

## **Fornsby Creek Project: Self-regulating tidegates and estuary restoration**

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### **Abstract**

Estuarine habitat is increasingly recognized as critical and limiting to salmonid populations (Beamer, 2000). The Swinomish Indian Tribal Community has initiated a restoration project, the Fornsbys Creek SRT Project, to accomplish restoration of former estuarine habitat adjacent to the Swinomish Channel on the Swinomish Indian Reservation. The project will re-open more than five miles of estuarine-riparian channel to fish and improve more than 70 acres of associated aquatic habitat by replacing existing impassible tidegates with self-regulating tidegates (SRTs), improving the channel quality behind the new tidegates, and installing vegetated buffers adjacent to the channels. An extensive monitoring program, documenting pre-, syn-, and post-project ecologic and hydrologic conditions, is included to facilitate evaluation of positive and negative impacts of the project to fish use and adjacent land uses.

### **Introduction**

Reservation waters support a vast fisheries resource that Tribal members rely on for subsistence and commercial harvest and ceremonial use. Salmon are particularly culturally significant, playing a central role in the community and spiritual life of the Tribe. Aquatic vegetation is also important to the Tribe, as it provides critical habitat to aquatic species including salmonids and their prey. Estuarine, and particularly pocket estuary, habitat is increasingly recognized as critical and limiting to salmonid populations in the region (Beamer, 2000).

The Swinomish Reservation, located on the southeast peninsula of Fidalgo Island about 70 miles north of Seattle, WA, is the homeland for the Swinomish Indian Tribal community (Tribe) and comprises 7,431 acres of uplands within 24.62 miles of marine shoreline and 2,750 acres of tidelands (Figure 1). It is bounded to the east by the Swinomish Channel, to the north by Padilla Bay, to the west by Turners Bay and Kiket Bay, and to the south and southwest by Skagit Bay. The project area was once part of an 900+ acre estuary that existed when the Skagit and Samish River deltas were one large delta and included the Swinomish Slough. The U.S Army Corps of Engineers constructed a navigable channel now known as the Swinomish Channel by dredging, in part, along Swinomish Slough. The Swinomish Channel today comprises 11 miles of dredged channel maintained to a depth of 20 feet below MLLW. Geomorphic modifications including creation of the navigable channel, construction of a jetty south of the channel to deflect water and sediment from the North Fork of the Skagit River, diking and channelization of other adjacent estuarine sloughs, and wetland filling have destroyed 105 miles of tidal sloughs and resulted in a 56% loss of historic channel and 75% loss of mudflat, salt marsh, and sea grass habitat in the area. Remnant channels remain as farm ditches simplified by decades of agriculture with flap-style tidegates prohibiting use by salmon.

Because the Swinomish culture is so intrinsically tied to the welfare of the salmon, the Tribe is committed to protection and restoration of the resource and its habitat. This commitment often brings the Tribe into conflict with other groups whose goals and needs appear to be incompatible with desired protective or restorative methods. Restoration of estuarine habitat involving replacement of conventional tidegates with self-regulating tidegates (SRTs) that allow increased saltwater flux is an example of one such controversial method. While SRTs improve fish passage and may enhance estuarine habitat function, the effects of the increased saltwater flux landward of such gates on adjacent land use have been poorly documented and are viewed as a threat, particularly to agricultural productivity.

The Fornsbys Creek SRT project provides a unique opportunity for the Tribe to restore estuary habitat on Tribal lands, implementing the same methods they ask others to employ for salmonid protection and restoration, while quantitatively investigating the positive and negative impacts of the restoration activities. The completed project will

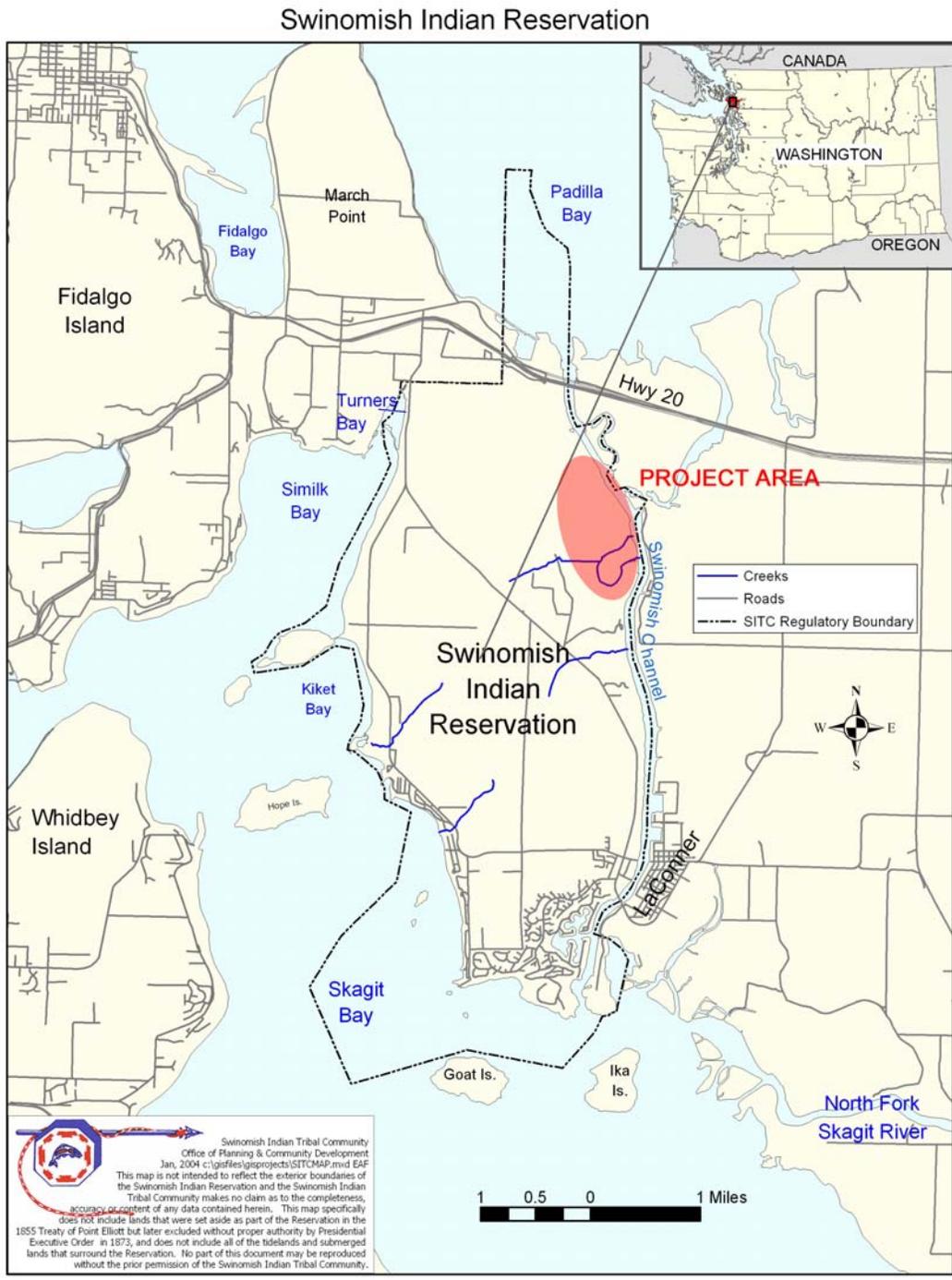


Figure 1. Location of Swinomish Indian Reservation and Fornsby Creek Project area.

increase habitat available for salmon rearing, particularly Chinook, and provide data to evaluate collateral effects of SRTs on adjacent land use on the Skagit.

## **Project Description**

The project can be broken down into three overlapping phases: pre-restoration (“baseline”) monitoring, active restoration/construction, and post-restoration monitoring. Baseline monitoring began in autumn 2003 and includes monitoring of existing hydrologic conditions, habitat, and fauna. Active restoration began in autumn 2004 and includes tidegate replacement, channel shaping, and riparian plantings. The monitoring activities initiated for baseline observation are maintained to provide ongoing baseline data in areas not yet under active restoration and post-restoration monitoring in those areas that have been modified. More detail on project activities is provided below

The baseline monitoring program for this project includes biological surveys, hydrologic monitoring, and some soils studies. The spatial distribution of these monitoring stations is shown in Figure 2. More than 70 acres of riparian habitat were surveyed for existing vegetation to inform a restoration planting plan. Fish use was documented by bi-monthly beach seining at three sites within the project area, and benthic macroinvertebrate samples were collected. Channel morphology, sediment grain size, and flow rates were assessed before any modifications were implemented. Surface water levels and water temperatures are continuously monitored at twelve sites and surface water quality parameters (pH, conductivity, dissolved oxygen, salinity, turbidity, and chloride) are sampled bimonthly. Groundwater levels are monitored continuously at seven pairs of monitoring wells and groundwater quality parameters (pH, conductivity, dissolved oxygen, salinity, and chloride) are sampled monthly. Soil salinities have been measured and mapped in cooperation with the USDA along transects parallel to well transects in both wet and dry seasons using electromagnetic induction methods.

Restoration activities planned as part of this project include installation of SRTs; channel restoration, modification and/or enhancement; and riparian plantings. SRTs will be installed at three locations along the Swinomish Channel, replacing two flap-style tidegates and adding one additional access point. The first of these SRTS was installed at the southernmost site (FOR.1) in autumn 2004. This tidegate was not originally intended for replacement as part of this project, but the existing flap-style gate failed and a SRT was chosen as a replacement. The new SRT is being operated as a flap-style tidegate for a one-year period to permit gathering of additional “baseline” data. The second tidegate will be installed in autumn of 2005 at the FOR.3 site, and the third at OLD.1 in autumn 2006. These SRTs should restore fish access and tidal influence to more than five miles of channel for salmonid rearing. Re-grading and modifying the channel morphology will enhance more than two miles of this re-opened channel habitat. Grading and shaping was begun in autumn 2004 along segments 1 and 2 (Figure 1). Segments 3, 4, and 5 will be graded in 2005 and 2006 and native plants will be installed as grading is completed. Native plantings will enhance more than 70 acres of adjacent riparian habitat as a buffer for the restored channel.

Post-restoration monitoring will mirror the baseline monitoring and utilize the same monitoring stations and sampling methods. Monitoring efforts will effectively continue without alteration in the activities, simply different implications for the resultant data. A minimum of two years of data will be collected after active restoration is complete, though some monitoring activities may be continued indefinitely.

## **Discussion Of Baseline Observations**

Our monitoring objective to date has been to document existing conditions in the project area to evaluate the effectiveness of the restoration for fish passage and use and to facilitate analysis of any post-installation hydrologic and ecologic changes. To fulfill the objectives of the project, we seek to not only quantify the enhanced fish use within the project area, but also evaluate and quantify the impacts of the restoration to adjacent agricultural land use. This should inform the cost/benefit questions surrounding this type of restoration work.

Baseline monitoring includes two main components, biologic characterization and hydrologic characterization of existing conditions. Biologic characterization included identification of current riparian vegetation, fish use studies,

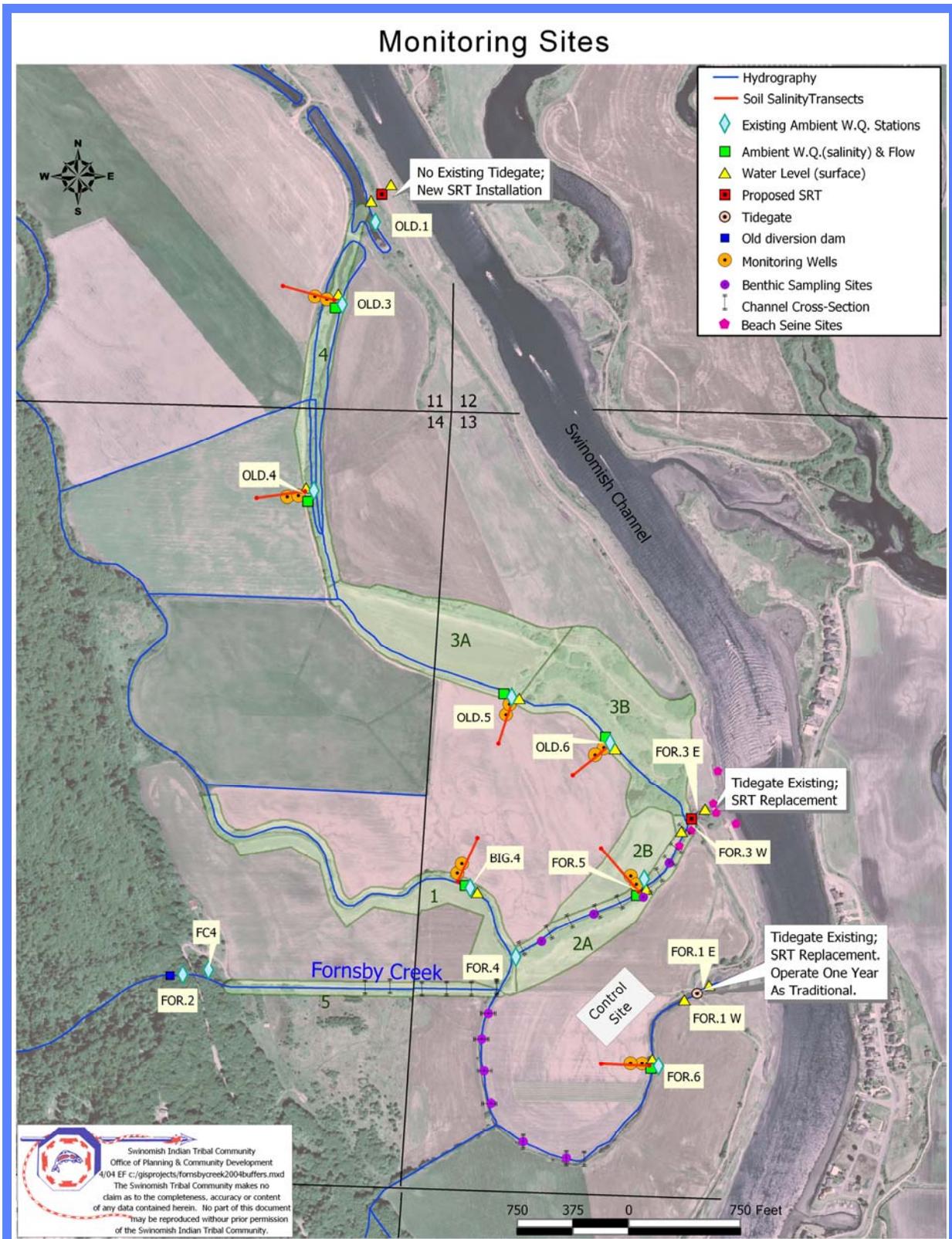


Figure 2. Map of Forsby SRT project area showing location and distribution of monitoring and restoration activities. Green shaded areas adjacent to restored channels indicate approximate areas of planned riparian enhancement.

and benthic macroinvertebrate sampling. A total of 118 species were identified within the project area, while 66 plant species were identified within the two representative wetlands (Colcazier, 2004). Thirty individual plant communities were identified within the project area survey. Seven plant communities were grass communities typically dominated by saltgrass (*Distichlis spicata* var. *spicata*). Four communities were wheat and triticum crop grasses. Another common plant community within the project area was crabapple (*Malus fusca*) and Nootka rose (*Rosa nutkana*), which comprised six of the total thirty communities. Sticklebacks were the most abundant fish caught during beach seine fish use surveys and were also most abundant fish species upstream of the tidegate (Beamer, 2004). Staghorn Sculpin were also consistently present upstream of the tidegate. However, all other estuarine or nearshore origin fish (Surf Smelt, Starry Flounder, Shiner Perch, and juvenile salmon) are more abundant downstream of the tidegate or in the vicinity of the tide gate rather than upstream of the tidegate. Of a total of 210 juvenile salmon captured by this project, only one juvenile salmon was caught upstream from a tidegate. Results of benthic sampling are not yet available.

Hydrologic characterization has included monitoring of water levels in and adjacent to the creek and slough channels, basic water quality parameters in surface and ground water, groundwater and surface water flow characteristics, and soil salinity. The hydrologic data indicate that the area is already experiencing some saltwater interaction due either to the natural salt/freshwater gradient or periodic tidegate failures or malfunctions. Such malfunctions do not seem adequate to explain the overall trends in the data, thus we believe the baseline data to largely reflect natural conditions rather than being event-driven. Groundwater salinities and chlorides, as well as soil salinity, tend to decrease with increasing distance from both the tidegates and the freshwater channels. Water levels in the freshwater channels and the monitoring wells typically mimic tidal fluctuations though groundwater flow directions vary from site to site (Figure 3). This suggests that the elevation of the water surface may not, at least in all cases, reflect landward progradation of saltwater under tidal influence, but instead may indicate a backwater or ponding effect due to reduced freshwater outflow to the Swinomish Channel. Limited surface water flow observations in the channels themselves showed no landward flows, only seaward flow at rates varying over the tidal cycle.

## Summary

Increased saltwater influence in and adjacent to the channels landward of the tidegates is expected following tidegate replacement. It is the magnitude and impact of this increase that we are most interested in. Replacement tidegates will be selected to enhance tidal flux into the landward channels and more readily permit fish passage, particularly for salmonid species that have been identified in the vicinity of the tidegates in the Swinomish Channel. The increased tidal prism is expected to produce moderate increases in water salinity behind the tidegates, as well as increasing DO and decreasing water temperatures during the summer months, thereby improving water quality for salmonids seeking shelter in this estuarine environment. Based on the preliminary data available, we expect to see some sympathetic response in both groundwater levels and groundwater quality adjacent to the estuarine channels. However this response, particularly impact to water quality, is expected to be laterally limited. We hope that, with the hydrologic feedback gained from the monitoring network, tidegate function can be fine-tuned to accomplish the habitat and fish passage restoration goals with minimal impact to adjacent land use.

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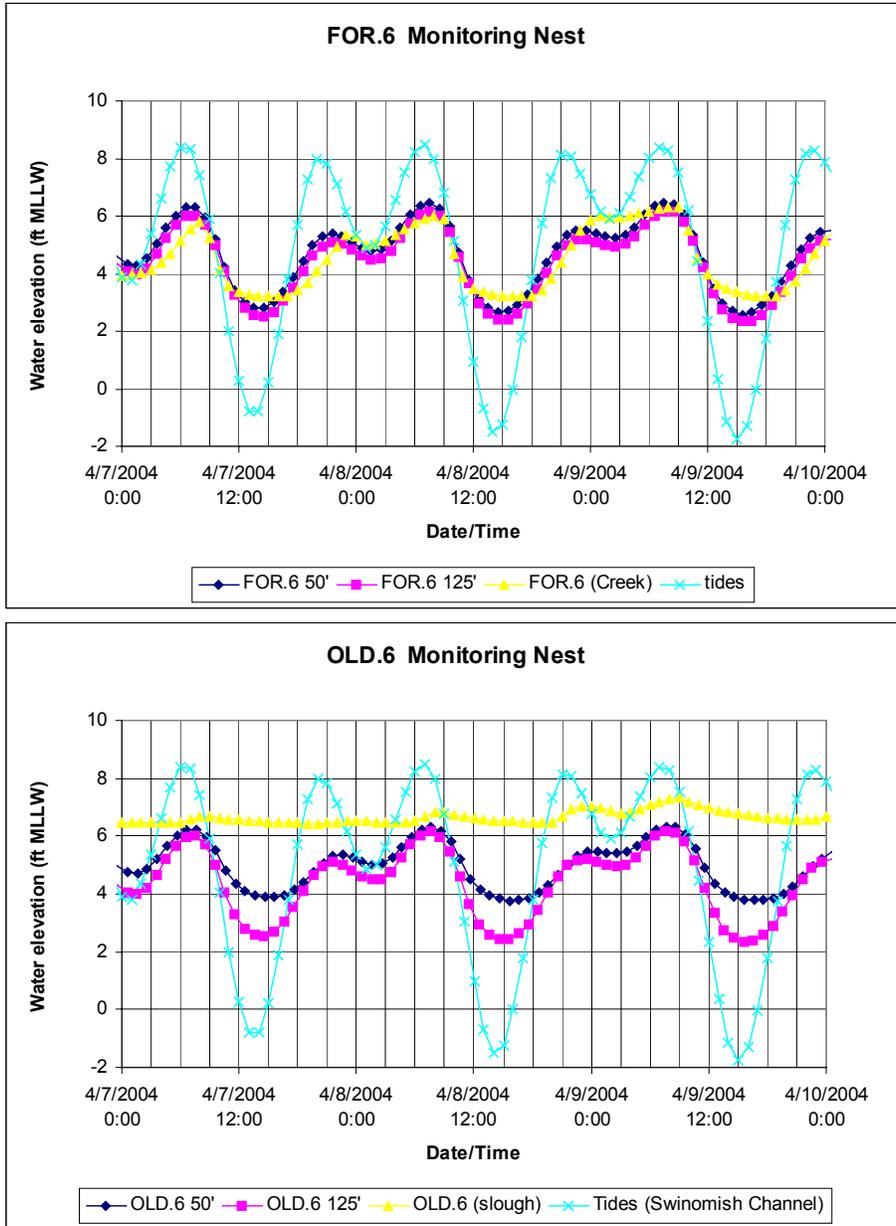


Figure 3. Comparison of water surface elevations including predicted tidal surface (in Swinomish Channel), water surface in slough, and monitoring well water tables at two of the seven general monitoring sites. Note that at the OLD.6 site, groundwater flow appears to be away from the slough, which shows minimal influence from tidal fluctuations. At the FOR.6 site, groundwater flow is generally toward the creek during the high tide and away from the creek during low tide.

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