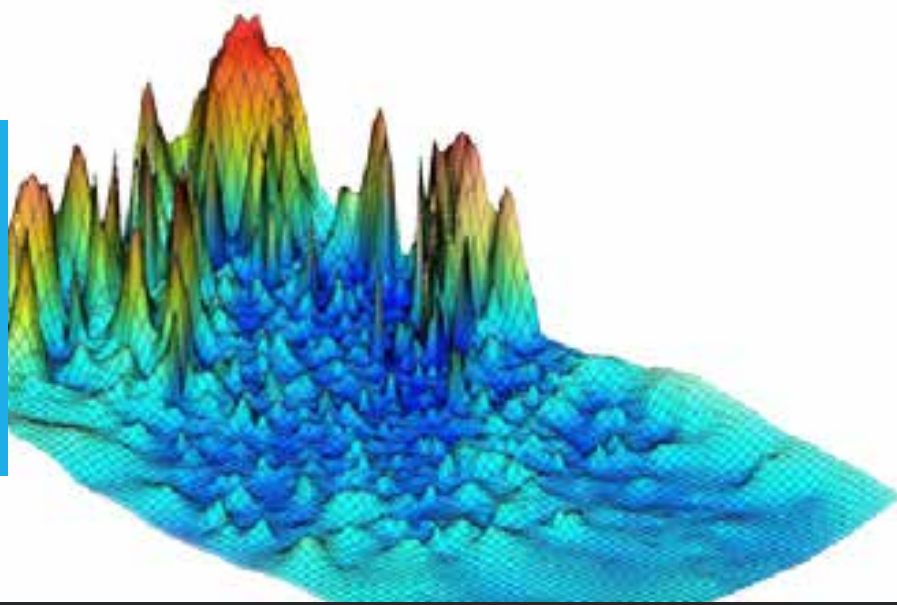


MODELING AND OPTIMIZATION

Management Strategies for a Sustainable Future



HGL is a leader in modeling groundwater and surface water to visualize and predict contaminant transport, estimate cleanup time frames, and manage water resources. Modeling is a valuable tool that allows designers and engineers to understand the behavior of a dynamic system and support technical and managerial decision-making. HGL's modelers have in-depth experience in building models that meet user needs and provide the output necessary to develop solutions to complex environmental and resource management challenges.

Groundwater/Surface Water Modeling: HGL has successfully developed and applied industry standard modeling software and decision support tools (MODFLOW-SURFACT™ and MODHMS®) to solve environmental restoration and water resources management problems. Services include the following:

- Hydrogeologic Investigations
- Groundwater/Surface Water Interaction Modeling
- Multimedia Flow and Transport Modeling
- Watershed Evaluation
- Water Resource Planning

Physics-Based Management Optimization (PBMO™): PBMO™ links advanced optimization algorithms with site flow and transport models and integrates multiple variables and constraints into the decision process at a level of detail previously considered impractical. For each site, HGL considers the conceptual site model (CSM), the goals of the remedy, available data, remedy performance, protectiveness, cost-effectiveness, and closure strategy. PBMO™ features include the following:

- Optimal solutions for multiple remedial objectives
- Distributed computing (Cloud)
- Linkage to MODFLOW-MT3D and MODFLOW-SURFACT™
- Optimized remedial design
- Water resource management



HGL DISTINCTIONS

ENR Top 200 Environmental Firm

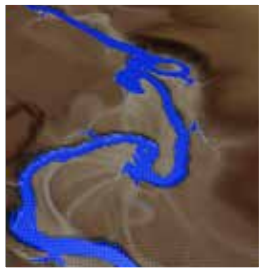
Sophisticated, 3-D models of groundwater flow and contaminant fate and transport assist site owners and regulators with determining liability and making cost-effective, defensible site remediation decisions

Specialized models and expertise to assess long-term impacts of groundwater and surface water use on groundwater levels, streams and wetlands, and saltwater intrusion in coastal areas

MODELING AND OPTIMIZATION

Products: HGL has a wide array of innovative tools for modeling, data management, and environmental remediation and water resource management optimization. For more information about the following, please contact info@hgl.com.

- MODHMS®
- MODFLOW-SURFACT™
- PBMO™ TOOLKIT
- PlumeSeeker™



HGL's PlumeSeeker™ technology optimizes monitoring well networks to efficiently and accurately delineate contaminant plumes in groundwater. PlumeSeeker™ combines geostatistics and 3-D groundwater flow and contaminant transport modeling to predict the spatial distribution of groundwater plumes that exceed a specified screening or remedial concentration. The technology is particularly effective for defining large, diffuse plumes or contamination in complex hydrogeologic settings.

CREDENTIALS

- Certified Construction Managers
- Certified Hazardous Materials Managers
- Certified Industrial Hygienists
- Certified Project Management Professionals
- Certified Safety Professionals
- Certified Sustainable Development Professionals
- Certified Wastewater Treatment Plant Operators
- LEED® Accredited Professionals
- Professional Engineers
- Professional Geologists
- Subject Matter Experts
- USAESCH Certified UXO Personnel

CLIENTS

- US Air Force
- US Army Corps of Engineers
- US Army Environmental Command
- US Bureau of Reclamation
- US Department of Energy
- US Environmental Protection Agency
- Department of Justice
- Environmental Security & Technology Certification Program, DoD
- Federal Bureau of Prisons
- National Aeronautics and Space Administration
- National Park Service
- Strategic Environmental Research and Developmental Program, DoD
- Arizona Department of Environmental Quality
- Florida Water Management Districts
- International Public and Private Clients

CASE STUDIES

Modeling

Peace River Integrated Modeling Project (Peace River, Florida). Project highlights:

- Developed a conceptual hydrological and regional hydrogeological model, including the roles of Karst sinkhole features, lakes, and streams on groundwater/ surface water interactions.
- Developed local and regional groundwater and surface water budgets.
- Prepared and calibrated a transient integrated groundwater/surface water model.
- Performed model sensitivity analyses and simulated select future land use and management scenarios, including changes in groundwater pumping.
- Trained SWFWMD personnel on use of the model.

Simulation of Water Flow and Phosphorus Transport in a Highly Interactive Surface Water/ Groundwater System in the Everglades National Park (Everglades, Florida). Project highlights:

- Developed and calibrated an integrated surface water/groundwater flow and transport model for phosphorus in a highly interactive hydrological system.
- Used available data for total phosphorus concentrations, potentiometric elevations, canal and detention basin stages, and flow rates through canals between 2000 and 2007 as quantitative calibration targets.
- Evaluated marsh-driven operational plan design and effectiveness.
- Identified an operational procedure to achieve hydraulic and ecological objectives.

Optimization

Application of Numerical Optimization to Remedy Evaluation and Planned Implementation at Pantex Plant, TX. Project highlights:

- Linked calibrated flow/transport model was linked with PBMO™ to evaluate potential treatment options for the impacted groundwater.
- Considered potential remedies consisting of pump and treat, enhanced in situ bioremediation (EISB), and combinations of these technologies; natural attenuation was included as part of each design evaluated.
- Over 3,000 different remedy configurations were evaluated in determining the best remedy and design configuration.
- Results indicated a combination of EISB with limited pump and treat represented the best groundwater remedy within the context of client schedule/budget, land use and source water restrictions.

Innovative Approach for Implementing Performance-Based Remediation Project (Former Fort Ord, California). Project highlights:

- Recalibrated the groundwater flow and transport model developed during the remedial design phase to simulate the migration of TCE.
- Used a groundwater model in conjunction with PBMO™ to evaluate alternative pumping strategies, including varied extraction rates and continual versus intermittent pumping at any combination of wells.
- Conducted PBMO™ simulations that provided the basis for developing an optimized exit strategy that ensured that cleanup goals would be met in the most cost-effective manner and within the time period envisioned in the ROD.