

Siuslaw Estuary Partnership

An Integrated Multiple Objective Approach To Watershed Protection and Restoration

February 21, 2011

TO: Water Quality and Quantity Team and Community Stakeholders

FROM: Mike Miller, Florence Public Works Director

Subject: Surface Water and Groundwater Monitoring Program Status Report

The Surface Water and Groundwater Monitoring Program commenced in October 2010 and continued on through January and into February 2011. City Public Works staff and consultants from GSI Water Solutions, Inc. have completed five rounds of groundwater sampling and water level measurements and three rounds of surface water chemical and microbiology testing. Future sampling events are planned and schedules for that sampling have been prepared.

The reports for the most recent groundwater and surface water monitoring are presented below. The reports for all other groundwater and surface water monitoring to date are attached; please see these reports for a detailed description of the program. The monitoring program provides technical data on water quantity and quality. When sufficient sampling data are available, staff will prepare a report that describes what the data mean, including any data trends detected. This should occur in the next six to eight months and the report will be posted to the web site: www.siuslawwaters.org.

Groundwater

Water Quantity: Variation in Water Table Elevation

The depth to the water table is a primarily a function of the balance between recharge (precipitation), evaporation rate, and discharge (to surface water, via wells, etc.). At the present time, we are unable to determine the relative impact of pumping, however, Table 1 indicates the level of precipitation that has been recorded during the sample intervals. Based on this data, it is evident that precipitation varies throughout the Florence Dunal Aquifer.

Date	CoCoRaHS ¹ (in)	WWTP ² (in)
10/1 – 10/15/2010	2.01	1.52
10/15 – 11/22 to 12/1	11.4-15.1	12.66-15.93
12/1/2010 – 1/7/2011	15.53	13.97
1/7 -2/1/2011	7.2	7.95

Table 1. Rainfall data within the City of Florence

1. Community Collaborative Rain, Hail and Snow (CoCoRaHS) site

2. Florence Waste Water Treatment Plant (WWTP) site

Table 2 below provides the hydraulic head (elevation as feet above mean sea level) of the water table at monitoring well locations for four sampling events. The 9/29-10/1 set of samples were measured by the well constructors at the time the wells were installed. The remaining head levels were measured by City or GSI staff. Red indicates a decrease in hydraulic head, i.e., a decline in the water table, and the color blue indicates an increase in hydraulic head, i.e., a rise in the water table, since the previous measurement.

As described in previous reports, the water table dropped during the relatively dry period in late September to mid October, but, with the increased rainfall, and perhaps reduced pumping, it has been rising since. The relation between water table rise and rainfall reported during the mid-October to late November interval was approximately 0.12 ft of rise per 1.0 in of rain. Between the early December and January measurement, ~14-15.5 inches of precipitation fell, resulting in hydraulic head increases varying from <1foot (B-1) to >4 feet (see B-2) equivalent to 0.003 to 0.30 ft rise per inch of rain. With the exception of B-1, the infiltration rate and subsequent rise in water table was greatest along the shoreline, and less on the eastern side of the City (compare B-2 (shoreline) to B-7 (inland east) in Figure 1). Rainfall in the time elapsed between January and February sampling times varied from 7.2 to 7.95 inches and produced a change in the water table from -0.01 to 0.14 ft/in, in a similar pattern to that observed in the December-January interval.

Water Quality: Hydraulic Head

The hydraulic head data, elevation of the water table relative to sea level, is of fundamental importance with respect to achieving a better understanding of groundwater movement and its relationship with nearby surface water bodies. After five periods of measurement, the head data observed remains generally consistent with previous interpretations of groundwater movement (see below). The data suggest a slight flattening in the groundwater gradient from east to west as the water table rises.

Well	Head (ft-msl) 9/29-10/1/10	Head (ft- msl) 10/14- 10/18/10	Head (ft- msl) 11/22- 12/1/10	Head (ft- msl) 1/7/11	Head (ft- msl) 2/8/11
B-1	26.88	26.23	28.73	28.78	28.68
B-2	46.26	45.36	45.97	50.31	51.36
B-3	50.06	49.61	51.17	54.86	55.94
B-5	86.74	86.24	89.34	90.04	90.04
B-6	57.72	56.92	58.61	60.97	61.27
B-7	39.48	39.28	41.23	42.28	42.34
B-8	33.61	34.06	35.38	37.76	37.81
B-9	26.62	25.92	27.62	30.37	30.42
B-10	13.21	13.06	13.76	16.36	16.51
B-11	9.74	9.24	10.3	11.04	10.84

Table 2. Hydraulic head of groundwater in the Florence Monitoring Wells. Heads have been rising, associated with increased precipitation and lower temperatures (less evaporation).

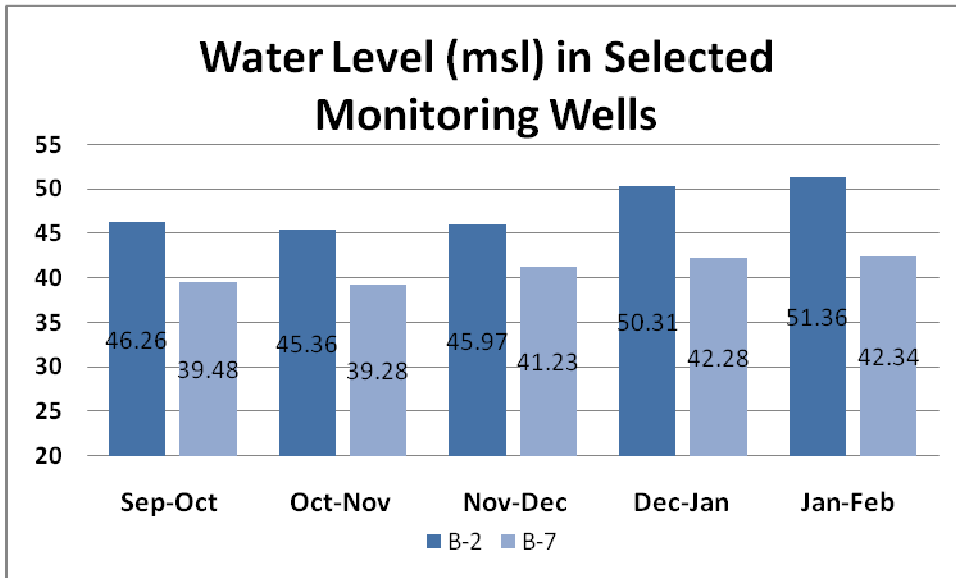


Figure 1. Changes in the elevation of the water table compared between a shoreline well (B-2) and an inland well (B-7). Water level increases are greater in the shoreline area.

The slope of the water table towards the west is apparently steeper than the slope of the land surface. With some exceptions, depths of the water table below the surface are greater in the shoreline area than they are inland (Figure 2).

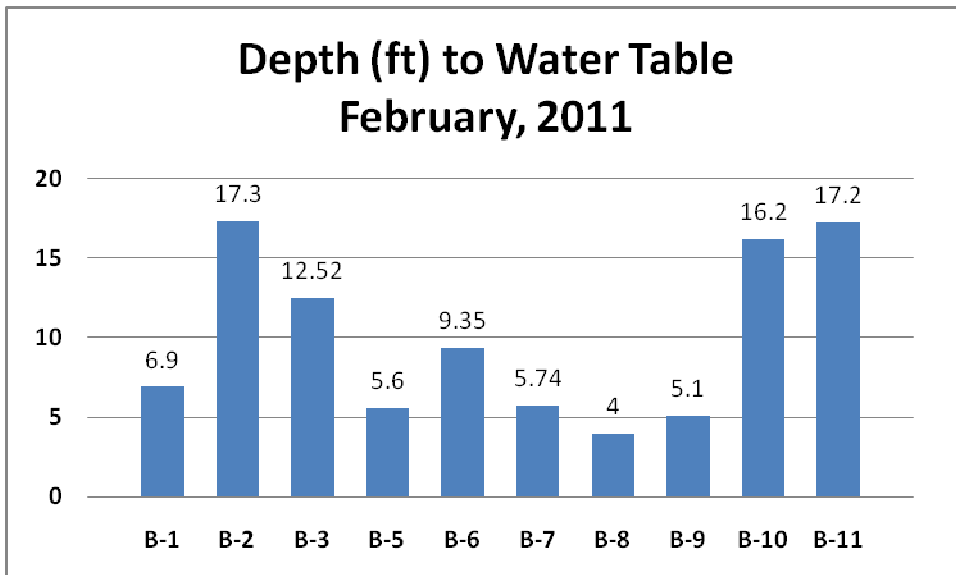


Figure 2. Depth to the water table, i.e., static water levels (SWLs), measured in early February, are greater in proximity to the Pacific Ocean or Siuslaw River e.g., B-2, B-3, B-6, B-10, and B-11, than wells that are inland from these water bodies, e.g., B-5, B-7, and B-8.

The January 2011 hydraulic head data above was used to construct the map shown in Figure 3. This map is consistent with previous interpretations regarding groundwater flow, i.e., groundwater flows towards and discharges to the Siuslaw River in south Florence, and flows toward and discharges to the Siuslaw River and the Pacific Ocean in north Florence. The

cause of the steep gradient in the west in proximity to the river and ocean remains uncertain at this time.

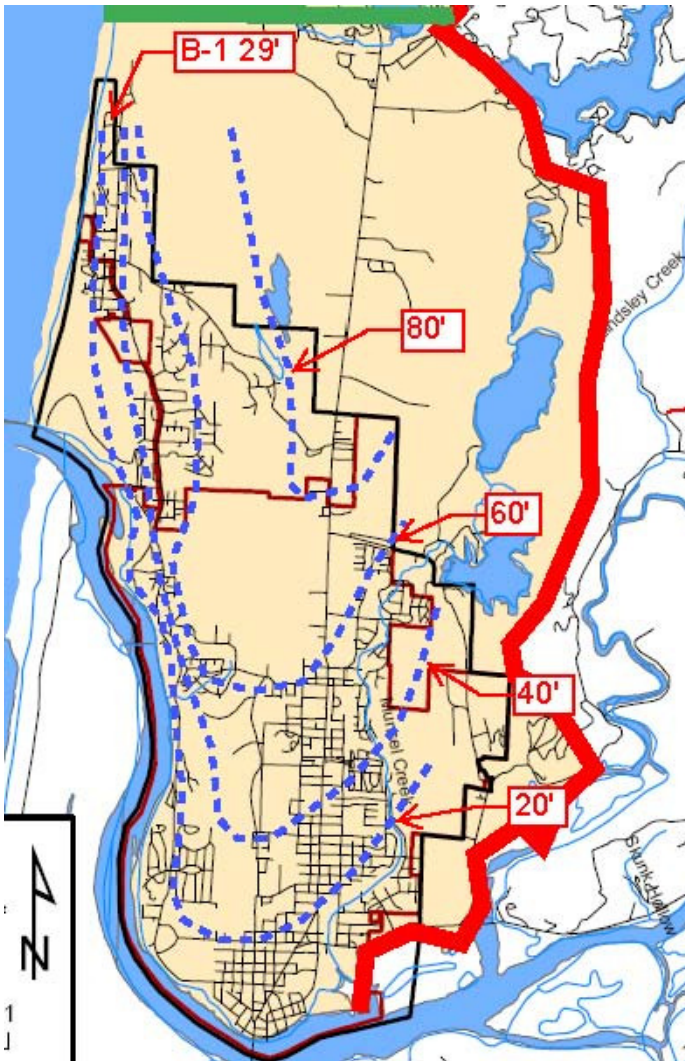


Figure 3. Map of the hydraulic head, i.e., surface of the water table, in the Florence area based on water level measurements collected on January 7, 2011.

Water Quality

Water quality analyses of groundwater collected from the monitoring wells during January and February of 2011 consisted of total coliform, *E. coli*, and selected nitrate tests. The results are given in Table 3 below. As is evident, no *E. coli* positive results were found. Total coliform was found in B-2, B-3, B-8, and B-10 in both sampling events while results were positive for B-1 in February only. As of this writing, nitrate analyses are only available for B-2 (ND) and B-10 (1.6 mg/L). The results for B-2 are in stark contrast to previous monitoring results which indicated nitrate in excess of 25 mg/L. This well remains somewhat of a mystery.

Sample Date	Well	Total Coliform (MPN)	E coli. (MPN)	NO ₃ -N (mg/L) MCL = 10
January 2011	B-1	1.0	ND	NA
	B-2	>2200	ND	ND
	B-3	1.0	ND	NA
	B-5	ND	ND	NA
	B-6	ND	ND	NA
	B-7	ND	ND	NA
	B-8	150	ND	NA
	B-9	ND	ND	NA
	B-10	325	ND	1.6
	B-11	ND	ND	NA
	February 2011	B-1	ND	ND
B-2		248	ND	NA
B-3		2.0	ND	NA
B-5		ND	ND	NA
B-6		ND	ND	NA
B-7		ND	ND	NA
B-8		95.9	ND	NA
B-9		ND	ND	NA
B-10		68.9	ND	NA
B-11		ND	ND	NA

Table 3. Total coliform, E. coli, and selected nitrate data for the Florence monitoring wells, January and February, 2011 sampling events. *Detections are shown in red, but the color does not necessarily imply a health threat.*

With respect to the field parameters for groundwater, we note that comparing the October, 2010 and January, 2011 data, that there is a slight decrease in the temperature range (from 12.9 – 15.3 °C to 11.5 – 13.1 °C) and pH (from 6.21 – 6.55 to 5.33 – 5.98), both consistent with increased recharge through infiltration of precipitation.

Specific conductance, related to the concentration of dissolved solids in the water, shows little temporal variation, with October to February data varying from 93 to 171 uS/cm, equivalent to approximately 60 – 110 mg/L total dissolved solids. An exception is the value for well B-7, which decreased in its conductance value from 81 to 45 uS/cm (~30 to 55 mg/L TDS) during that time period. The values for B-7 are more in line with what would expect from precipitation alone and probably reflect minimal reaction with aquifer materials or interacting with other inputs to groundwater.

Lastly, the January values for dissolved oxygen (DO) in groundwater from the City's monitoring wells exhibit a considerable variation (Figure 4). The equilibrium concentration of DO at approximately 12°C and atmospheric pressure is approximately 10.5 mg/L (see Drever, 1982) and likely, precipitation during January had a DO close to this figure. Once the precipitation infiltrates below the surface and encounters organic matter, the DO decreases as a result of microbial activity. This perhaps offers an explanation of the lower DO values of groundwater from the monitoring wells.

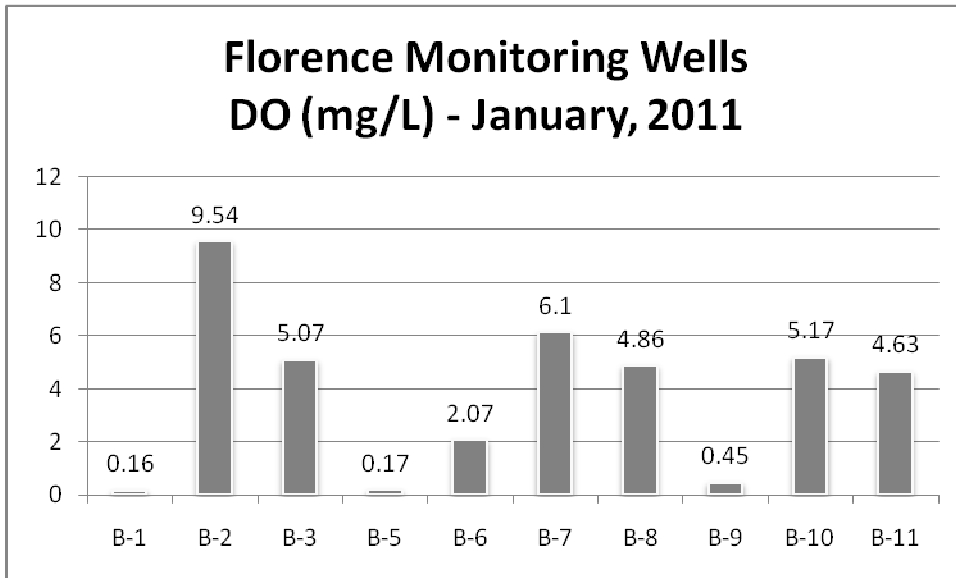


Figure 4. Dissolved Oxygen in groundwater monitoring wells in January 2011

Interesting are the very low values exhibited by groundwater from wells B-1, B-5, B-6, and B-9. This observation may be relevant to the current study in that at these low DO values, it is quite possible that nitrate, had it been present initially as a result of contamination, would have been transformed into other nitrogen compounds, e.g., the gaseous N₂, and would therefore not be detected by analysis. Whether this is the case here has yet to be demonstrated.

Future monitoring will follow the schedule that has been distributed to team members earlier with a slight modification. The full suite of chemicals of interest sampling has been moved to March instead of February due to lab processing timelines and City staff availability. Working with the lab, we are now targeting the first of the month for sampling. The sampling event scheduled for February 28th – March 2nd will include the first full suite of the chemicals of interest identified early in this study, including volatile organics, selected pesticides and metals.

Reference: Drever, J.I., 1982. The Geochemistry of Natural Waters. Prentice-Hall, Inc., Englewood Cliffs, N.J., 388p.

Surface Water Monitoring: Munsel Creek and Ackerley Creeks

The City sampled surface water sites on January 5th and January 31st, except for the Ackerley Creek site on January 31st due to the presence of spawning steelhead and redds at that site on that date.

Table 1 shows the water quality parameters measured by City staff and their values. The range of stream temperatures on January 5th (6.7–7.6 C) was lower than the preceding November 29th sampling (8.3-8.4 C) and subsequent January 31st sampling (8.6–8.7 C). The range of pH values on January 31st (6.8-7.16 SU) was higher than on January 5th (6.71-6.7 SU). Specific conductance and turbidity had a similar range as previous samplings.

Dissolved oxygen values on January 5th, confirmed a concern raised after the November 29th sampling that the difference between the values measured using the YSI probe and the values measured using the Winkler Titration and Saturated Air accuracy checks were too large. The City replaced the dissolved oxygen sensor membrane and changed the membrane fluid in an attempt to fix the discrepancy shortly before sampling on January 31st. Winkler Titration and Saturated Air accuracy checks on January 31st revealed that the differences in dissolved oxygen values had greatly narrowed between the probe reading and the accuracy checks as a result of that sensor maintenance. Consequently, now the dissolved oxygen sensor membrane will be replaced and the membrane fluid changed on a monthly basis.

Table 1. Results of surface water monitoring.

Site	Date	Temp (C)	pH (S.U.)	DO (mg/L)	Specific Conductance (us/cm)	Turbidity (NTU)
PWS	01/05/11	7.6	6.71	11.81	68.6	2.83
MGP	01/05/11	7.3	6.57	12.05	66.2	1.7
MLK	01/05/11	6.7	6.74	11.96	62.1	1.99
ACK	01/05/11	7.2	6.7	11.68	59.8	0.97
PWS	01/31/11	8.6	6.82	10.4	72.6	1.08
MGP	01/31/11	8.7	6.92	10.3	69.2	1.16
MLK	01/31/11	8.6	7.16	10.9	64.7	0.77

The City collected surface water samples for lab analyses of Total Coliform and *E. coli*. The results of the lab analyses are presented in Table 2. In all cases, total coliform and *E. coli* levels did not present a concern.

Table 2. Results of laboratory analysis of water samples from the four surface water sampling sites.

Site	Date	Total Coliform (MPN)	<i>E. coli</i> (MPN)
PWS	1/5/2011	308	16
PWS (Duplicate)	1/5/2011	345	20
MGP	1/5/2011	387	50
MLK	1/5/2011	387	4
ACK	1/5/2011	2420	13
PWS	1/31/2011	261	9
PWS (Duplicate)	1/31/2011	248	12
MGP	1/31/2011	261	16
MLK	1/31/2011	186	ND
ACK	1/31/2011	Not tested	Not tested

The duplicate sampling at PWS is for control purposes.