BCT Hydrus Modeling Presentations
Objective and Scope
September 2017

Presentations

1. Hydrus Modeling: Part 1-Hydrogeologic Conditions Affecting SS030
2. Hydrus Modeling: Part 2- Hydrus Modeling of SS030 including ST054, ST057, & SS084
3. OU5 (Sites SS083 and FT082) Hydrus Model Development Process
4. OT071 Hydrus Model Proposed Setup and Calibration

Objective

The objective of the presentations is to familiarize regulatory agency staff with how Hydrus models are developed and implemented at various sites to establish soil and groundwater remedial goals. The goal is to use the presentations to facilitate technical discussions regarding development, calibration, and use of the Hydrus models. Included in the presentations are key data evaluations conducted to determine hydrogeologic conditions affecting contaminant flow and transport. An important part of these discussions will be input from regulatory agencies on the modeling. Comments will be used in development and documentation of Hydrus models in various reports that will be documents for regulatory approval.

Description of Hydrus Model Code

The Hydrus model code (https://www.pc-progress.com/en/Default.aspx?hydrus-3d) was originally developed by the U.S. Department of Agriculture in 1998 for one-dimensional simulations of variable-saturation flow and transport through shallow soils and the underlying vadose zone. The code has been expanded to the current 2D/3D code that includes vadose zone and groundwater flow and transport. The Hydrus code uses basic data including soil geotechnical properties, precipitation and evapotranspiration, and contaminant migration properties as input parameters. Hydrogeologic parameters such as recharge and contaminant migration rates are derived from basic data and not assumed values for these parameters. Hydrus has robust computational schemes to minimize simulation numerical effects and maximize model stability even though it solves highly non-linear equations. Hydrus is supported extensively by Dr. Šimůnek at University of California Riverside. Dr. Šimůnek is one of the primary authors of the Hydrus code. For GAFB simulations, Hydrus will be used to develop two-dimensional cross-section models of the various sites. The models will be calibrated to observed contaminant plumes from initial contaminant release through 2016 or until the plumes become stable. 2D models are proposed because of the complexity of simulations with a thick vadose zone with underlying aquifers requiring extensive computational resources even for 2D simulations of the George groundwater systems.

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Scope of Presentations

Hydrus Modeling: Part 1-Hydrogeologic Conditions Affecting SS030. This presentation addresses the key geotechnical soil properties and hydrogeologic conditions at SS030 affecting contaminant migration. This includes determination of site-specific van Genuchten parameters governing flow in the variably-saturated vadose zone as well as how Hydrus processes precipitation/evapotranspiration data to determine recharge to the Upper Aquifer water table. There is a discussion of Upper Aquifer artificial recharge water level changes from the Adelanto sewage treatment plant and the new percolation ponds as well as natural recharge pulses. An updated LNAPL volumetric estimate over time is also presented along with resolution of the various historical volume estimates.

Hydrus Modeling: Part 2- Hydrus Modeling of SS030 including ST054, ST057, & SS084. This presentation covers the development and calibration of the SS030 Hydrus benzene model. Calibration period is 40 years from the time LNAPL first reached the water table (the benzene vapor and groundwater plumes become stable after 10 to 20 years). Hydrus model results are presented along with updated LNAST one-dimensional simulations. LNAST has been used in some SS030 historical reports. Long-term simulations of vapor migration to shallow soils and downward toward the Lower Aquifer are presented.

OU5 (Sites SS083 and FT082) Hydrus Model Development Process. Using SS083 TCE contamination as an example, this presentation addresses how site data are evaluated in three dimensions (3D) to determine hydrogeologic conditions prior to development of a Hydrus model. Animations of the SS083 and FT082 3D data models along with times-series analyses of water levels and TCE concentrations are presented. Development and calibration of the SS083 TCE Hydrus model is presented.

OT071 Hydrus Model Proposed Setup and Calibration. This presentation addresses the proposed development and calibration of the OT071 dieldrin Hydrus model. Based on literature review, it is proposed that dieldrin contamination is the result of colloid-enhanced migration from the areas of application in the former housing areas into the Upper and Lower Aquifers. Seasonal artificial recharge from irrigation in the housing and golf course areas appears to have been a major factor in dieldrin migration into the Upper and Lower Aquifers. Calibration period will be from time of initial dieldrin application in the surface soils to 2016.

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