μ MU Hydrogeological and Environmental Services Wildwood, Missouri

Hydrogeology Study Summary
J Street Drainage Improvement Project
Oxnard, California

Background

The planned improvements to the J Street Drain channel in Oxnard, California will stretch along nearly a 2200-ft length of the drain. A geotechnical study (Fugro, 2009) identified the subsurface conditions for the drain, and it recommends that dewatering be performed to maintain the water table at least three feet below the bottom of the concrete channel during construction. With portions of the channel located close to the Pacific shoreline, the dewatering will require pumping to lower the water table to approximately mean sea level and below in order to accommodate construction of the improvements to the channel. Based on timetables established for the project, it is anticipated that dewatering along the lower reach of the channel would endure from two-to-four months.

The nearby Halaco Superfund Site, located approximately 1500 feet east of the southern portion of the J Street Drain, contains plumes of groundwater impacted primarily by metals. A hydrogeological study was undertaken to evaluate the potential migration of groundwater from beneath the Halaco Site in response to dewatering along the J Street Drain.

Objective of Groundwater Model

The primary objective of the hydrogeologic study is to evaluate the potential for the dewatering effort to draw impacts from the Halaco Superfund Site toward the J Street Drain Improvement Project. A secondary objective is to evaluate prospective mitigation measures that may be needed for potential future conditions beneath the J Street Drain and Halaco Site areas that may result from construction dewatering. Collection of information from the Halaco Site, aquifer testing, and groundwater modeling were performed to address the objectives of this study.

Approach

The approach for this study was to construct a numerical model of the J Street Drainage area using information of the regional hydrogeology and site specific information provided in the Fugro study (2009), Halaco Site investigations by US EPA, and aquifer testing provided as part of this study. The model was used to evaluate groundwater migration from the Halaco Site in response to dewatering during the channel construction. The anticipated period of pumping / dewatering is projected to be up to four months in the southern section of the channel.

Hydrogeology

The Oxnard Plain is located within the Transverse Ranges geologic province of California which is characterized by generally east-west trending mountain ranges composed of sedimentary and volcanic rocks ranging in age from Cretaceous to Recent. Sediments comprising the Oxnard Plain originate from the Santa Clara River system that drains the surrounding mountains (i.e., the Topatopa Mountains, to the north, and the Santa Monica Mountains and Santa Susana Mountains to the east). The accumulation of sediments beneath the Oxnard Plain is characterized by fine-to-coarse grained alluvial fan deposits. From data in the vicinity of the study area, the upper 100 ft of sediments are predominantly fine-to-coarse sands with discontinuous layers of clay and silt. Beneath the 100 ft sandy interval is a thick clayey layer that serves as a confining layer for groundwater flow.

Groundwater under unconfined conditions is found beneath the Site with groundwater elevations ranging from less than 2 ft mean sea level (msl – referencing the NAVD 88 datum) to approximately 17.5 ft msl at the northern extent of the channel. Groundwater flows generally from north and east (i.e., inland and upland areas) toward the southwest and west (i.e., toward the coast). However, two factors contribute to influence the flow of groundwater in the focus area of this study. One is elevated surface water conditions in the Ormond Beach Lagoon and the Oxnard Industrial Drain (OID). The second is the presence of sewer lines in the vicinity of the southern reach of J Street Drain and the Halaco Site; these sewer lines draw in groundwater as drains.

There are few streams in the Oxnard Plain, and most flow only during wet periods and after storms. The Santa Clara River lies to the north of the study area, and its presence does not affect the modeling efforts described herein. However, the buildup of surface water within the Ormond Beach Lagoon and the OID influences the flow of groundwater in the study area. These two surface water features accumulate surface water to more than 8 ft msl due to the sediment buildup along the shoreline. During significant winter storms, the flood waters within the OID and the J Street Drain breach the buildup of sediments to drain these surface water features into the Pacific Ocean.

Annual precipitation over the Oxnard area is approximately 15.6 inches with most of this (nearly 13 inches annually, on average) falling during the four-month period between December and March.

Numerical Model

The groundwater system beneath the Site and adjacent properties was simulated using the U.S. Geological Survey model MODFLOW (McDonald and Harbaugh, 1986). Groundwater VISTAS software was used to construct the model mesh and served as a graphical processor that interfaced with MODFLOW as well as the post-processing program MODPATH. MODPATH identified pathways of flow within the groundwater system which aided in evaluation of potential impacts to groundwater flow into the channel project area.

Geographic boundaries utilized in the model cover the entire J-Street channel. However, the focus for the model is the southern portion of the channel which lies closest to the mouth of the J Street Drain at Ormond Beach Lagoon and the Halaco Superfund Site approximately 1500 ft toward the east. An overlay of the project area was utilized as the base map to construct the model. Thus, the model domain was a rectangular area 20,000 ft north-south by 10,000 ft east-west covering an area of 7.2 square miles (or approximately 4,600 acres). There were ten horizontal layers used with each layer five-feet thick. The model grid was refined in the vicinity of the J-Street Channel and the Halaco Site in order to produce greater numerical stability and more accurate results.

Subsurface Properties

The primary groundwater bearing unit, or aquifer, is composed of fine-to-coarse sandy alluvium extending to a depth of approximately -90 ft msl where a prevalent and relatively thick clayey unit serves as a confining layer. The primary material/soil characteristic that affects groundwater flow within the numerical model is hydraulic conductivity, which is a measure of resistance to flow within the porous medium with higher values showing less resistance to flow. A test pumping well was installed, and aquifer tests were conducted from this well with observations monitored in two closely spaced and adjacent observation wells. The results of the aquifer testing and analysis provided an estimated value for hydraulic conductivity beneath the Site at 100 ft/day. Also, based on the aquifer testing and the aggregate of geotechnical information, fine grained material of relatively low permeability within the upper 50-to-100 ft from the land surface is present in discontinuous layers that do not appear to serve as confining layers.

Recharge

Recharge was provided in the first layer of the model uniformly across all of the active model area. The value for recharge was based on an estimated 25% of the annual precipitation rate of 15.6 inches infiltrating uniformly across all active areas of the model, thus at a constant rate of 0.0009 ft/d. Since the recharge rate is viewed as conservative and reasonable, and a parameter that does not significantly affect model outcome, it was fixed uniformly throughout the year and not varied throughout the duration of the simulations.

Model Simulations

Simulated dewatering was undertaken only for the southern reach of the channel between Port Hueneme Road (i.e., north of the Oxnard Waste Water Treatment Plant) and the planned location of the coffer dam at the Ormond Beach Lagoon, located approximately 1700 ft south of Port Hueneme Road. A line of 35 pumping wells was emplaced at depths of -5 to -10 ft msl along the channel with one well approximately each 50 ft and one cell per well. Pumping rates for the sixteen pumping wells closest to shoreline were approximately double those further inland due to the elevated surface water boundary conditions in the model representing the Ormond Beach Lagoon and the OID.

There were three phases of groundwater modeling conducted in order to meet the objectives of this project, and the results of each phase are described briefly as follows:

1. **Calibrate to boundary conditions**. The model was calibrated by adjusting boundary conditions within the model domain in order to closely match observed groundwater elevations within monitoring wells in the area. Since hydraulic conductivity was established during the aquifer testing and the water levels within the Ormond Beach Lagoon and OID were established from relatively long-term gauging records collected by US EPA, the primary changes that were necessary in order to calibrate to observed groundwater elevations were associated with the

sewer line running east-west beneath McWane Boulevard and north-south beneath Perkins Road beginning at McWane. From monitoring well data associated with the Halaco Site, the sewer line acts as a drain that lowers groundwater elevation to between -2 and 0 ft msl (NAVD 88) adjacent to the sewer line north of the Halaco Site as well as along the J Street Drain near the wastewater treatment plant. The elevation of water within the sewer line (i.e., simulated as a drain) that best matched the observed monitoring well data was -2 ft.

2. **Identify the potential influence on groundwater beneath the Halaco Site in response to dewatering**. During dewatering of the southern reach of the Drain, the cumulative dewatering rate to maintain groundwater at elevations necessary for construction was approximately 400 gallons per minute over the approximate 1700 ft length of the southern reach of the Drain with greater pumping rate required nearer the shoreline. Due to the strong influence of the sewer line, groundwater migration beneath the Halaco Site is not affected by dewatering under current conditions, and there is likely to be no migration of groundwater toward the dewatering wells.
3. **Identify prospective mitigation measures.** Under current conditions, there does not appear to be the need for mitigation measures. Monitoring of selected monitoring wells (e.g., MW-15, MW-21, and MW-22 located on the Halaco Site, and MW-23 located in the beach parking area off Perkins Road) can be performed during dewatering to evaluate the need for mitigation. Under conditions where the sewer is amended to cease acting as a drain, migration of groundwater offsite from the Halaco Site is possible in response to dewatering. In this case, the migration of groundwater from beneath the Halaco Site can be mitigated using a set of approximately five injection wells placed in the beach parking area between the J Street Drain and the Halaco Site. An aggregate total injection pumping rate of between 50 and 70 gallons per minute (or between 10 and 14 gallons per minute per injection well) would prevent migration of groundwater offsite from the Halaco Site.

In the latter two phases of groundwater modeling, pumping rates were iteratively adjusted to maintain groundwater levels at approximately -3 ft msl in the lower (i.e., southwestern) reach of the pumping channel. This elevation is considered the approximate elevation that will need to be maintained in the southwesternmost reach of the drain in order to construct the bottom of the channel. The elevation of the channel rises along the northward trend reflecting the natural rise in topography toward the north. Thus, the target groundwater elevation for the northernmost pumping well was approximately 0 ft msl.

Conclusions

The numerical model of the groundwater system beneath the J Street Channel area demonstrates that the sewer line beneath McWane Blvd and Perkins Road in combination with elevated surface water in the Ormond Beach Lagoon and the OID have significant effects on groundwater elevations and migration in the area with groundwater flow identified in the direction of the sewer lines. The simulations demonstrate that it is unlikely for dewatering to draw groundwater from beneath the Halaco Site toward the J Street Drain under current conditions. However, should the sewer line become amended or upgraded to cease acting as a drain for groundwater, the dewatering effort may cause migration of potentially impacted groundwater from beneath the Halaco Site toward the J Street Drain. In this case, injection of water into the shallow aquifer through several wells located in the beach parking area between the J Street Drain and the Halaco Site can be utilized to mitigate potential migration of groundwater from beneath the Halaco Site. The monitoring of water levels within selected monitoring wells in the vicinity of the Halaco Site can be utilized to identify if migration of groundwater from the Halaco Site is occurring.