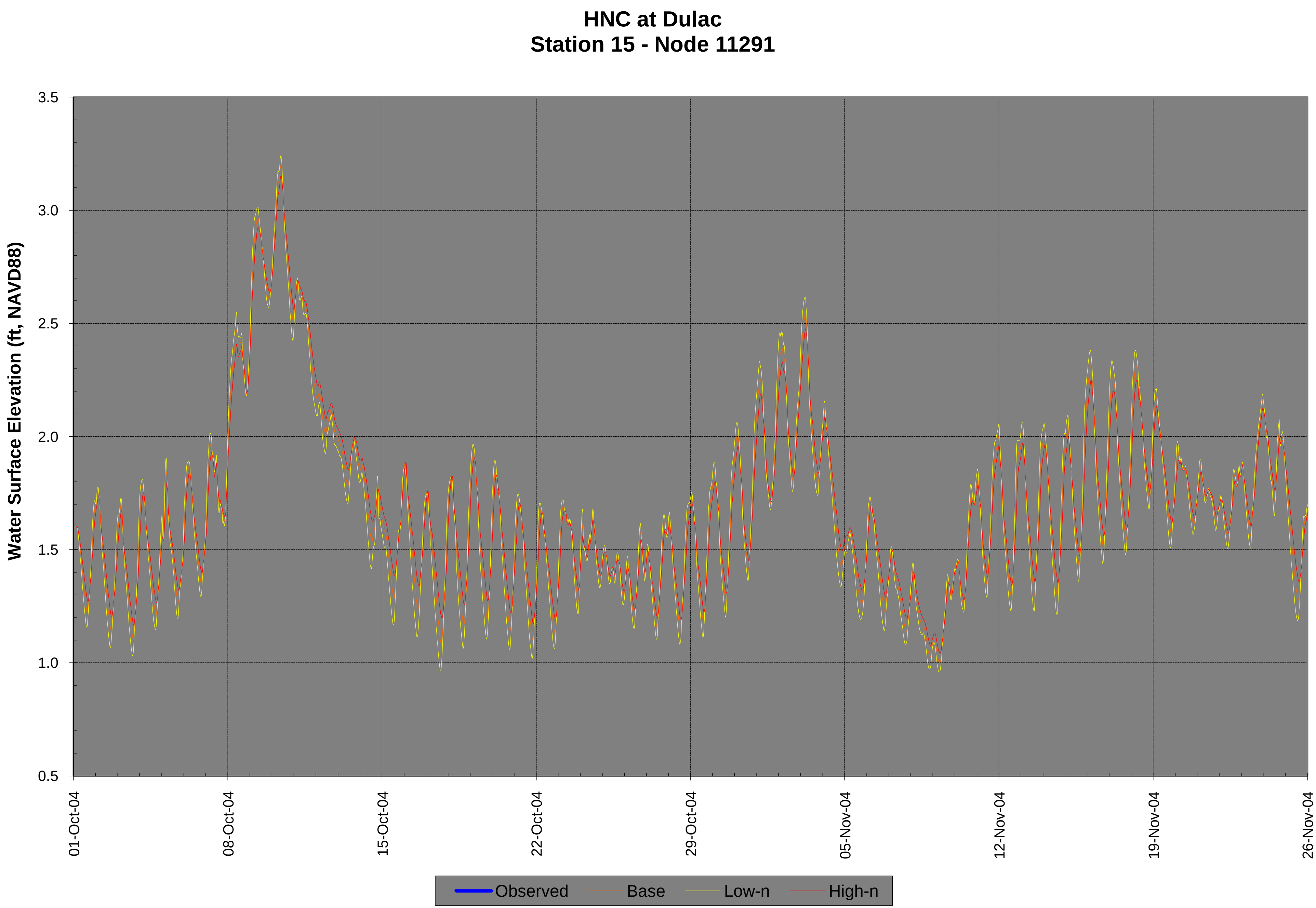
Lake Cataouatche
Station 12 - Node 33388
Water Surface Elevation (ft, NAVD88)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-n
High-n



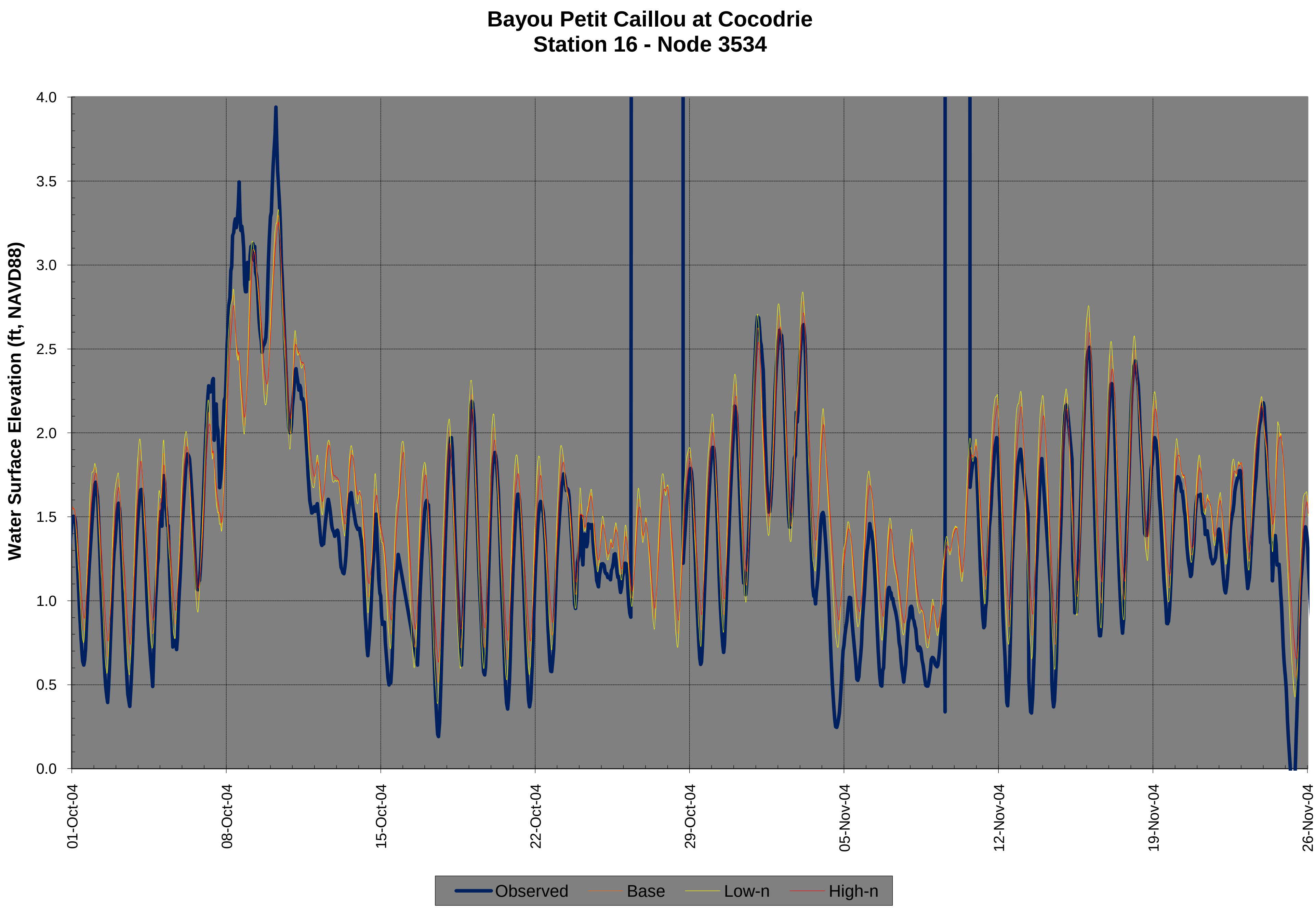
Lake Salvador
Station 13 - Node 33207
Water Surface Elevation (ft, NAVD88)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-n
High-n

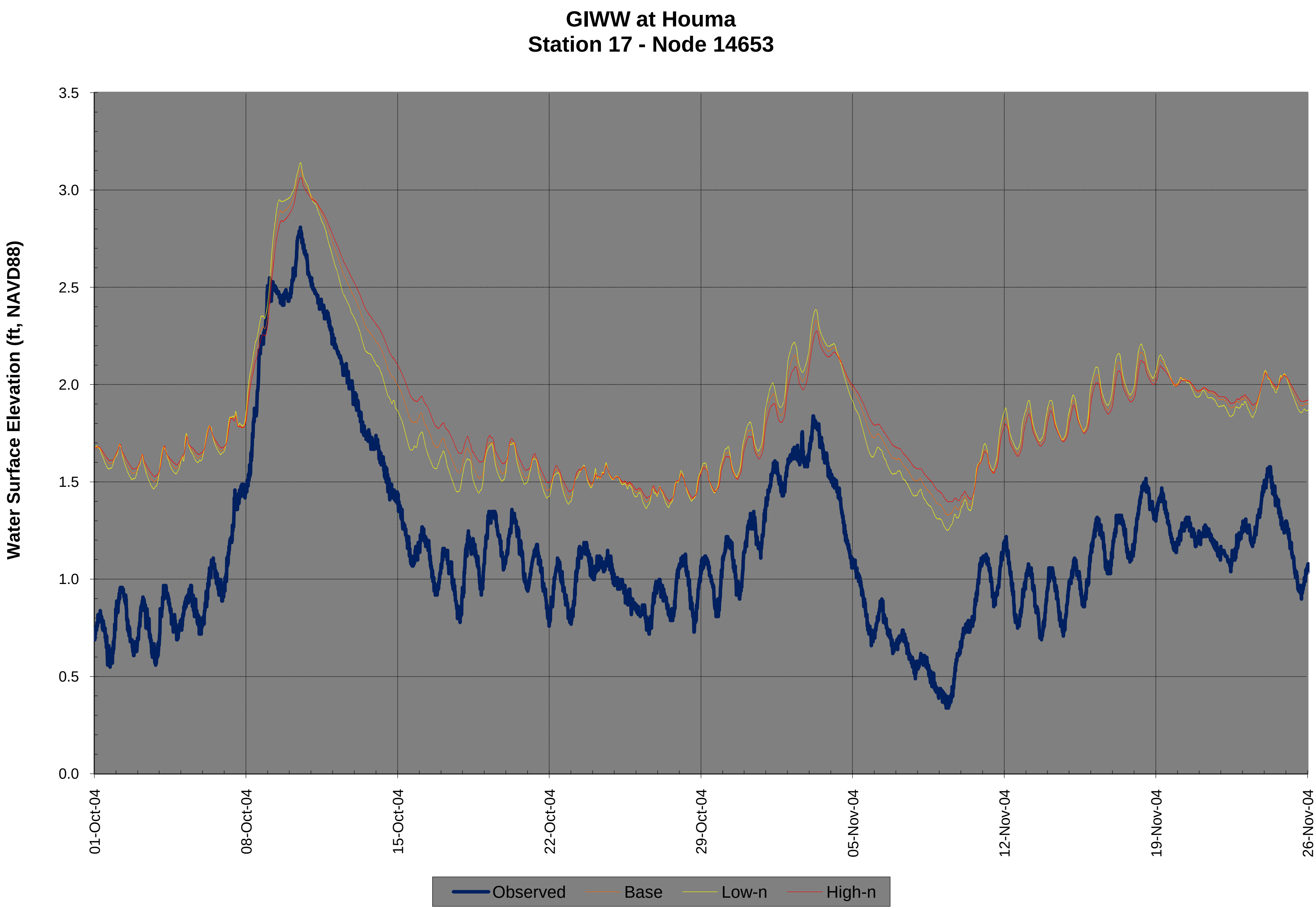
Barataria Pass East of Grand Isle
Station 14 - Node 22757



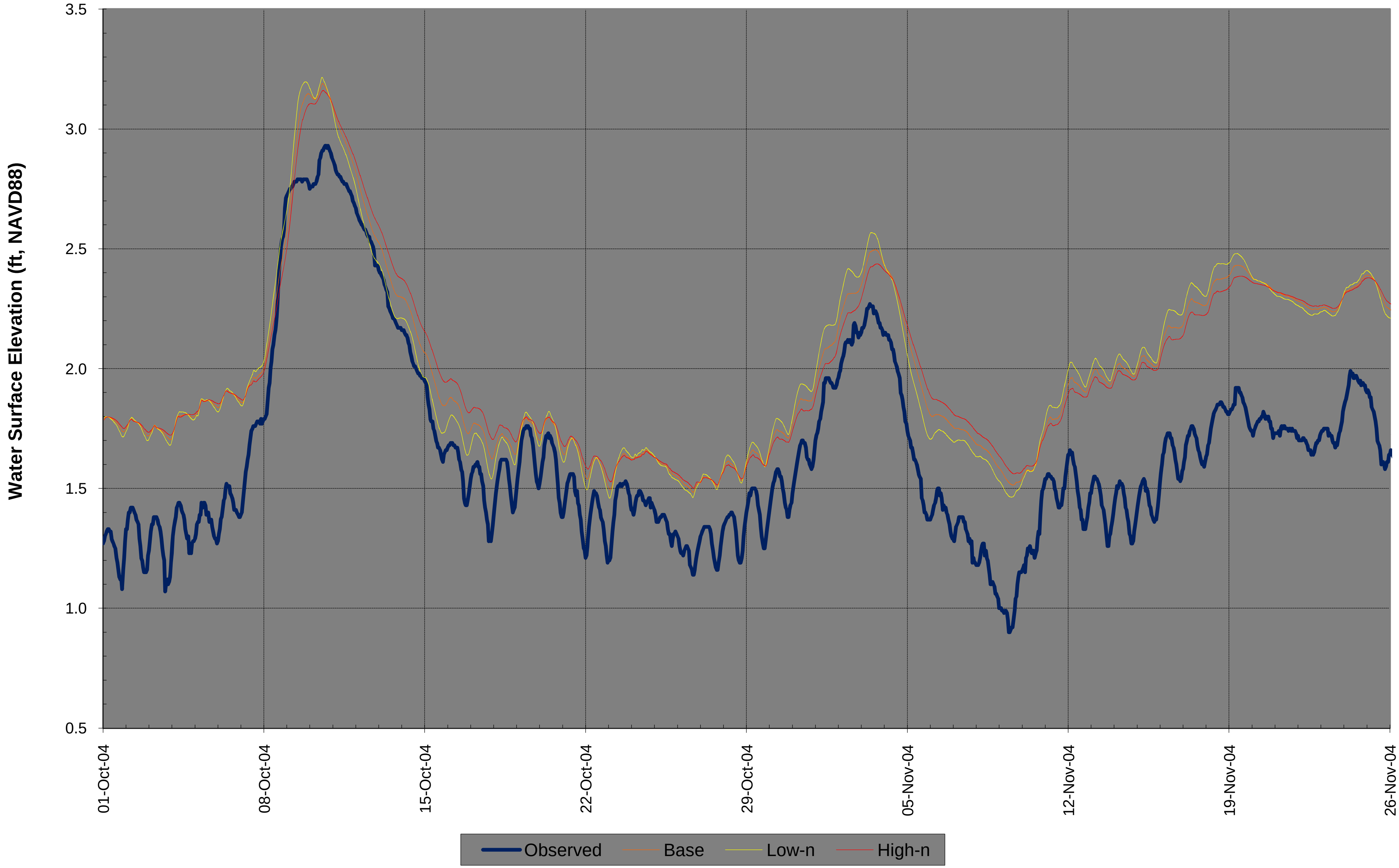


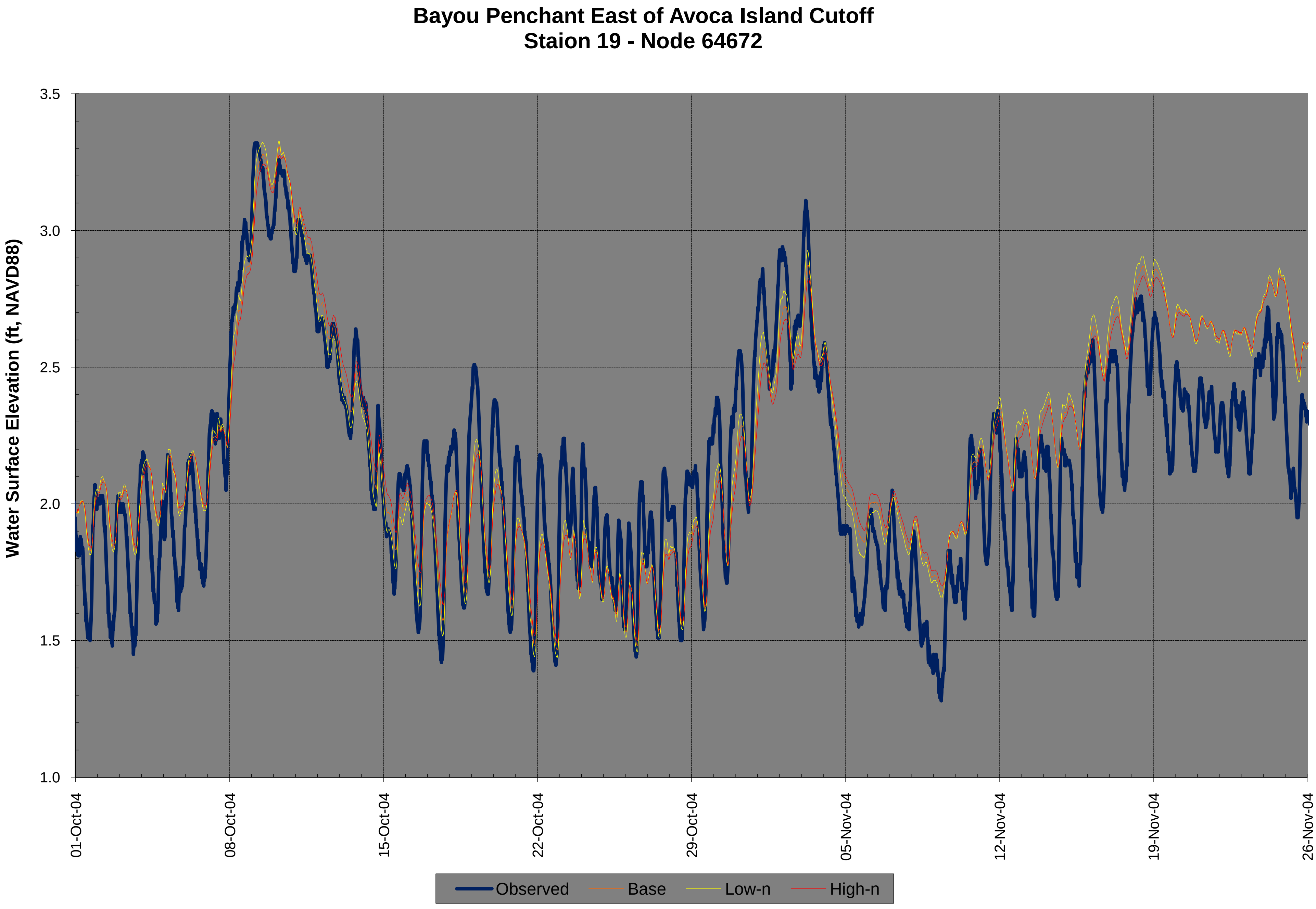
HNC at Dulac
Station 15 - Node 11291
Water Surface Elevation (ft, NAVD88)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-n
High-n


Bayou Petit Caillou at Cocodrie
Station 16 - Node 3534
Water Surface Elevation (ft, NAVD88)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-n
High-n

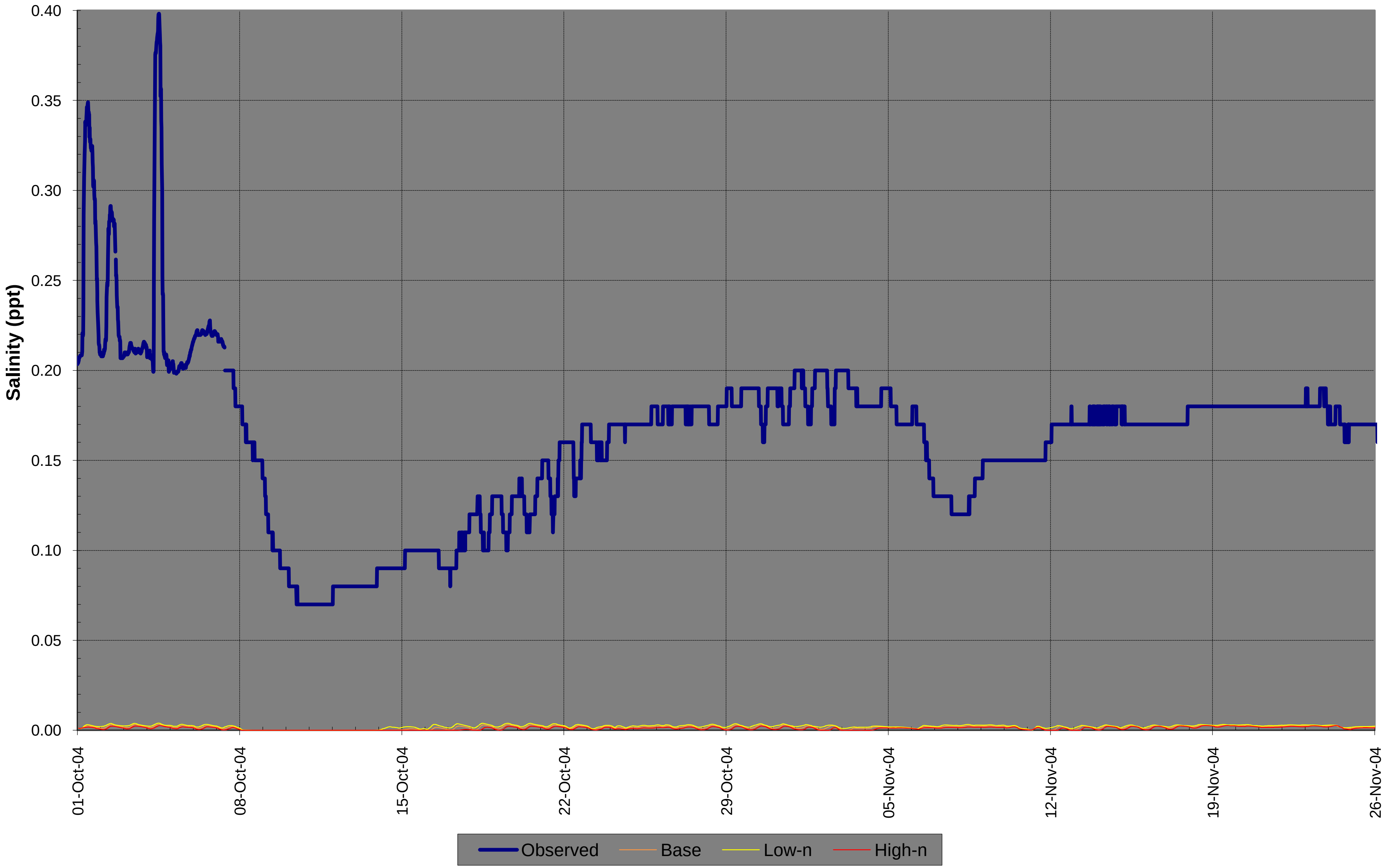

GIWW at Houma
Station 17 - Node 14653
Water Surface Elevation (ft, NAVD88)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-n
High-n

GIWW West of Minors Canal
Station 18 - Node 63877

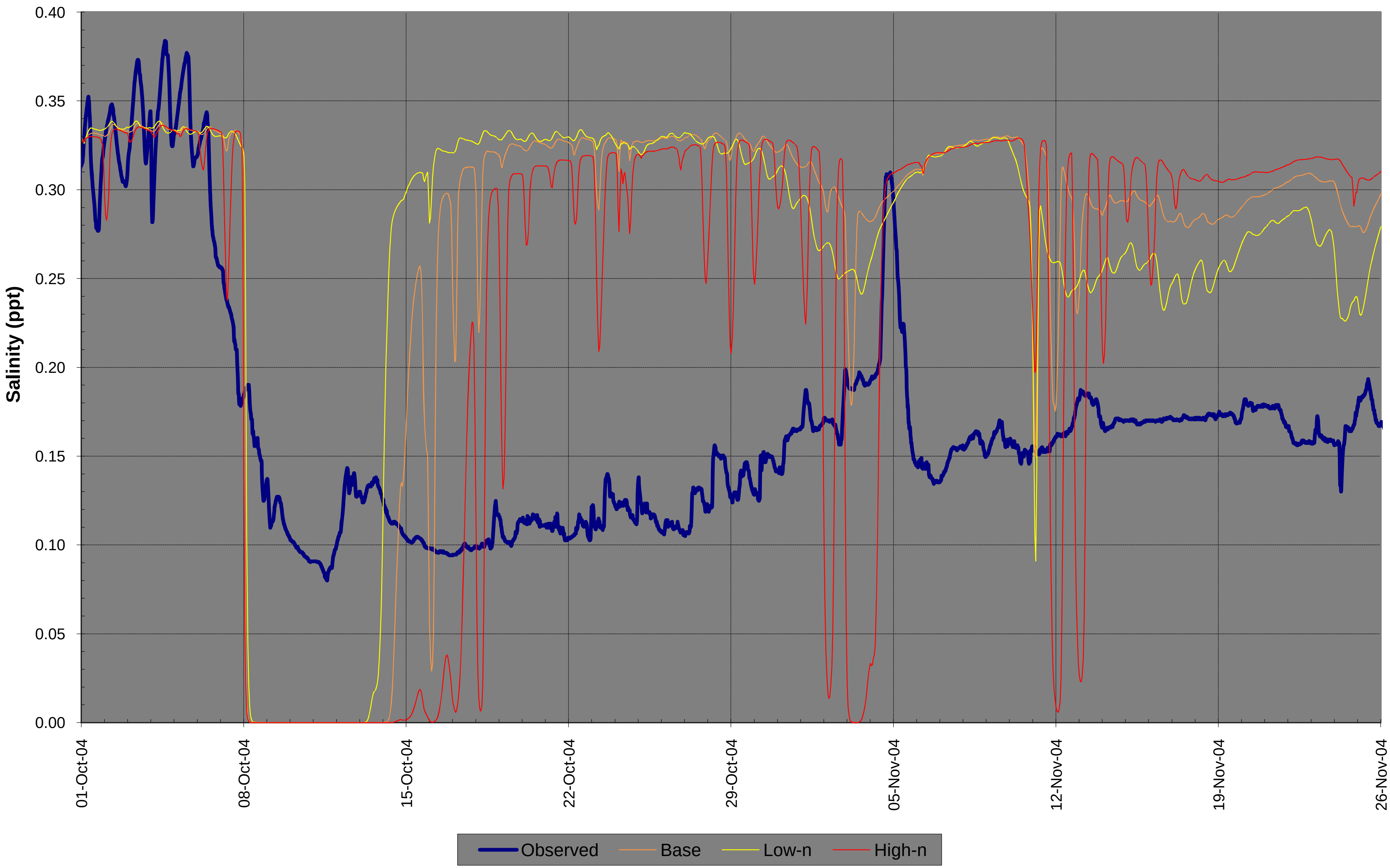



Bayou Penchant East of Avoca Island Cutoff
Staion 19 - Node 64672
Water Surface Elevation (ft, NAVD88)
3.5
3.0
2.5
2.0
1.5
1.0
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-n
High-n

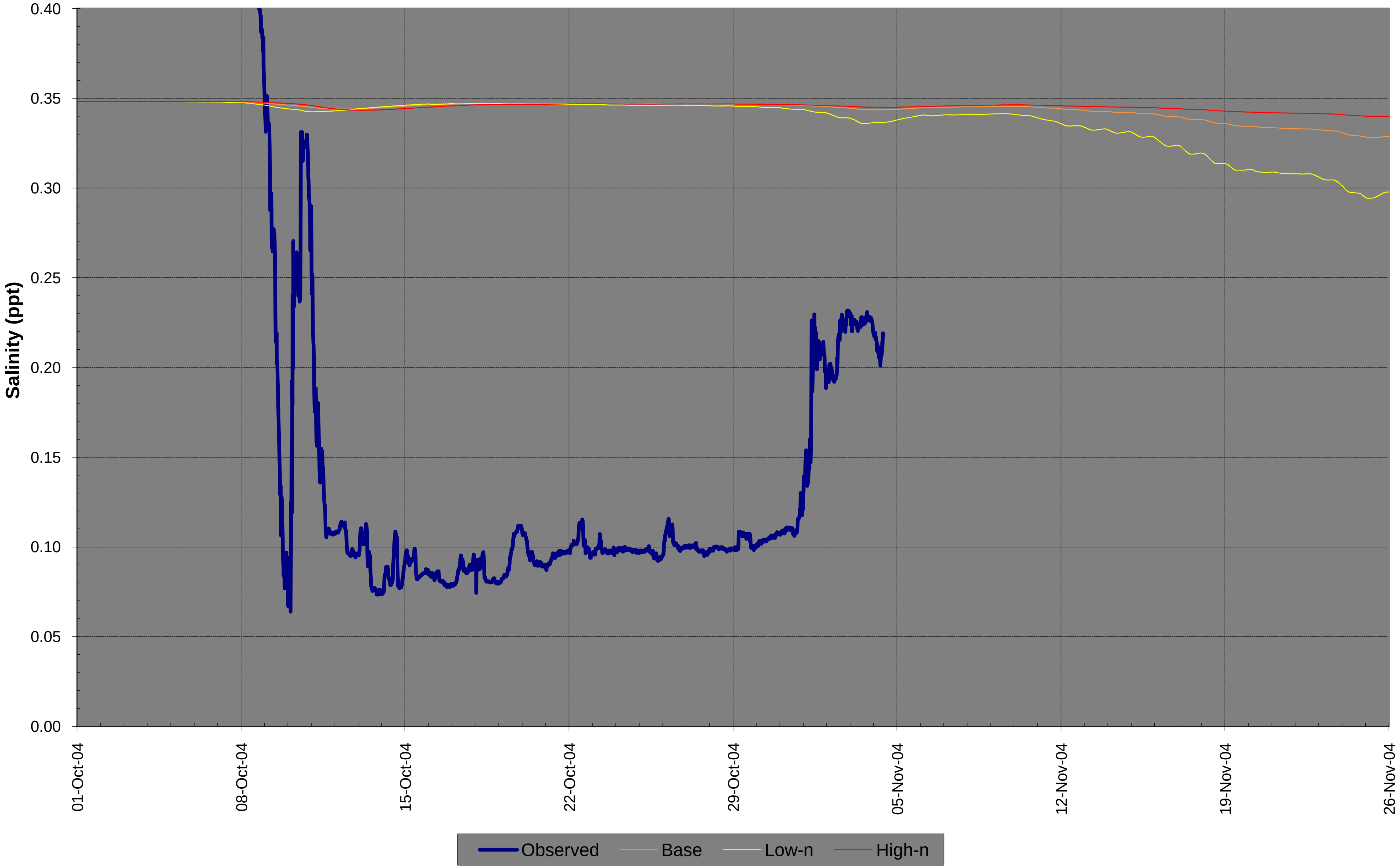
Bayou Lafourche North of Company Canal
Station 1 - Node 435

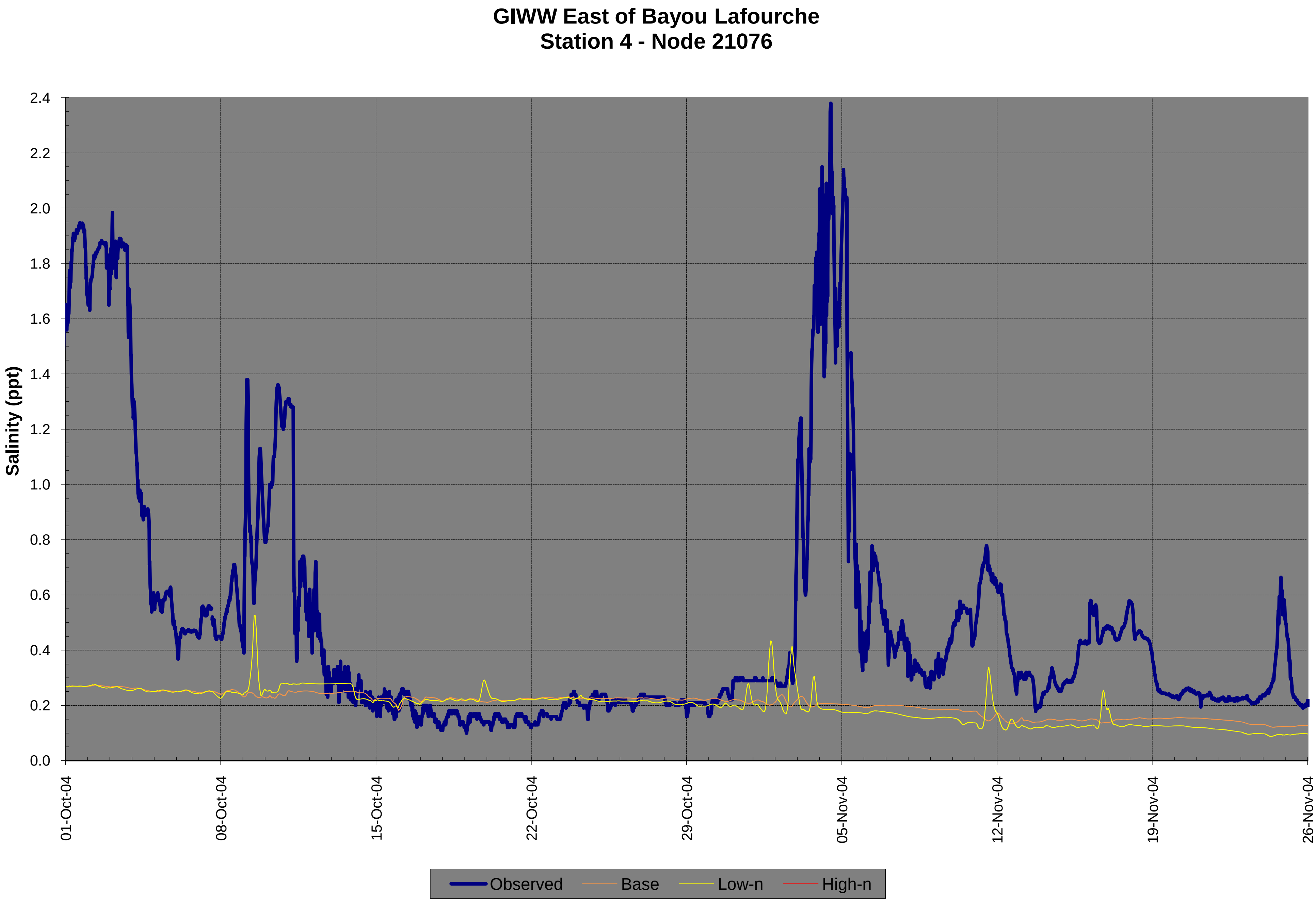


Company Canal at Highway 1
Station 2 - Node 15795

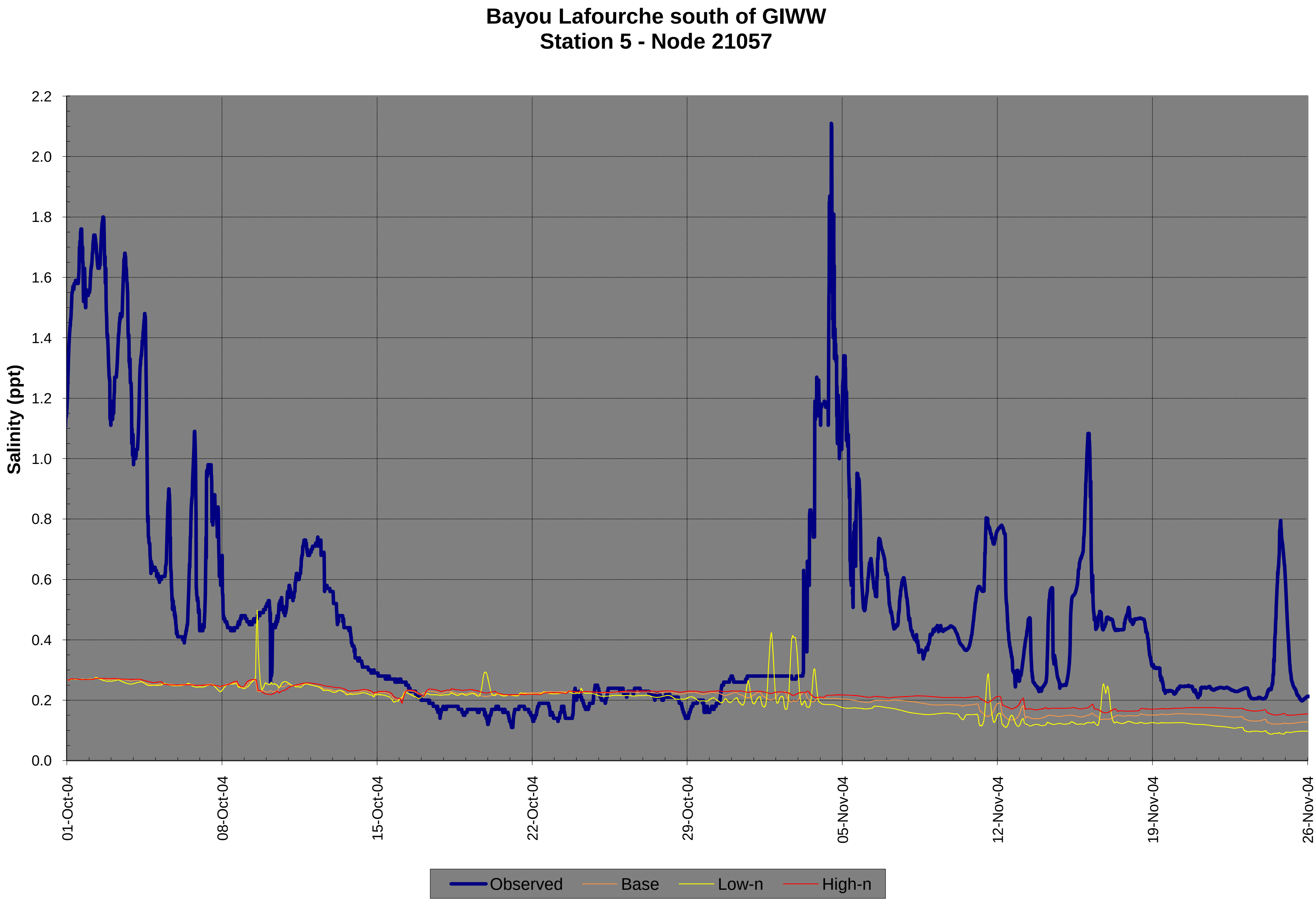


Lake Fields
Station 3 - Node 17403



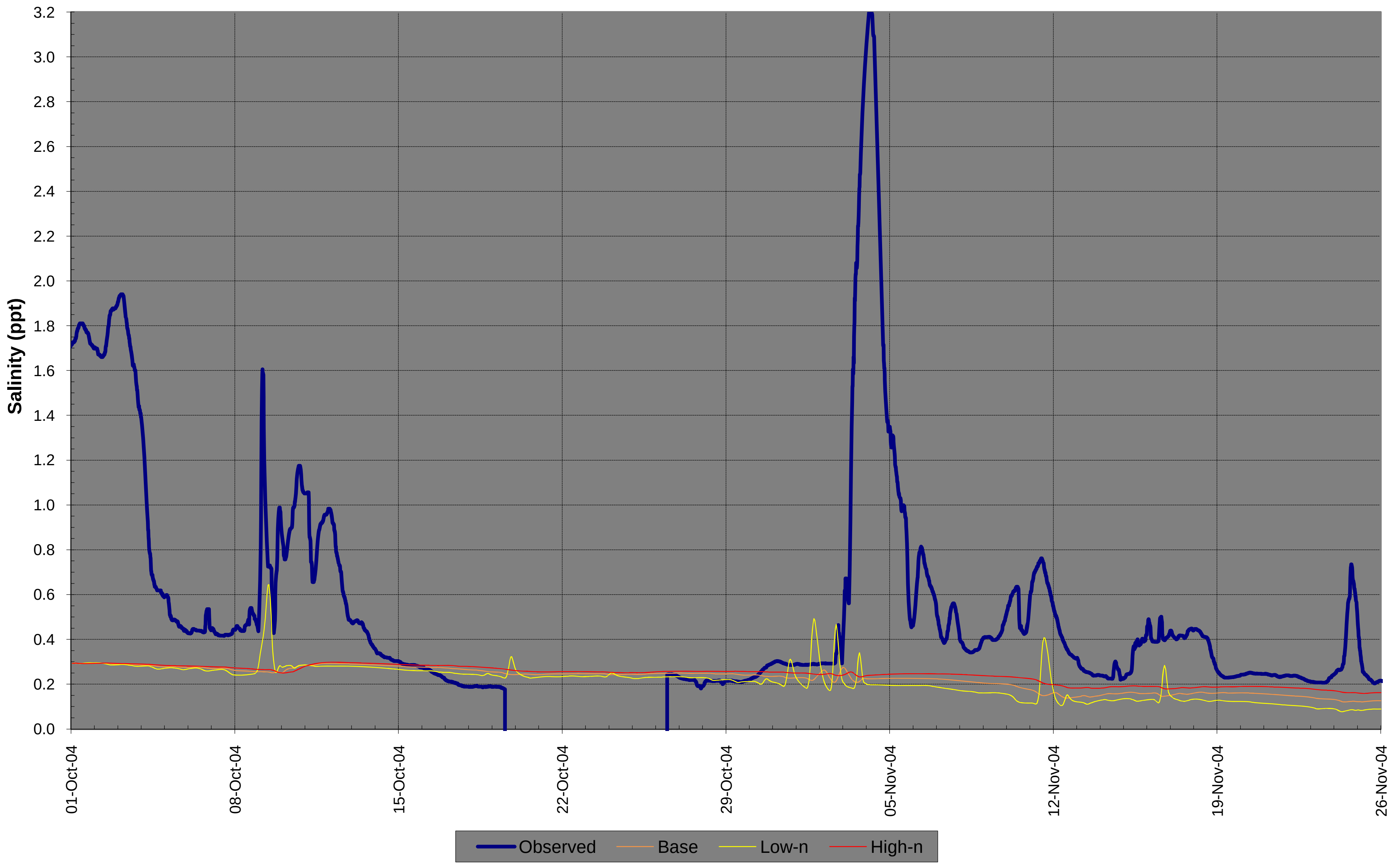


GIWW East of Bayou Lafourche
Station 4 - Node 21076
Salinity (ppt)
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-n
High-n

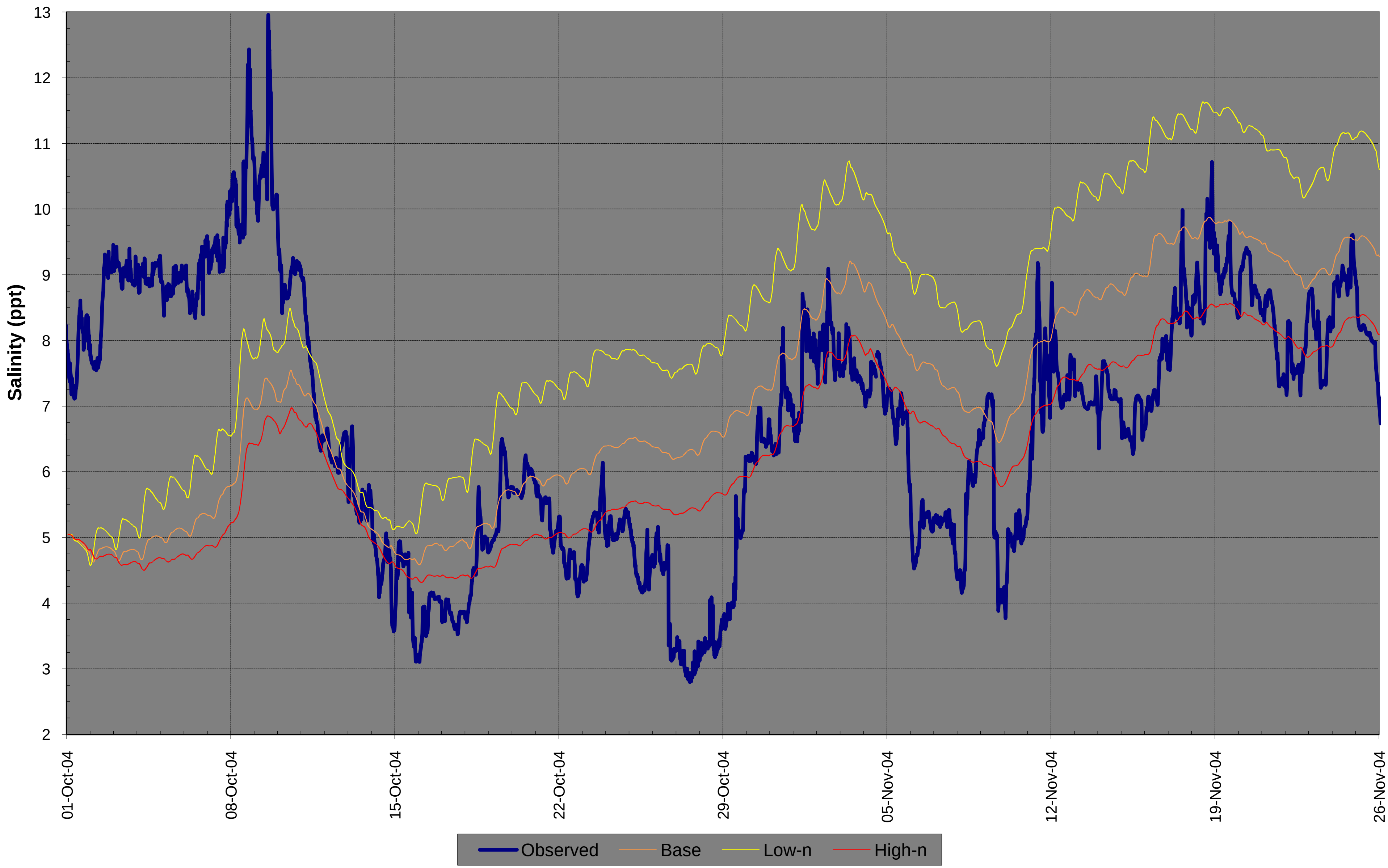


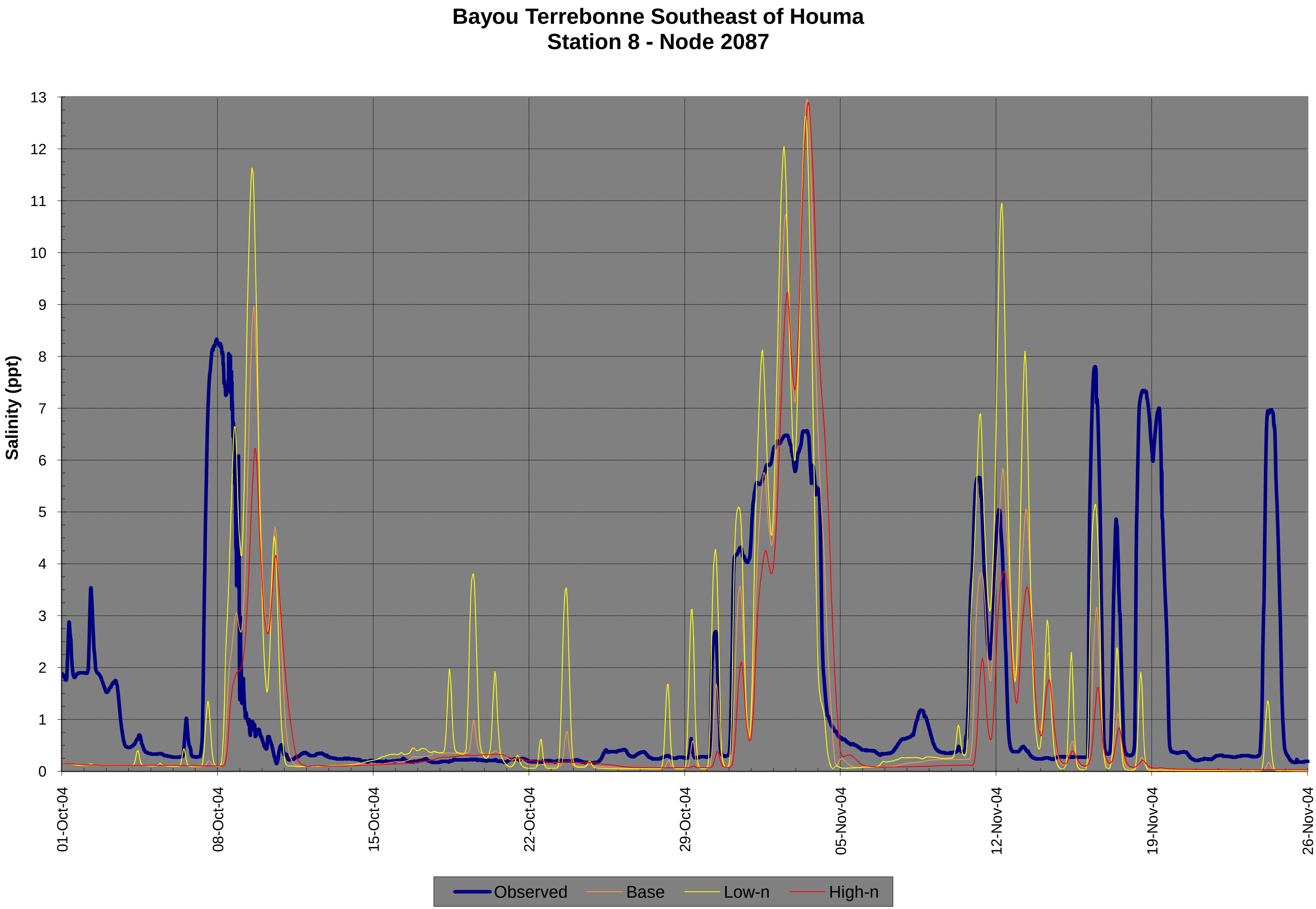
Bayou Lafourche south of GIWW
Station 5 - Node 21057
Salinity (ppt)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-n
High-n

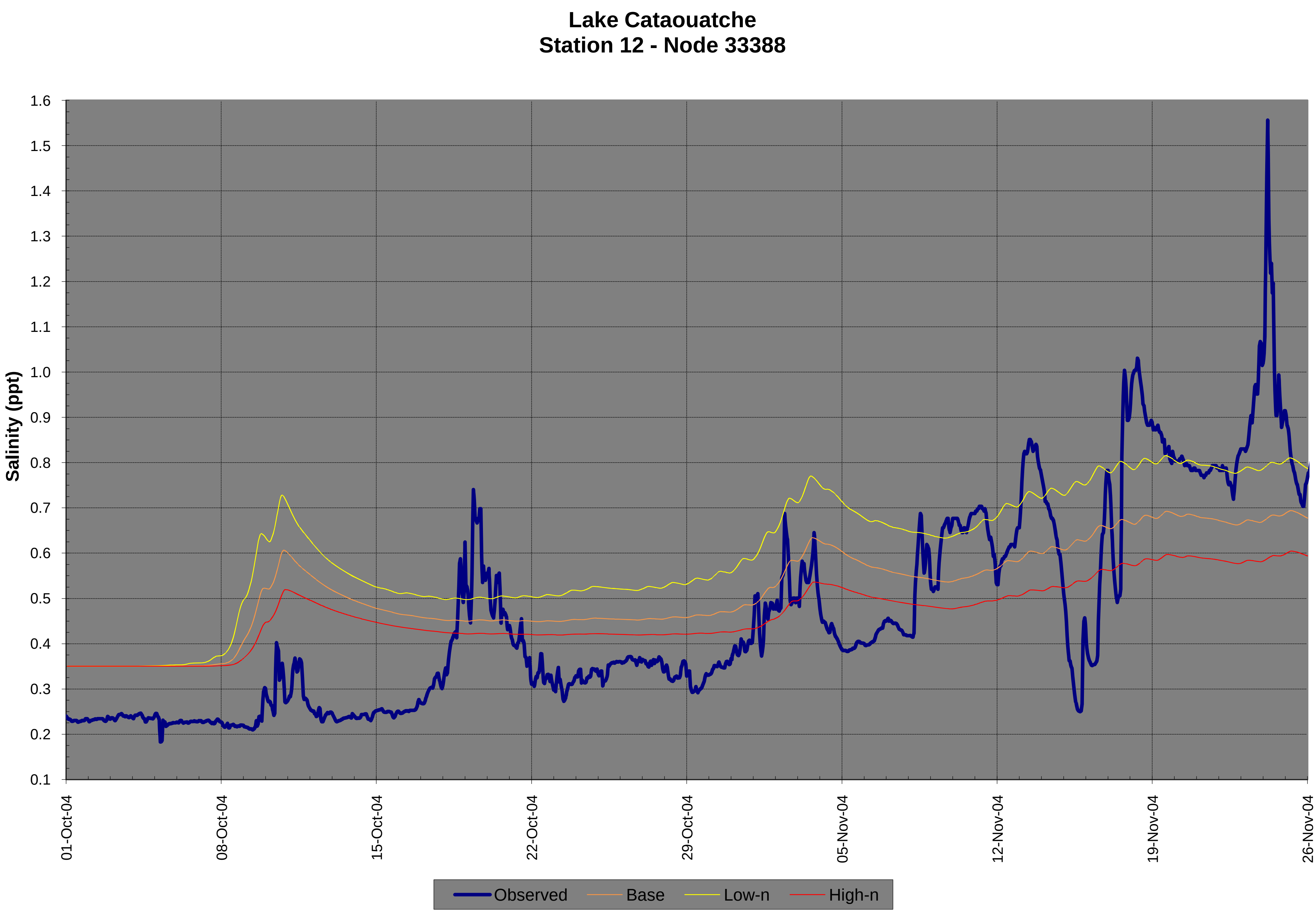
GIWW West of Bayou Lafourche
Station 6 - Node 15791

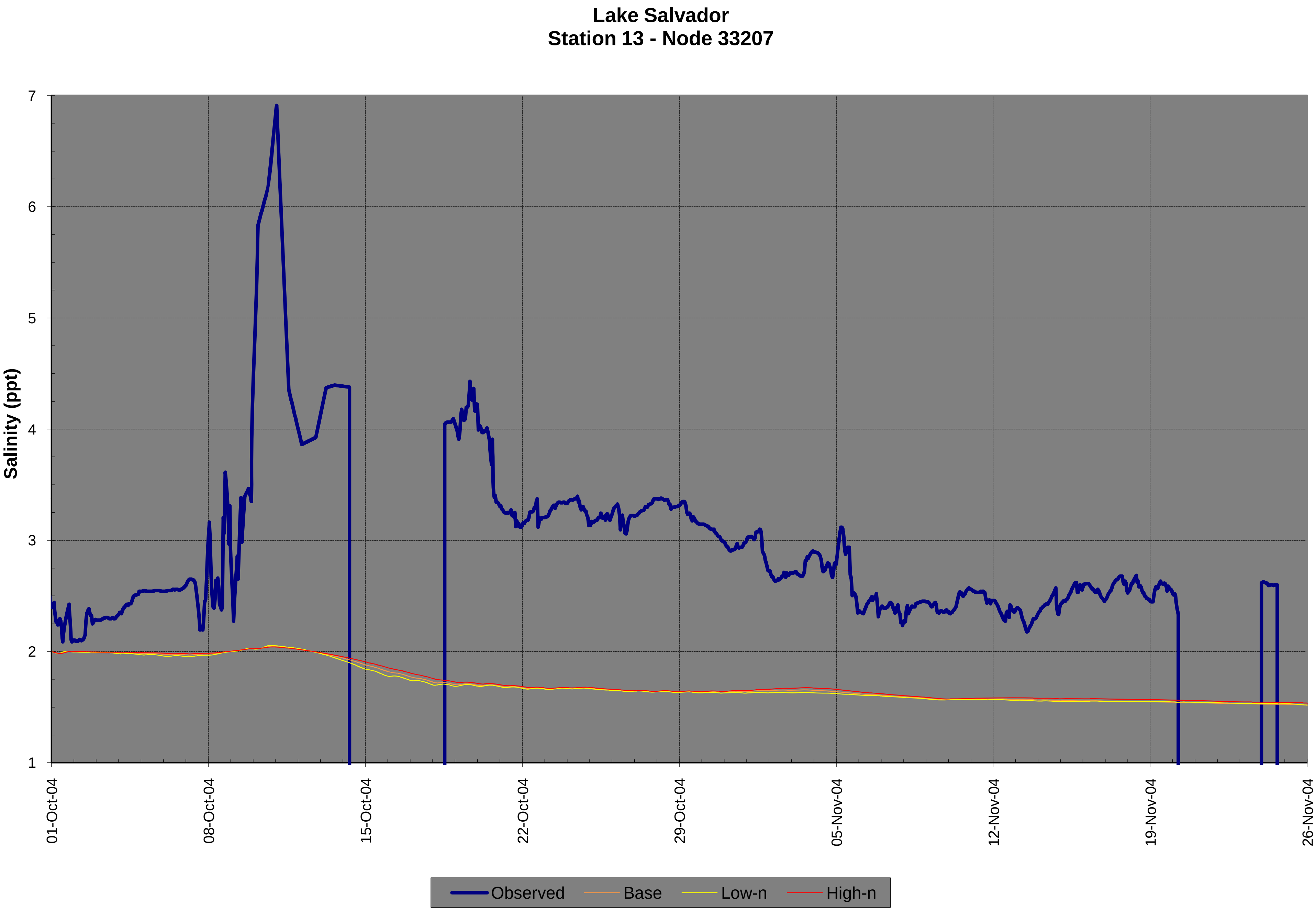


Sulphur Mine Canal Marsh East of Grand Bayou
Station 7 - Node 13044

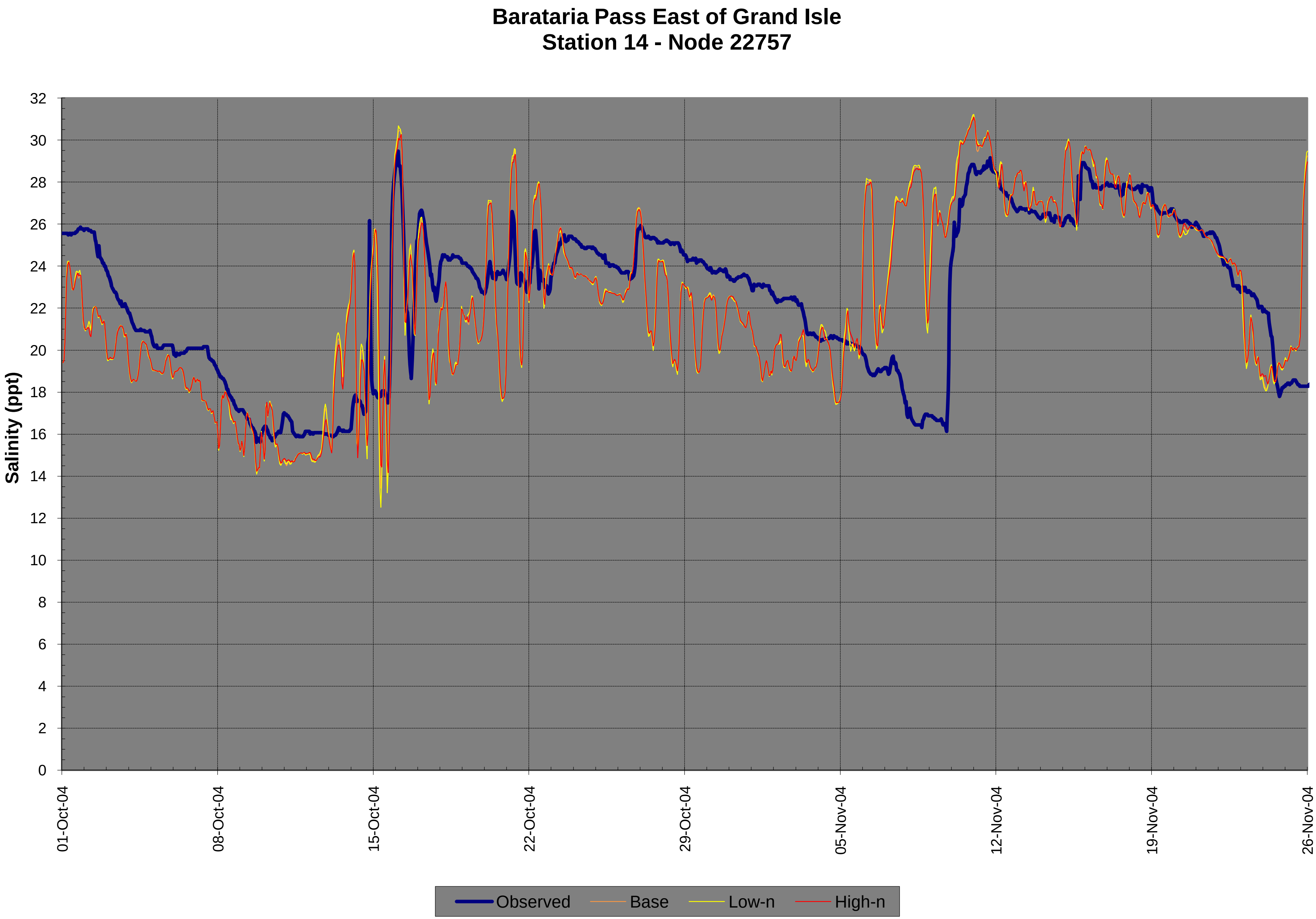



Bayou Terrebonne Southeast of Houma
Station 8 - Node 2087
Salinity (ppt)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-n
High-n

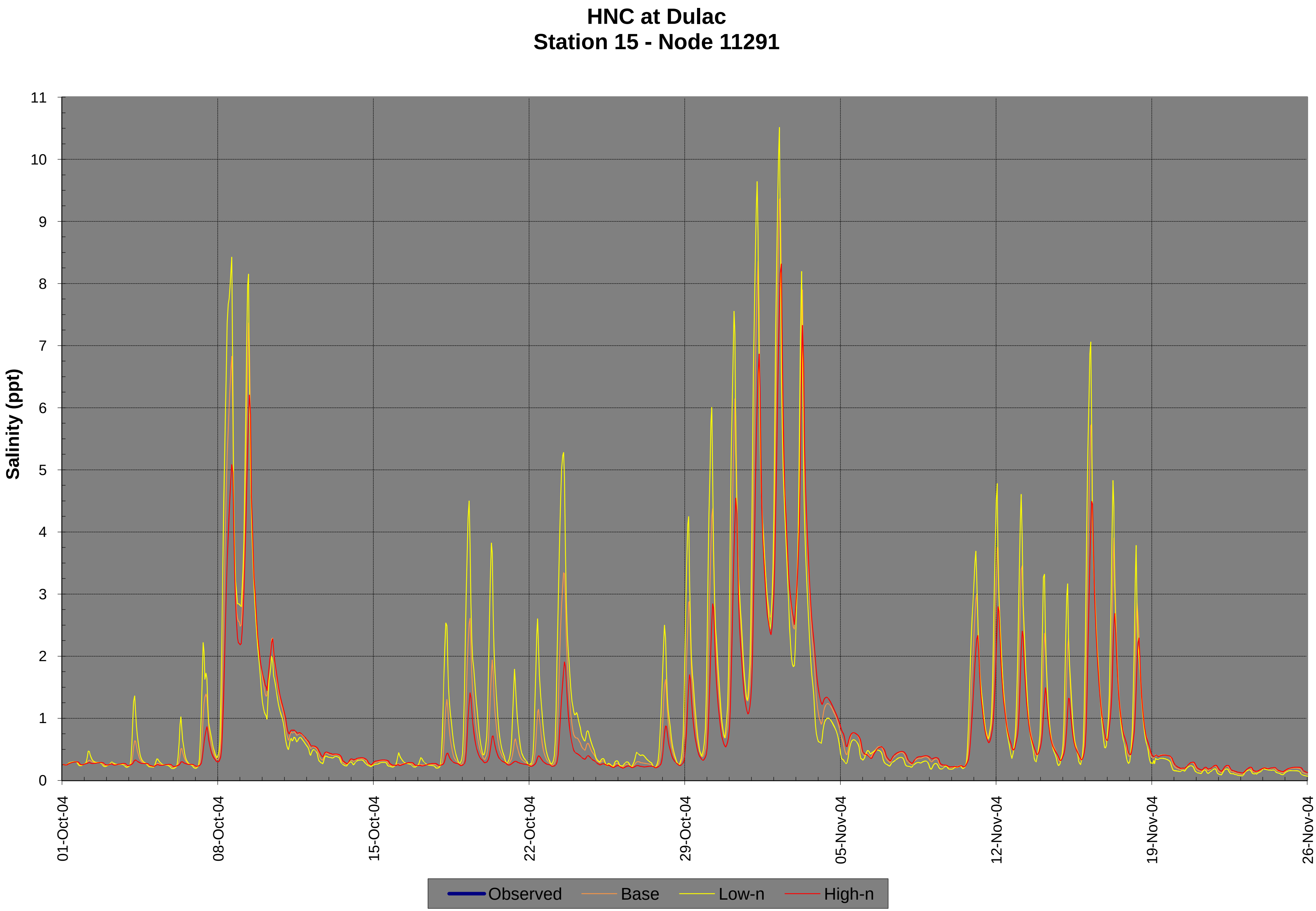

Lake Cataouatche
Station 12 - Node 33388
Salinity (ppt)
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-n
High-n

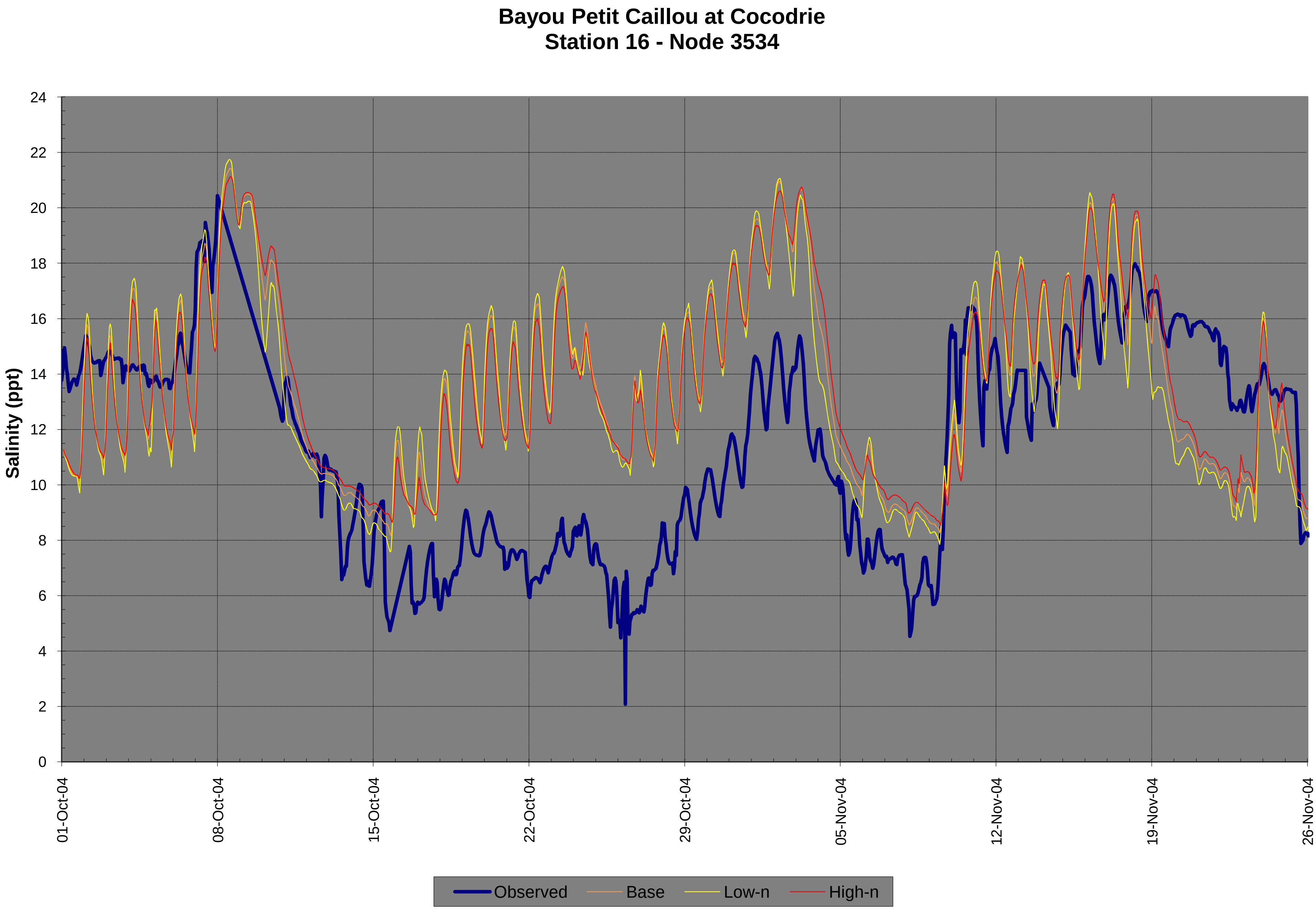


Lake Salvador
Station 13 - Node 33207
Salinity (ppt)
7
6
5
4
3
2
1
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-n
High-n

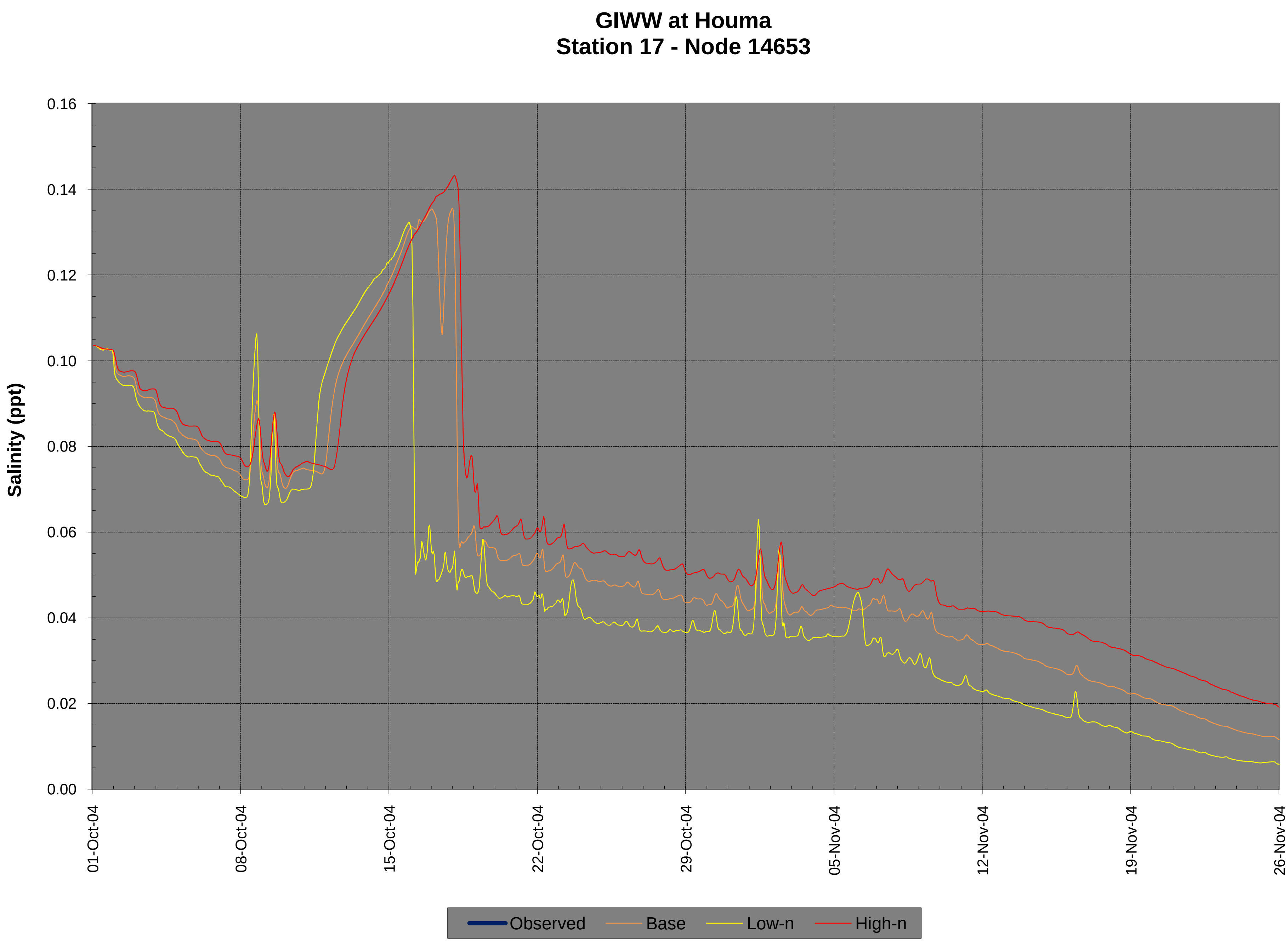


Barataria Pass East of Grand Isle
Station 14 - Node 22757
Salinity (ppt)
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-n
High-n


HNC at Dulac
Station 15 - Node 11291
Salinity (ppt)
0
1
2
3
4
5
6
7
8
9
10
11
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-n
High-n

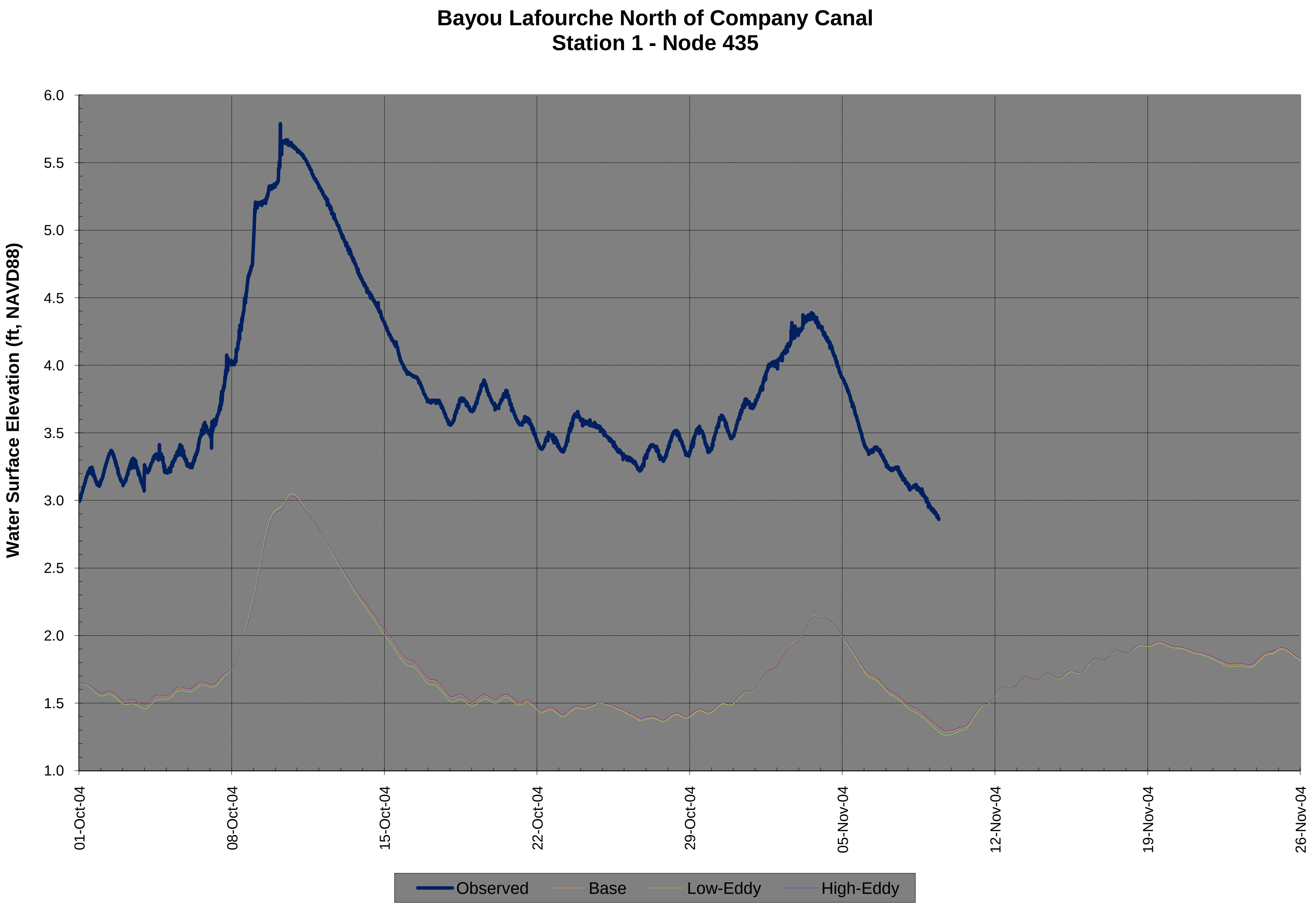


Bayou Petit Caillou at Cocodrie
Station 16 - Node 3534
Salinity (ppt)
24
22
20
18
16
14
12
10
8
6
4
2
0
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-n
High-n

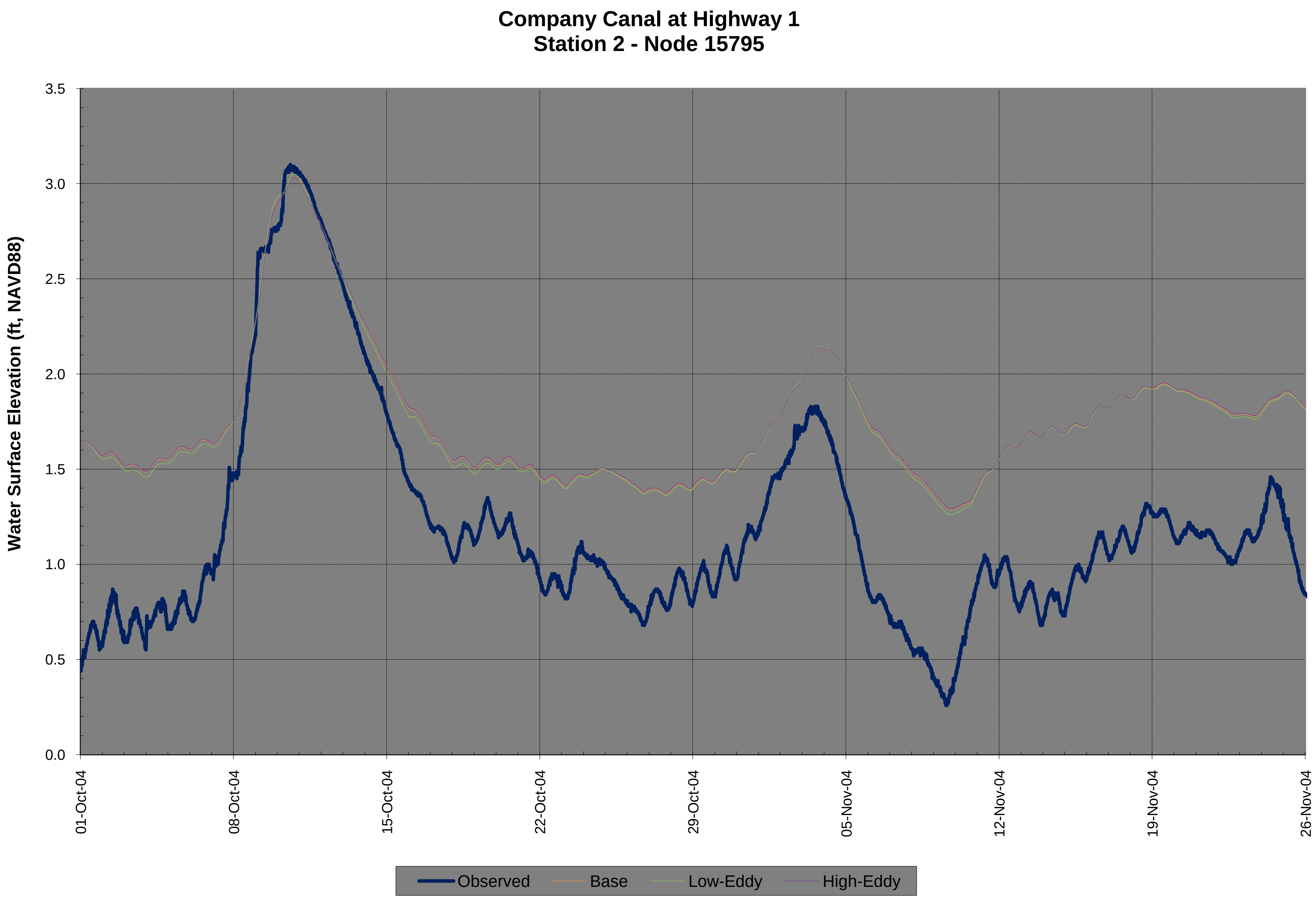

GIWW at Houma
Station 17 - Node 14653
Salinity (ppt)
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-n
High-n

APPENDIX B

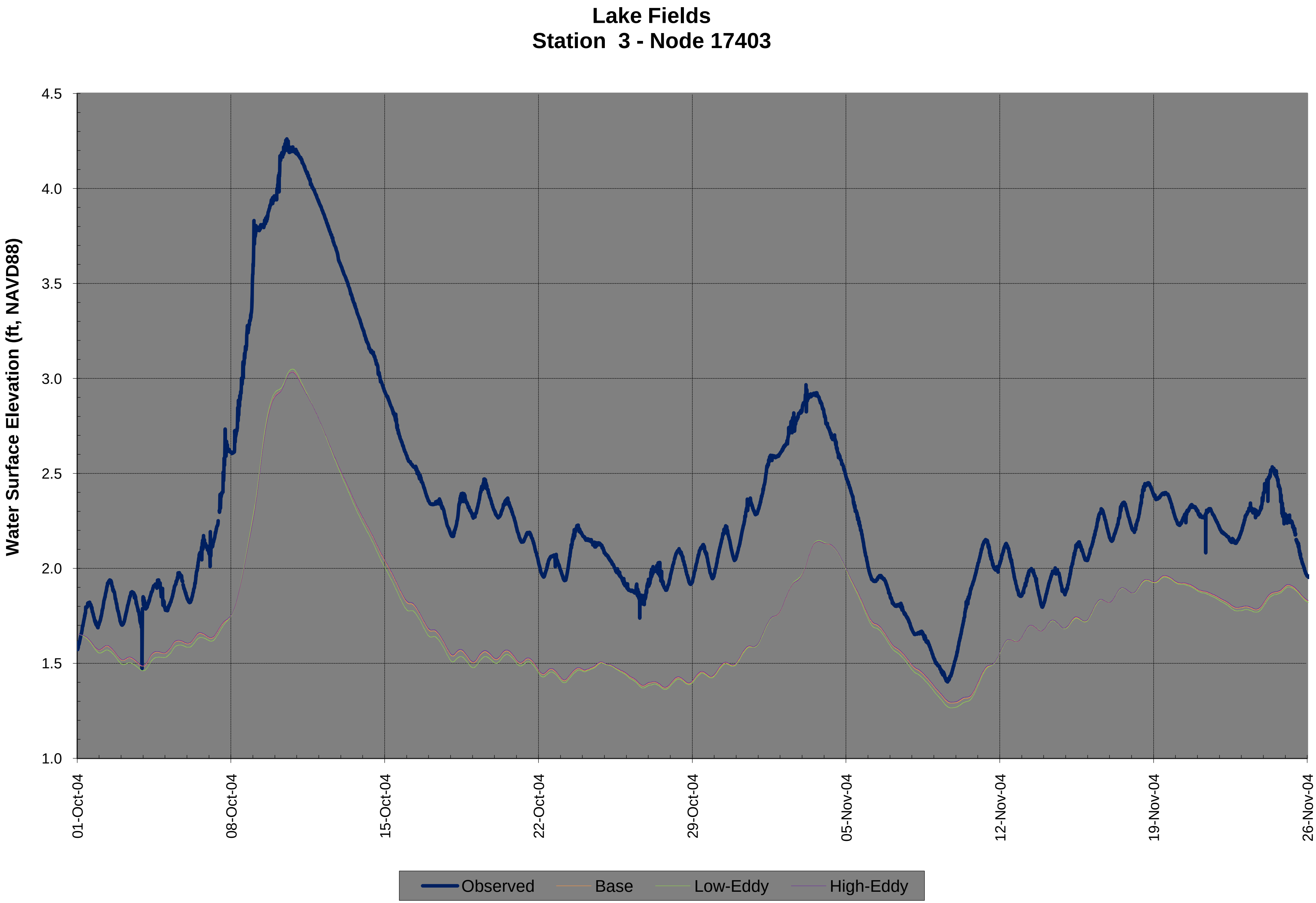
Water Surface Elevation and Salinity Time-Series Plots for Eddy Coefficient Sensitivity Analysis



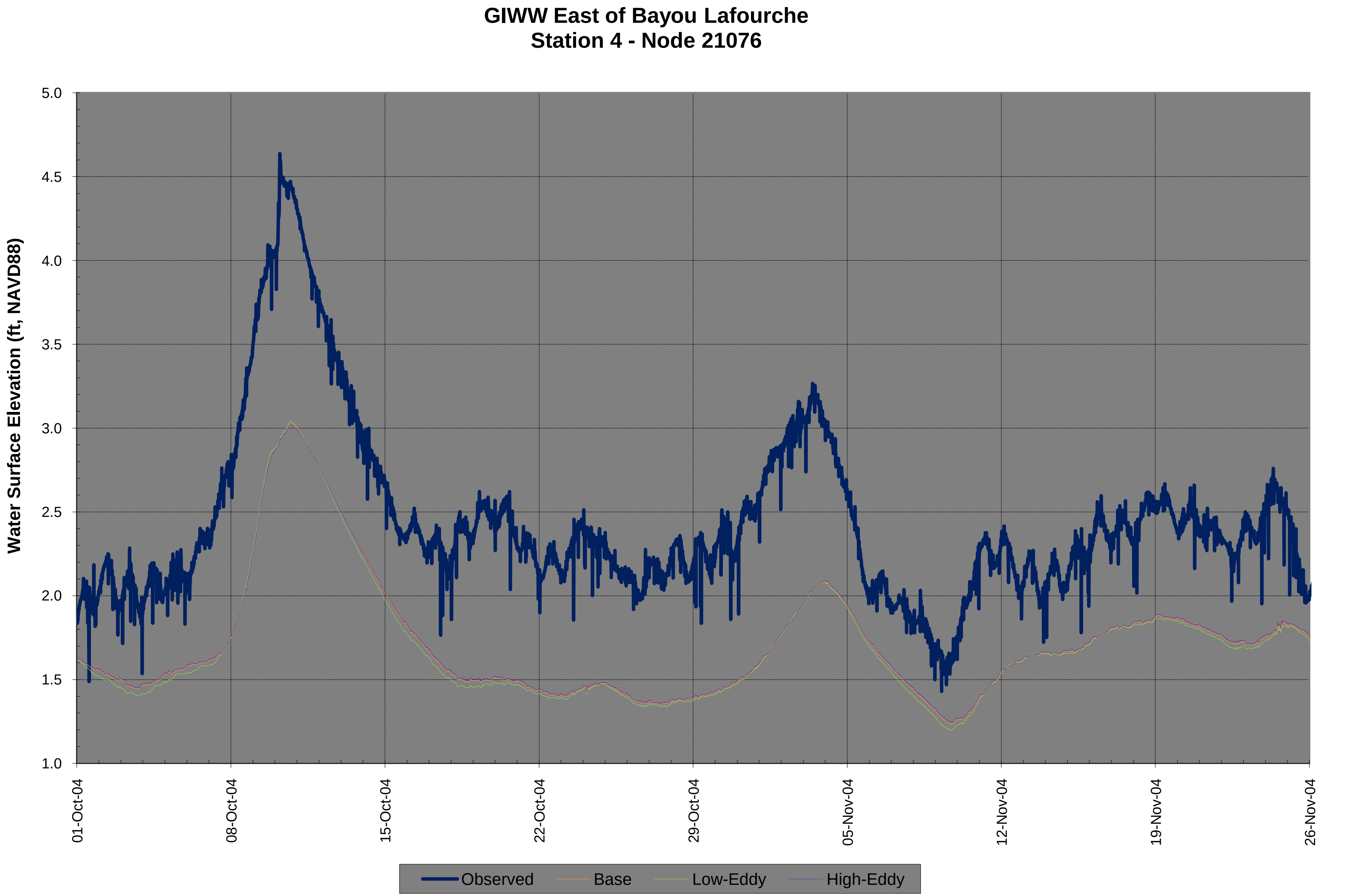
Bayou Lafourche North of Company Canal
Station 1 - Node 435
Water Surface Elevation (ft, NAVD88)
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Eddy
High-Eddy

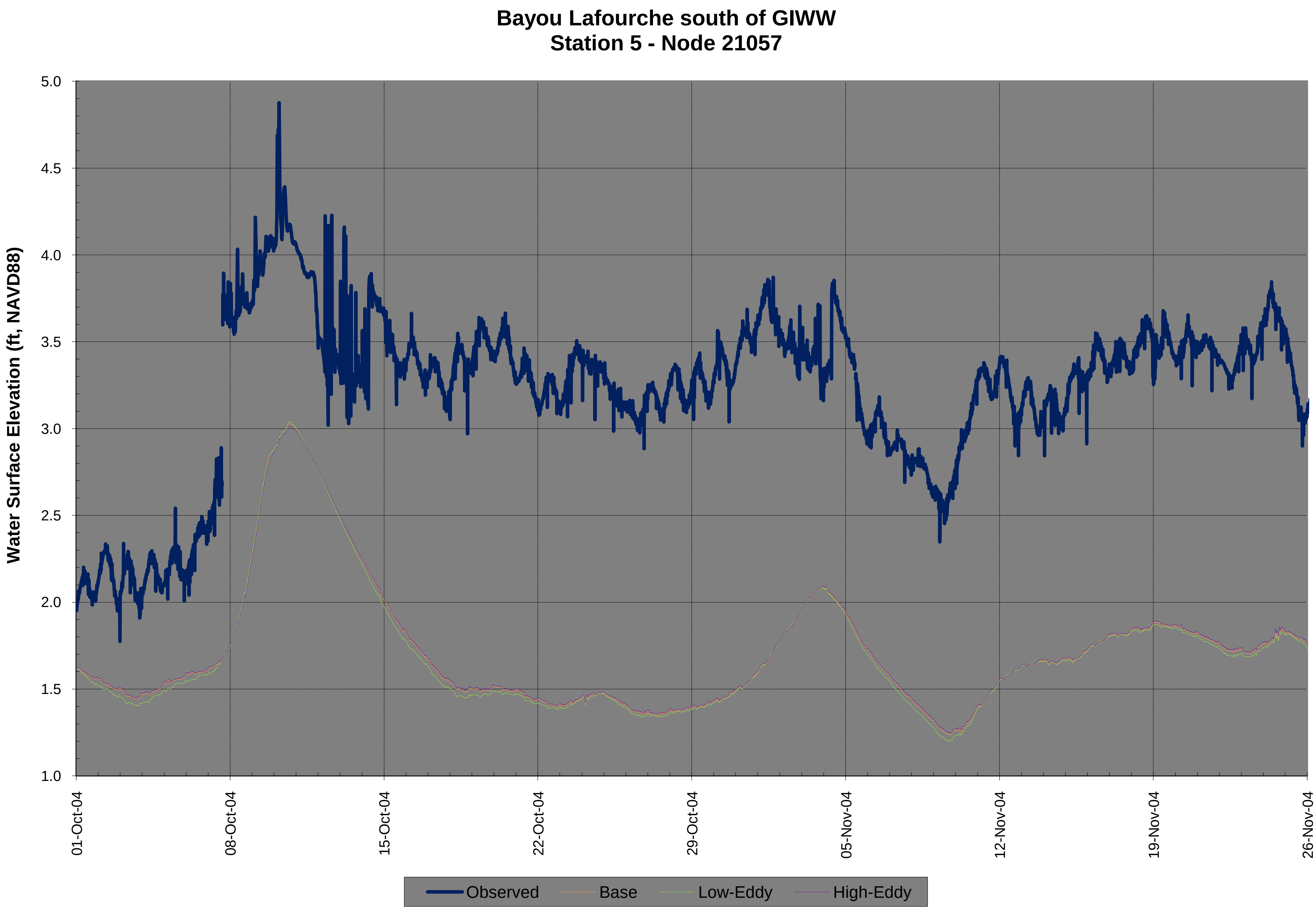


Company Canal at Highway 1
Station 2 - Node 15795
Water Surface Elevation (ft, NAVD88)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Eddy
High-Eddy

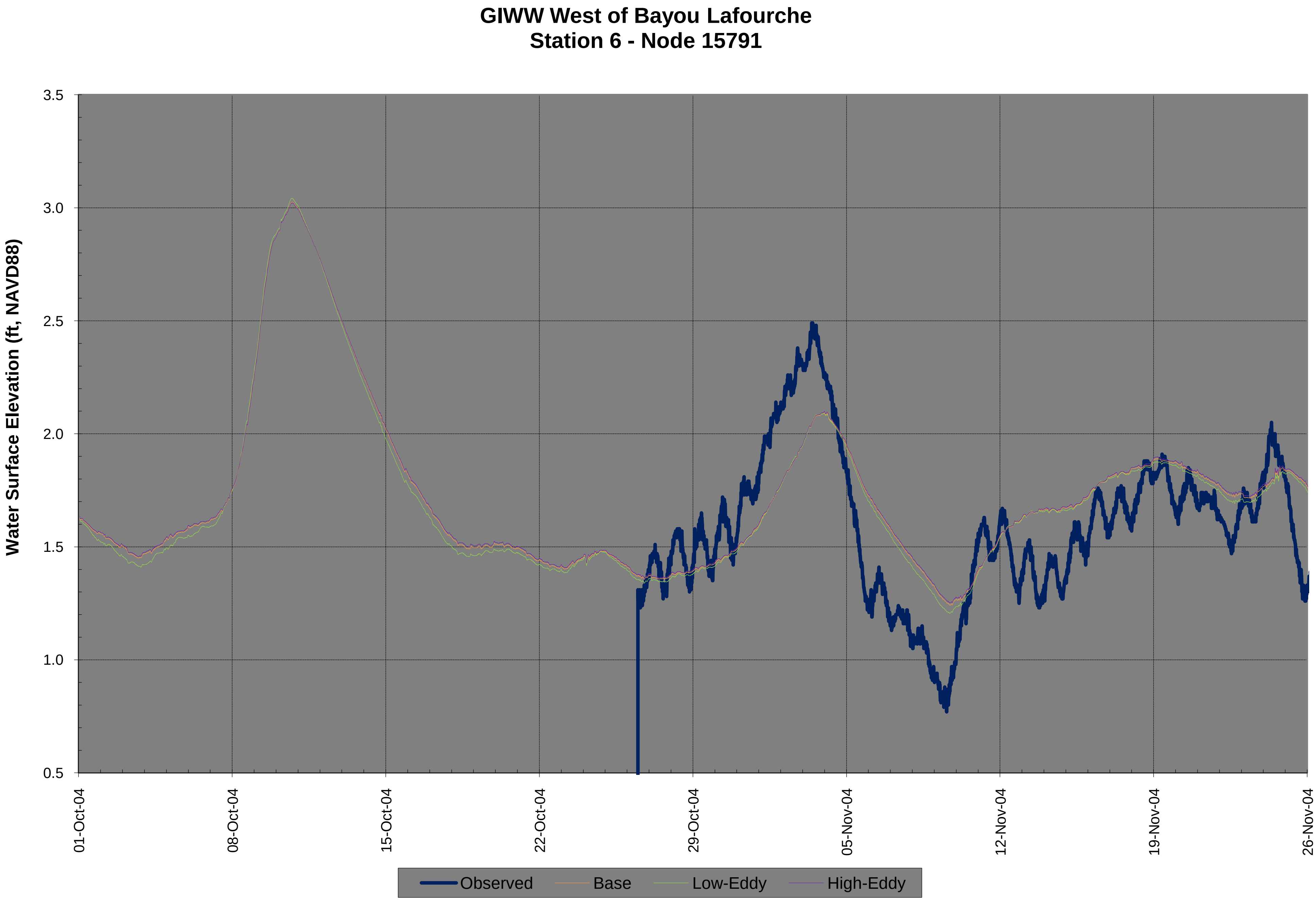


Lake Fields
Station 3 - Node 17403
Water Surface Elevation (ft, NAVD88)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Eddy
High-Eddy

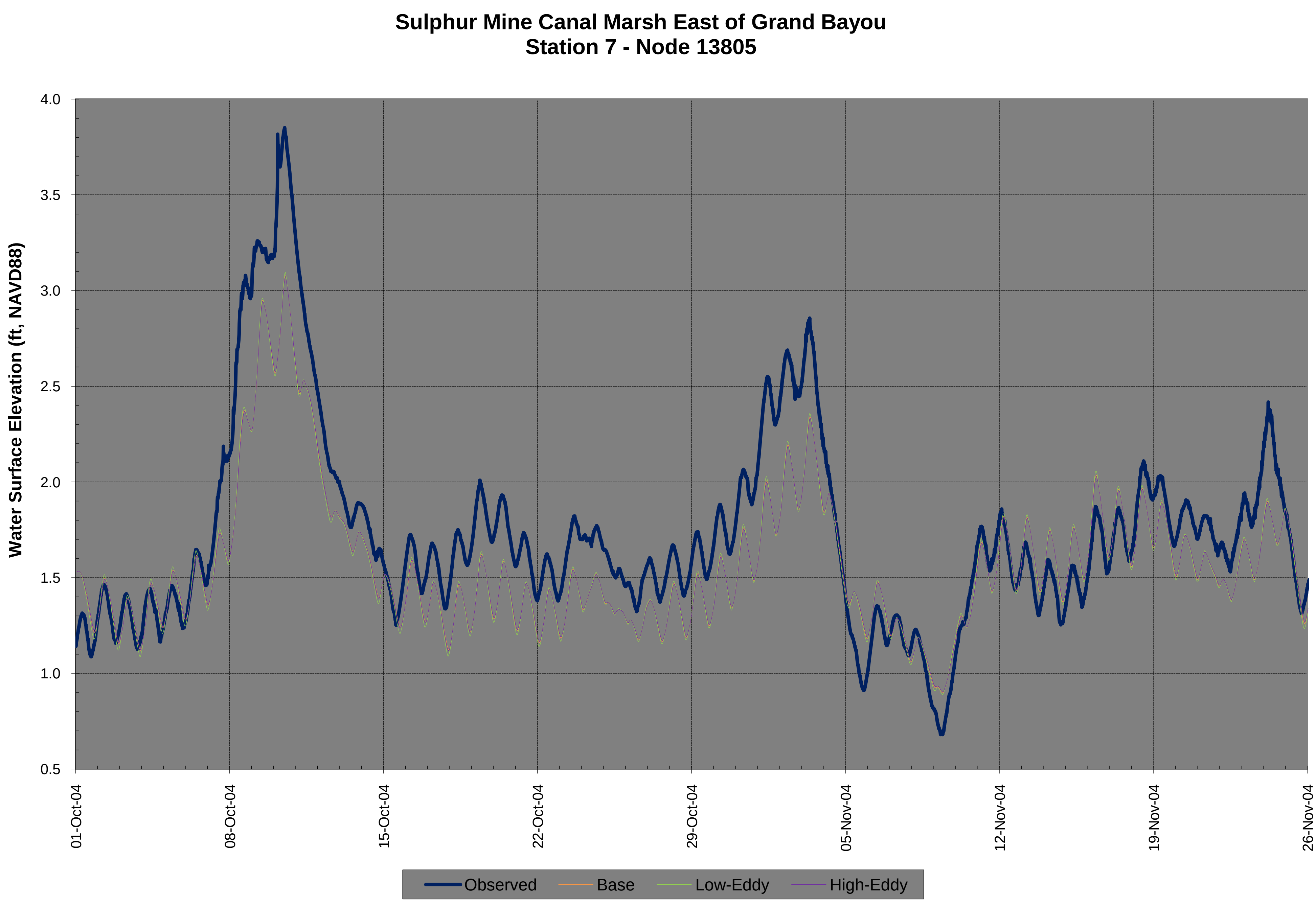

GIWW East of Bayou Lafourche
Station 4 - Node 21076
Water Surface Elevation (ft, NAVD88)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Eddy
High-Eddy



Bayou Lafourche south of GIWW
Station 5 - Node 21057
Water Surface Elevation (ft, NAVD88)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Eddy
High-Eddy

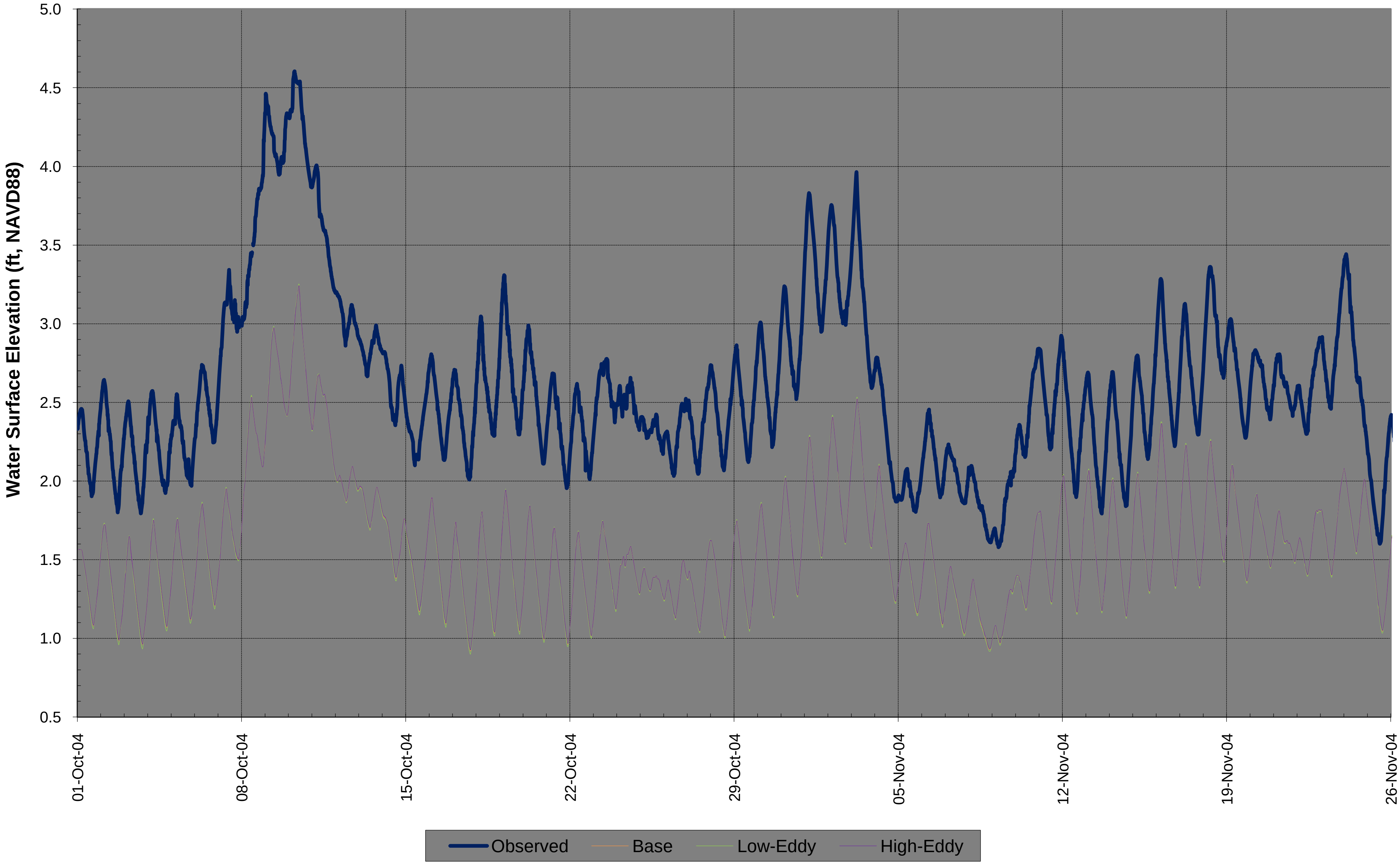


GIWW West of Bayou Lafourche
Station 6 - Node 15791
Water Surface Elevation (ft, NAVD88)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Eddy
High-Eddy

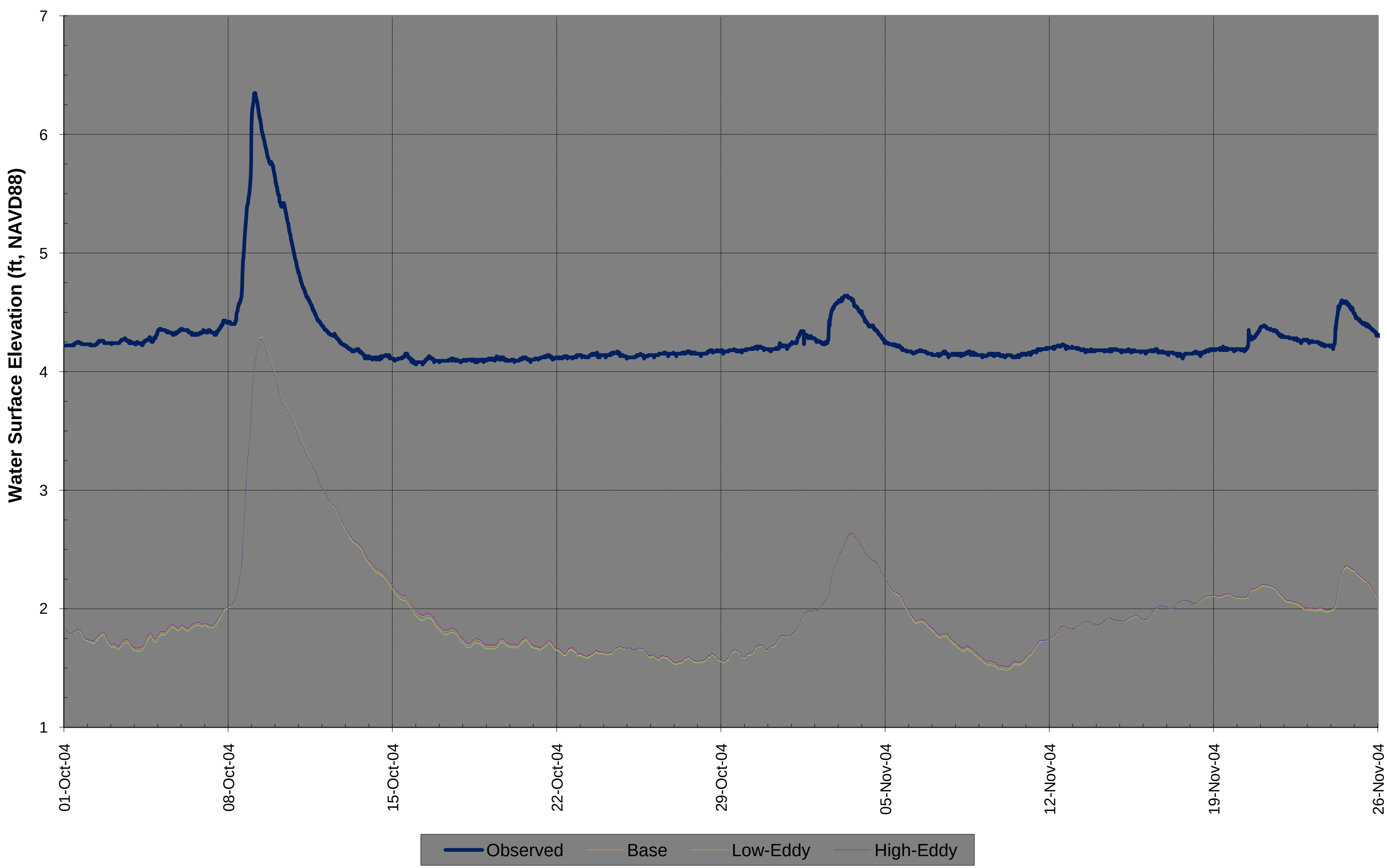


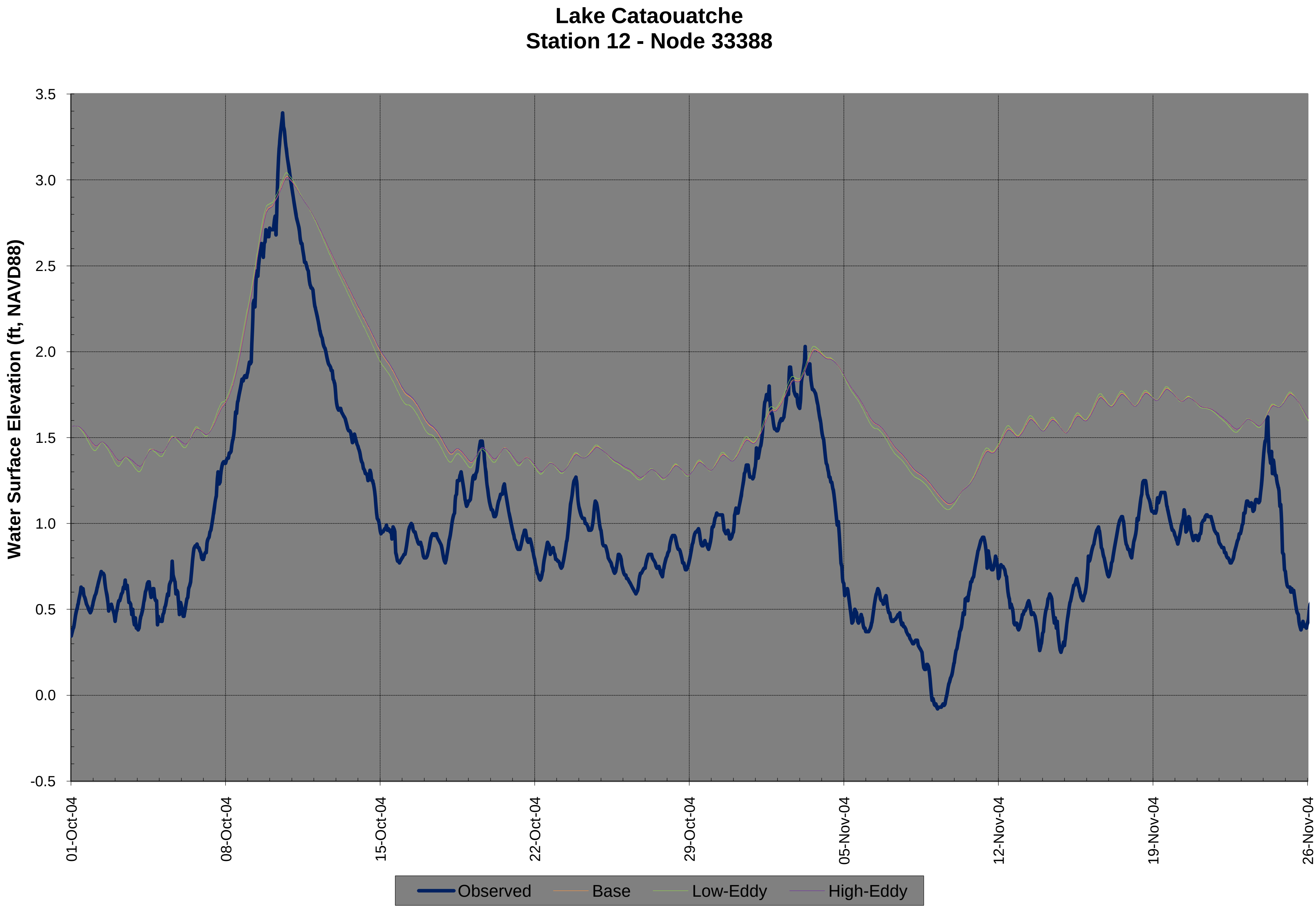
Sulphur Mine Canal Marsh East of Grand Bayou
Station 7 - Node 13805
Water Surface Elevation (ft, NAVD88)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Eddy
High-Eddy

Bayou Terrebonne Southeast of Houma
Station 8 - Node 2087

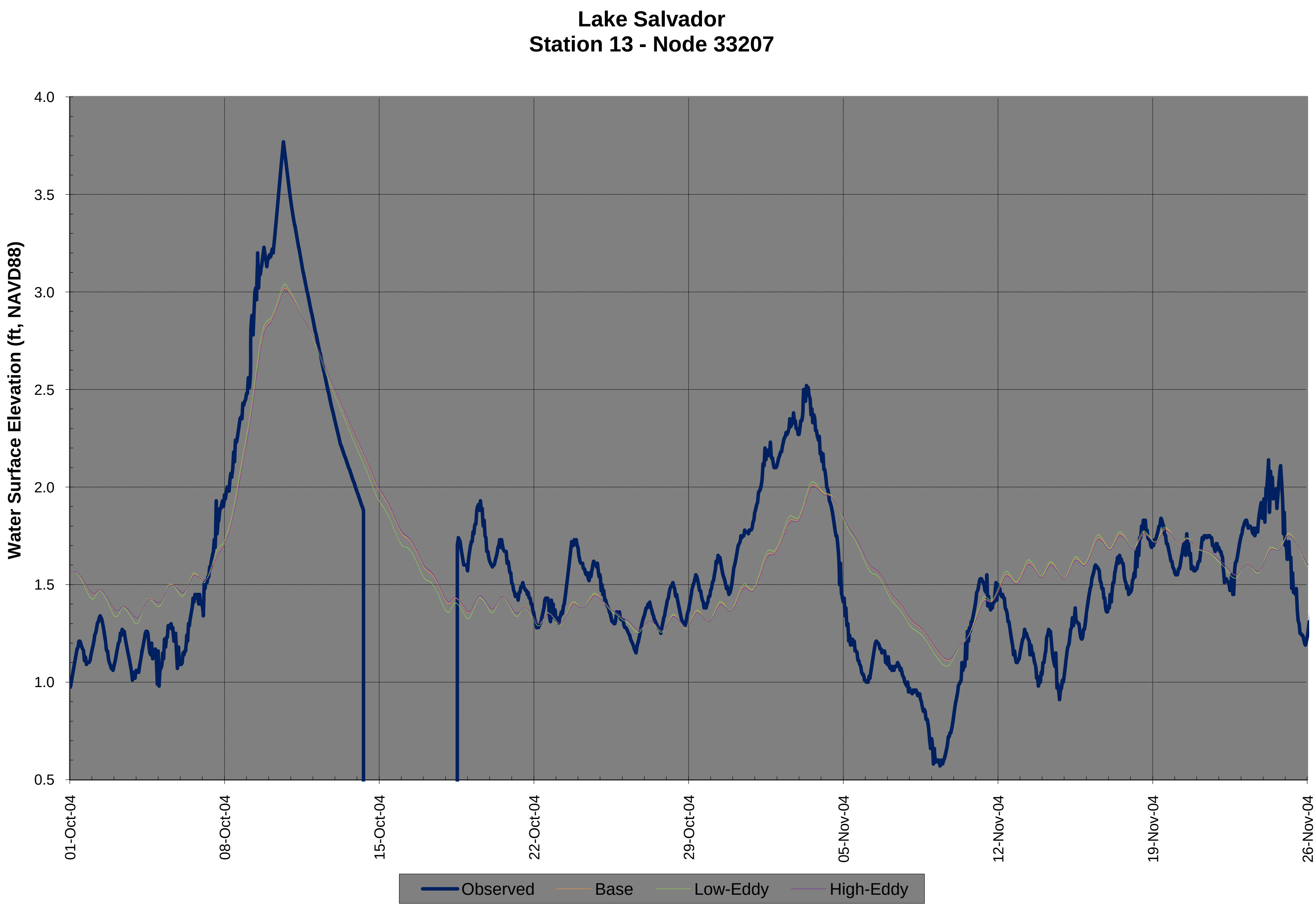


Bayou Lafourche at Thibodaux
Station 10 - Node 163

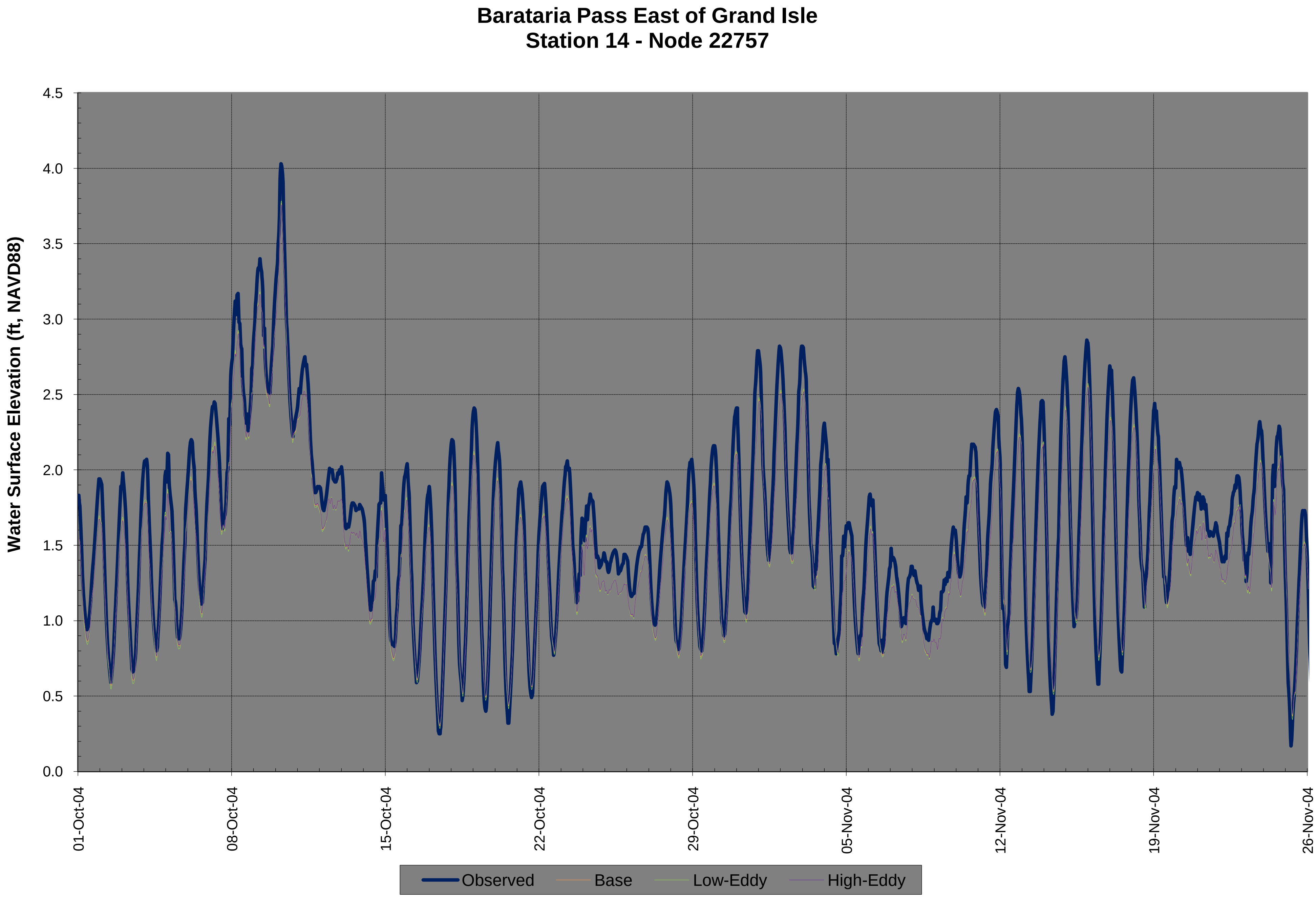




Lake Cataouatche
Station 12 - Node 33388
Water Surface Elevation (ft, NAVD88)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Eddy
High-Eddy

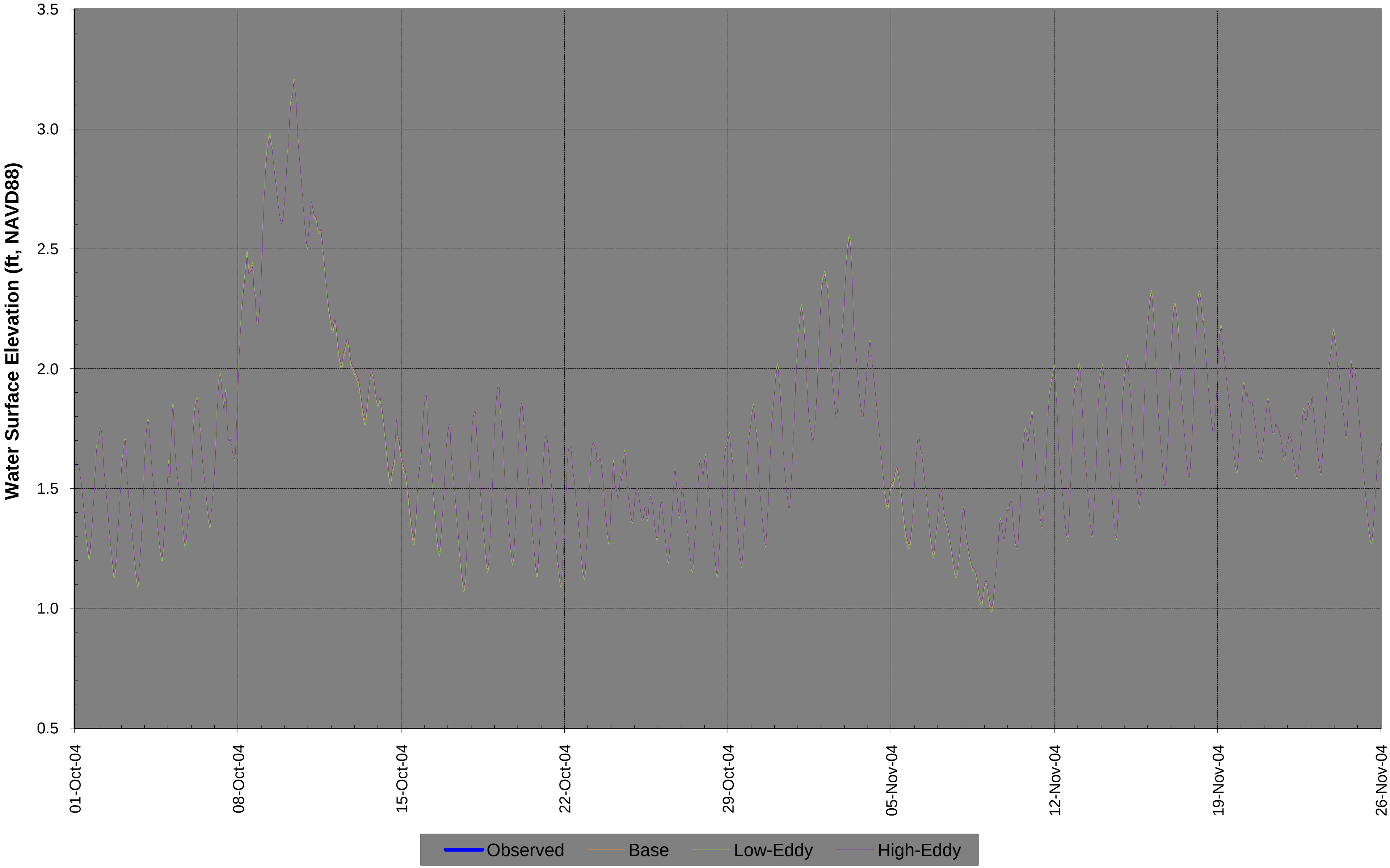


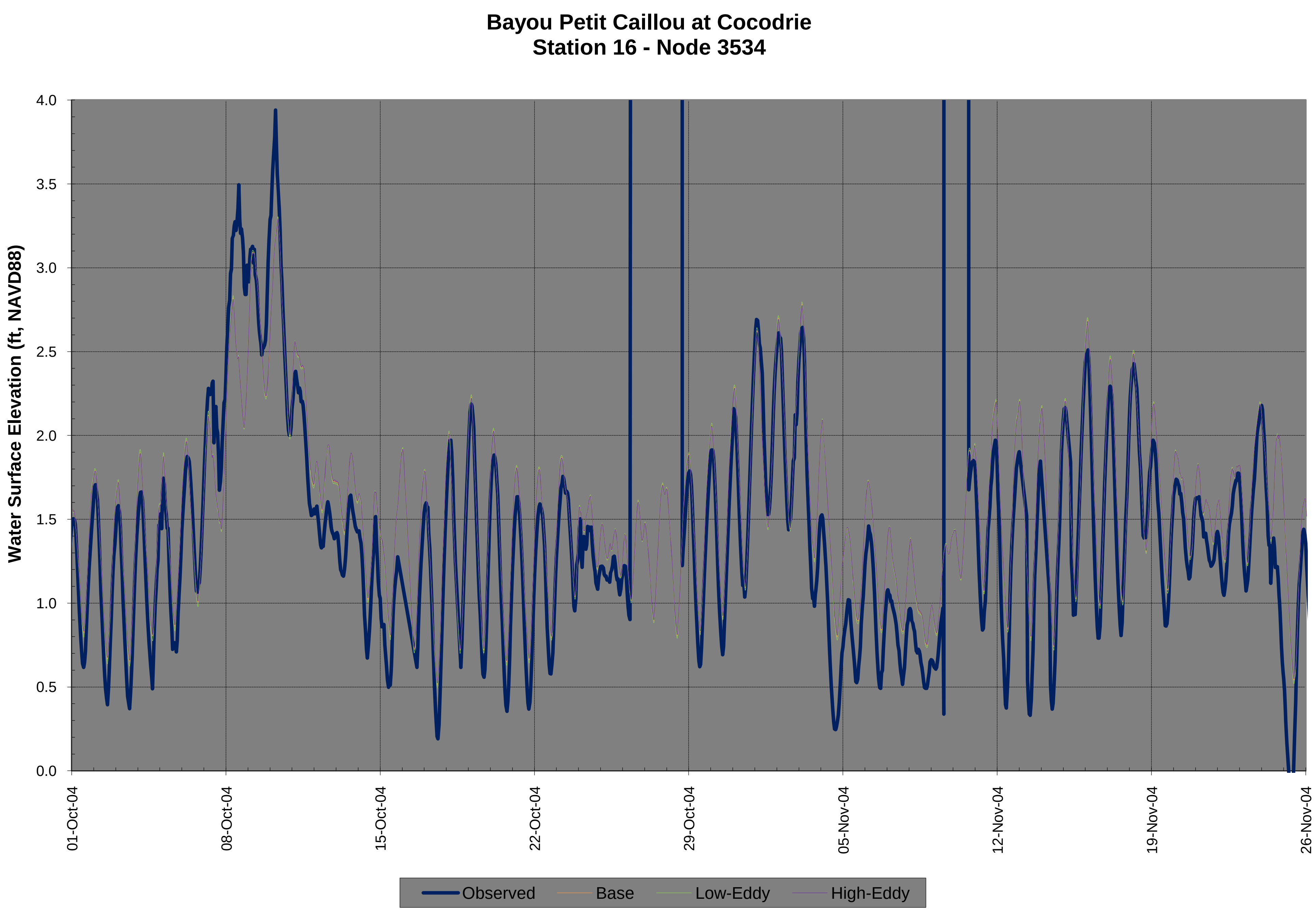
Lake Salvador
Station 13 - Node 33207
Water Surface Elevation (ft, NAVD88)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Eddy
High-Eddy

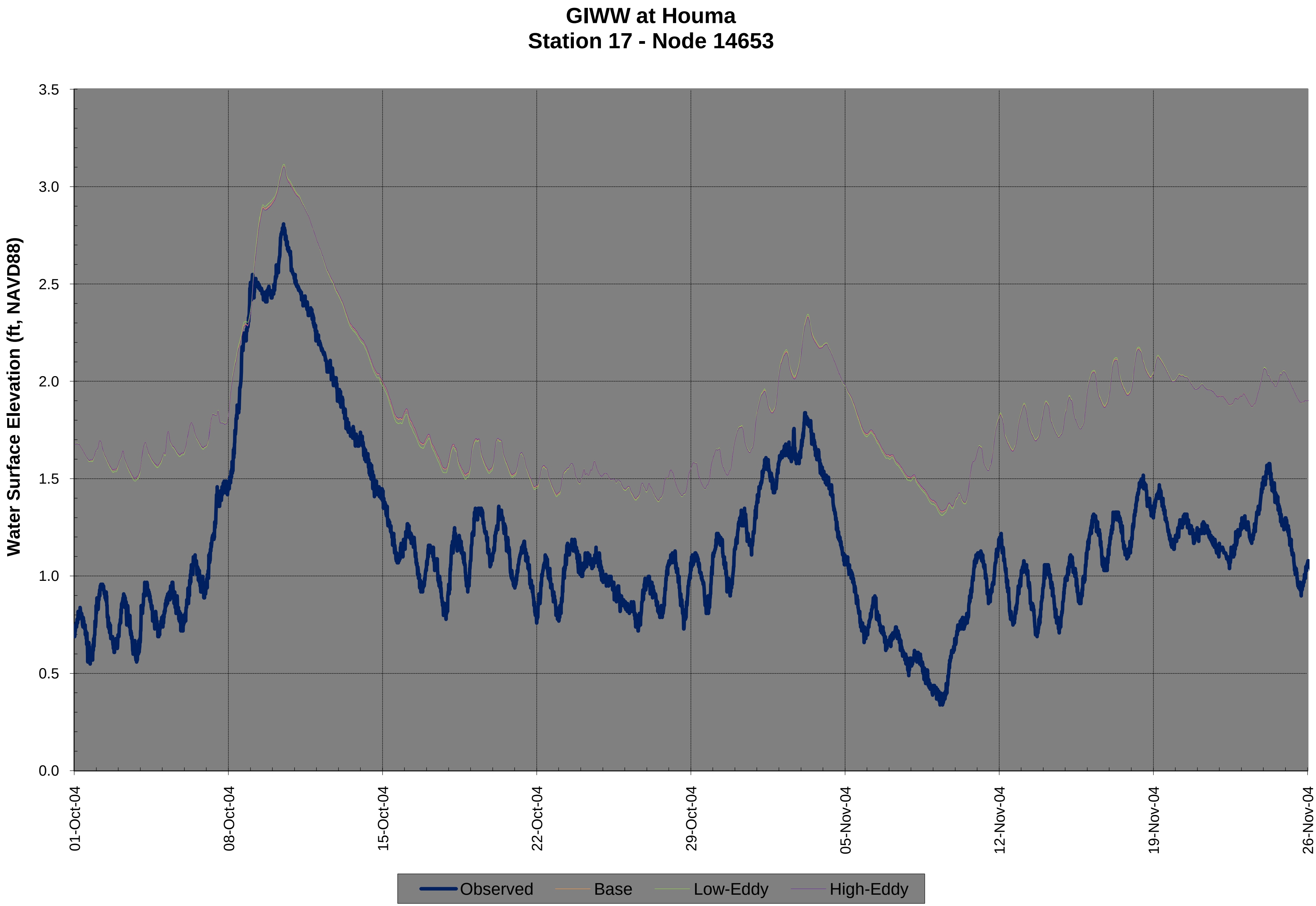


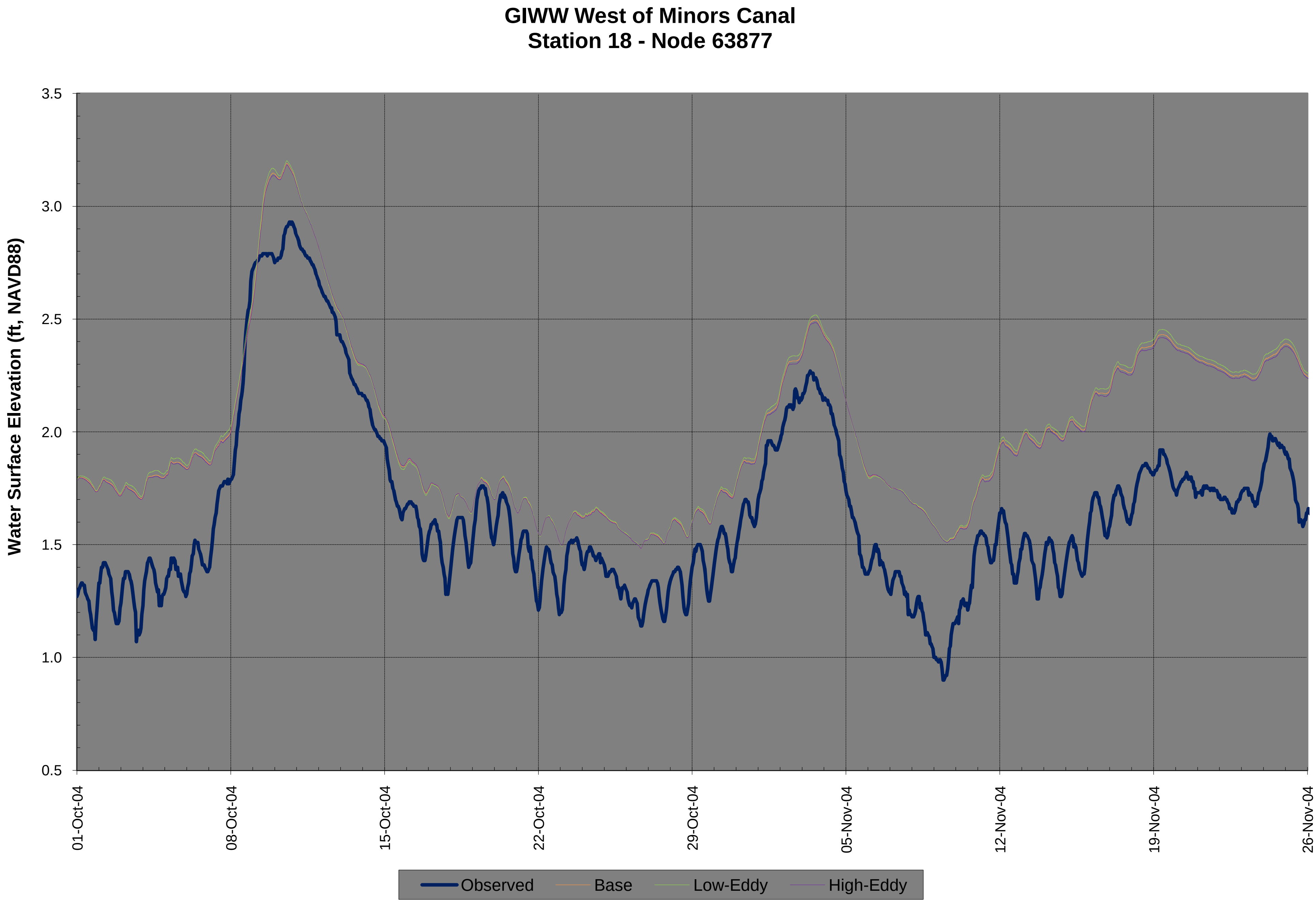
Barataria Pass East of Grand Isle
Station 14 - Node 22757
Water Surface Elevation (ft, NAVD88)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Eddy
High-Eddy

HNC at Dulac
Station 15 - Node 11291

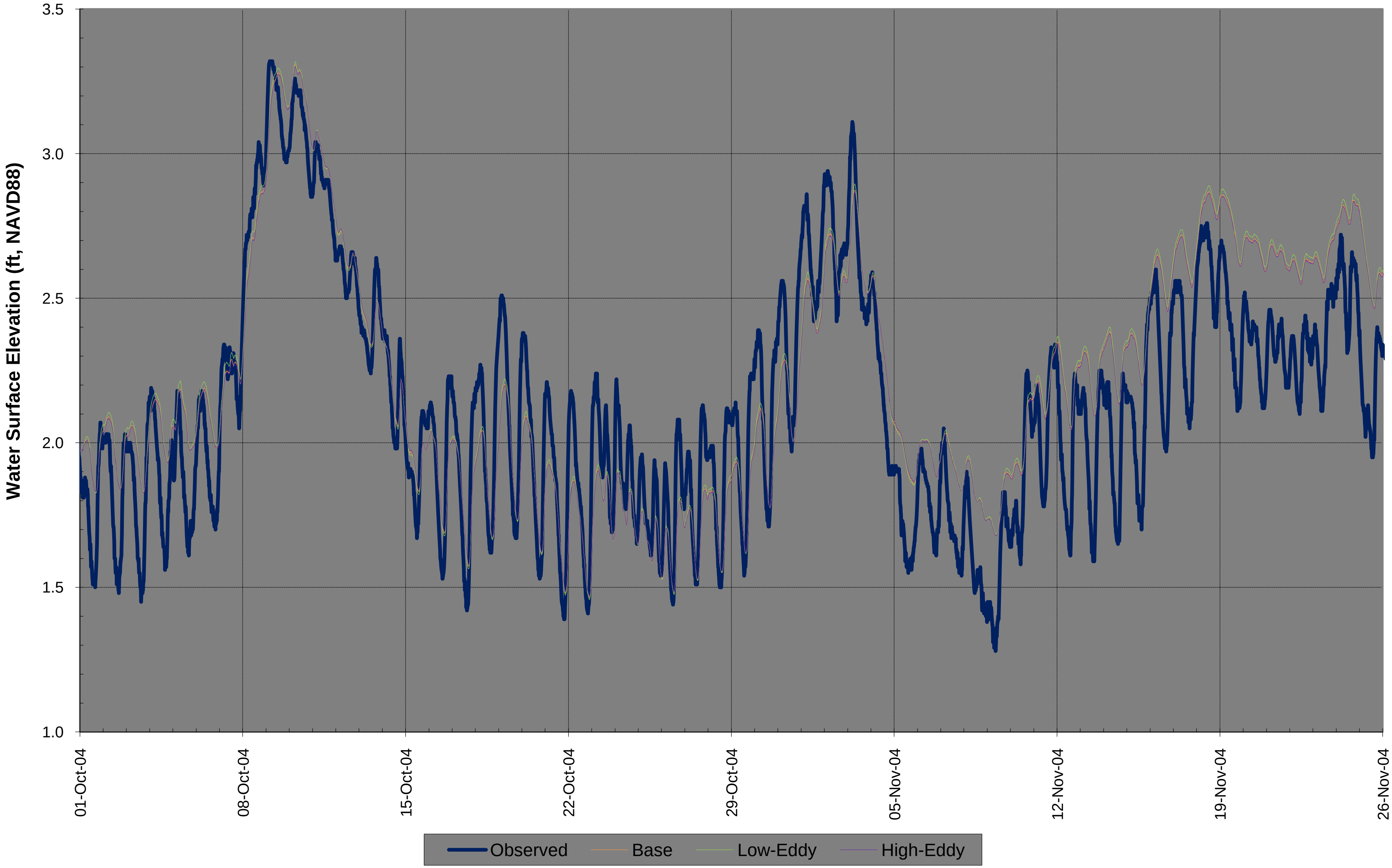



Bayou Petit Caillou at Cocodrie
Station 16 - Node 3534
Water Surface Elevation (ft, NAVD88)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Eddy
High-Eddy

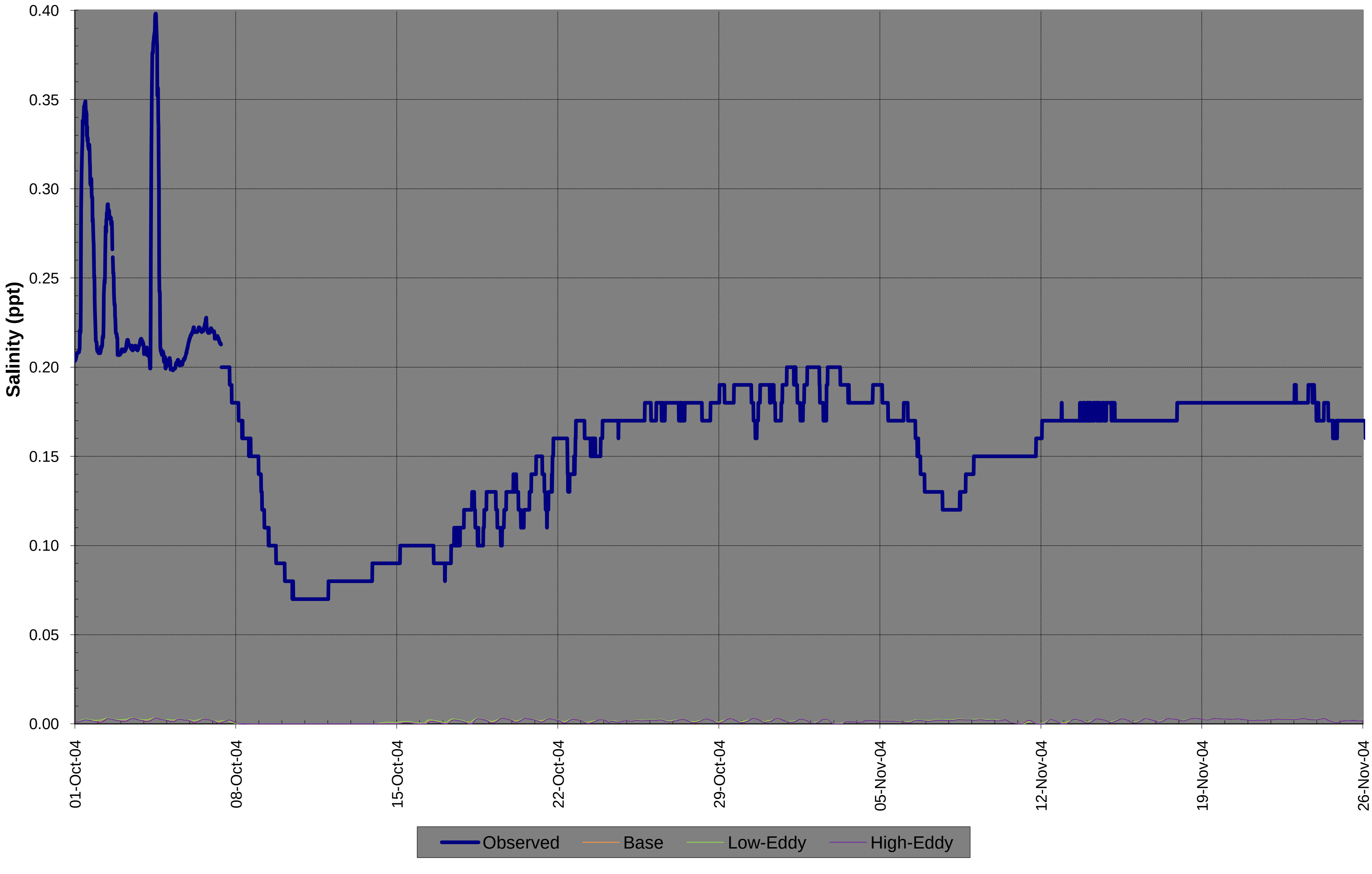

GIWW at Houma
Station 17 - Node 14653
Water Surface Elevation (ft, NAVD88)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Eddy
High-Eddy

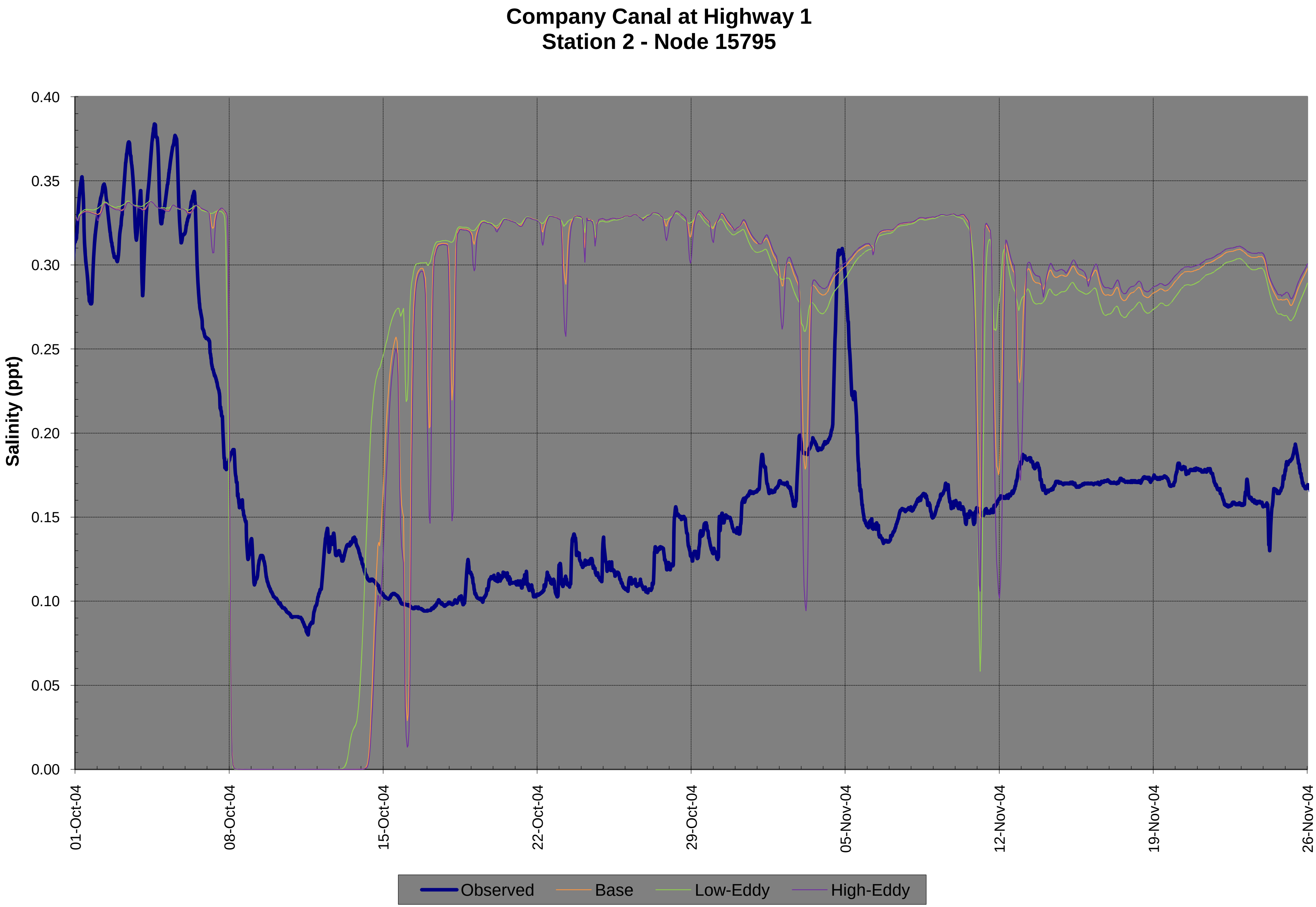

GIWW West of Minors Canal
Station 18 - Node 63877
Water Surface Elevation (ft, NAVD88)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Eddy
High-Eddy

Bayou Penchant East of Avoca Island Cutoff
Station 19 - Node 64672

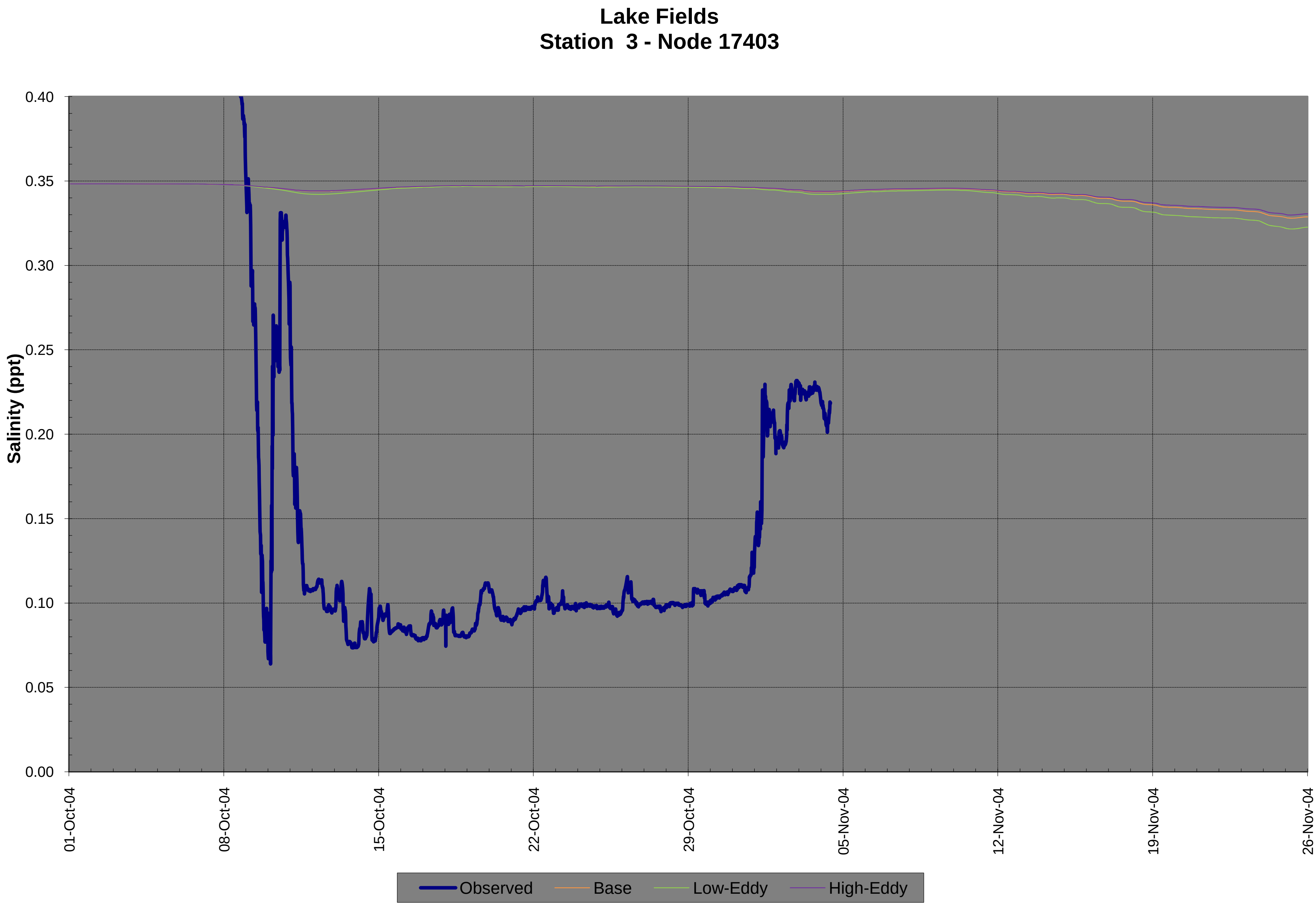


Bayou Lafourche North of Company Canal
Station 1 - Node 435



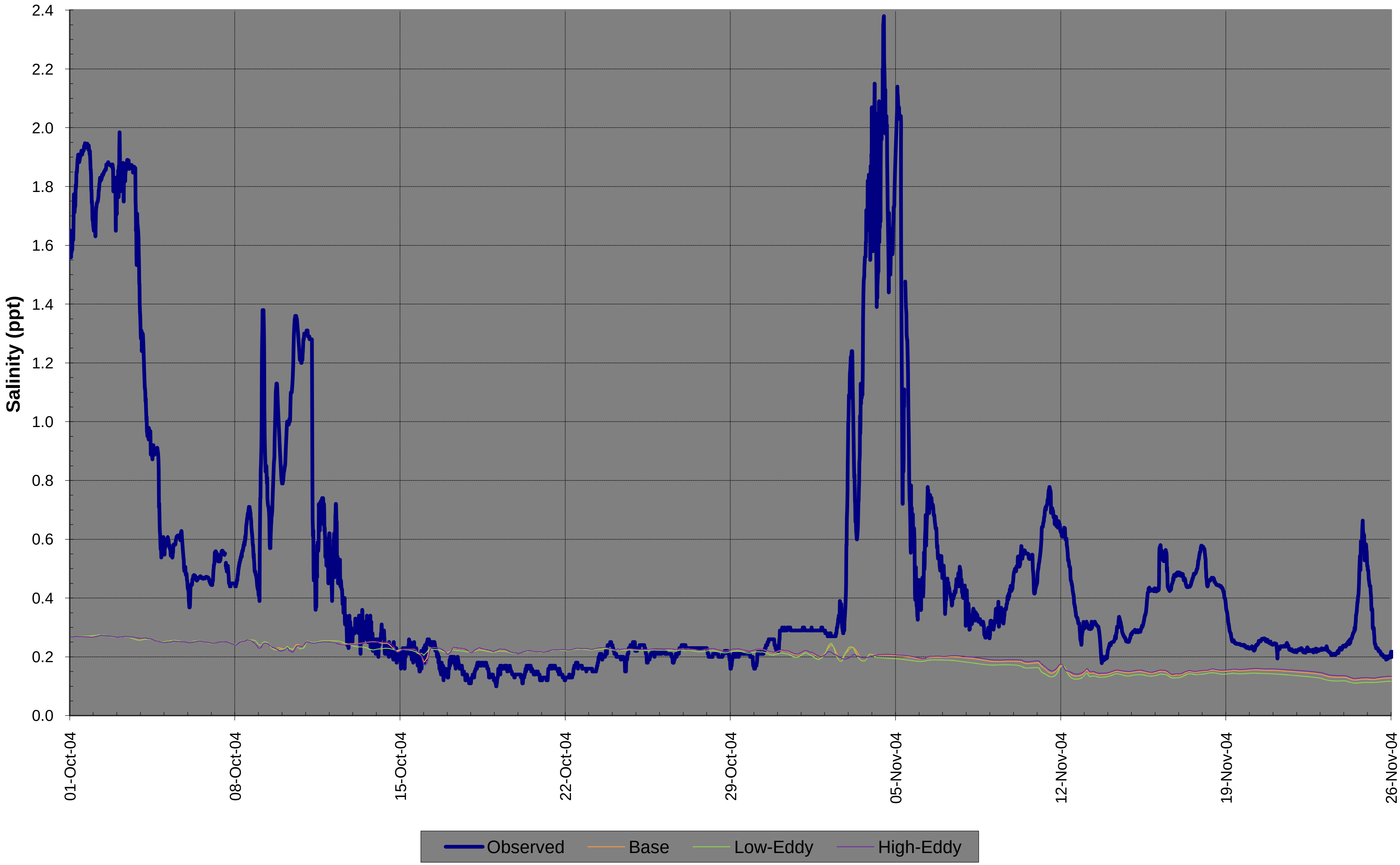


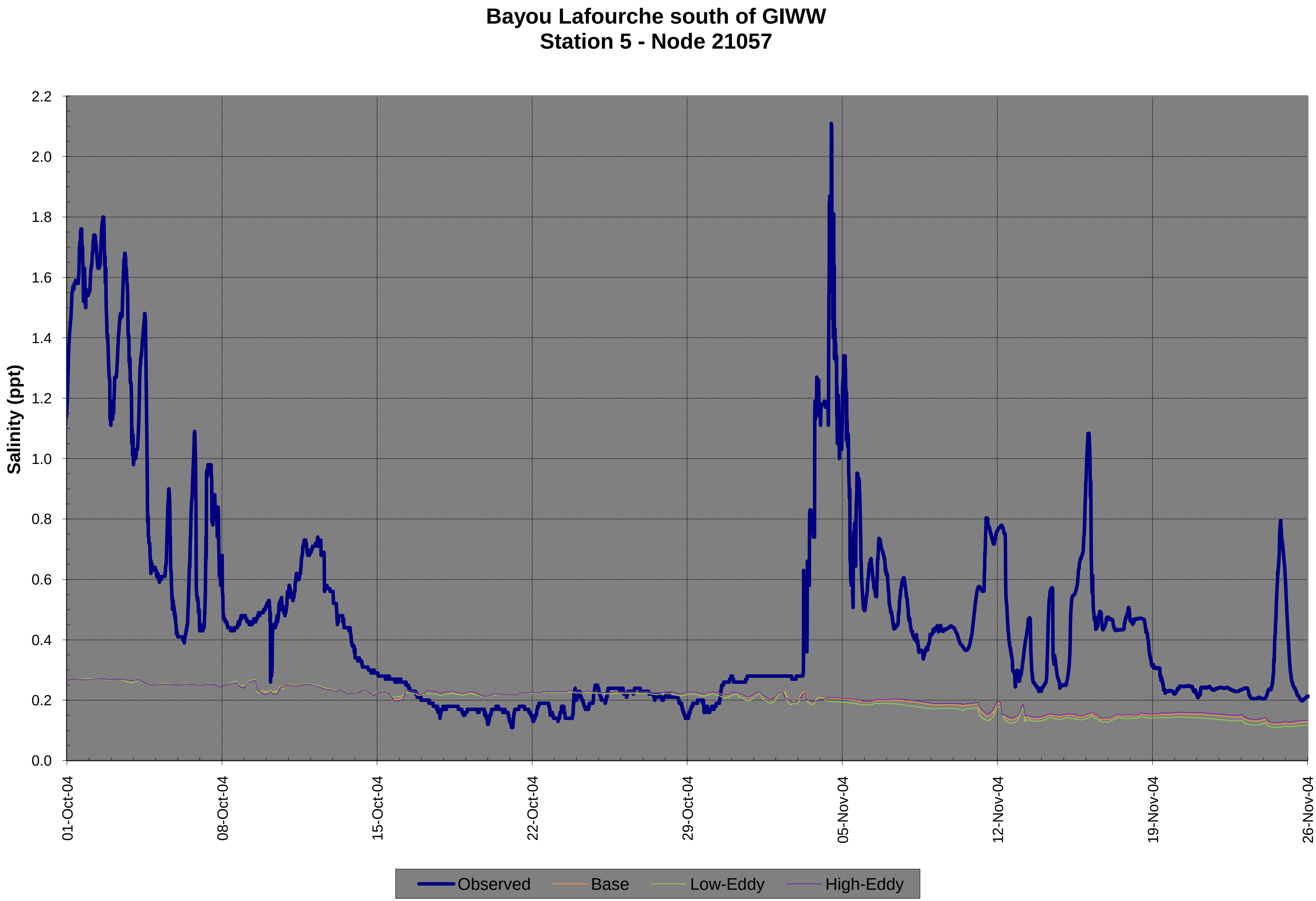
Company Canal at Highway 1
Station 2 - Node 15795
Salinity (ppt)
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Eddy
High-Eddy



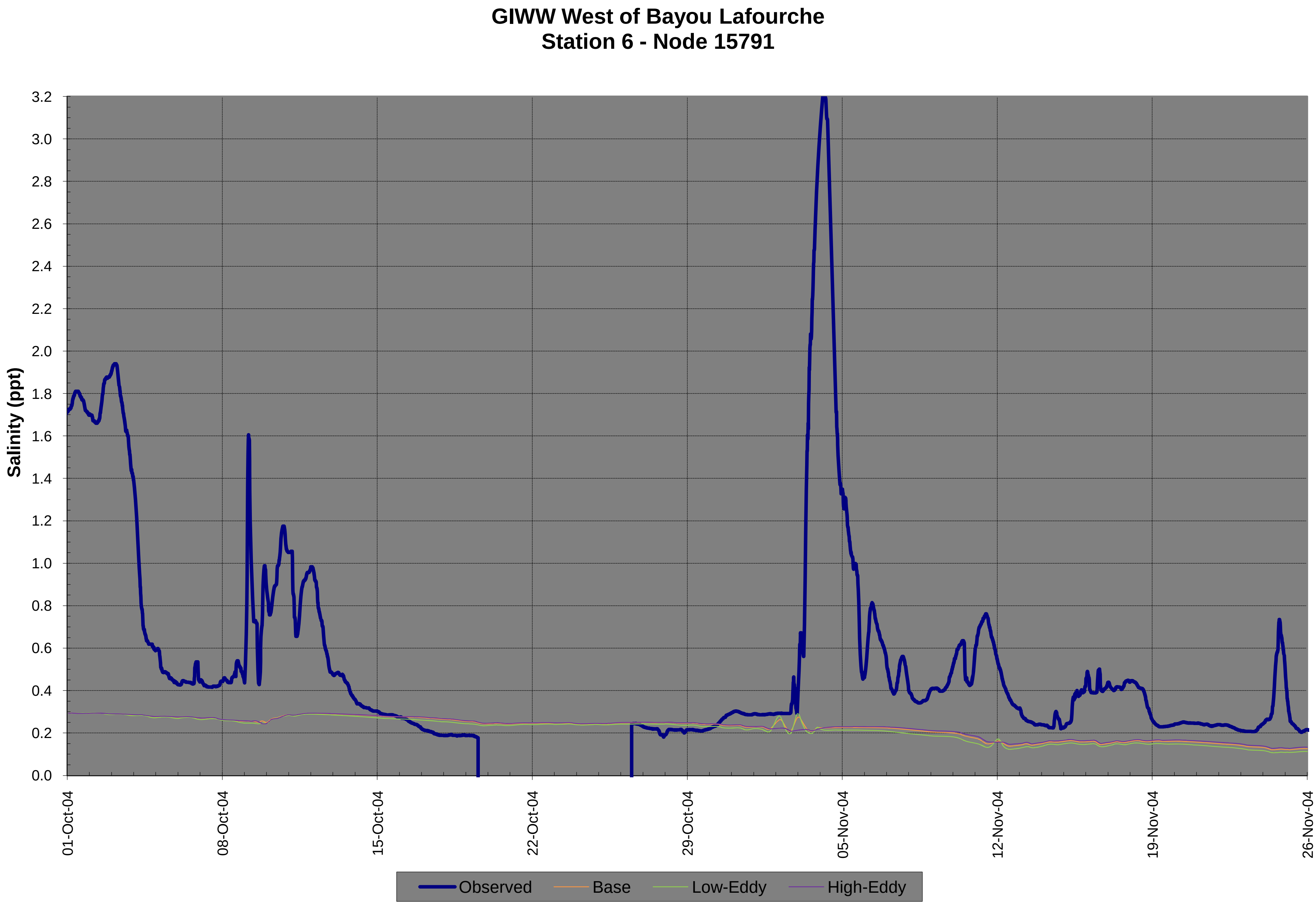
Lake Fields
Station 3 - Node 17403
Salinity (ppt)
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Eddy
High-Eddy

GIWW East of Bayou Lafourche
Station 4 - Node 21076

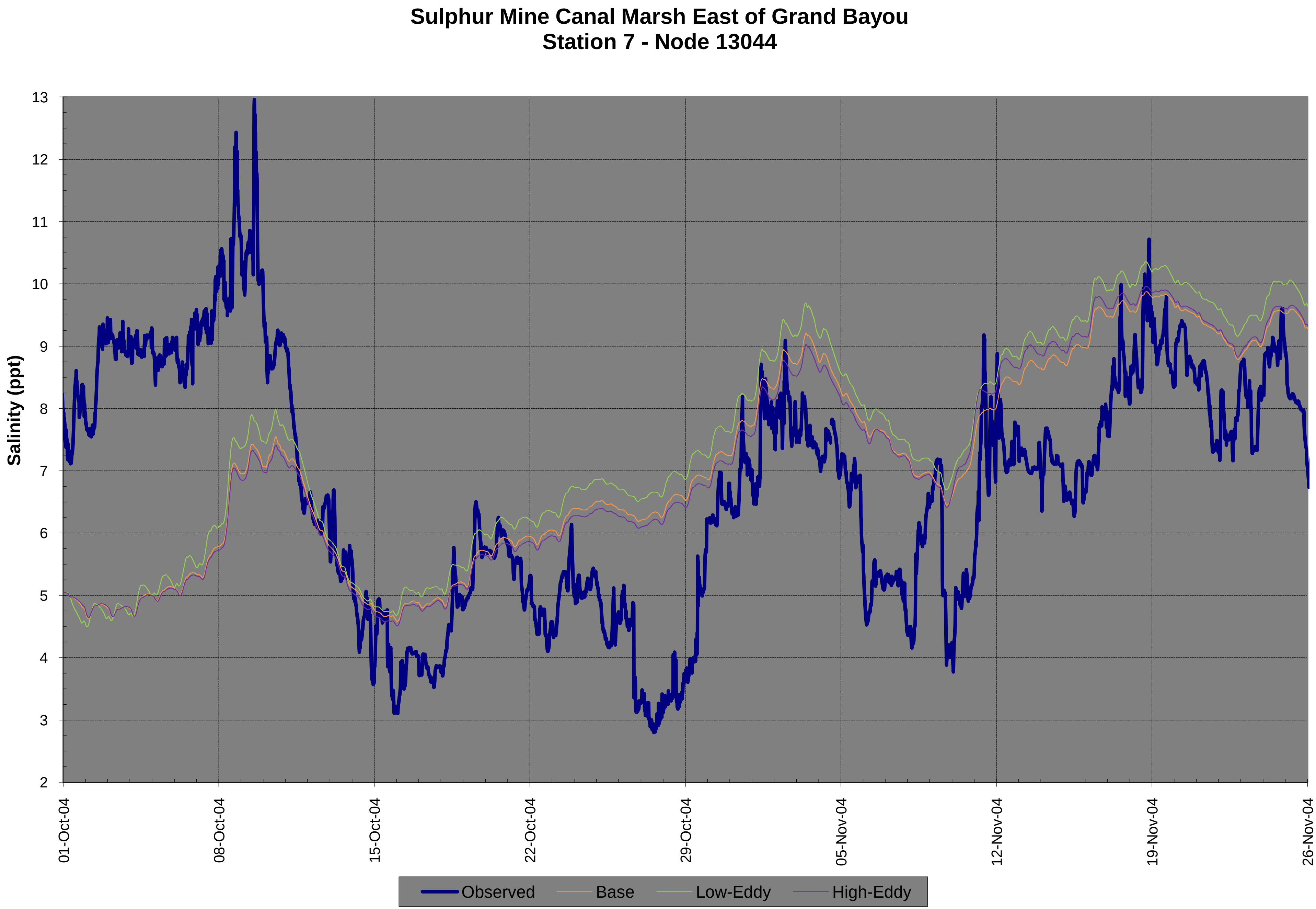




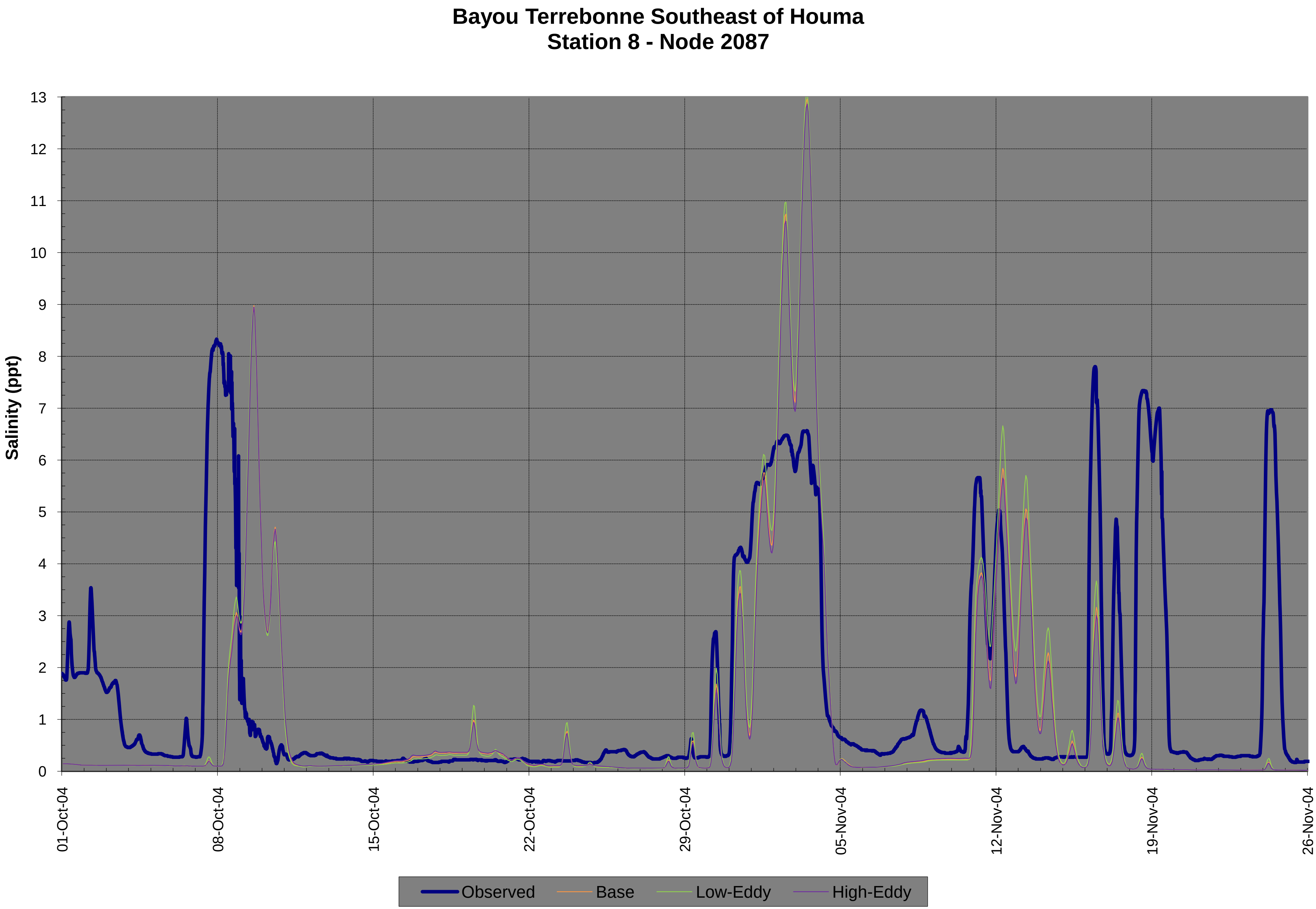
Bayou Lafourche south of GIWW
Station 5 - Node 21057
Salinity (ppt)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Eddy
High-Eddy



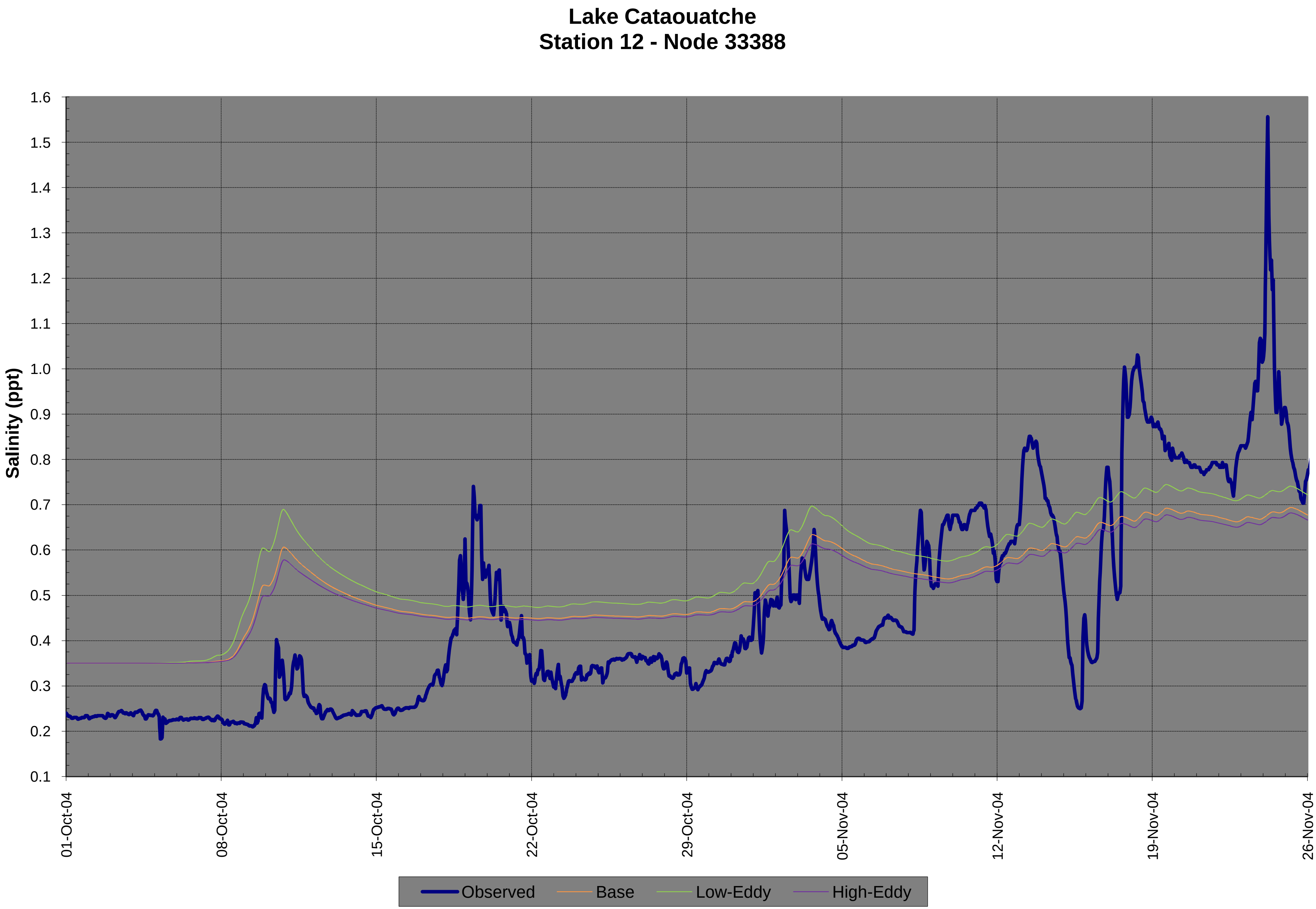
GIWW West of Bayou Lafourche
Station 6 - Node 15791
Salinity (ppt)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Eddy
High-Eddy



Sulphur Mine Canal Marsh East of Grand Bayou
Station 7 - Node 13044
Salinity (ppt)
13
12
11
10
9
8
7
6
5
4
3
2
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Eddy
High-Eddy

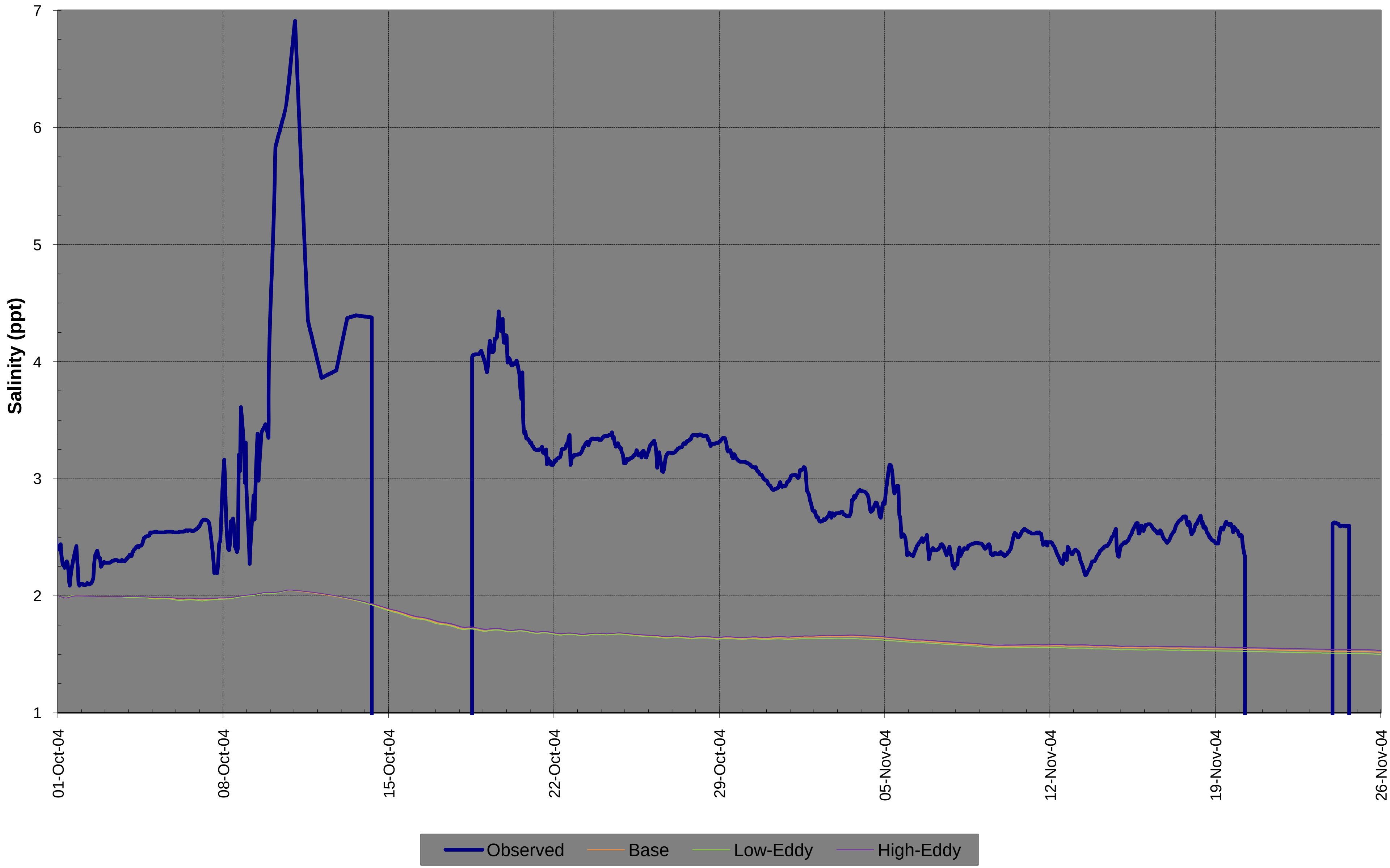


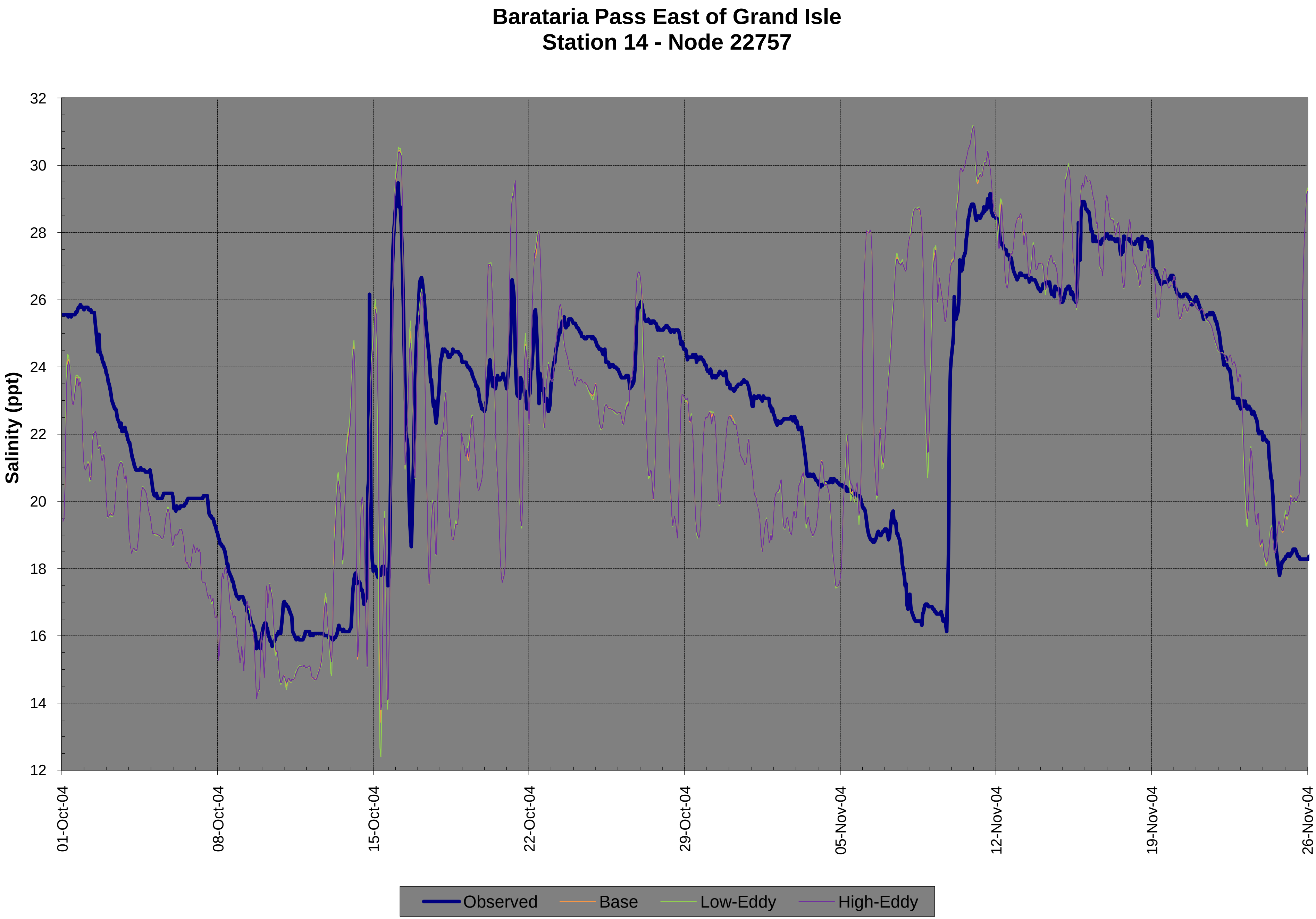
Bayou Terrebonne Southeast of Houma
Station 8 - Node 2087
Salinity (ppt)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Eddy
High-Eddy

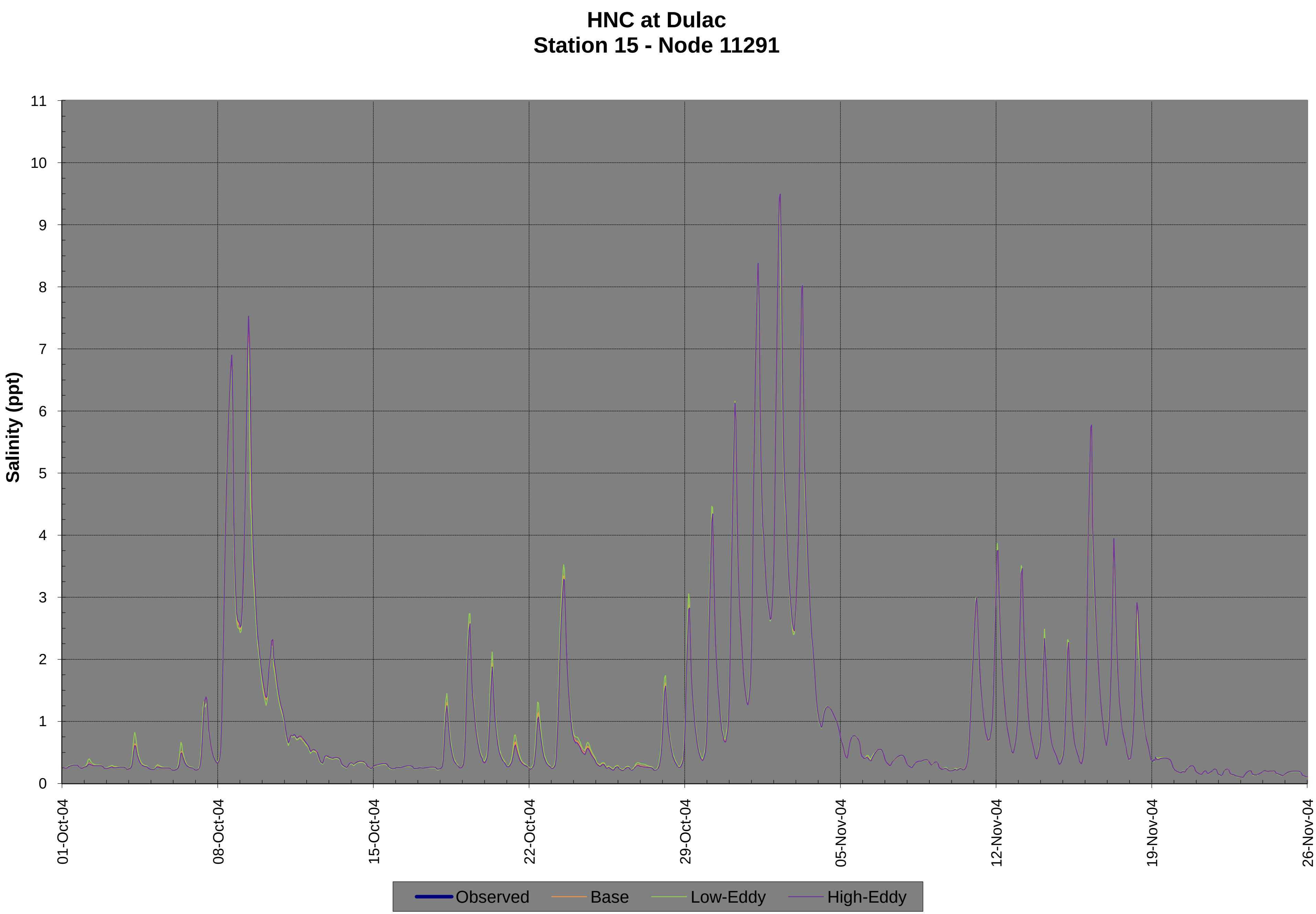


Lake Cataouatche
Station 12 - Node 33388
Salinity (ppt)
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Eddy
High-Eddy

Lake Salvador
Station 13 - Node 33207

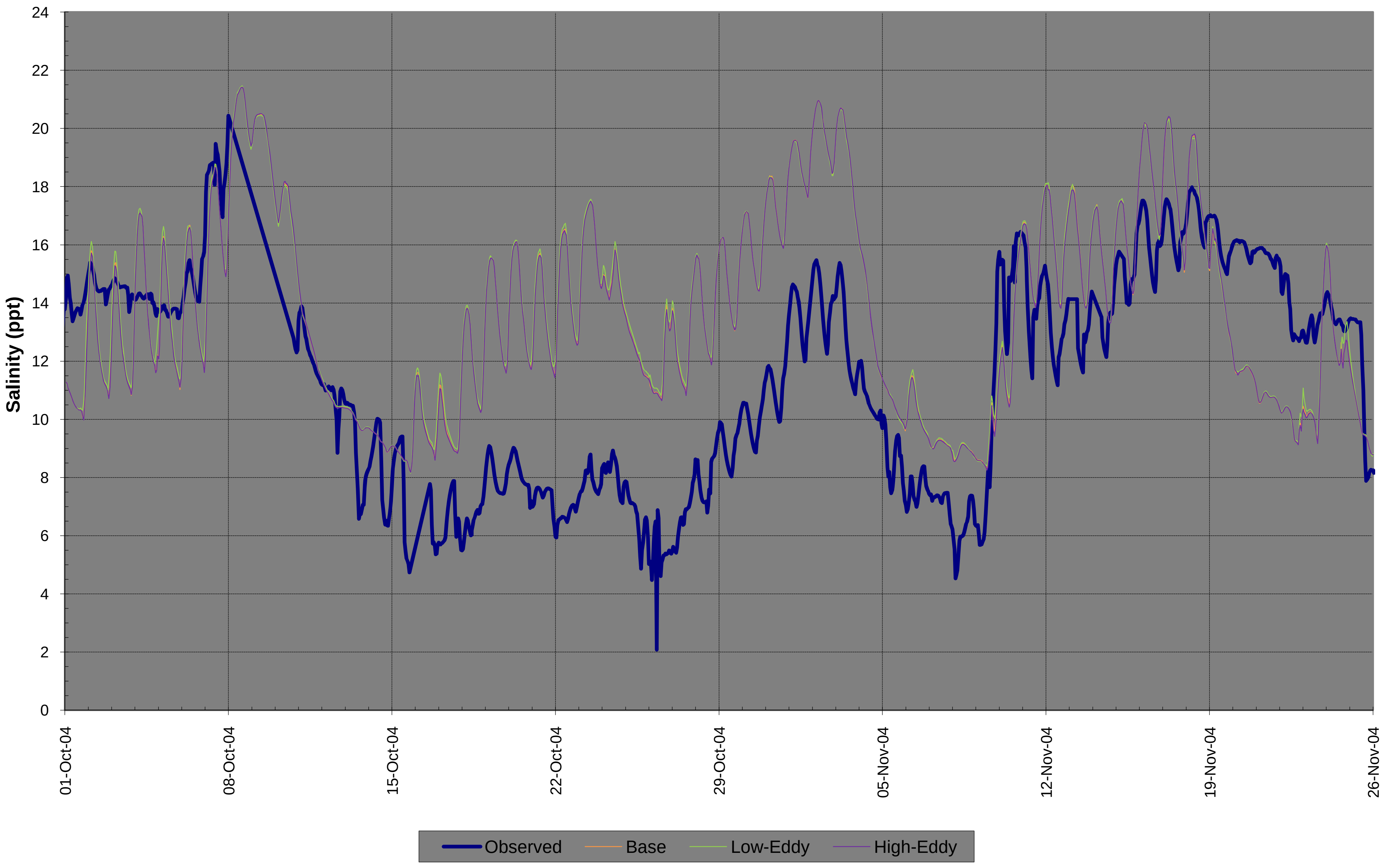


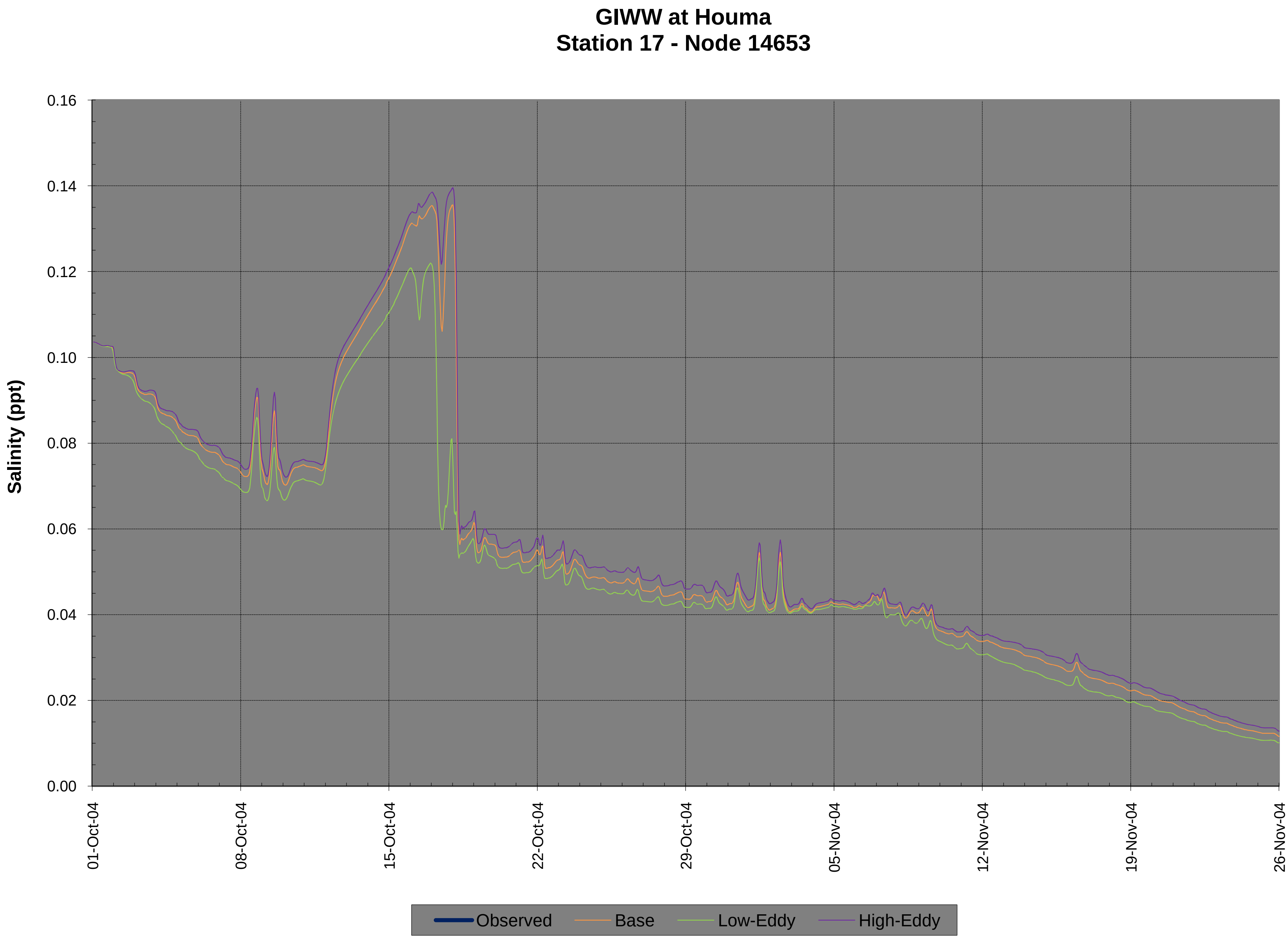

Barataria Pass East of Grand Isle
Station 14 - Node 22757
Salinity (ppt)
32
30
28
26
24
22
20
18
16
14
12
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Eddy
High-Eddy



HNC at Dulac
Station 15 - Node 11291
Salinity (ppt)
0
1
2
3
4
5
6
7
8
9
10
11
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Eddy
High-Eddy

Bayou Petit Caillou at Cocodrie
Station 16 - Node 3534

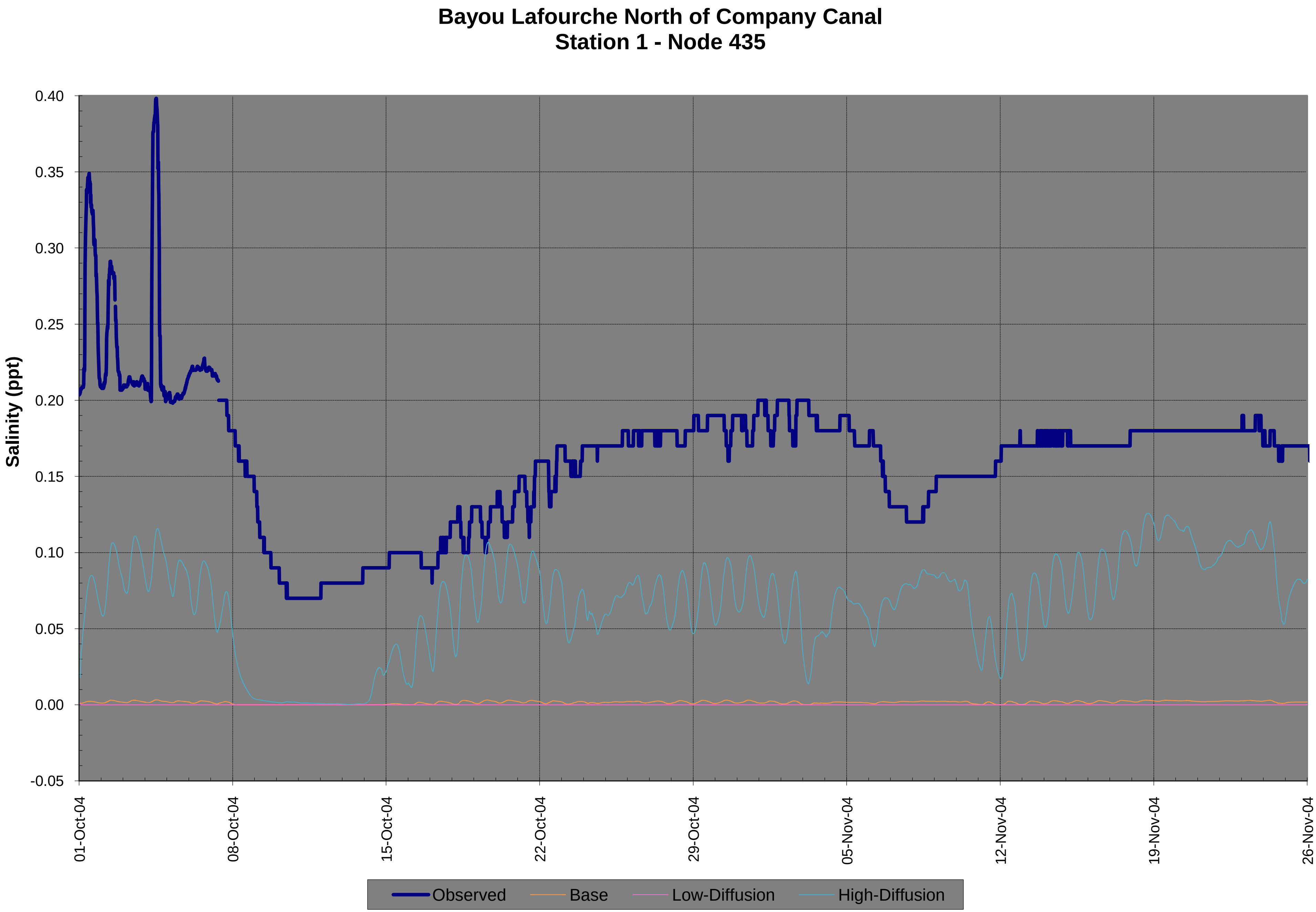




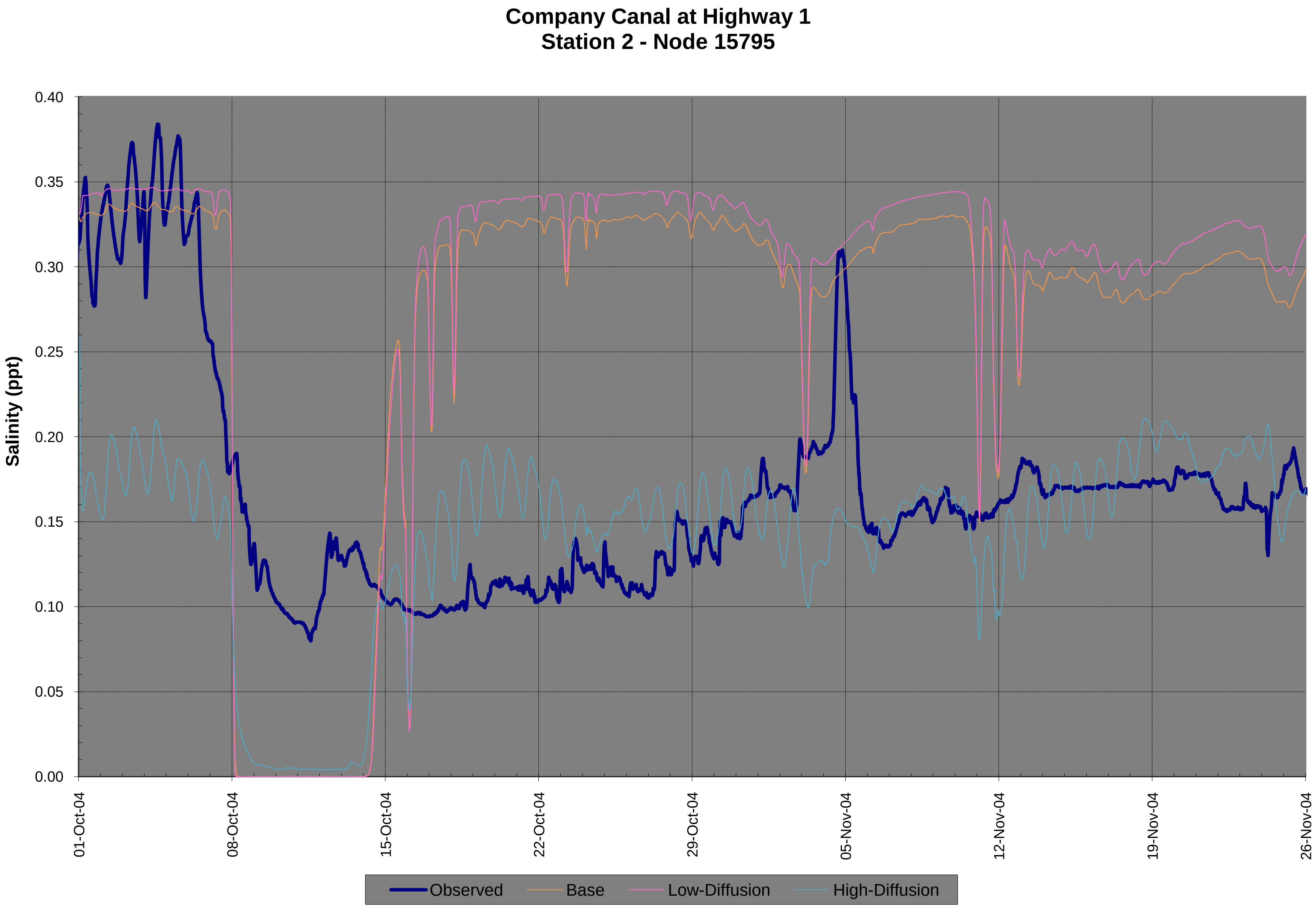
GIWW at Houma
Station 17 - Node 14653
Salinity (ppt)
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Eddy
High-Eddy

APPENDIX C

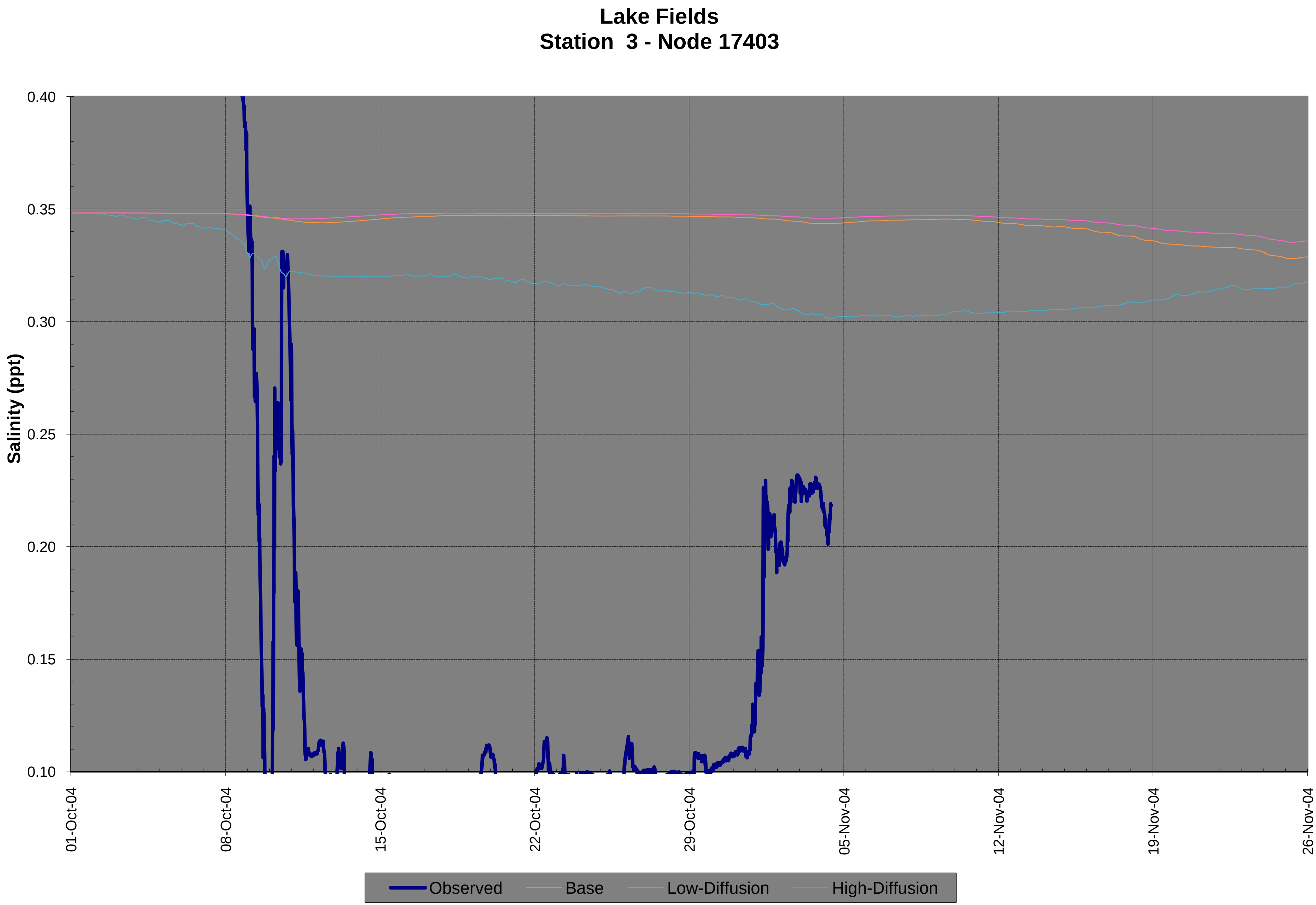
Salinity Time-Series Plots for Diffusion Coefficient Sensitivity Analysis



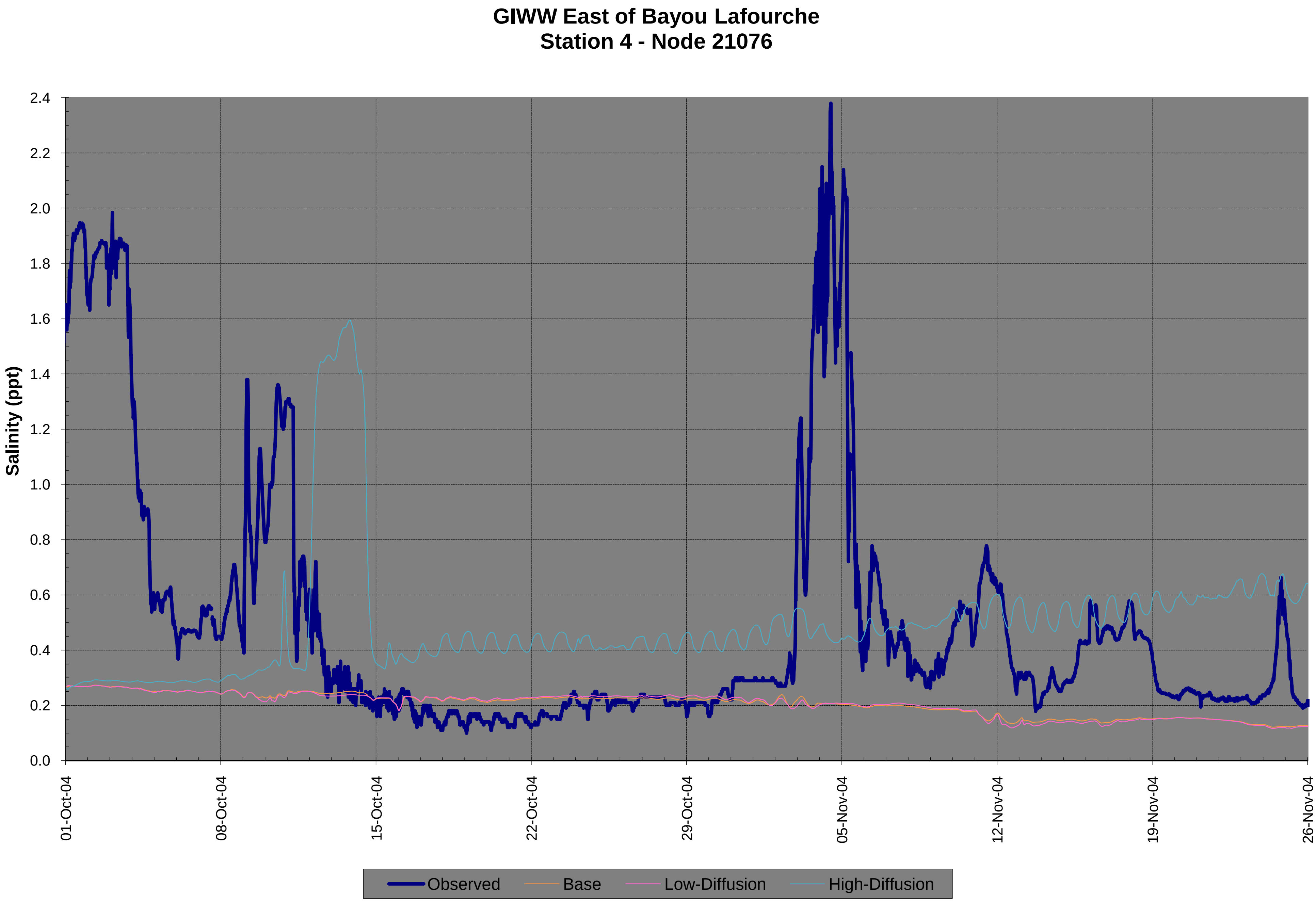
Bayou Lafourche North of Company Canal
Station 1 - Node 435
Salinity (ppt)
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Diffusion
High-Diffusion



Company Canal at Highway 1
Station 2 - Node 15795
Salinity (ppt)
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Diffusion
High-Diffusion

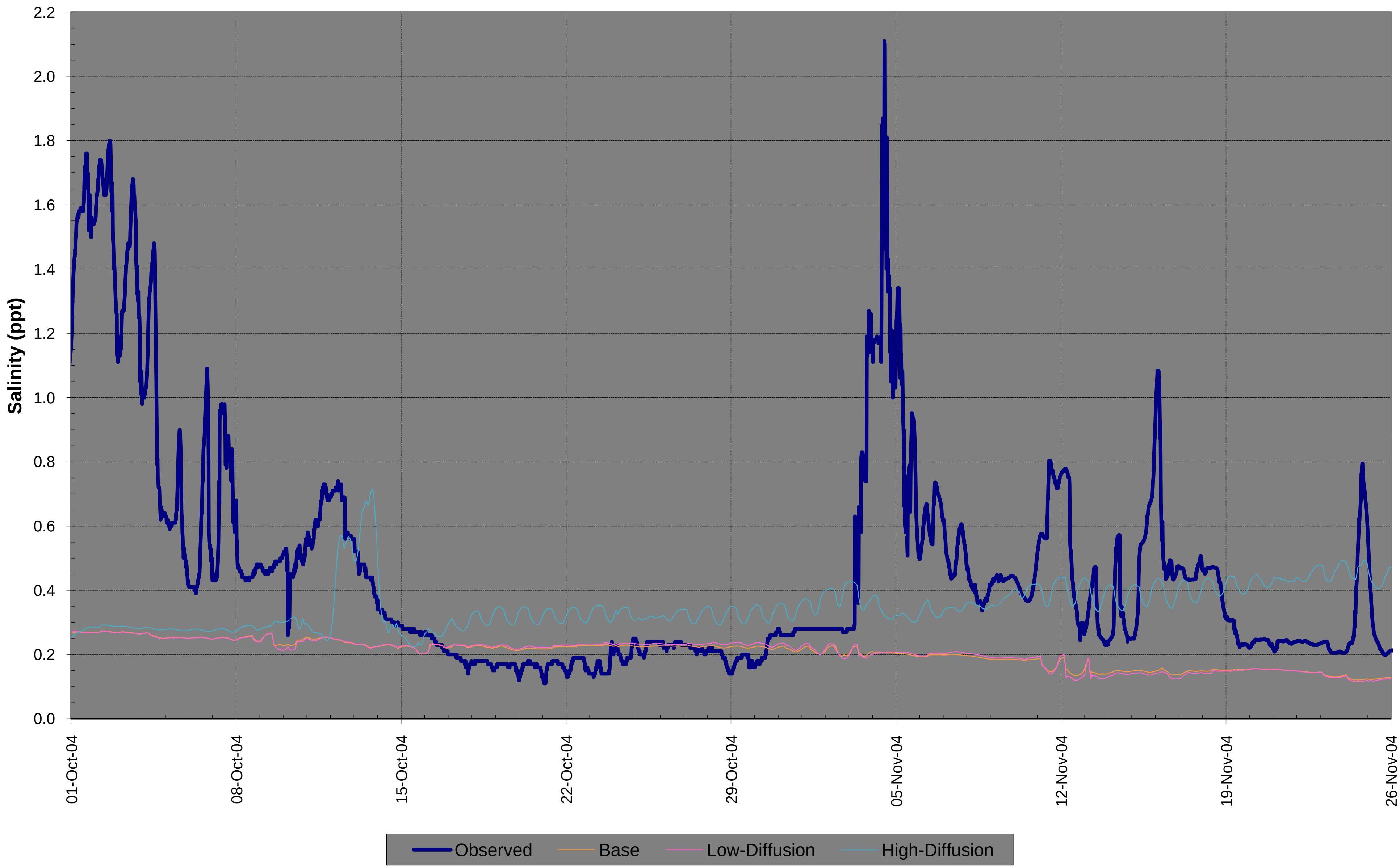


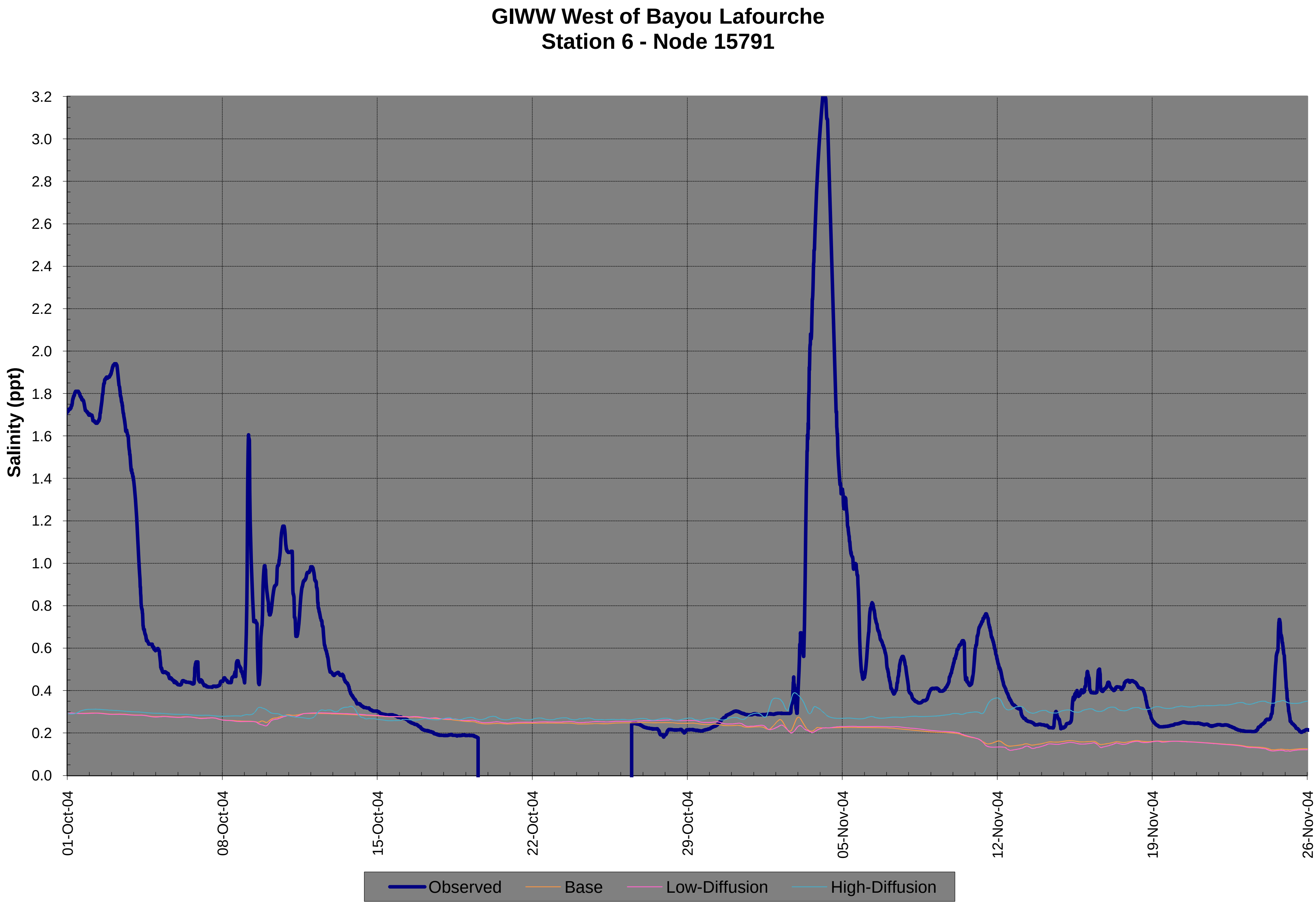
Lake Fields
Station 3 - Node 17403
Salinity (ppt)
0.40
0.35
0.30
0.25
0.20
0.15
0.10
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Diffusion
High-Diffusion

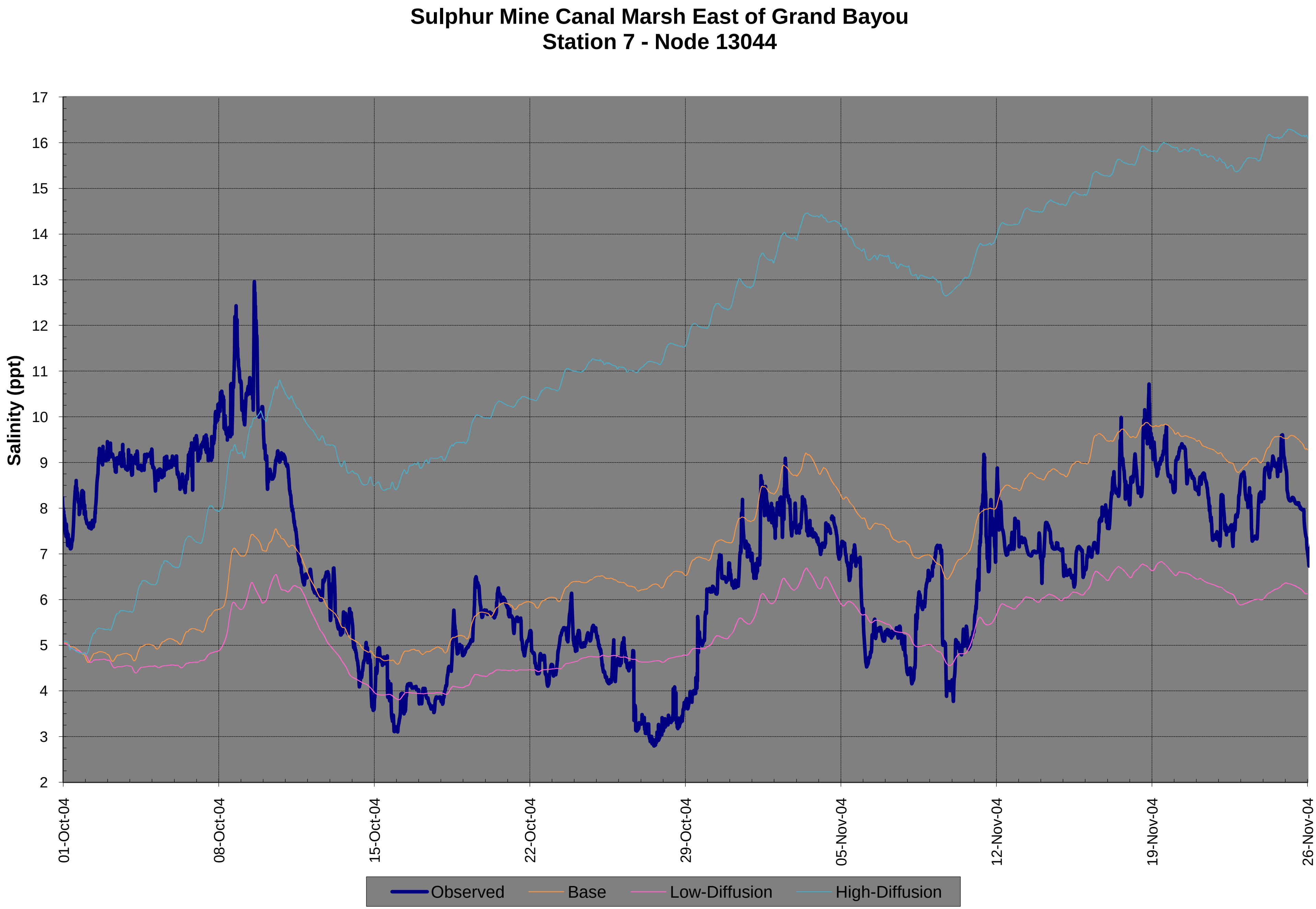


GIWW East of Bayou Lafourche
Station 4 - Node 21076
Salinity (ppt)
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Diffusion
High-Diffusion

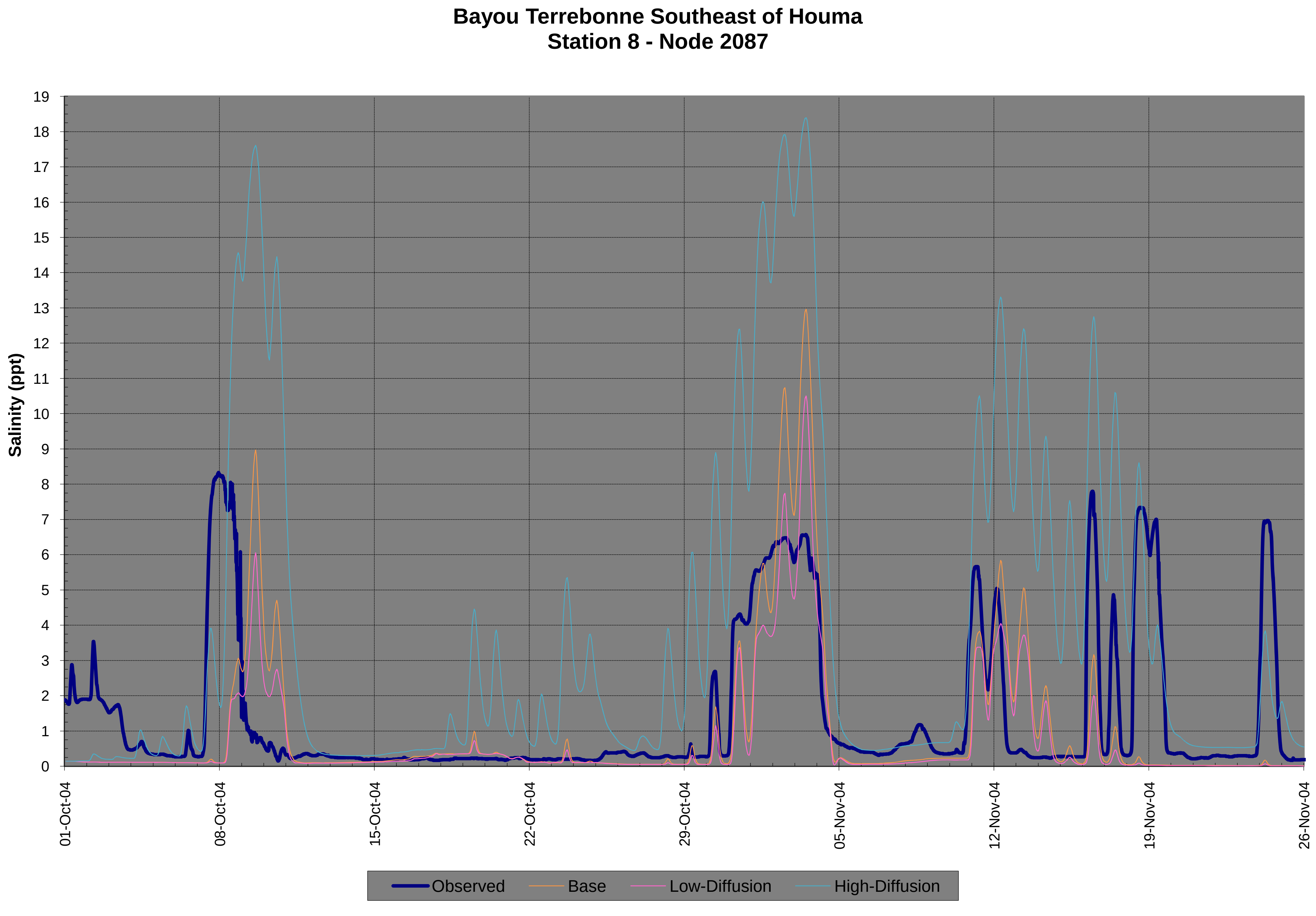
Bayou Lafourche south of GIWW
Station 5 - Node 21057



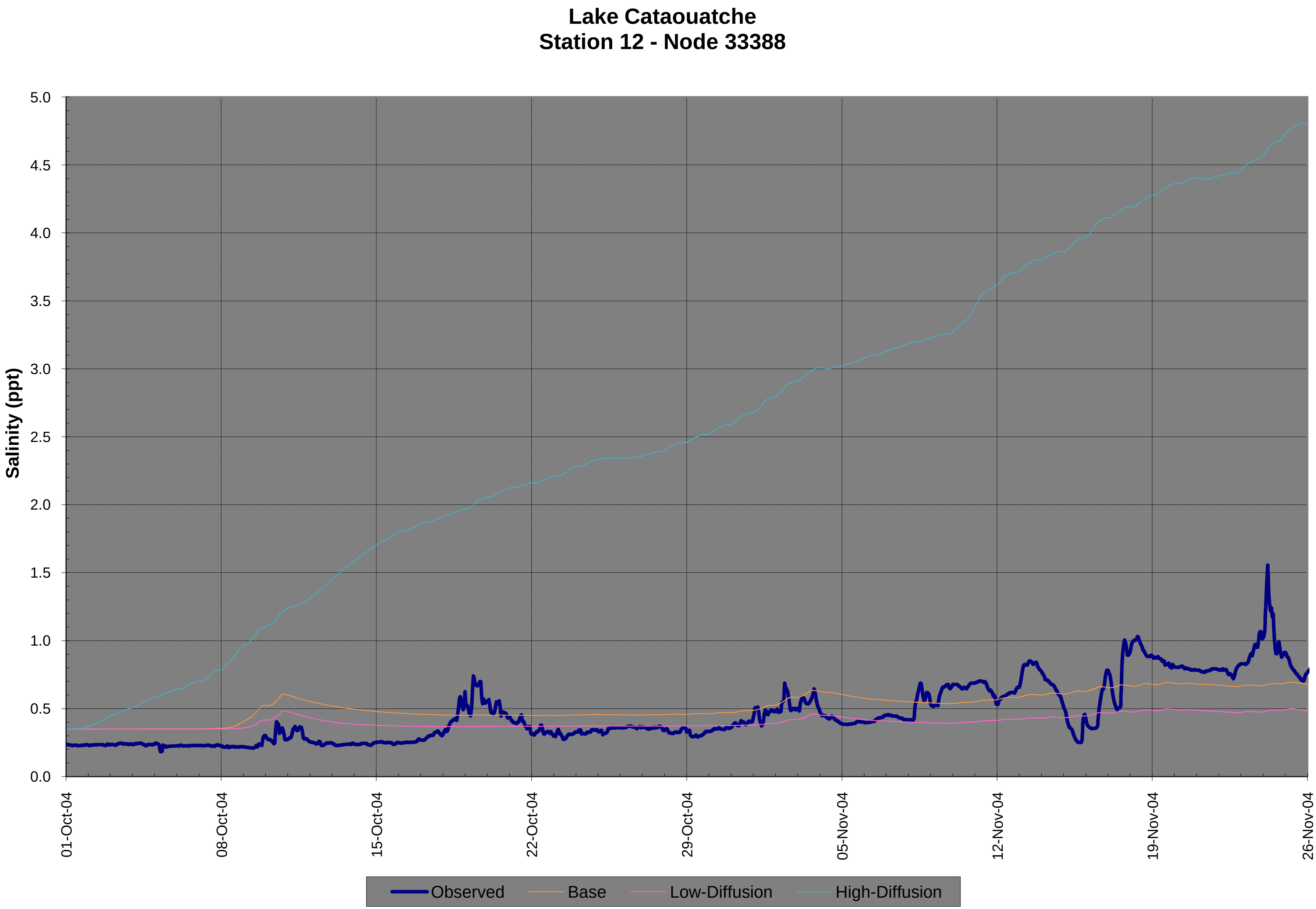

GIWW West of Bayou Lafourche
Station 6 - Node 15791
Salinity (ppt)
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Diffusion
High-Diffusion

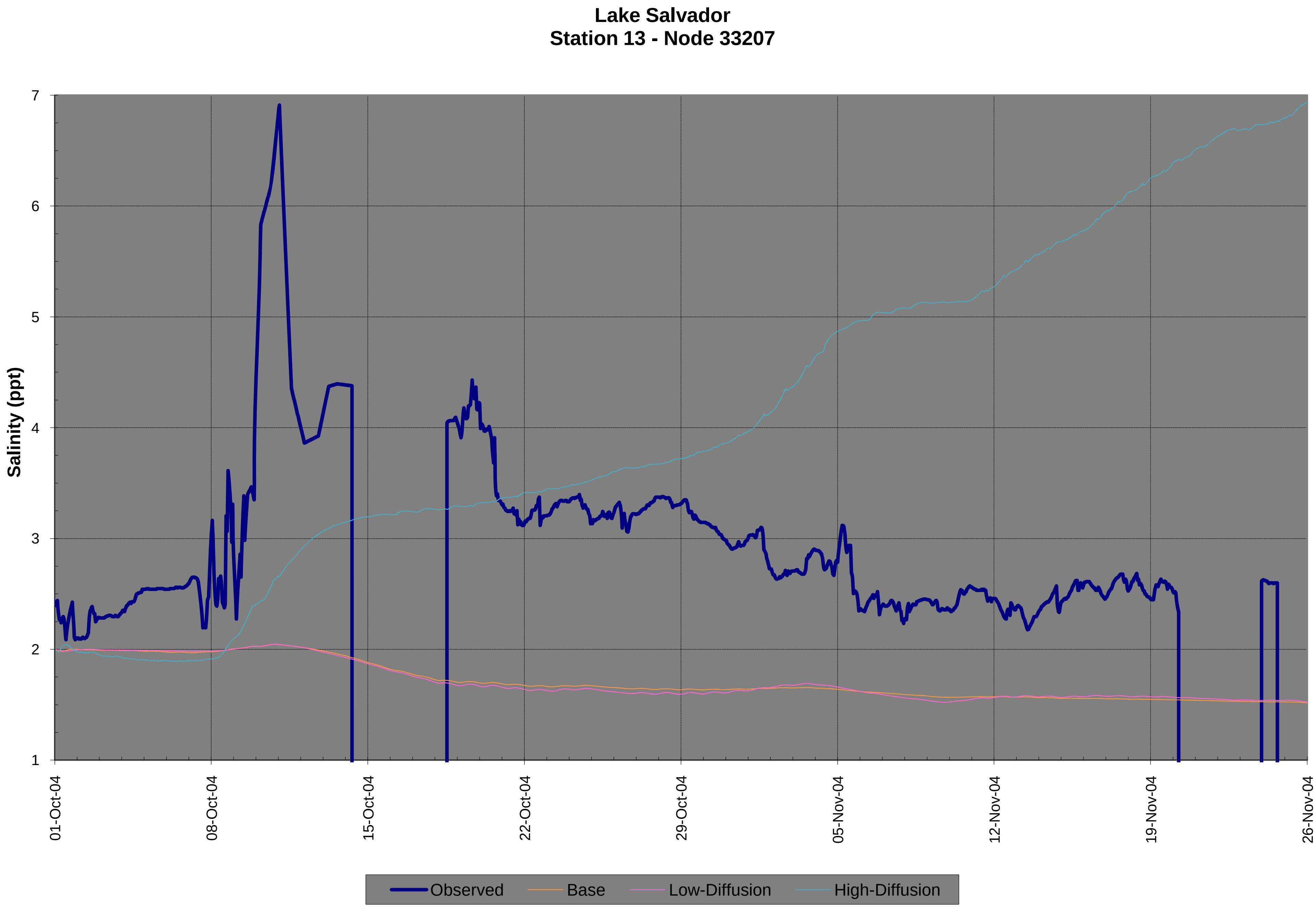


Sulphur Mine Canal Marsh East of Grand Bayou
Station 7 - Node 13044
Salinity (ppt)
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Diffusion
High-Diffusion

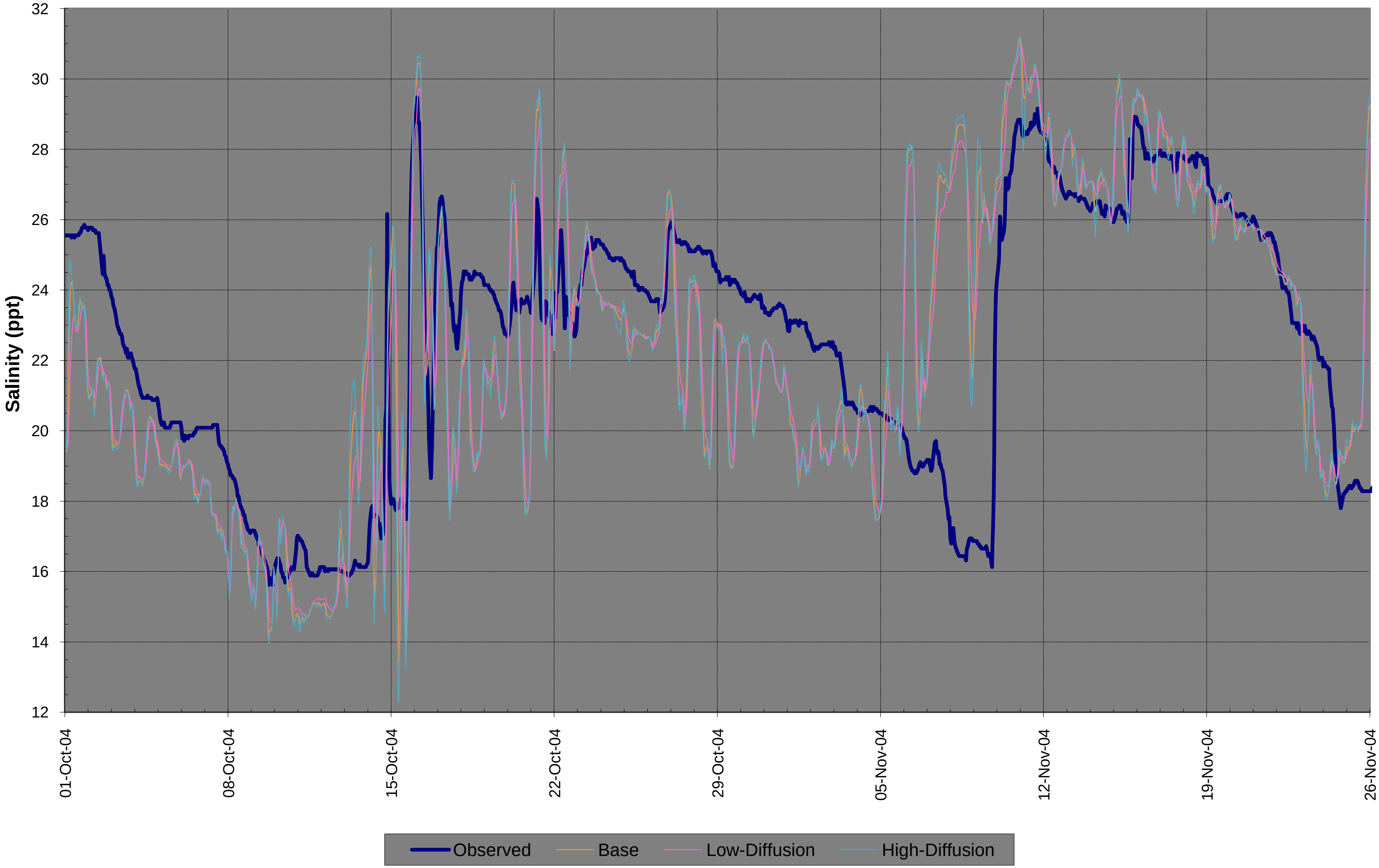


Bayou Terrebonne Southeast of Houma
Station 8 - Node 2087
Salinity (ppt)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Diffusion
High-Diffusion

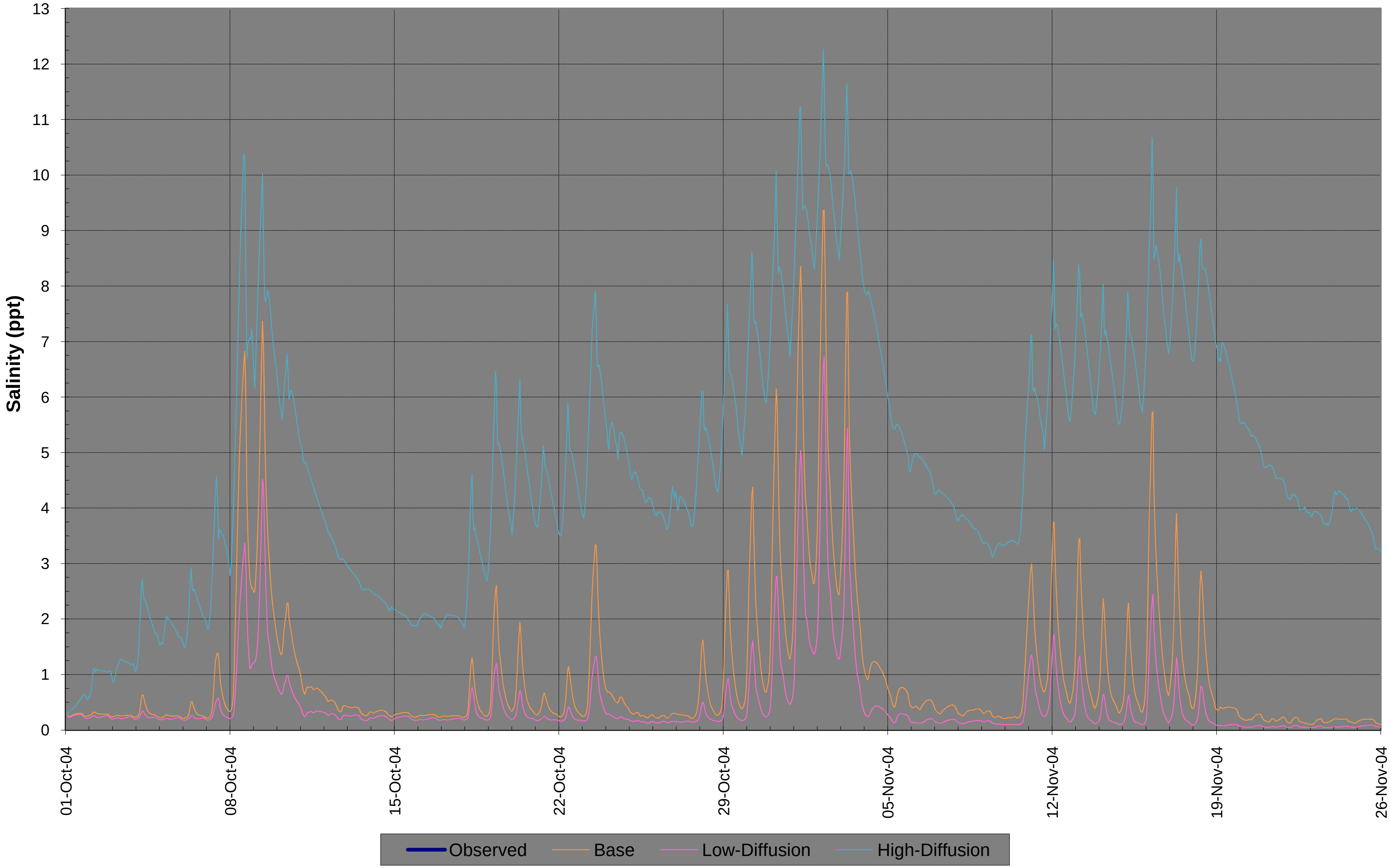

Lake Cataouatche
Station 12 - Node 33388
Salinity (ppt)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Diffusion
High-Diffusion

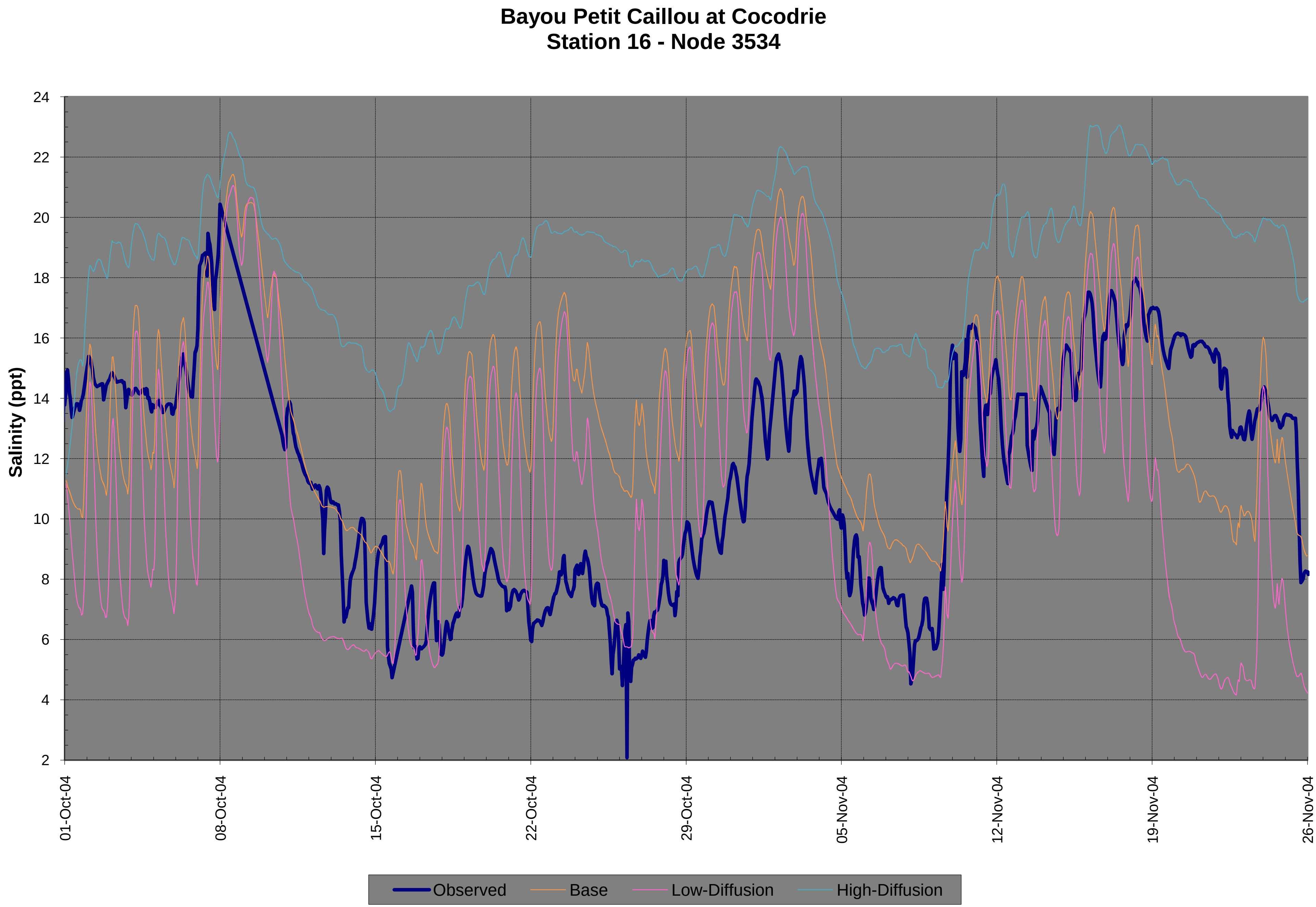

Lake Salvador
Station 13 - Node 33207
Salinity (ppt)
7
6
5
4
3
2
1
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Diffusion
High-Diffusion

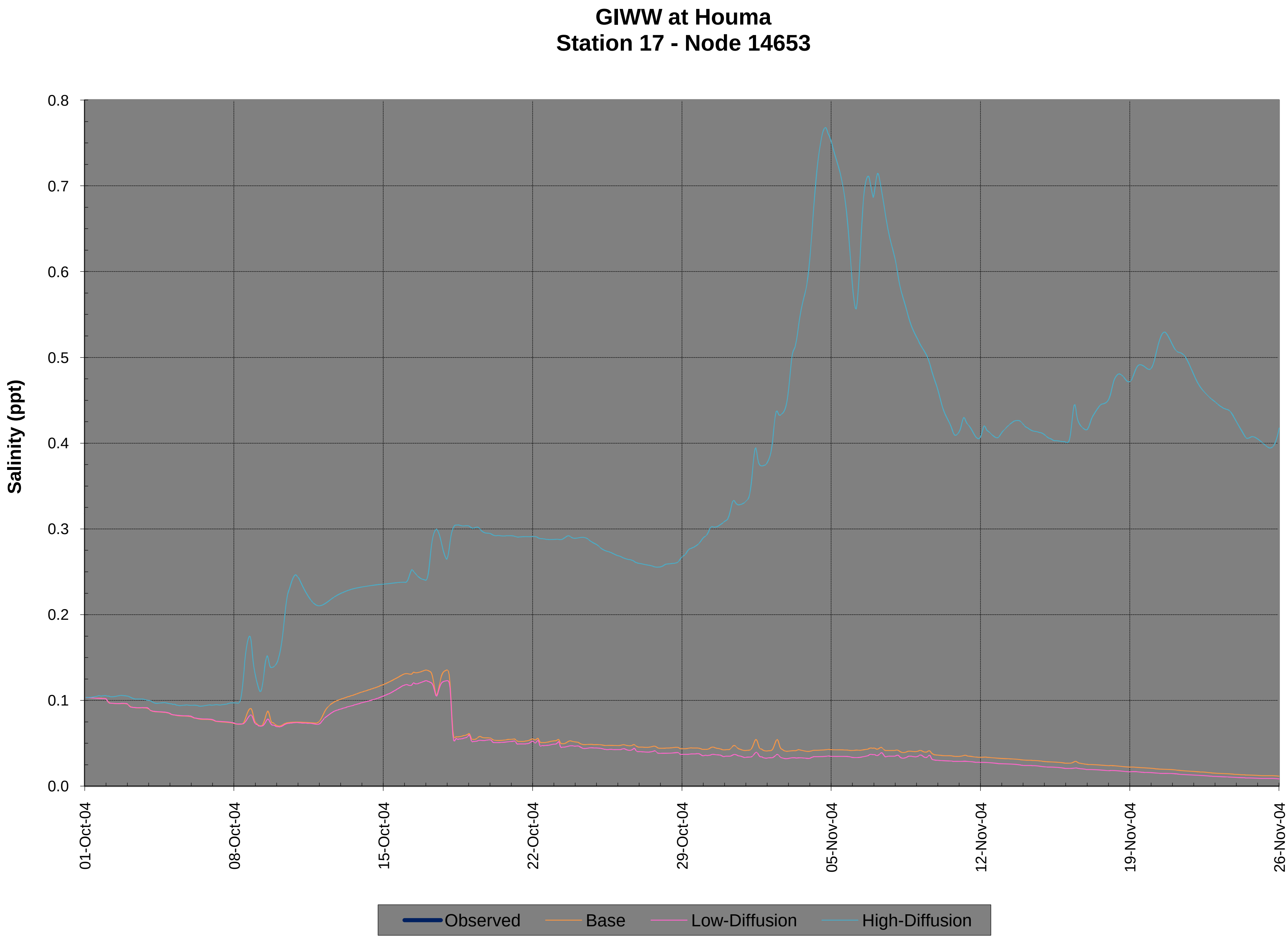
Barataria Pass East of Grand Isle
Station 14 - Node 22757



HNC at Dulac
Station 15 - Node 11291



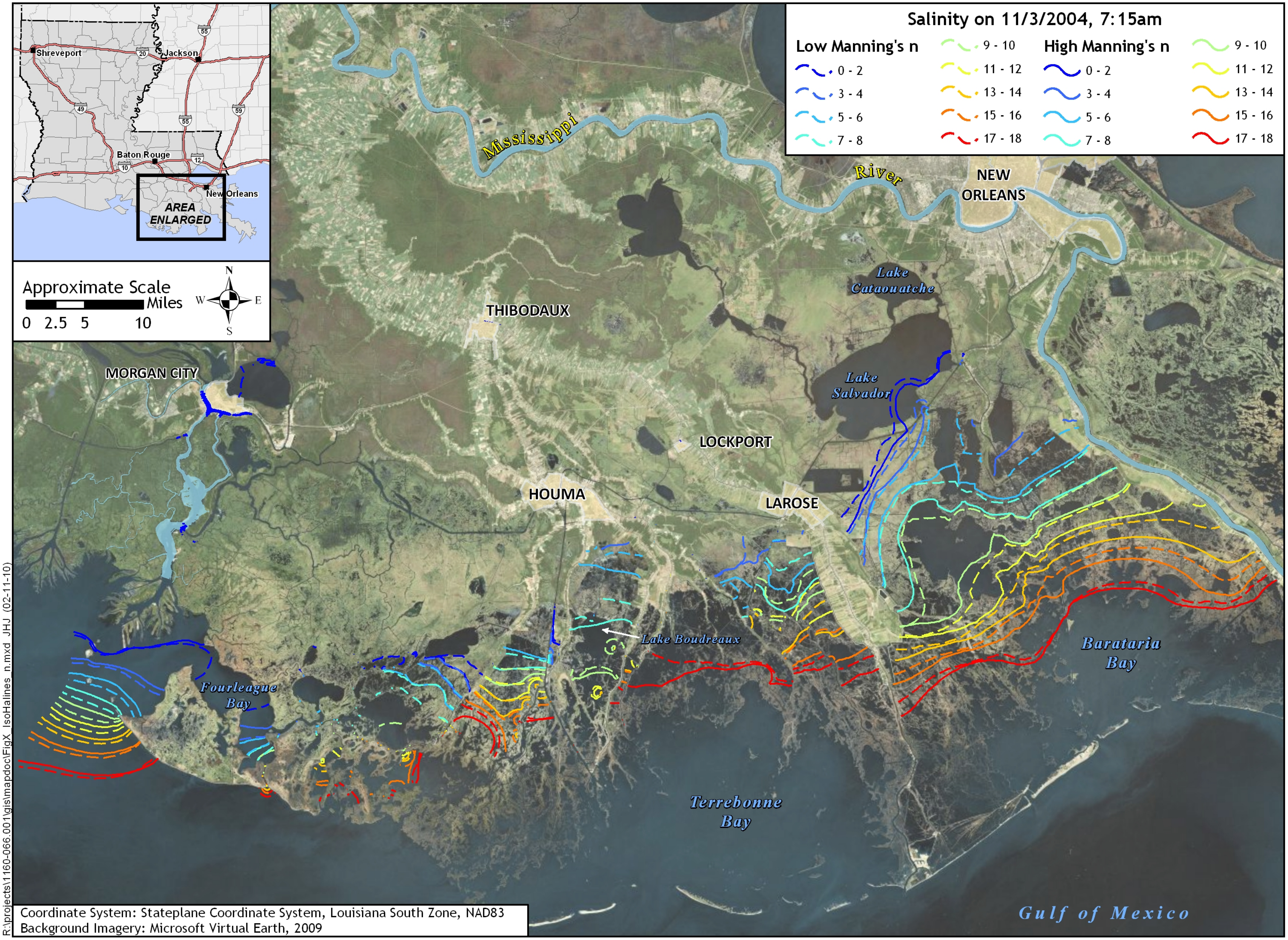

Bayou Petit Caillou at Cocodrie
Station 16 - Node 3534
Salinity (ppt)
24
22
20
18
16
14
12
10
8
6
4
2
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Diffusion
High-Diffusion



GIWW at Houma
Station 17 - Node 14653
Salinity (ppt)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
01-Oct-04
08-Oct-04
15-Oct-04
22-Oct-04
29-Oct-04
05-Nov-04
12-Nov-04
19-Nov-04
26-Nov-04
Observed
Base
Low-Diffusion
High-Diffusion

APPENDIX D

Salinity Isohalines



Coordinate System: Stateplane Coordinate System, Louisiana South Zone, NAD83
Background Imagery: Microsoft Virtual Earth, 2009

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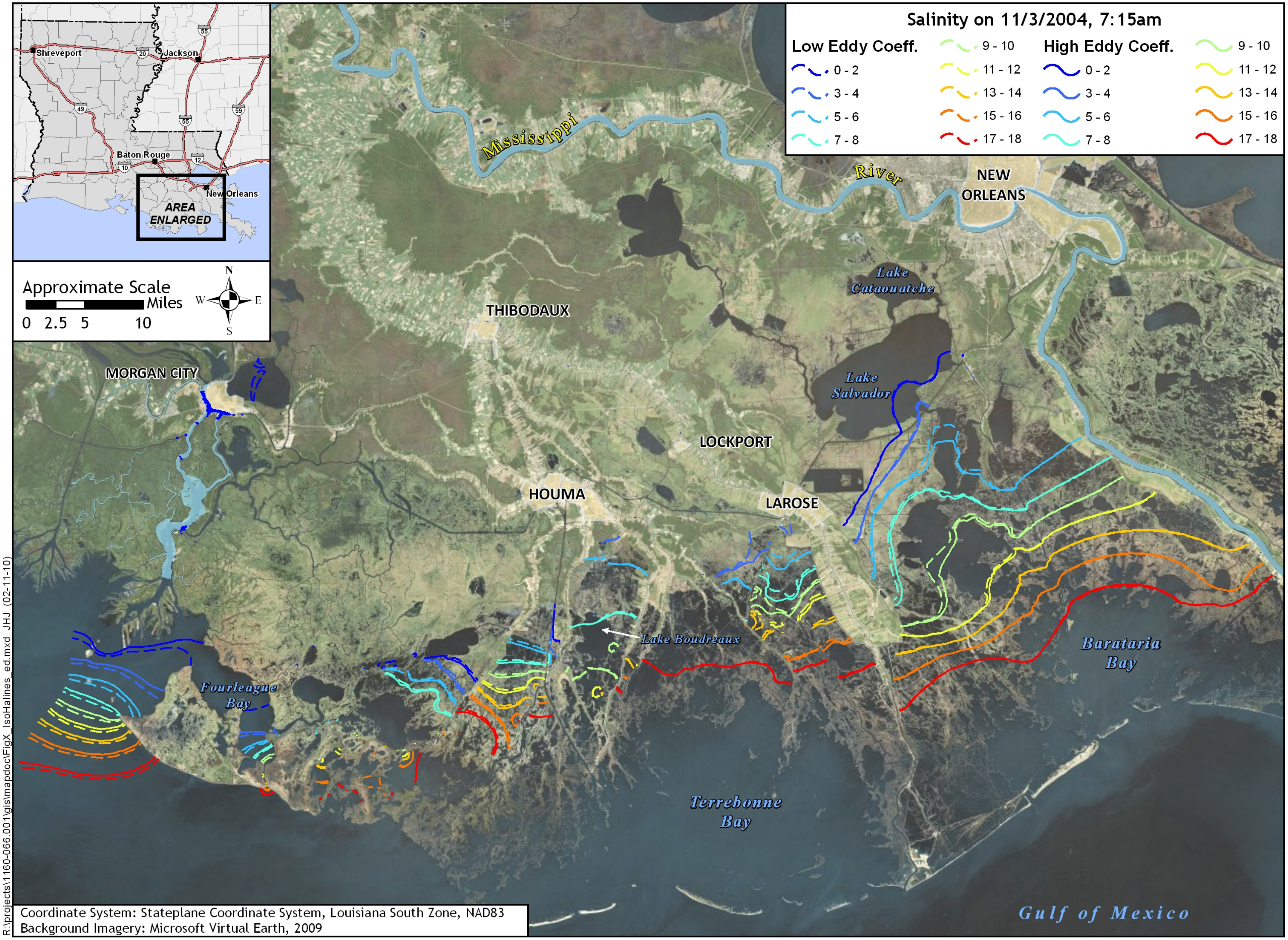

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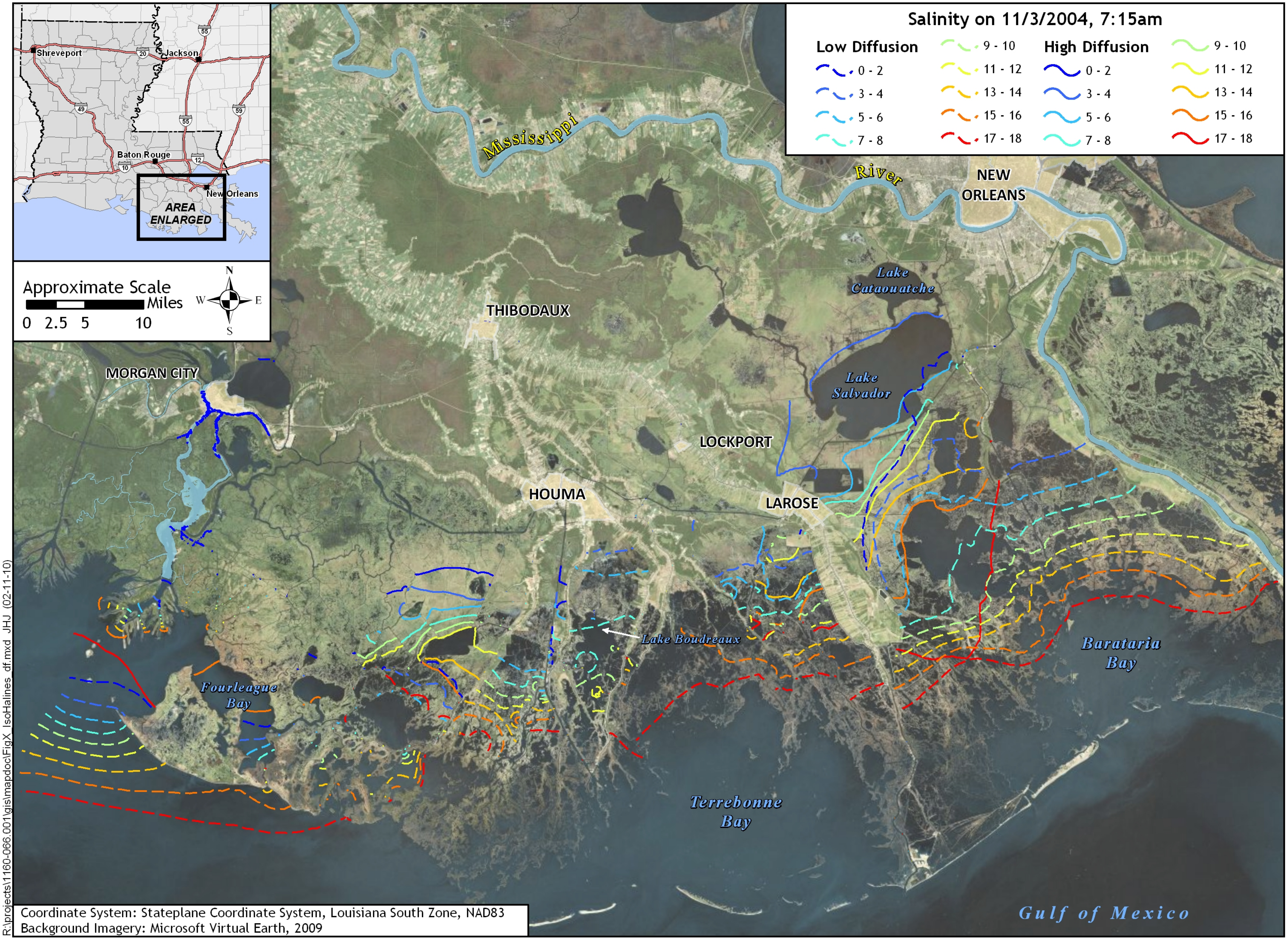

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