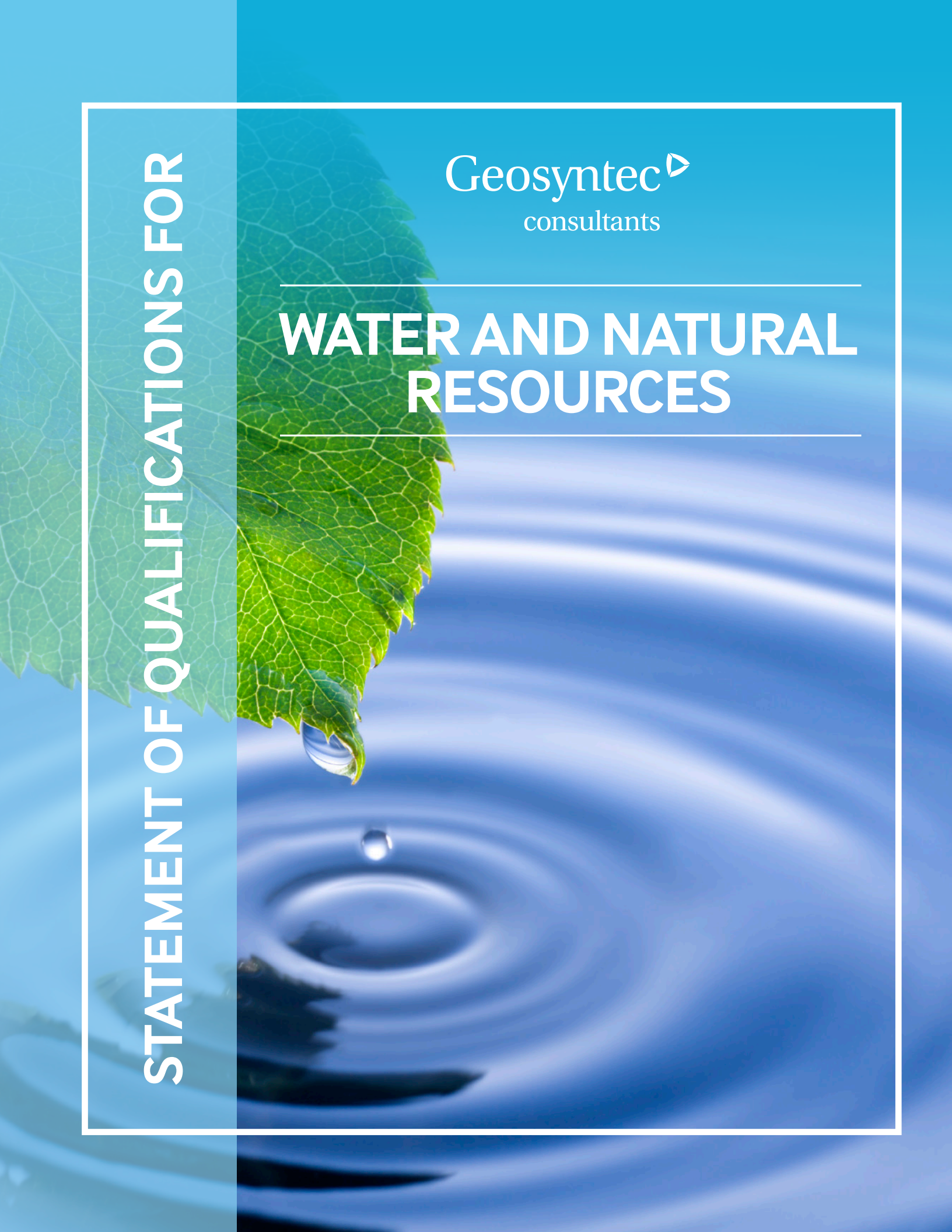
STATEMENT OF QUALIFICATIONS FOR

Geosyntec consultants

WATER AND NATURAL RESOURCES



KEY CLIENT ISSUES

Watershed managers in watershed districts, cities and counties face a multitude of issues related to surface water (quality, flooding and low flow); groundwater (quality, availability, and baseflow); ecological (improvement, restoration, and maintenance); and the desire for healthy communities (resilient and thriving). Geosyntec recognizes that these issues are exacerbated and made more difficult to manage in the face of continued urban sprawl and climate change. Our clients rely on us to provide high quality and experienced professionals to help them protect their watersheds and keep them healthy, and provide innovative solutions for the challenges that watersheds, rivers, and lakes face.

WHY GEOSYNTEC?

To help clients achieve their watershed goals, Geosyntec works closely and collaboratively with clients to fully understand the nature of the problem. We provide experts who specialize in water resources management along with rigorous assessment and modeling services to thoroughly investigate the factors impacting a resource, and then deliver a well-conceived plan and design for improvement or mitigation.

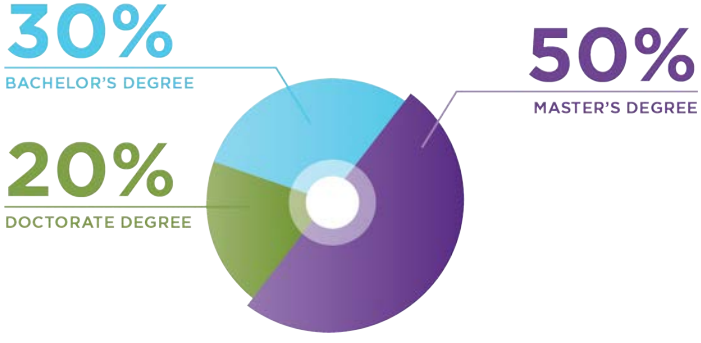
APPLIED RESEARCH FOR SOLUTIONS

Geosyntec conducts external applied research and funds internal research efforts. Our research and development (R&D) funds are directed to the most promising internal R&D initiatives identified by our employees. This internal effort has received more than 160 pre-proposals and 115 final proposals; and has funded nearly 70 studies and technology development projects since 2015.

70% OF EMPLOYEES WITH **ADVANCED TECHNICAL DEGREES**

SUBJECT MATTER EXPERTS

Geosyntec has built a team of nationally-recognized technical experts, with 70% having advanced technical degrees and 20% holding doctoral degrees in relevant fields. Technical leadership in water and natural resources by Nigel Pickering, Matt Bardol, Joe Kula, David Vance, Ken Susilo, and Mark Hanna is illustrated below. These Geosyntec leaders instill the value of contributing and advancing the state of the practice, and also share and enhance the knowledge base throughout the firm.



PROFESSIONAL AND TECHNICAL DEVELOPMENT

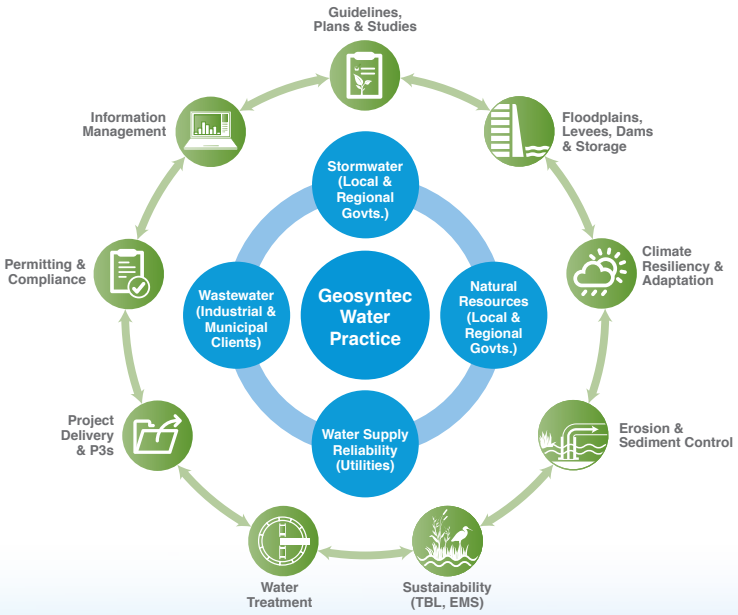
Colleagues at all levels consistently exchange new technological developments and best practices at annual national practice group conferences. Geosyntec's Water and Natural Resources Group advances the state of the practice through sub-practices that include watershed planning and permitting, natural resource restoration, stormwater and erosion management, water monitoring, hydrologic/hydraulic/water quality modeling, and dam safety and restoration. These practices serve as key groups for maintaining technical leadership and fostering a culture of collaboration and collegiality throughout the firm.

INNOVATIONS FOR DELIVERY

Geosyntec understands that cost, schedule, compliance, and corporate sustainability goals can drive the need for alternative project valuation and delivery. Geosyntec has been an engineering leader in water-based Public-Private Partnerships, as well as in the integration of social equity, economic, and environmental benefits, demonstrated through our projects using Triple Bottom Line (TBL) and life-cycle analyses.

CORE SERVICES

The strategy of our Water Practice is to leverage our exceptional professional staff, entrepreneurial approach, innovative solutions, and our sell-manage-do business model to identify and create market advantages for our services. In this manner, we win engagements on projects of consequence to our communities, our profession, and the world that also sustains the business, creates opportunities for our employees, and produces a return for our shareholders.



WATER AND NATURAL RESOURCES MANAGEMENT

- Storm / Drinking / Waste and Natural Water Resource Management
- Clean Water Act (CWA) Permitting and Compliance
- Watershed Plans/ Total Maximum Daily Loads (TMDLs) and Receiving Water Quality Studies
- Low Impact Development (LID) / Green Infrastructure (GI) / Stormwater Best Management Practices (BMPs)
- Erosion and Sediment Control (ESC)
- Natural Resource Assessments and Monitoring
- Sustainable Drinking Water and Source Water Management
- Surface Water Modeling for Water Quality and Flooding
- Groundwater Modeling for Pollutant Transport and Quantity

WATER PLANNING, ENGINEERING, AND DESIGN

- Urban Infrastructure Planning and Design
- Constructed Stormwater BMPs
- Advanced Water Supply and Wastewater Treatment
- Industrial Wastewater Treatment
- Production Wells, Extraction, Treatment, and Piping
- Dams, Floodplains, and Levees

SITE CIVIL AND GEOTECHNICAL ENGINEERING

- Stormwater and Combined Sewer System Design
- Roads, Grading, and Earthworks
- Geotechnical and Geostructural Design
- 3D Modeling and Visualization
- Design of Onshore and Offshore Structures

INFORMATION MANAGEMENT

- Data Visualization and Analytics
- Geographic Information System (GIS) Analysis and Mapping
- Information/Asset Management
- Real-Time Data Acquisition and Control

ENVIRONMENTAL PLANNING, PERMITTING AND MANAGEMENT

- Site Assessment and Planning
- Environmental Permitting and Compliance
- Federal Energy Regulatory Commission (FERC) Licensing Support
- Environmental Management System (EMS)
- Agency Consultations and Liaisons

KEY PEOPLE

Geosyntec has identified key personnel with the qualifications, expertise, and technical experience necessary for your projects. These key members will be supported by staff from Minneapolis and other offices across the United States. Geosyntec has many other site remediation and civil engineers who are not listed here but are available for projects.

NIGEL PICKERING, PH.D., P.E. | Senior Engineer (Minnesota)

Dr. Pickering is a Senior Water Resources Engineer with more than 30 years of experience in the academic, nonprofit, and consulting arenas, providing his expertise to agricultural water quality, crop modeling, watershed monitoring and modeling, water resources planning, and stormwater design and modeling. He is proficient with numerous crop, hydrology/hydraulic, and water quality models including CropGro, HEC-RAS, HydroCAD, Hydrological Simulation Program Fortran (HSPF), P8, Stormwater Management Model (SWMM), and ArcGIS. Nigel has managed many large, long-term projects including watershed plans and watershed TMDLs with full oversight from start to finish.

DAVID RICHARDSON, P.E., P.G. | Senior Engineer (Minnesota)

Mr. Richardson has more than 30 years of experience in environmental engineering projects for petroleum, chemical, agricultural, and electrical power clients. He managed the installation of two OptiRTC real time stormwater monitoring and control systems in Minnesota. He has developed Stormwater Pollution Prevention Plans (SWPPP) for operating facilities; ESC plans for construction projects; discharge permit applications for wastewater; and provided subcontractor oversight for landfilling of impacted sediments. He also designed a dual geotextile liner across a pond bottom to keep sediments from re-entering suspension.

RICA ENRIQUEZ, PH.D., P.E. | Project Engineer (Minnesota)

Dr. Enriquez is a water resources and remediation specialist with more than 15 years of experience, who focuses on geospatial data analysis and hydrodynamics, sediment transport, and water quality modeling in rivers, reservoirs, lakes, and estuaries. She often provides expert witness and litigation support. Dr. Enriquez combines her data analysis and GIS expertise to develop, analyze and visualize models; to analyze data; and to develop visualization tools. In particular, she is proficient in developing Python tools to efficiently generate multidimensional model input files from environmental data and create insightful visualizations of environmental data and model results.

DAVID KEIN, B.S., P.E. | Project Engineer (Minnesota)

Mr. Kein is a civil engineer with over five years of professional experience. Mr. Kein performs civil design and layout, site investigation and characterization, reporting and data management for landfills, landfill remediation, construction oversight and quality assurance (CQA), and preparation of technical reports. He is also skilled at performing geotechnical analyses including bearing capacity, settlement, and slope stability. He is trained in industry standard software (e.g. AutoCAD, SLIDE, HELP, Settle 3D, Infraworks, WaterGEMS).

MATTHEW BARDOL, P.E., CFM, CPESC, D.WRE | Senior Principal (Illinois)

Mr. Bardol has more than 24 years of diverse environmental and water resource engineering experience performing complex water resources designs for major facilities. He has played a key role in developing detailed hydrologic and hydraulic studies to obtain revisions to Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs), developing effective stormwater management designs, navigating intricate flood control efforts, and managing dam safety permits and designs. His career includes designing flood mitigation strategies for large residential developments and conducting complex stormwater studies.

RISHAB MAHAJAN, P.E., CFM, CPSWQ | Senior Engineer (Illinois)

Mr. Mahajan has more than 10 years of expertise on hydrology and hydraulics, hydrodynamic, sediment transport, water quality modeling, stormwater management, surface water system assessments, TMDL development and implementation, and nutrient criteria limit development. His breadth and depth of technical expertise has created resourceful solutions for complex problems. He has completed FEMA FIRMs and Flood Insurance Studies (FIS), floodplain permitting, effective stormwater management designs, National Pollutant Discharge Elimination System (NPDES) permits, and dam safety permits.

ADRIENNE NEMURA, P.E. | Principal (Ohio)

Ms. Nemura is a water resources engineer with 37 years of experience. She helps clients identify cost-effective, affordable, and sustainable solutions to meet water quality goals and comply with the CWA. She has worked for more than 50 cities, wastewater utilities, and watershed groups on watershed and water resource management and planning, including design and implementation of regional watershed and water quality monitoring and modeling programs. At the Virginia Water Control Board, she conducted monitoring and modeling of the James and Appomattox Rivers. For the Anacostia and Potomac Estuaries, she led regional monitoring and modeling programs.

JACOB KRALL, PH.D., P.E. | Senior Engineer (Oregon)

Dr. Jacob Krall is a Senior Engineer with 10 years of applied experience in consulting and academia, including sophisticated environmental modeling, data management and statistical analyses. His project work has included hydrodynamic, sediment transport and contaminant fate and transport modeling in rivers, hydrodynamic and temperature modeling in reservoirs, analyses of water availability under current and future conditions, scour potential calculations and mixing zone modeling. For his PhD, Jacob conducted field work and numerical modeling to study sediment deposition in and around a non-potable water supply reservoir.

AARON PORESKY, P.E. | Principal (Oregon)

Mr. Poresky has more than 15 years of experience directing high profile and complex projects for clients in the municipal, industrial, land development, and applied research sectors. He applies his expertise in water resources, stormwater, GI and LID, stormwater control retrofits, stream protection and rehabilitation, flood risk mitigation, water supply augmentation, and asset management. His work has focused on innovative open-source systems for asset management, streamlined reporting, and decision support. Through his diverse experiences, he has developed a range of effective tactics to solve water resources problems for municipalities and site owners.

THOMAS AMSTADT, P.E., CFM | Principal (Florida)

Mr. Amstadt has 18 years of experience on water resources projects for state, county and city government clients. His expertise includes watershed management plans, stormwater retrofits, stormwater master planning efforts, floodplain analysis, hydrologic and hydraulic modeling, pollutant load analysis, BMP design and environmental resource permitting. He has developed numerous stormwater models using the Interconnected Channel and Pond Routing, SWMM, and HEC-RAS models. He is also proficient with construction plans, bid and specifications preparation, construction oversight, and as-built plans preparation for stormwater design projects.

MIKE HARDIN, PH.D., P.E., CFM | Principal (Florida)

Dr. Hardin has 16 years of experience in water quality and stormwater work. At the University of Central Florida's field research laboratory for stormwater runoff, he focused on green roofs, pervious pavements, stormwater harvesting, chemical treatment, ESC, and media filtration. Dr. Hardin has worked on watershed assessments, hydrologic and hydraulic modeling, evaluating stormwater BMP practices, stormwater sampling, optimization of BMPs, microbial source tracking studies, surface water hydrologic and nutrient budget studies, water quality master plans, and water quality modeling. He was also an ESC instructor for the Florida Department of Transportation.

RENEE BOURDEAU, P.E. | Senior Engineer (New Hampshire)

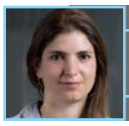
Ms. Bourdeau is a civil and water resources engineer with 15 years of technical experience in civil/site design specializing in stormwater, hydrology, watershed planning, land use planning and municipal and state permitting. She has provided watershed planning and engineering services for over 25 watershed management plans. She has conducted hydrologic, hydraulic, and water quality modeling analyses to determine the pollution loads to receiving water bodies. She has also designed and overseen construction of many Green Infrastructure structural BMPs. She is certified for designing road-stream crossings passage for aquatic organism passage.

DAVID VANCE, P.G. | Principal (Georgia)

Mr. Vance has 8 years of experience in fluvial geomorphology and its application to ecosystem restoration projects across the United States. His experience on stream and river restoration where natural flow regimes have been altered includes providing mitigation potential and geomorphic assessments. He provides an approach for adaptive management or restoration planning for these stream systems and oversees construction and monitoring. Mr. Vance is certified in river restoration through Rosgen Level IV in Natural Channel Design and North Carolina Stream Restoration Institute Level III. He also has experience restoring wetlands and designing stormwater BMPs for urban watersheds.

JOE KULA, P.E. | Senior Principal (Maryland)

Mr. Kula has more than 40 years of experience, specializing in dams and hydraulic structures with services for more than 250 dams and levees including engineering and failure analyses, risk-based evaluations, and alternatives analyses. He has been involved in the design and/or construction of nine new dams and the rehabilitation of more than 20 existing dams. Mr. Kula serves on the Association of State Dam Safety Officials and Advisory and Design and Construction Committees. He is also a trainer for dam safety webinars and workshops for various agencies and associations.



JULIE CHAMBON, PH.D., P.E. | Senior Engineer (California)

Dr. Julie Chambon is a Senior Engineer with over nine years of consulting experience in hydrogeology, modeling, remediation, and strategic advisement with a wide variety and scale of sites. She is responsible for managing and supporting multiple projects that include water resources assessment, hydro-geological evaluation, groundwater flow and transport modeling, groundwater monitoring, remediation performance evaluation, and site investigation and characterization. She applies her background in environmental engineering, hydrogeology, flow and transport modeling, and microbiology to remediation and water resources projects.

KEN SUSILO, PE, D.WRE, ENV SP | Senior Principal (California)

Mr. Susilo has 30 years of experience in planning, permitting, engineering, design, hydraulics, hydrology, stormwater management, and integrated water resources. To enhance project and program implementation, he actively investigates public-private partnerships, funding approaches, asset management, and Triple Bottom Line assessments. Mr. Susilo has served as an Expert Witness for stormwater, hydrology, flooding, sediment fate and transport, and water quality topics. His projects have been recognized by the American Society of Civil Engineers (ASCE), Water Environment Federation (WEF), California Stormwater Quality Association (CASQA), and many others.

MARK HANNA, PH.D., P.E., LEED AP | Senior Principal (California)

Dr. Hanna has more than 25 years of experience in integrated water resources, including water resource planning, surface water/groundwater design, hydrology and hydraulics, stormwater management, and stream flow management. He has designed and implemented multi-beneficial stormwater and snowmelt capture projects prioritizing water supply, water quality, conjunctive use, and environmental management. He also serves as the water rights lead for many groundwater remediation initiatives.

PRACTICE AREAS

WATERSHED AND WATER RESOURCE MANAGEMENT AND PLANNING

Geosyntec, a national leader in watershed management, works with local, state, regional, and national clients to meet their watershed planning, water quality, and flooding challenges by assembling teams of experienced professionals known for their innovative work in watershed and stormwater management. Geosyntec is recognized for facilitating transfer of technologies from academia to commercial and public use.

Geosyntec's water resources management planning experience includes:

- Watershed, stormwater, and wastewater planning
- NPDES permitting and receiving water studies
- Water body use attainability analysis
- Water resources planning/policy development
- Water quality criteria development
- Receiving water monitoring
- TMDL development

> Our projects involved a high level of ongoing collaboration between Mirror Lake Protective Association and Geosyntec Consultants. The leadership and advice provided by Geosyntec's professional staff was extremely timely, of high quality, creative and adaptive to our changing needs. The overall experience has been excellent.
>
> **Dusty Davies, President**,
> Mirror Lake Protective Association

STATEWIDE WATERSHED-BASED PLANS | Massachusetts

Massachusetts Department of Environmental Protection selected Geosyntec to develop a web-based tool for statewide Watershed-Based Plans (WBPs). Geosyntec developed a watershed-planning tool that integrated science, engineering, public policy, and public education. Geosyntec's tool helped users develop WBPs that meet the nine elements required by the United States Environmental Protection Agency (USEPA). A WBP is a prerequisite for communities or local organizations that wish to apply for federal grant funding under Section 319 of the CWA. The tool allows organizations and communities to complete a technically robust WBP efficiently and allow the state to focus on funding watershed restoration.

WATERSHED PLANNING PROJECTS | Illinois

Geosyntec has supported the Chicago Metropolitan Agency for Planning in the development of WBPs for six watersheds. Geosyntec conducted watershed-wide evaluations of stream conditions and pollution sources and developed detailed existing condition watershed characterizations for four watersheds. For three of the watersheds, Geosyntec performed strategic field assessments of the stream corridors and upper watershed areas, with a specific focus on the condition of stormwater management facilities. Each plan benefited from a strong public education and outreach program.

GREEN INFRASTRUCTURE (GI) OUTREACH FOR MUNICIPALITIES
Northeastern Illinois

Geosyntec worked with the Chicago Wilderness' Sustainable Watershed Action Team to help communities integrate GI into their master planning and help achieve the region's Green Infrastructure Vision. Our team worked with local agency staff to facilitate all day mapping workshops to identify spatial data and compile a GIS-based resource inventory of GI and other features to identify opportunity areas for implementing GI strategies.

STORMWATER MASTER & CAPITAL IMPROVEMENT PLANNING
Framingham, Massachusetts

Geosyntec worked with the Town of Framingham on a four-year multi-phased stormwater master plan. We field-verified and collected data for over 1,000 drainage structures and adjoining conveyance features such as pipes, culverts, and open channels. Geosyntec used rigorous Quality Assurance and Quality Control procedures on all collected data before integration into the town's asset management system. We developed hydrologic and hydraulic models using SWMM5 for all sub-basins to evaluate existing conditions, identify areas of flooding concern, and determine areas of high pollutant loading. Geosyntec also developed a Capital Improvement Plan that ranked all proposed projects.

PAWTUCKAWAY LAKE WATERSHED MANAGEMENT PLAN | New Hampshire

Geosyntec was contracted by the New Hampshire Department of Environmental Services to conduct field investigations and develop a phosphorus loading model for the Pawtuckaway Lake watershed in Nottingham, New Hampshire. Geosyntec also assessed potential stormwater management improvements, developed conceptual BMP designs, and provided final engineering/design and construction oversight for several high-priority sites.

INTEGRATED PLANNING FOR THE SQUAMSCOTT-EXETER RIVER
New Hampshire

Geosyntec led a team to develop the foundation for a Water Integration Plan for three coastal communities in the seacoast region that have experienced increased urbanization, more impervious cover, and the negative impacts to water quality. The goal of the plan was to help these communities meet new, more stringent wastewater and stormwater permit requirements, improve water quality in the Squamscott River and Great Bay, and support the economic viability of the participating communities. The project developed an integrated plan to evaluate and manage water quality within and across municipal boundaries. The Integrated Plan also provided the three communities with the information to make long-term financial commitments and planning decisions.

STORMWATER MASTER PLAN, DENVER FEDERAL CENTER | Colorado

Geosyntec developed a Stormwater Master Plan at the 650-acre Denver Federal Center (DFC) in Colorado, the single largest federal campus outside of Washington, D.C. We successfully incorporated sustainable design into their stormwater planning to make it not only compliant with federal regulations but to also make it a model for other similar public and private campuses. We helped the DFC in developing a Sustainability Plan and a set of Sustainable Design Guidelines by taking advantage of our in-house professionals who are nationally recognized for their work on sustainable stormwater management techniques and BMPs. We conducted an evaluation of the campus' existing stormwater collection system, including the design, construction, and present maintenance status.

COBBETT'S POND WATERSHED RESTORATION PLAN | New Hampshire

Geosyntec developed a comprehensive watershed restoration plan for Cobbett's Pond. This project included development of a phosphorus loading model, water quality and flow monitoring, aquatic vegetation survey, stormwater design, permitting and outreach materials. This project developed an annual phosphorus load reduction goal to reduce in-lake phosphorus concentrations to the New Hampshire median of 12 μg/L to control cyanobacteria blooms. Geosyntec also provided final design and construction oversight for LID stormwater improvements in the Pond's watershed.

MIRROR LAKE WATERSHED MANAGEMENT PLAN AND LID STORMWATER IMPROVEMENTS | New Hampshire

Geosyntec developed a comprehensive lake watershed management plan for Mirror Lake in Tuftonboro and Wolfeboro, New Hampshire. Mirror Lake has experienced declining water quality and is on the New Hampshire List of Impaired Waters due to cyanobacteria blooms. Phase 1 included development of a phosphorus loading model and establishment of a phosphorus management strategy to significantly reduce cyanobacteria blooms. The project also involved sediment sampling, vegetation survey, stormwater design, and developing outreach materials. Phase 2 of the project involved design, permitting and construction oversight of LID stormwater improvements.

STORMWATER PROGRAM ASSESSMENT, CITY OF ROCHESTER | New Hampshire

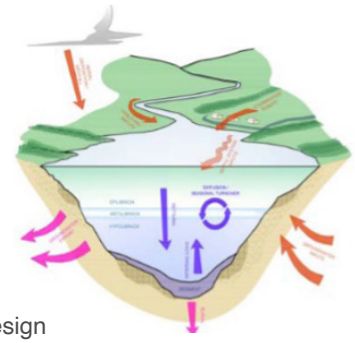
Geosyntec and Wright-Pierce are currently assisting the City of Rochester as part of a three-year stormwater engineering contract to provide services in support of their Phase II Municipal Separate Storm Sewer Systems (MS4) Permit implementation including the development of a USEPA-approved Nutrient Control Plan. The final Nutrient Control Plan will include nutrient control targets, management strategies, specific proposed BMP locations, identification of non-structural BMPs and prioritized ranking for BMP cost-effectiveness. The plan also included a financial capability analysis with a detailed schedule for implementation identifying major goals and milestones. Additional services to the city included updating the city's stormwater ordinance, site plan and subdivision review regulations.

EXETER RIVER WATERSHED VULNERABILITY ANALYSIS | New Hampshire

Geosyntec was contracted by New Hampshire Department of Environmental Services to assess the vulnerability of the Exeter River Watershed to water quality impacts. The primary goals were to (1) forecast which subwatersheds are most vulnerable to future development; and (2) identify and rank subwatersheds that merit prompt watershed management planning. Geosyntec mapped impervious cover, assessed land use, habitat, and water quality parameters to develop an overall ranking of subwatershed vulnerability. Geosyntec then conducted a field investigation of high priority areas and developed conceptual plans for stormwater infrastructure and bank stabilization improvements.

LAKE, WETLAND, AND STREAM RESTORATION AND MANAGEMENT

Geosyntec offers a comprehensive approach to the management of water bodies, with nationally-recognized expertise in assessment and management techniques. We put the latest technology to work for our clients, from stormwater management strategies to techniques for nuisance aquatic vegetation and algae control. Geosyntec's wetland scientists provide outstanding depth and range of experience in conducting delineation, monitoring, function/value assessments, and regulatory reporting for wetland and aquatic habitats. For wetland mitigation, Geosyntec has designed a wide range of successful wetland replication and restoration projects. Our stream restoration staff has significant project experience with Rosgen and other stream geomorphic/bioassessment methods.



Our expertise includes the following services:

- Flow, biological, and water quality monitoring
- Aquatic vegetation and bathymetric mapping
- Aquatic vegetation and algae management
- Sediment sampling, mapping and dredging studies
- Lake assessments and management plans
- Stream classification and natural channel design
- Sediment transport and scour analysis
- Wetland delineation, monitoring, assessment, permitting and mitigation

ASSESSMENT OF BACTERIAL CONTAMINATION FOR SIX LAKES | Massachusetts

Elevated bacteria levels resulted in repeated swimming beach closures at six Massachusetts Department of Conservation & Recreation (MADCR) water bodies - Beaman Pond, Damon Pond, Pearl Hill Brook Pond, Upper Mystic Pond, Pequot Pond, and North Pond. Geosyntec was contracted by the MADCR to evaluate bacterial loading to these water bodies and develop management recommendations. To further evaluate pollutant loading contributions to these six water bodies, a land-use export model was applied to estimate phosphorus, nitrogen, and sediment loading from subwatershed areas.

DETENTION BASIN RETROFITS AND STREAMBANK AND CHANNEL STABILIZATION | City of St. Peters, Missouri

Geosyntec was hired by the City of St. Peters to provide engineering services to develop detailed designs and bid documents for the implementation of several GI retrofits. The design included retrofitting three existing detention basins to improve water quality and enhance flood mitigation, stabilization of a severely degrading stream channel, and implementation of bioretention cell and swales to relieve neighborhood flooding. Each retrofit was on private property. Geosyntec worked closely with the city to educate the landowners about the project, engaged them via public workshops to gain their input – and ultimately – their support.

RARITAN RIVER TRIBUTARY HABITAT ASSESSMENT AND RESTORATION New Jersey

Geosyntec led the site investigation, remediation and associated ecological assessment, design, and permitting for the conversion of the 100- acre Somerville Landfill Redevelopment Area to a mixed-use commercial/retail area. Geosyntec conducted a habitat and geomorphic assessment of a Raritan River tributary that flows through the site, including fisheries, macroinvertebrates, vegetation, and a geomorphic assessment using the USEPA Rapid Bioassessment Protocol. The stream assessment provides a baseline for comparison to post-restoration conditions.

STREAM RESTORATION DESIGN FOR A METALS-IMPACTED BROWNFIELD Confidential Location

This site was a metals-impacted site undergoing a site cleanup by removal of contaminated soil from 500 linear feet of an intermittent tributary and over two acres of adjacent wetland. Geosyntec redesigned the stream to replicate the existing stream ecosystem including native vegetation, gravel, cobble substrate, and meandering flow path. Geosyntec also managed the restoration of two acres of bordering wetland to replicate a heavily vegetated forested floodplain.

PIEDMONT PARK STREAM AND WETLAND RESTORATION | Atlanta, Georgia

Existing conditions showed a century's worth of watershed management infrastructure and modified stream channels from concrete flumes to culverted streams. The project goal was to recreate a natural stream system that functioned ecologically, hydrologically, and hydraulically. Geosyntec used HEC-RAS and XPSWMM models to validate 100-year flood elevations and test the proposed stream and wetland design. Geosyntec designed the wetland to treat combined sewer overflows (CSOs) while still being an appealing water feature within the park. The site design was tested in late September 2009 by a 20-year flood which caused no significant damage.

BIOLOGICAL ASSESSMENT OF HUDSON RIVER TRIBUTARY | Alsen, New York

Geosyntec was selected by Lehigh Northeast Cement, Inc. to conduct a comprehensive biological assessment and restoration planning for a stream/wetland complex, which drains into the Hudson River. The assessment included an inventory of freshwater mussels, macroinvertebrates, macrophytes, algae, birds, reptiles, and amphibians. Geosyntec also conducted sediment and water chemistry sampling for a wide range of constituents to characterize impact from an adjacent cement kiln dust landfill. Geosyntec provided the site Wetland Impact Assessment and development of a Wetland Mitigation Plan, including specifications for post- mitigation monitoring.

CHICOPEE RIVER WATERSHED–DEGRADED STREAM ASSESSMENTS
Massachusetts

Geosyntec conducted a comprehensive field assessment of 15 streams in the Chicopee River Watershed using the Rapid Stream Assessment Technique. Geosyntec conducted monitoring and stream geomorphic assessments to evaluate channel stability, channel scouring/sediment deposition, stream and riparian habitat, water quality, and biological indicators. Geosyntec developed a report that included the results of each stream assessment, a ranking of relative stream impairment, information on probable or known contributors to the stream impairment(s), and all field data. Geosyntec also provided prioritized recommendations to restore water quality, bank stability, and reduce pollutant loading.

LEHIGH RIVER RESTORATION SITE | Pennsylvania

A remediated former hazardous waste site was donated to Lehigh County for use as a Lehigh River recreational access site, which included wetlands and waterfront access. The project included wetland delineation and preparation of a Joint Application for a Water Obstruction and Encroachment/Section 404 Permit along with the development of design plans and construction bid documents. Construction included mitigation of residual contaminated soils, construction of boat ramp/access road along with 0.3 acres of wetland restoration. A project webpage was established as an efficient means for clients, stakeholders, contractors, and project team staff to access and share current project information.

LOWER BUTTERMILK CREEK BANK STABILIZATION PROJECT
Austin, Texas

Lower Buttermilk Creek had significant streambank erosion from high flows resulting from upstream urbanization. The eroded stream bank had undermined an existing storm drain and was threatening other infrastructure. Geosyntec was hired to design and implement engineering solutions to stabilize the existing stream bank, protect threatened infrastructure, restore native vegetation, and preserve existing aquatic habitat. The project team constrained the stabilization system design within a limited drainage easement without affecting the 100-year floodplain. The approach used drilled pile and a concrete retaining wall for bank stabilization, combined with limestone block facing and reinforced vegetated soil slopes to resist erosion and retain a natural aesthetic. Geosyntec's design restored stream functionality and protected residential properties.

MITIGATION BANK STREAM RESTORATION ASSESSMENT | Confidential Location

A private client requested assistance in the development of a five square mile stream mitigation bank with over eight miles of potentially restorable streams impacted from logging and ranching management practices. The mitigation bank is located in Georgia within the Savannah District of the United States Army Corps of Engineers (USACE). The client requested assistance with providing a prospectus level geomorphic assessment of all streams on the property to classify them for their restoration, enhancement, or preservation potential. The results of the prospectus level assessment led by Geosyntec personnel, certified to Level IV in the Rosgen Natural Channel Design, illustrated that the proposed stream mitigation bank was viable and that the streams and their ecosystems while varied in degree of impact were largely restorable.

FAIRFIELD-SUISUN HYDROMODIFICATION MANAGEMENT PLANNING
Suisun City, California

The Fairfield Suisun Urban Runoff Management Program was required, by their NPDES Permit, to develop and implement a Hydromodification Management Plan to better manage the effects of future development and significant redevelopment on channel stability, and, in particular, on channel incision and widening. Geosyntec focused on developing the performance standard based on maintaining a balance in the sediment supply and sediment transport capacity (Energy Potential (EP) Methodology). Geosyntec conducted hydrological modeling using the USACE HEC-HMS model along with the EP methodology to evaluate development scenarios in the Soda Springs Watershed.

URBAN STORMWATER BMP DESIGN AND CONSTRUCTION MANAGEMENT

Geosyntec's national stormwater management practice utilizes local experts to focus on urban runoff management and other water quality and quantity issues that can influence the environment, project economics, and long-term regulatory compliance management. We regularly design BMPs, including LID and GI techniques. We have significant experience in providing direct construction management and monitoring for the projects that we have designed. Geosyntec has also prepared and contributed to many stormwater technical design manuals for municipalities, counties, states, and federal agencies on LID and GI applications. Geosyntec has nearly 100 stormwater practitioners in offices throughout the United States.

Our relevant areas of expertise include:

- Integrated municipal planning services related to stormwater
- Stormwater management services that support regulatory compliance
- Design services for water quality and quantity control in urban environments
- Stormwater system performance monitoring and tracking
- Real-time monitoring and control of stormwater practices
- Policy development and development of standards and design
- Public-private market-based financing for stormwater
- Water harvesting for high performance water conservation and CSO mitigation
- Construction management services at many types of sites

DEVELOPMENT OF PRETREATMENT GUIDANCE FOR STORMWATER RUNOFF CONTROL PRACTICES | Minnesota

Geosyntec was tasked by the Minnesota Pollution Control Agency to gather information on water quality benefits and maintenance expectations for pretreatment systems such as vegetated filter strips, hydrodynamic separators, underground settling devices, swales, and forebays for incorporation into the Minnesota Stormwater Manual. The Stormwater Manual is used by stormwater practitioners for selecting appropriate BMPs, meeting stormwater regulatory requirements, and determining pollutant and stormwater volume reductions associated with implementation of different stormwater management practices.

UPPER VILLA PARK: DESIGN AND INSTALLATION OF AN INTELLIGENT STORMWATER CONTROL SYSTEM TO IMPROVE WATER QUALITY | Roseville, Minnesota

Geosyntec designed and installed an OptiRTC stormwater monitoring and control system as part of the Upper Villa Park water quality improvement project. The goal was to install an infiltration-based water quality retrofit in the Lake McCarrons subwatershed to reduce phosphorus loading. Geosyntec designed the system, which includes an automated butterfly valve at the outlet of a rainwater harvesting reuse cistern, water level sensors, and an electric control panel. The system uses internet-based predictive weather information and real-time water level data to release water from the reuse cistern prior to storm events.

CURTISS POND: DESIGN AND INSTALLATION OF AN INTELLIGENT STORMWATER CONTROL SYSTEM FOR FLOOD MITIGATION | Falcon Heights, Minnesota

The project objective was to improve the flood risk protection at Curtiss Field. A gallery of underground perforated pipes was installed at the outlet of a retention basin to optimize storage and infiltration by using an intelligent stormwater monitoring and control system. The system was installed in May 2015 with OptiRTC, an internet-based, real-time monitoring and control network for stormwater detention and water conservation.

RUST POND, NORTH INLET TRIBUTARY ASSESSMENT, AND STORMWATER IMPROVEMENTS | Wolfeboro, New Hampshire

Geosyntec developed a management plan and stormwater engineering designs for a portion of the Rust Pond watershed in Wolfeboro. Rust Pond has experienced excessive sediment loading from its North Inlet and associated loss of depth. Geosyntec developed a sediment loading model, conducted stream geomorphic assessments, and developed designs for stream channel restoration to remediate the impacts of hydromodification prior to restoration dredging within the Pond. Geosyntec also provided permitting and construction oversight for the stream restoration project.

LONG LAKE STORMWATER RETROFIT DESIGN | Littleton, Massachusetts

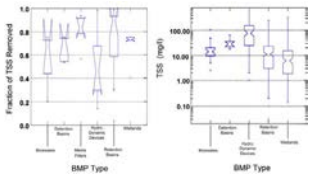
Geosyntec was selected by the Town of Littleton to design innovative watershed-based approaches to managing stormwater inputs to Long Lake. Using LID stormwater techniques (bioswales, bioretention cells, rain barrels, constructed wetlands, lawn care education, etc.), Geosyntec designed a comprehensive retrofit program to reduce sediment and nutrient loading to the lake. Geosyntec also provided designs, permitting and construction oversight for daylighting of a stream that previously discharged to the pond via a culvert adjacent to the town beach.

BLACKSNAKE CREEK ACTIVE AND PASSIVE GREEN INFRASTRUCTURE PROJECT | Missouri

In collaboration with Black and Veatch, Geosyntec designed passive and active GI controls to enhance water quality, reduce stormwater runoff, and attenuate flow rates for the Blacksnake Creek watershed. Geosyntec is leading the conceptual, preliminary, and final design of 20 sites throughout the watershed; three of which incorporated real- time control of stormwater, with the main purpose to reduce wet weather flow to the City's combined sewer system. Hydrologic and hydraulic analysis of performance for all 20 sites will also be evaluated for the project, which will quantify the benefit of GI installation throughout the watershed.

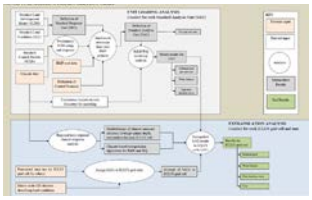
MIRROR LAKE WATERSHED MANAGEMENT PLAN AND LID STORMWATER IMPROVEMENTS | New Hampshire

Geosyntec developed a comprehensive lake watershed management plan for Mirror Lake. Mirror Lake has experienced declining water quality and is on the state List of Impaired Waters due to cyanobacteria blooms. Phase 1 of this project included development of a phosphorus loading model and establishment of a phosphorus management strategy to significantly reduce cyanobacteria blooms. The project also involved sediment sampling, vegetation survey, stormwater engineering, and development of public outreach materials. Phase 2 of the project involved design, permitting and construction oversight of LID stormwater improvements, including bioretention, sand filters, and bioswales.



INTERNATIONAL STORMWATER BMP DATABASE | Nationwide

The stormwater BMP database is a collection of BMP design and performance information from BMPs implemented throughout the United States and other countries. Geosyntec and a team of partners were selected by WERF to design the database based on standardized BMP performance monitoring and reporting protocols. Geosyntec assisted with the development of a guidance document on how to conduct BMP effectiveness studies such that the monitoring and reporting protocols are met, as well as effectively monitoring and designing LID practices. Geosyntec routinely performs technical evaluations of the data in the database to investigate and report on BMP effectiveness.



EVALUATING THE EFFECTIVENESS OF A NATIONAL STANDARD FOR STORMWATER MANAGEMENT | Nationwide

Geosyntec worked with the USEPA, Washington, D.C. to develop a tool to analyze the hydrology and water quality conditions under both the existing and proposed rule conditions to efficiently evaluate the many variables that affect BMP performance, including soil type, climate, slope, and development types, and densities. The primary deliverable of this project was the Least Cost Mix of Best Management Practices (LCM BMPs) tool. The tool was used to develop estimates of cost, water quality performance, and water quantity performance for a wide range of project development scenarios applicable across the United States under a range of existing and proposed rule standards.

GUIDANCE MANUAL FOR PHOSPHORUS REMOVAL IN STORMWATER | New York

Geosyntec worked with New York State Department of Environmental Conservation (DEC) to develop guidance and design standards intended to achieve a high level of phosphorus treatment within watersheds draining in New York City drinking water supply systems. Supporting work included HydroCAD (TR-55) analysis of current stormwater examples in the design manual for further analysis using USEPA's SWMM model version 4. The SWMM model was used for continuous simulation analysis of storage pond and flow-through treatment systems, to facilitate evaluation of various modifications to the existing DEC design standards.

EROSION & SEDIMENT CONTROL AND PLANTINGS

Geosyntec is a national leader in water resources engineering with skills in stormwater design and river restoration. As part of these projects, Geosyntec regularly encounters the need for erosion and sediment control (ESC) and management of vegetation. For ESC design and installation, we use Geosyntec staff who are Certified Professionals in ESC (CPESC). For planting design and installation, we regularly partner with landscape architects and landscape contractors to accomplish the planting requirements of the projects.

McCAIN PIPELINE COMPANY EROSION CONTROL PROJECT | Meridian, Mississippi

The site had erosion issues in the vicinity of a pipe. Geosyntec's approach stabilized the area above the pipe and oversaw the construction of the proposed solution. Geosyntec performed a detailed site visit to identify the cause of erosion. High intensity rainfall events in the upstream contributing area were causing large, flashy flows in the ditch. Based on the site conditions, a hard-armoring approach was necessary to protect the ditch from future erosion. The final design consisted of reconstructing the ditch, providing a hard-armored covering to protect the soils, and installing check dams upstream and downstream of the pipe crossing to reduce flow velocities and allow additional sediment accumulation. Geosyntec provided full construction oversight to ensure project quality control.

RIPARIAN RESTORATION OF THE OTTAWA RIVER | Lima, Ohio

Geosyntec worked with the City of Lima to create a restoration design for the Ottawa River corridor. Geosyntec recommended that the city establish a rigorous three-year restoration schedule and long-term maintenance plans. A sustainable restoration plan and associated costs was developed for the city. While working onsite, Geosyntec identified the need for a comprehensive invasive species removal strategy. Geosyntec then developed plans for long-term mitigation of invasive species, prepared a bid package and managed the bidding process for ecological restoration contractors. The selected contractor provided tree planting, seeding, and control of invasive species to allow for native species to establish.

SLOPE STABILIZATION AT VANDALE JUNKYARD SITE | Marietta, Ohio

The site was formerly used for waste disposal with a 150-ft high slope consisting of glass, metal debris, and ash mixed with native soils. Geosyntec conducted an extensive geotechnical investigation to understand the cause of slope movements and develop a conceptual site model for remediation. The characterization program showed the failure was caused by colluvium over bedrock and was sensitive to precipitation. Geosyntec developed a slope stabilization plan incorporating a geosynthetic-reinforced, mechanically stabilized earth and a crushed rock buttress keyed into bedrock near the toe of slope. Geosyntec supervised the construction to ensure proper installation and protection of the tributary at the toe of the slope.

SULLIVAN CREEK STREAMBANK RESTORATION | Lehigh Cement, Washington State

This project was a streambank restoration for Sullivan Creek, a pristine mountain creek in northeast Washington. The project challenges included its difficult location on the cut bank of Sullivan Creek, the presence of endangered sensitive aquatic species, its proximity to a downstream stabilization effort, and the need to maintain groundwater movement through the bank. Geosyntec designed and managed the restoration of 150 feet of streambank using armoring methods that were permeable. The design included gabion baskets covered by soil encasements, fast-germinating plant/grass species, and groin structures to anchor the restoration components into the streambank.

PLEASANT CREEK STABILIZATION | City of Greenwood, Indiana

The City of Greenwood initiated a creek rehabilitation project through an urbanized reach of Pleasant Creek in the city's downtown area. Project construction began in the fall of 2014 using a design developed by another consultant. Shortly after completion, system failures became noticeable. Geosyntec was engaged by the city to provide expert witness testimony relative to the failures during its dispute negotiations with the designer and contractor. Geosyntec's expert opinions found that the use of geoweb retaining walls was a misapplication and that the revetment riprap was undersized to withstand the anticipated stream forces. This technical support aided the city in securing a favorable settlement for repairs. Geosyntec was subsequently awarded a second scope for the design, permitting, and construction for repairs to Pleasant Creek.

ADVANCED SITE ENGINEERING AND EROSION CONTROL

Since its foundation in 1983, Geosyntec has provided high-value solutions to industrial and public-sector clients on projects to cost-effectively address complex geotechnical / geostructural challenges. Our nationally-recognized practitioners specialize in providing engineering services for challenging sites by applying advanced technologies. Our integrated services bridge the gap between characterization and analysis, structural design, and construction.

We provide services in the following areas:

- Geotechnical site characterization
- Geotechnical / Geostructural analysis and design
- Value-added services for the heavy construction industry

RIVER CHANNEL RISK MANAGEMENT DESIGN AND CONSTRUCTION SUPPORT

Toronto, Ontario

The Port Lands Flood Protection and Enabling Infrastructure Project is a major waterfront redevelopment project consisting of over 715 acres around Lake Ontario. The former industrial area, with soil and groundwater contamination issues, is being redeveloped into major park lands and mixed-used development. This project included the excavation of a new outlet river channel connecting the Don River to Lake Ontario to alleviate upstream flooding and provide new wetlands and park assets. Geosyntec lead the geotechnical design of the long-term risk management measures (RMMs) associated with the river channel, which are being implemented to mitigate the transfer of contaminants into surface water. The RMMs include a vertical cutoff wall, slurry walls, a horizontal membrane layer, and activated carbon reactive layer. Geosyntec is currently serving as the resident site inspector during installation of the cutoff wall. Geosyntec's collaborative approach allowed for the continued early identification of design alternative optimizations and potential challenges, while meeting strict design deliverable deadlines.

GEOTECHNICAL SITE INVESTIGATION FOR OFFSHORE WIND FARM CABLE ROUTE | Massachusetts

The developer was granted a commercial renewable energy lease within a 760-square-kilometer area 24 km off the south coast. The developer hired a data acquisition contractor (DAC) to conduct the shallow geotechnical site investigation through a 97 km cable route, which lies within the Sakonnet River channel and the continental shelf. The DAC requested Geosyntec's assistance in this project to assist the offshore geotechnical campaign with quality control and oversight of the geotechnical survey for this investigation. The geotechnical survey included conducting over 100 piezocone penetration tests and collecting more than 100 vibrocore samples reaching almost 20 feet below mudline in water depths of up to 150 feet. Geosyntec provided technical personnel with geotechnical engineering experience to maintain quality control of in situ tests, sediment sampling, laboratory tests, and core logging. Geosyntec set up and maintained a geotechnical offshore laboratory to describe, handle, store, and prepare soft marine sediment, as well as to conduct tests, such as moisture content, bulk unit weight, thermal conductivity, pocket penetrometer, torvane, and mini vane.

ALGAE GREEN ENERGY BIOMASS RENEWABLE ENERGY PLANT

Albany, Georgia

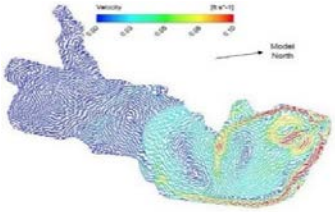
Geosyntec provided foundation engineering services for this $200 million plant. DCO Energy, LLC, retained Geosyntec to evaluate options to improve efficiency for the proposed steel H-pile foundations, both in terms of cost and construction schedule. We accomplished both objectives using our experience in deep foundation pre-design testing programs and complex Coastal Plain geology to increase the working geotechnical resistance of the piles and reduce the total number of piles for the project. Geosyntec developed a field-testing program comprising dynamically monitored test piles, lateral load tests, and tension load tests. The H-piles had greater lateral resistance at tolerable deformations than expected, eliminating the need to drive battered piles. Geosyntec developed the pile foundation specification for the project and established and adapted the driving criteria throughout production to maintain the design and performance intent. Difficult ground conditions manifested during installation of piles for the vital turbine structure and resulted in piles lengths nearly doubling. The severity of these conditions was not identified from prior cone penetration tests and microgravity geophysical testing. Geosyntec evaluated these critical piles separately and developed site-specific soil setup factors using dynamic monitoring results from initial drives and restrikes to establish that sufficient long-term geotechnical resistance was available.

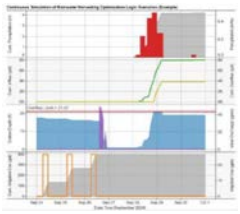
GEOTECHNICAL MODELING OF INTERNAL EROSION | Confidential Client

Geosyntec conducted numerical modeling of the geotechnical and hydrotechnical components of potential internal erosion failure after a sinkhole was discovered at the toe of an earthen embankment dam. The dam was classified as a high hazard dam where failure could result in probable loss of human life and significant property destruction. The objective of this modeling analysis was to characterize the failure rates and hydrographs due to potential internal erosion through the dam. Downstream hydrographs were developed using a numerical model for ranges of different reservoir headwater elevations, operation strategies, and soil parameters.

HYDROLOGIC/HYDRAULIC/SEDIMENT MODELING

An assessment of environmental changes can require advanced hydrologic and hydraulic analyses. Through stream restoration, stormwater management, TMDL development and implementation, and hazardous waste projects, Geosyntec has developed excellent surface water modeling expertise including hydrology and hydraulics hydrodynamics, sediment transport, water quality, and fate and transport modeling, both in the upland and receiving waters.



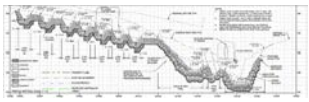


Geosyntec practitioners are proficient in variety of numerical models including:

- **Hydrology:** BASINS/HSPF, HEC-GeoHMS, HEC-HMS, HydroCAD, WAM, WARMF, XPSWMM, PCSWMM, SWMM
- **Hydraulic:** FLOW-3D, HEC-RAS, HEC-GeoRAS, ICPR, PCSWMM (2D), SpillwayPro, WMS
- **Sediment Transport:** FLUVIAL-12, GeoWEPP, HEC-RAS, RiverFLO-2D, SEDZL, WinDAM

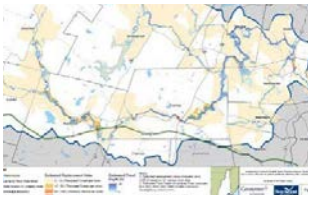
These tools are incorporated into the following services:

- Modeling of watersheds and floodplains
- Dam hydrology, hydraulics, and dam break simulations
- Fluvial geomorphology, sediment transport, and fish habitat modeling



BEVILLE CREEK RESTORATION | Gainesville, Florida

Beville Creek is a channelized suburban creek with chronic erosion along a 1,000-foot section. An open natural system creek restoration was investigated to address the ongoing erosion issues, while still preserving environmental and biological function of the corridor. An existing conditions model was established using an ICPR model to assess creek flows and elevations. A separate HEC-RAS model was developed for the existing and proposed improvements to assess the peak velocity profiles of the creek.

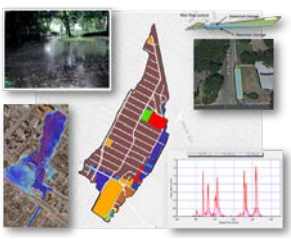


FLOOD DAMAGE COST AVOIDANCE ANALYSIS FOR COMMUNITY RESILIENCE (HAZUS) | New Hampshire

Geosyntec assisted the University of New Hampshire to estimate potential flood damages and cost avoidance for three communities within the Lamprey River watershed because of changes in land use and climate. To accomplish this work, previously developed hydrologic and hydraulic models were used to generate flood frequency statistics and inundation maps for an array of model scenarios under different land use and climate change scenarios. Inundation results were then used to estimate resulting economic losses for each scenario.

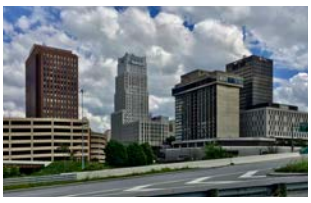
GREEN STORMWATER INFRASTRUCTURE MODELING, METROPOLITAN WATER RECLAMATION OF GREATER CHICAGO (MWRD-GC) | Illinois

Geosyntec worked with the MWRD-GC in determining the best solutions to urban flooding in the Calumet Service Area in the City of Chicago. The team used an innovative modeling approach to identify GI solutions based on site conditions and evaluation criteria then outlined an implementation strategy and created a comprehensive plan with a long-term vision of managing stormwater. The study is the first use of cloud-based optimization software to evaluate GI. The modeling approach allowed 70,000 scenarios to be analyzed to converge quickly on optimal combinations of green and gray solutions.



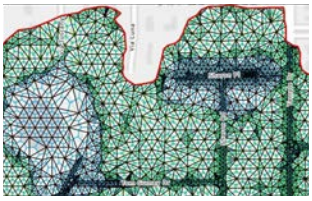
IMPACT OF DECENTRALIZED GREEN STORMWATER CONTROLS | Austin, Texas

The City of Austin is evaluating opportunities to solve flooding, channel erosion, and water quality problems in Grover Channel, which frequently exceeds its conveyance capacity and causes flooding. Geosyntec explored a decentralized, GI approach to reduce peak flows and runoff volumes to the conveyance system. Modeling used 25 years of 5-min precipitation, 6-inch resolution surface topography, and the PCSWMM 2D model for overland flow simulation. This project was a first in using continuous simulation to evaluate the impacts of decentralized controls on peak flowrates and runoff volumes.



LONG-TERM CONTROL PLAN UPDATE AND INTEGRATED PLAN | Akron, Ohio

The City of Akron's long-term control plans (LTCPs) require zero CSOs in a typical year. Geosyntec provided expert advice about innovative ways to meet CWA requirements and evaluated the performance of GI and stormwater BMPs. Geosyntec built SWMM models for the majority of the city's combined sewer system and modeled stormwater runoff from separated systems. The work resulted in $300 million in potential cost-savings for the CSO Program.



TEMPLE DRIVE DRAINAGE RETROFIT | City of Winter Park, Florida

Winter Park experiences nuisance flooding from poor grading, inadequate stormwater inlets, and undersized storm sewer pipes and pumps. This project developed cost effective and feasible engineering alternatives to provide an acceptable flooding level of service. Geosyntec compiled existing GIS data, reports, surveys, and plans then conducted a field investigation to confirm drainage infrastructure. ICPR4 was used for 2D overland flow and a one-dimensional piped networks to establish baseline conditions. Geosyntec modeled scenarios to examine mitigation alternatives, then developed conceptual plans and cost estimates for each feasible alternative.

BRINGING INNOVATIVE FLOODPROOFING TECHNOLOGIES TO SMALL BUSINESSES NEW YORK CITY | New York

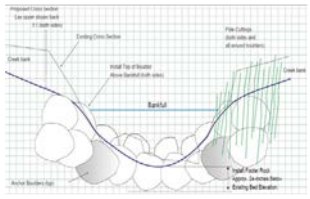
Geosyntec was part of team hired by New York City Economic Development Corporation (NYC-EDC) aimed at bringing innovative floodproofing technologies to small businesses in New York City through NYC-EDC's program known as Resiliency Innovations for a Stronger Economy, or RISE: NYC. Geosyntec and its project partners conducted site audits to collect site specific information and evaluate flood risk at 30 small businesses throughout the city and identify potential flood monitoring and proofing strategies. A network of sensors and active and passively controlled floodproofing measures were installed to help protect against localized flooding at 3-5 small business pilot sites.

EARTHEN DAM AND SPILLWAY HYDRAULIC ANALYSIS | Confidential Client

Geosyntec led the quantitative risk analysis for an earthen embankment dam that included hydrologic risk analyses of the primary and auxiliary spillway. Key tasks included review of design and construction documents, geotechnical and hydraulic engineering analyses, risk assessment and quantification, and overall project management. One-dimensional hydraulic analyses of the concrete-lined primary spillway were completed using SpillwayPro to analyze water surface profiles and cavitation characteristics of high-velocity spillway flows. A two-dimensional HEC-RAS model was developed to assess the hydraulic conditions of the unlined emergency spillway. Hydraulic modeling results were used to evaluate structural integrity and erosion potential of the primary and secondary spillways.

RIVER CHANNEL RISK MANAGEMENT DESIGN AND CONSTRUCTION SUPPORT Toronto, Canada

The Port Lands Flood Protection and Enabling Infrastructure Project is a major brownfield redevelopment project consisting of over 715 acres of waterfront land around Lake Ontario. The former industrial area, with soil and groundwater contamination issues, is being redeveloped into major park lands and mixed-used development. This project includes the excavation of a new outlet river channel connecting the Don River to Lake Ontario to alleviate upstream flooding and provide new wetlands and park assets. Geosyntec is leading the environmental design associated with the river channel, which is being implemented to mitigate the transfer of contaminants into surface water. Geosyntec's collaborative approach to the river channel design has facilitated a solid working relationship with the lead landscape architect, Waterfront Toronto, the site construction manager, and other design team consultants.

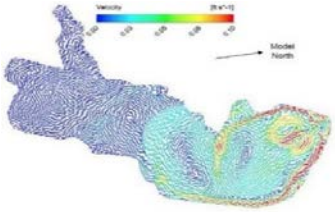


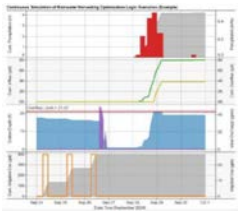
HYDROMODIFICATION FOR THOMPSON CREEK | Santa Clara Valley Water District (SCVWD)

Geosyntec assisted the SCVWD in preparing a Hydromodification Management Plan to provide technical guidance for mitigating the effects of urban development on stream erosion and sedimentation. Geosyntec developed HEC-HMS and HEC-RAS models for Thompson Creek Watershed. Bankfull and 100-year flows were used in the design of a drop pool system of rock control structures, taking into account energy dissipation and scour. The design also added a curved weir to minimize potential scour along the banks of the stream. Bank stabilization measures were used upstream of each drop structure. The number, size and spacing of drop structures were estimated using the EP methodology.

WATER QUALITY MODELING AND MONITORING

An assessment of environmental changes can require advanced hydrologic analyses. Through stormwater management, TMDL development and implementation, and hazardous waste projects, Geosyntec has developed excellent surface water modeling expertise including hydrology and water quality, and fate and transport modeling, both in the upland and receiving waters.





Geosyntec practitioners are proficient in variety of numerical models including:

- **Water Quality:** BATHTUB, BMPTRAINS, CE-QUAL-W2, EAAMOD, EFDC, BASINS/HSPF/LSPC, PHREEQC, P8, QUAL2K, SPARROW, XPSWMM / PCSWMM / SWMM, WAM, WARMF, WINSLAMM
- **Hydrology:** BASINS/HSPF/LSPC, XPSWMM/PCSWMM / SWMM, WAM, WARMF

These tools are incorporated into the following services:

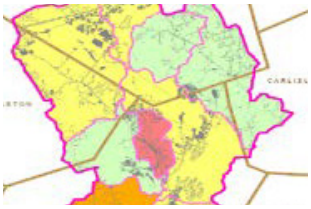
- Modeling of watersheds, stormwater, and pollutants
- Receiving water quality modeling (rivers, reservoirs, lakes, and estuaries)

GUIDANCE MANUAL FOR PHOSPHORUS REMOVAL IN STORMWATER
New York

Geosyntec worked with New York State Department of Environmental Conservation (DEC) to develop guidance and design standards intended to achieve a high level of phosphorus treatment within watersheds draining in New York City drinking water supply systems. Supporting work included HydroCAD analysis of current stormwater examples in the design manual for further analysis using USEPA's SWMM4 model. The SWMM model was used for continuous simulation analysis of storage pond and flow-through treatment systems, to facilitate evaluation of various modifications to the existing DEC design standards.

LAKE TAHOE POLLUTANT LOAD REDUCTION MODEL | California

Geosyntec Consultants and Northwest Hydraulic Consultants developed a Pollutant Load Reduction Model that can be used to estimate pollutant load reductions associated with water quality improvement projects in the Lake Tahoe Basin. The project included: developing a load reduction modeling framework that integrates watershed hydrology and stormwater BMPs; providing default input data sets specific to Lake Tahoe conditions; developing user interfaces and program code to create a release version of the model for testing.

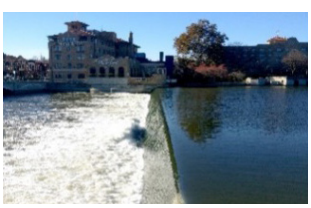


NASHOBA BROOK WATERSHED LID MODEL | Massachusetts

Geosyntec developed a model to evaluate the suitability of developable parcels in the Nashoba Brook Watershed for LID stormwater management practices. The model was based on a variety of ranking factors, including soils/geology, site proximity to a receiving water, stormwater infrastructure, impervious cover analysis of subwatershed areas, and site proximity to public wells, Zone 2 areas, etc. For each parcel, the model evaluated the net benefits of LID compared to traditional stormwater management regarding groundwater recharge and water quality. The model also estimated the costs of traditional versus LID stormwater practices.

LAKE SUNAPEE MONTE CARLO WATER QUALITY MODEL | New Hampshire

The New Hampshire Department of Environmental Services selected Geosyntec to develop a phosphorus loading model for the Lake Sunapee watershed using the Monte Carlo simulation method. The model assessed the potential impact of future development on Lake Sunapee's water quality. The model is an empirical, volume-based, pollutant loading model used to estimate a distribution of stormwater volume, concentration of pollutants in stormwater runoff, and a statistical description of the pollutant load (total mass of pollutants) in runoff associated with (1) current watershed land uses, and (2) watershed land uses at "full build-out".



FOX RIVER WATER QUALITY MODEL | Fox River, Illinois

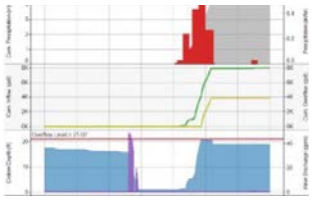
The Fox River Study Group is implementing a long-term, phased workplan to eliminate water quality impairments due to nuisance algae, low dissolved oxygen, large diel dissolved oxygen swings, and high phosphorus concentrations. This work includes intensive water quality monitoring, development of several watershed and water quality models, and development and updating of a Fox River Implementation Plan. Geosyntec recalibrated an existing QUAL2k model to a dynamic version for a continuous simulation of water quality. Geosyntec used the new model to simulate the various watershed management scenarios including dam removal and point/non-point source control to improve river water quality.

URBAN WATER QUALITY PROJECT | Boston, Massachusetts

Geosyntec was selected by the Boston Water and Sewer Commission in 2015 to apply innovative Microbial Source Tracking forensic analytical tools to advance their Illicit Discharge Detection and Elimination program. This will include investigation of human and non-human (fecal and other) sources of contamination within their Municipal Separate Storm Sewer System and the surface receiving waters, as well as strategic regulatory support. The purpose of this study is to investigate sources of human waste, fecal indicator bacteria (FIB), and phosphorus in the Commission's MS4 discharges during dry and wet weather. The objectives are to: 1) determine whether human fecal contamination is present at representative outfalls where FIB concentrations are elevated, for representative catchments with varying levels of implementation of conventional illicit discharge investigation; and 2) evaluate the relative contribution from various sources of FIB and phosphorus to the MS4, particularly during wet weather.

WATER QUALITY EVALUATION OF STORMWATER DISCHARGES
Boston, Massachusetts

The Boston Water and Sewer Commission retained Geosyntec to conduct a stormwater quality evaluation in support of the NPDES permit requirements to assess the current concentrations of pollutants, including nutrients and bacteria, in stormwater discharge from three representative land use drainage areas. Our team (which included CDW Consultants, Inc.) collected water quality samples of stormwater runoff in each drainage area for three storm events. Geosyntec analyzed the collected data to advise the Commission on any observed changes in stormwater quality and provide recommendations for reducing pollutant concentrations in discharges.

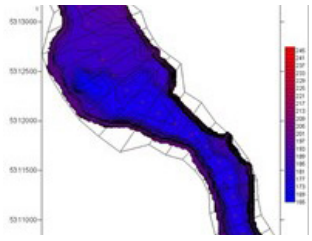


FAIRFIELD-SUISUN HYDROMODIFICATION MANAGEMENT | Suisun City, California

The Fairfield Suisun Urban Runoff Management Program was required, by their NPDES Permit, to develop and implement a Hydromodification Management Plan to better manage the effects of future development and significant redevelopment on channel stability, and, in particular, on channel incision and widening. Geosyntec focused on developing the performance standard based on maintaining a balance in the sediment supply and sediment transport capacity (EP Methodology). Geosyntec conducted hydrological modeling using the USACE HEC-HMS model along with the EP methodology to evaluate development scenarios in the Soda Springs Watershed.

RUN RESERVOIR SYSTEM DAM 2 TOWER IMPROVEMENTS | Portland, Oregon

As part of the City of Portland's Habitat Conservation Plan effort, a hydrodynamic and water quality model was developed (CE-QUAL-W2) for two drinking water reservoirs and the river below the reservoirs. The results of the modeling study were used to assist the city in making upgrades to the Reservoir 2 Dam intake tower to allow targeted water releases for fish habitat downstream. Geosyntec further developed the reservoir temperature model to ensure it was able to reproduce reservoir temperatures with the new tower in place. The calibrated model was utilized to explore alternative reservoir operations management scenarios.



LAKE CHAPLAIN DRINKING WATER SUPPLY | City of Everett, Washington

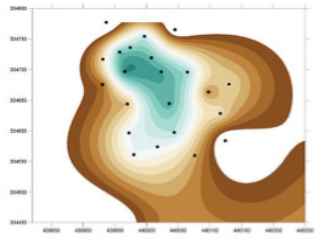
Lake Chaplain is the primary drinking water source for the City of Everett. Lake Chaplain was originally operated with single inflow, two municipal water withdrawals, and a paper mill withdrawal. Since the paper mill closed, a potential decrease of lake mixing could result. The city hired Geosyntec to investigate the future ramifications on mixing and water quality in the lake. Geosyntec used the hydrodynamic and water quality model, CE-QUAL-W2 to model Lake Chaplain's hydrodynamics, temperature and water quality. The modeling effort examined long-term effects over a 10-year time period. The results indicated there would not be long-term impacts on lake water quality but there might be some changes in currents.

WATER QUALITY MODELING AND TECHNICAL SUPPORT
New York City Department of Environmental Protection (NYC-DEP)

NYC-DEP has developed an Operations Support Tool (OST) to enhance the regular operations their drinking water reservoirs. CE-QUAL-W2 water quality models were developed for three reservoirs and incorporated into the OST rule framework. The models simulate the hydrodynamics, temperature and sediment within each reservoir. Geosyntec provided technical support to NYC-DEP on CE-QUAL-W2 by improving the code, highlighting additional features, and providing seamless integration into the OST. Geosyntec also conducted a peer review of the models and participated in a three-day workshop as part of an Expert Technical Review Panel.

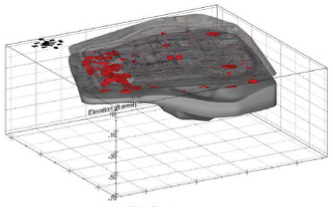
GROUNDWATER MODELING MONITORING AND ANALYSIS

An assessment of environmental changes and impacts can require advanced groundwater modeling and contaminant transport analyses. Geosyntec specializes in bringing insight to data, thus allowing site conditions to be comprehensively documented and understood. Our groundwater modeling and data visualization services effectively deliver technical content in a way that decision makers, regulators, stakeholders and the general public understand, so that a common understanding of a complex site can be reached.



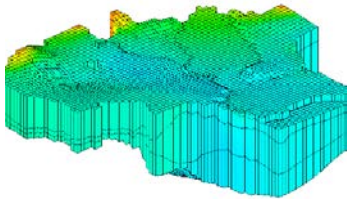
Geosyntec practitioners are proficient in variety of numerical tools including:

- **Groundwater models** – MODFLOW, MODFLOW-USG, MT3DMS, RT3D, HYDRUS, UTCHEM, TOUGH
- **Surface water models** – HSPF, HEC-RAS, WARMF, PHREEQE, MIKE-SHE
- **Integrated models** – GSFLOW, IWFM, FEFLOW



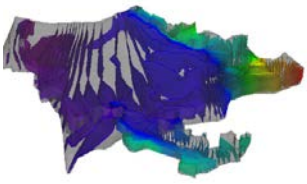
These tools are incorporated into the following core services:

- Interpretation of borehole logs, geophysical data and to identify key geologic features critical to the overall site conditions
- Data gap analysis – identifying relationships between various datasets to clarify model uncertainties which can be resolved with further site investigation
- Spatial analysis – exploratory and statistical analysis used for sampling optimization, plume stability analysis, trend analysis, and spatial interpolation
- Support of site conceptualization, remedial decisions and design with source and plume zone delineation
- Development of hydrogeologic visualizations to aid in identifying key relationships between geology, hydrogeology and geochemistry
- Advanced flow and transport model analysis to predict changing groundwater quality conditions including complex geological settings such as fractured rocks
- 3D and 4D visualization of data interpolations to communicate spatial and temporal relationships



GROUNDWATER DEVELOPMENT AND AUGMENTATION PLAN | Los Angeles Department of Water and Power (LADWP)

Geosyntec is providing the Los Angeles Department of Water and Power with services to develop a Groundwater Development and Augmentation Plan to enhance groundwater resources within the Los Angeles Plain south of the Elysian Narrows. Geosyntec's scope of work included evaluation of hydrogeologic conditions, groundwater treatment approaches, distribution system hydraulics, recycled water sources, stormwater capture, resource economics, and permitting. Specific analyses included groundwater flow modeling using the MODFLOW model developed by USGS for the Water Replenishment District to evaluate extraction and recharge scenarios within the Central Basin and identify feasible locations for potential projects.



NUMERICAL MODEL DEVELOPMENT AND DRINKING WATER PERMITTING San Gabriel Valley Superfund Site

Geosyntec is the USEPA-designated supervising contractor for one remedy within the San Gabriel Valley Superfund Site. The project includes development of a conceptual site model, groundwater flow model, and designing and implementing a 1,500 gallon per minute groundwater extraction and treatment system with treatment for potable use. Geosyntec is the lead consultant for development and calibration of the groundwater model (FEFLOW). The groundwater model is a key component of the remedy development and implementation; it is used for designing the remedy, evaluating remedy performance, performing assessment for the California Division of Drinking Water's 97-005 Policy and for approval from the Main San Gabriel Basin Watermaster.

EL MONTE OPERABLE UNIT (EMOU) | San Gabriel Valley Superfund Site

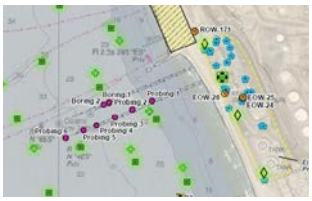
Geosyntec is the lead technical consultant for the implementation of two remedies at EMOU for remediation of Volatile Organic Compound (VOC)-impacted groundwater. As part of this work, Geosyntec developed a complex regional groundwater flow model in MODFLOW that was used to evaluate remedial alternatives and design the groundwater remedy for VOCs in groundwater associated with a multi-party industrial site. The ten-layer model covered a domain of approximately 50 square miles to a depth of greater than 500 feet in the western San Gabriel basin. Following approval of the calibrated model by the USEPA, 30-year transient predictive simulations were performed to evaluate extraction remedy alternatives for groundwater extraction and re-injection remedy design.

REMEDIATION OF MOLYBDENUM IN GROUNDWATER, CLIMAX MOLYBDENUM COMPANY | Fort Madison, Iowa

Geosyntec was retained to evaluate the nature and extent of molybdenum impacted groundwater on the site. The project objective was to evaluate monitored natural attenuation (MNA) of molybdenum as an alternative to pump-and-treat. A conceptual site model was developed and used to design and perform a groundwater investigation and geochemical evaluation. Geosyntec developed a groundwater flow and fate and transport model for molybdenum to potential source areas, groundwater migration pathways and transport mechanisms, and natural attenuation mechanisms. Geosyntec then conducted a remedial alternatives assessment and prepared a Remedial Action Plan recommending a remedy consisting of source controls, institutional controls, and MNA.

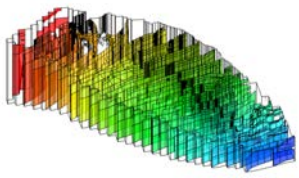
GROUNDWATER/SURFACE WATER INVESTIGATION AND FLOW MODELING, GOWANUS CANAL SUPERFUND SITE | Brooklyn, New York

Geosyntec was the prime technical consultant and Engineer of Record to conduct the remedial design and regulatory negotiations for the Gowanus Canal Superfund Site, one of the most polluted water bodies in the country. Geosyntec used porewater temperature to identify groundwater discharges, ultrasonic seepage data, hydraulic conductivity and stratigraphy to construct a 3D groundwater model. The groundwater model was used in combination with experts and geotechnical engineers to evaluate various alternatives for remediation. Model simulations were used to evaluate responses to dredging, capping, in situ stabilization, bulkhead emplacement, and restoration of filled channels.



SUBSURFACE SEAWATER INTAKE FEASIBILITY STUDY, WEST BASIN MUNICIPAL WATER DISTRICT | El Segundo, California

Geosyntec was retained to conduct a feasibility study of subsurface seawater intakes (SSIs) for a proposed 20-60 million gallons per day desalination facility. Geosyntec prepared a feasibility guidance document and then applied the guidance document to the proposed SSIs based on geologic, hydrogeologic, geotechnical, offshore sea floor, and coastal margin. Geosyntec then developed a MODFLOW groundwater flow models using aquifer properties from West Basin's West Coast Basin Barrier Model and Water Replenishment District groundwater model of Los Angeles Basin. Pumping options included vertical beach wells, slant wells, radial collector wells, and horizontal wells beneath the coastal margin. The models were also used to evaluate potential lowering of the water table to draw water from inland aquifers. Geosyntec developed life-cycle costs for the best alternatives.



GROUNDWATER HYDROLOGY MODEL, ALASKA AIRFORCE BASE (AFB) Eielson, Alabama

Geosyntec and Ahtna Engineering were retained to develop a groundwater flow model at the AFB to evaluate fate and transport of per- and polyfluoroalkyl substances (PFAS). The AFB has multiple areas where historical use of fire-fighting foams contaminated the site with PFAS. Geosyntec developed a 3D groundwater model in MODFLOW-USG extending over 70 square miles and including regional groundwater flow and discontinuous permafrost effects. The groundwater model was calibrated to updated seasonal water levels. The model was then used to illustrate potential PFAS movement using both particle tracking and fate and transport simulations. The AFB is using the model to inform ongoing remedial investigation of PFAS downgradient impacts.

CRITICAL AQUIFER RECHARGE AREA ANALYSIS | City of Issaquah, Washington

Geosyntec is supporting the City of Issaquah on groundwater recharge and contaminant transport issues associated with the city's groundwater supply in the Lower Issaquah Valley aquifer system. An update to the city's Critical Aquifer Recharge Area map was prepared based on a combination of hydrogeologic analysis of surficial soils and a groundwater flow model. The groundwater flow model, constructed in MODFLOW, simulates groundwater flow and surface water interaction throughout the Lower Issaquah Valley and incorporates pumping from both the city's wells and wells for Sammamish Plateau Water. The model was a valuable multi-purpose tool for characterization of groundwater flow paths, pumping patterns, recharge/infiltration, contaminant transport, and interaction with surface waters.

DAMS AND LEVEES DESIGN, PERMITTING, MODELING AND SAFETY

Geosyntec partners with owners and operators of dams, levees, and flood control facilities to assess flood risk hazards and regulatory compliance, obtain water quality certifications and permits, evaluate water quality and use impacts on the environment, develop engineering solutions, and deliver conservation and restoration projects.

Geosyntec's team of engineers work collaboratively across a range of disciplines to prepare integrated designs for dams, levees, and flood control facilities. The multi-faceted team provides innovative design for spillways, energy dissipators, erosion protection techniques, and construction sequencing. Our team also performs Probable Maximum Flood and Precipitation studies and prepares FIRMs.

We can efficiently navigate through regulatory agency processes to effectively address project-related demands and we leverage our expertise to perform hydrologic and hydraulic studies. Geosyntec develops, calibrates, and uses a variety of hydrologic, hydraulic, hydrodynamic, and water quality models (1D, 2D, 3D), data analysis, statistical packages, and software tools to conduct analyses related to dams. We also develop real-time operational, optimization, and compliance tools that integrate with above models and data.

Being highly knowledgeable in dam safety issues, Geosyntec has deep experience using state of the practice modeling and analytical methods, including standards-based deterministic and risk-based evaluations for safety assessments of earthen dams and levees, concrete dams, spillways, outlet works, and other structures. If removal is recommended, we can perform the necessary engineering activities for full or partial removal of different types of dams, and restoration of rivers from project planning through design and implementation.

MULE CREEK DAM RESERVOIR INUNDATION MAPPING | California

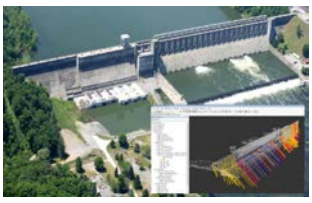
Geosyntec conducted the necessary steps for the dam breach analyses, inundation mapping, and updating of the Emergency Action Plan in the event of a failure of the California State Prison's Mule Creek Dam. The updated Emergency Action Plan would aid the relevant emergency authorities to plan an evacuation in the event of the dam breach failure. Geosyntec developed a HEC-RAS 2D model to simulate the flood inundation resulting from a breach. The study included data acquisition, model grid setup, model parameterization, model simulation execution, results evaluation, and inundation mapping. Sunny-day failure and storm-induced failure scenarios were also modeled.

DAM FERC LICENSING SUPPORT | Oconee River, Georgia

Geosyntec provided support of the National Environmental Policy Act scoping meetings and provided water quality modeling expertise to assist with potential mitigation for water quality issues for the Integrated Licensing Process (ILP) for Wallace Dam. The team prepared critical environmental assessment documents (e.g., Pre- Application Document, Study Plan, Study Reports) under FERC's ILP for the 321-megawatt hydro facility. The project is a pumped storage facility that includes the 19,050-acre Lake Oconee. Under FERC's ILP, Geosyntec led the preparation of the Pre-Application Document and the development of the Proposed Study Plan.

WOLF CREEK DAM | Kentucky

Wolf Creek is a large combined earthen and concrete dam on the Cumberland River. Due to seepage problems in the dam's foundation, it has become the USACE Nashville District's top priority dam. Geosyntec was retained by the Treviicos – Soletanche Joint Venture to manage data for USACE during the installation of a remedial barrier wall and grout curtain. We developed the Wolf Creek Information Management System, a 3D GIS application with the complete historical and construction dataset, seamlessly allowing storage and visual access to project data. This project was awarded the USACE Innovation Award.



BLUESTONE DAM | West Virginia

Bluestone is a concrete gravity dam constructed in the 1940's. Geosyntec was the USACE Huntington District's prime contractor for the Bluestone Dam Geospatial Project. We are created a complete 3D geospatial model (in GIS and CAD platforms) of the dam to synthesize all of the collected construction data to facilitate repairs. This model allows USACE to access this data in a variety of web-based reports and tools.

HERBERT HOOVER DIKE | Jacksonville, Florida

The Herbert Hoover Dike rehabilitation project is designed to stabilize and secure the aging dike from potentially damage during severe weather events, thereby protecting the downstream residents and businesses. Bauer Foundation Corporation constructed a demonstration segment of the planned 70-foot-deep cutoff wall. Geosyntec developed a data management/Construction Quality Assurance solution known as WallTracker™ for this project. Our system allowed Herbert Hoover Dike tabular and geospatial data to be viewed in plan and in cross-sectional views, as well as in automatically generated as-built drawings through an intuitive user interface. Our process streamlined the workflow, thereby creating a real-time decision support environment for project managers and stakeholders.

BOONE DAM | Tennessee

In response to a sinkhole discovered near the downstream toe of the earthen embankment, Tennessee Valley Authority implemented interim risk reduction measures to protect against progressive failure of the dam. Geosyntec was retained to execute the project Instrumentation Monitoring Plan during completion of a deep grout curtain and concrete cutoff wall. Geosyntec monitored the performance of the dam both through visual dam safety inspections and through real-time monitoring of dam safety instrumentation as well as the contractor's instrumentation system during construction. Geosyntec was responsible for the comprehensive evaluation of the collected data to assess the performance of the dam through all phases of construction and changes in reservoir levels.

R PAUL SMITH POWER STATION DAM 4 BREACH DECOMMISSIONING | Maryland

After all the coal combustion residual (CCR) material was removed from the site of a retired coal-fired power plant, the owner determined the remaining surface impoundment was a liability. Geosyntec completed the comprehensive design package and permit application for the decommissioning by breaching of the Significant Hazard-classified dam. After assessing site conditions and a breach location selected, Geosyntec estimated the design storm peak runoff discharge flow and water velocity, determined the size and shape of the dam breach, performed a geotechnical stability analysis of the breach side slopes, and designed permanent erosion control measures for the breach channel. Geosyntec supported the owner in reviewing contractor submittals, responding to contractor requests for information, and preparing monthly construction status reports. Our field staff provided full-time oversight and documentation of construction activities and assisted with preparation of the project completion report.

EEL RIVER SEDIMENT CHARACTERIZATION TO SUPPORT DAM REMOVAL California

Geosyntec designed and executed a Sampling and Analysis Program to characterize the sediments deposited in the reservoirs behind the two dams in the Eel River. The goal was to evaluate the potential impact of the sediments trapped behind the dams on downstream water quality upon dam removal. The team collected bathymetry, water quality, and sediment data - and based on these site factors - explored dam removal as an alternative to relicensing the facility. Our team also collected physical data from the reservoirs as part of this program to support the future development of a hydrodynamic model to estimate sediment transport and redistribution following dam removal. Geosyntec was involved in developing a predictive model to estimate downstream suspended sediment concentrations over time for the various dam notching/demolition options that will serve as a critical factor in protecting fish and other aquatic and related populations.

LOW-HEAD DAM REMOVAL | Confidential Client

A low-head dam constructed in the 1800s and located downstream of a bridge pier was scheduled for removal to increase aquatic organism movement in the area. Geosyntec evaluated the impacts on the bridge by initially analyzing the existing conditions, including available hydrology and hydraulic models, as-built drawings, and proposed conditions for the dam removal. Our team developed a hydraulic model by simulating hydrologic scenarios to evaluate pier impacts, including the selection of creek and river recurrence interval for coincidental flood events. Impacts of existing and proposed conditions for immediate and long-term removal scenarios were evaluated, including pier and abutment scour analysis, and velocity and water surface elevation comparisons. Geosyntec also developed alternative pier scour protection measures and proposed alternative dam removal options.

WATER RESOURCES PERMITTING

Geosyntec has extensive environmental permitting experience that ranges from wetlands delineation to environmental site assessment for hazardous wastes and materials to complicated environmental issues. In addition, we are experts in municipal stormwater permitting and USEPA Integrated Planning.

WETLANDS PROTECTION ACT (WPA)

Geosyntec's comprehensive experience with aquatic and wetland vegetation mapping, as well as wetland delineation and associated permitting, spans wetland delineations and WPA permit applications (including Notices of Intent, Requests for Determination of Applicability, and Abbreviated Notices of Resource Area Delineation) for numerous projects.

U.S. ARMY CORPS OF ENGINEERS SECTION 404 PERMIT:

- Bucks Creek Salt Marsh Restoration
- Dean Pond Beach Restoration and Aquatic Vegetation Control
- Blue Hills Pond Dredging Project
- Norfolk Southern Railways Projects
- Cherry Island Landfill Gas to Energy Pipeline
- Fresh Kills Park conversion to a public park
- Beulah Landfill Land Expansion

SECTION 401 WATER QUALITY CERTIFICATION:

Geosyntec has provided Section 401 Certification for many projects as part of WPA permitting. Geosyntec recently applied for Section 401 Water Quality Certification for Massachusetts Department of Conservation & Recreation dredging at Dean Pond and Blue Hills Pond.

ENVIRONMENTAL NOTIFICATION FORM, ENVIRONMENTAL IMPACT REPORTS, AND OTHER DOCUMENTATION:

- **Bucks Creek Salt Marsh Restoration, Massachusetts** for the Division of Ecological Restoration.
- **Wastewater System Upgrade, Little Neck, Massachusetts.** Wetland and Massachusetts EPA environmental permitting requirements for a wastewater system upgrade at Little Neck located within the Parker River/Essex Bay Area of Critical Environmental Concern (ACEC).
- **Ballard Street Salt Marsh Restoration, Revere, Massachusetts,** for Massachusetts Coastal Zone Management. Provided services for Environmental Notification Form and components of an Environmental Impact Report for a project to restore the Ballard Street Salt Marsh in Revere, Massachusetts.
- **Bristow Street Parking Lot Design,** for Massachusetts Department of Conservation & Recreation. Supported Environmental Notification Forms in support of engineering for a trail access parking area located within the Rumney Marsh ACEC.

NATURAL HERITAGE AND ENDANGERED SPECIES PROGRAM (NHESP):

- **Eagle Neck Creek Salt Marsh Restoration,** Truro, Massachusetts, for Massachusetts Division of Ecological Restoration. Provided comprehensive biological inventory to assess potential impacts and benefits of restoring tidal flow. Provided Natural Heritage and Endangered Species Program (NHESP) documentation related to Massachusetts Endangered Species Act-listed species for the project site, which included the Eastern Box Turtle, Spadderdock Darner, and Broom Crowberry.
- **Forge Pond,** Westford, Massachusetts. Provided permitting services for a lake drawdown with bordering wetland in a NHESP-Estimated Habitat Area for Blanding's Turtle and American Bittern.

NATIONAL ENVIRONMENTAL POLICY ACT (NEPA).

NEPA is an over-arching federal law that requires evaluation of project environmental impacts. Environmental Assessments are prepared for projects with minimal and no significant environmental impacts. The outcome of an Environmental Assessment is either a Finding of No Significant Impact or a requirement to prepare an Environmental Impact Statement. Typically, the federal Endangered Species Act, the CWA, and the National Historic Preservation Act are the primary regulatory drivers when an Environmental Impact Statement is required. Geosyntec has a multidisciplinary staff that is experienced in NEPA compliance, including GIS specialists that are highly skilled in the analysis and presentation of environmental impacts.

CLEAN WATER ACT (CWA).

The CWA requires that every point source discharge to a Water of the United States obtain a five-year NPDES permit. Permit writers are required to provide public notice for the permits. This can lead to extensive negotiations over permit conditions, which are typically based on conservative assumptions, or in some instances, bad information, leading to unnecessary facility upgrades. Violations of permit conditions can result in civil penalties of $25,000-$50,000 per day and in some instances, criminal penalties. Having a comprehensive CWA strategy in place can help avoid the need for large capital and operations and maintenance costs and reduce the risk of non-compliance. Geosyntec's practitioners include former regulators and staff who have decades of experience with different discharges.

STORMWATER PERMITS AND PLANS, SANTA ANA AND SAN DIEGO REGIONAL WATER QUALITY CONTROL BOARDS | California

The 4th Term Revised MS4 Stormwater Permits were adopted in 2009 and include new provisions requiring the implementation of LID and hydromodification control for new development and redevelopment projects in Orange County, California. To support implementation, the MS4 permit required the development of rigorous technically-based feasibility criteria for capturing and retaining stormwater on-site. Geosyntec assisted Orange County and the co-permittees in developing a Technical Guidance Document for implementing these provisions. The objective of the project was to develop guidance that incorporates stakeholder input; can be reasonably and cost-effectively implemented; is consistent with the requirements and intent of the adopted permits; and includes measures that are technically appropriate to the project type, site characteristics, watershed characteristics, receiving water beneficial uses, and receiving water hydrologic requirements.

REGULATORY SUPPORT FOR THE CITY OF LIMA | Ohio

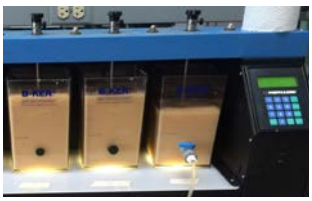
Lima faced staggering costs associated with a federal sewer overflow consent decree and a phosphorus TMDL. Geosyntec assisted Lima with finalizing an integrated plan under USEPA's new framework, demonstrating that the health impacts of sanitary sewer overflows were overstated. Geosyntec also critiqued the draft TMDL and worked with the state to incorporate flexibility into the TMDL to avoid the city committing to a $40 million treatment plant upgrade until benefits could be accurately quantified.

NPDES SUPPORT FOR THE CITY OF WARREN | Ohio

The City of Warren operates a 16 million gallon per day regional water pollution control facility (WPCF) which discharges to the Mahoning River. Geosyntec helped the city apply for a renewal of an administratively continued permit; prepare a local limits justification; diagnose issues with a centralized waste treatment facility and ultimately order cessation of discharge; and successfully defend itself in legal action against the WPCF from an environmental group.

PERMIT MODIFICATION FOR SOUTHERN MORROW COUNTY | Ohio

Southern Morrow County purchased a privately-owned WPCF to accommodate planned economic growth. Geosyntec is evaluating stream and effluent conditions to determine if the county could switch from land application to a surface water discharge. Geosyntec worked with USEPA Ohio to determine pollutants of concern, develop and execute a sampling plan, and conduct waste load allocation and stream flow modeling for the permit application.



LIME RESIDUAL DISPOSAL FOR CITY OF COLUMBIA | Missouri

Columbia City evaluated options for disposal of lime residuals from its water treatment plant. Geosyntec lead the best professional judgment evaluation of a surface water discharge to the Missouri River. This included mixing zone modeling, effluent/bench scale testing, regulatory negotiations, permitting support, and preparation of a Water Quality and Antidegradation Review.

IRON ASSESSMENT FOR STORMWATER PERMITTING | Missouri

The Missouri Department of Natural Resources began issuing effluent limits for iron in several landfill stormwater permits. These limits were overly stringent using default permitting approaches and naturally occurring iron levels. Geosyntec established sufficient basis for recommending an acute-based benchmark. The Missouri Department of Natural Resources revised the limits and has used study results to issue benchmarks in other industrial stormwater permits.

TMDL ALTERNATIVE FOR WISSAHICKON CREEK | Philadelphia, Pennsylvania

The state asked the USEPA to develop a phosphorus TMDL for Wissahickon Creek, Philadelphia. The targets lacked demonstrated water quality benefits and were unattainable for the WPCFs and the 13 MS4s. Geosyntec worked with the stakeholders to condense two years of technical studies and numerous meetings and led development of a TMDL alternative.

BROWNFIELDS, ENVIRONMENTAL ASSESSMENTS, AND ENVIRONMENTAL IMPACT STUDIES

Geosyntec regularly navigates brownfield issues including eligibility and grant applications; environmental due diligence; soil, groundwater, surface water, and vapor intrusion testing; risk-based remedial alternatives and remediation; geotechnical and engineering design; regulatory negotiation; environmental management; and closure support. Each investigation and mitigation plan is tailored to the clients' end use, working with stakeholders to maximize the site's economic potential, and benefit to the community. When unexpected challenges arise, we develop strategies to swiftly and effectively address them. Our goal is to minimize environmental liability exposure and maximize program incentives to help clients develop safe and vibrant urban spaces.

Our relevant areas of expertise include:

- USEPA All Appropriate Inquiry (AAI) environmental site assessment (EAs)
- Environmental impact statements (EISs)
- Environmental Due Diligence
- Vapor intrusion assessment and mitigation
- In-house toxicology and risk assessments
- Geotechnical stabilization, containment, gas control, and foundation design
- Construction management / quality assurance to implement proposed mitigation designs

> "Your team has run an exemplary program with utmost technical competence, honest endeavor, and goodwill."
>
> **Alex Lapostol**,
> Contractor to U.S. EPA for the Home Depot, Burbank project.

BROWNFIELDS REDEVELOPMENT | Minneapolis, Minnesota

Within the southeast Hennepin area, the Minnesota Pollution Control Agency (MPCA) identified a site where groundwater and vapor were contaminated primarily with chlorinated solvents. This identification led to an investigation during which multiple areas were determined to require remediation. Geosyntec was retained by the owner of a 17-acre property to assist with the renovation and redevelopment of portions of large warehouse into a modern logistics warehouse and commercial offices. Geosyntec completed a Phase I Site Assessment, enrolled the property owner in the MPCA's brownfields program to obtain liability assurances prior to property acquisition, and prepared remedial designs to support renovations and redevelopment, including a vapor intrusion mitigation system and upgrades of the current systems. Geosyntec was able to save $250,000 in project costs through risk-based remedial design and optimize the vapor intrusion mitigation system; saving overall future operation and maintenance costs.

THOROUGH ENVIRONMENTAL SITE ASSESSMENT PREVENTS SURPRISES DURING A COMMERCIAL REAL ESTATE TRANSACTION | Minneapolis, Minnesota

A food manufacturing facility, in operation since the 1960s, was in the process of shutting the manufacturing operations down and moving to a new facility. The client retained Geosyntec to conduct an environmental assessment to facilitate the sale negotiations. Geosyntec conducted detailed Phase I file searches at the city, county, and state to investigate the property and other nearby properties. Based on Phase 1 findings and our in-depth knowledge of the local soil and groundwater conditions in the area, we then conducted a targeted Phase II assessment. Our most likely scenario determined minimal on-site sources and minimal off-site impacts that would not require active remediation or continued monitoring. The buyer and their consultant also conducted on-site and off-site investigations and proved this determination was correct. The state regulatory agency agreed and issued a No Further Action (NFA) letter to both the buyer and our client. This NFA letter eliminated future liability for environmental cleanup costs for the client. Because of Geosyntec's experience on similar projects under Minnesota's state Brownfield program, we were able to anticipate the buyer's next moves and advise our client accordingly allowing the sale process to proceed smoothly with no surprises.

INVESTIGATION, REMEDIATION, AND REDEVELOPMENT OF BROWNFIELDS SITE
La Porte, Indiana

The City of La Porte was home to the agriculture machinery company Allis Chalmers for much of the 20th century until its closure in 1984. Geosyntec was hired in 2015 by the City to achieve regulatory closure of the former manufacturing site and its surroundings within the Indiana Department of Environmental Management and the Indiana Brownfields Program. After regulatory closure, the site will be redeveloped as NewPorte Landing, a proposed commercial and residential center for the City. Geosyntec supported the City in achieving regulatory closure at NewPorte Landing for the Phase 1 Area and the hazardous waste management units within this area with minimal required remediation. Geosyntec was able to accommodate the City's desire for sustainable practices through the potential beneficial reuse of on-site foundry sand in redevelopment. Geosyntec has worked in concert with the developer to ensure the remediation did not impact the development plans and incorporated facilities such as parking in areas with an engineered barrier.

IN-SITU REMEDIATION OF CHLORINATED SOLVENTS AT A FORMER MANUFACTURING FACILITY | Mission Viejo, California

Impacted with multiple chlorinated volatile organic compounds (VOCs), this 26-acre manufacturing site is under regulatory oversight of the Regional Water Quality Control Board (RWQCB) San Diego Region. Various areas on the site were associated with under and aboveground storage tanks, photo development activities, and hazardous waste storage. Geosyntec was retained to complete the Remedial Investigation and implement a remedial program under an accelerated schedule to meet client contractual needs. Following negotiations and authorization from the RWQCB, soil vapor extraction (SVE) and in-situ chemical oxidation (ISCO) pilot studies addressed residual VOCs in soil vapor, soil, and groundwater in a time-effective manner. ISCO and SVE tests reduced VOC mass in groundwater, soil, and soil vapor. Most wells and constituents are at or above 90% removal of initial VOC concentration levels in the vadose zone. VOCs in site groundwater historically exceeded maximum contaminant levels at several locations but are now decreasing toward non-detect and decreased by several orders of magnitude in the residual source area. The client received a no further action (NFA) letter for the property.

BROWNFIELD REDEVELOPMENT FOR HOME DEPOT | California, Burbank, California

The objective of this project was to redevelop a former defense manufacturing facility into a Home Depot site by remediating the site and attaining regulatory closure. Geosyntec designed remedies to address the soil and shallow groundwater contamination at the site. The remedies addressed soil and volatile organic compounds (VOCs) in both soil and groundwater, and hexavalent chromium (Cr^{6+}), heavy metals, polychlorinated biphenyls (PCBs) and petroleum hydrocarbons in the soil. From 2006-2010, Geosyntec operated and optimized the soil vapor extraction (SVE) and dual phase extraction (DPE) systems to maximize mass removal of VOCs. Geosyntec also designed and implemented an in situ chemical reduction (ISCR) remedy for Cr^{6+} by injecting 880,000 gallons of calcium polysulfide solution into the soil and groundwater in 2014. The ISCR was successful in reducing concentrations of Cr^{6+} from 6,100 μg/L to <5 μg/L in groundwater. Geosyntec collected confirmation samples in soil, vapor and groundwater; and conducted modeling to demonstrate a very low risk that residual VOCs and Cr^{6+} could migrate to the underlying regional drinking water aquifer. On this basis, the Regional Water Quality Control Board, Los Angeles Region (RWQCB) in January 2016 granted full site closure.

ENGINEERING, PERMITTING, AND CONSTRUCTION SERVICES FOR BISCAYNE COMMONS BROWNFIELDS SITE REDEVELOPMENT | North Miami Beach, Florida

The Biscayne Commons site on Biscayne Bay had been formerly used for fill material and also uncontrolled dumping of construction debris and solid waste. The site was also impacted by contamination issues at the nearby Munisport Landfill site, a former National Priorities Site. Geosyntec was hired to develop a geotechnical engineering and environmental regulatory compliance strategy to make the site useable as a commercial property. Geosyntec developed a site assessment strategy to address air, soil, and groundwater contamination issues and meet the Florida Department of Environmental Regulation (FDEP) requirements. Geosyntec also worked with the design/construction members of the Biscayne Commons team to prepare a comprehensive site planning, permitting, and construction package. Geosyntec used its expertise in deep dynamic compaction to improve subsurface conditions for foundation design and construction and incorporated a state-of-the-practice soil vapor detection and extraction system into the foundation design. Geosyntec recommended using the Florida Brownfields Site Rehabilitation program to reduce site redevelopment costs.

SOIL AND GROUNDWATER REMEDIATION AND BROWNFIELDS REDEVELOPMENT AT FORMER PUBLISHING COMPANY SITE | Orlando, Florida

The Publishing Site, located in an economically disadvantaged State Brownfield Area, comprises primarily industrial/commercial properties. The site was used as a printing facility from the 1960-1996, then used for general storage, and is currently being used as a cabinet manufacturing facility. In 2006, a Florida Department of Environmental Protection (FDEP) identified four underground sumps that stored waste inks, wash solvents, and septic effluent. Subsequent assessments conducted by others identified high concentrations of volatile organic compounds (VOCs). In 2009, the sumps were removed, and remedial actions implemented for contaminated soils and groundwater contamination, but the remedial actions were not successful in reducing VOC concentrations. FDEP's Brownfields Section then retained Geosyntec to select and implement a remedial method to address the persistent VOCs. Geosyntec proposed a limited duration air sparge/soil vapor extraction (AS/SVE) interim source removal (ISR) remedy to maximize the effectiveness of available funding. The AS/SVE system design and operation within the current facility operations was successful at removing significant VOC mass from the subsurface and reducing groundwater concentrations by 96%.

SITE INVESTIGATION AND REMEDIATION FOR RAILS-TO-TRAILS CONVERSION OF A FORMER RAILROAD CORRIDOR | Waycross, Georgia

The City of Waycross wanted to convert 1-mile of former CSXT railroad corridor into a rails-to-trails greenway but needed assurance of its condition. The objective of this project was to enroll the site into the Georgia Brownfield Program, complete the site assessment, and implement remediation to facilitate the sale of the property to the City. Geosyntec performed due diligence sampling on behalf of CSXT that indicated presence of arsenic in site soils at toxic levels. Geosyntec then prepared and submitted a notification package for arsenic in soil to the Georgia Environmental Protection Division. Geosyntec used a combination of x-ray fluorescence field screening and analytical sampling to delineate the impacted soils. We also evaluated the potential reuse of the ballast material to minimize disposal volumes. For implementation, Geosyntec prepared the Erosion and Sediment Control Plans, bid package, and assisted CSX with contractor selection. Upon successful remediation, Geosyntec submitted a final Compliance Status Report so that the City could have future limited liability.

GEOGRAPHIC INFORMATION SYSTEMS

Today's projects involving the natural and built environment require the collection, organization, and analysis of large amounts of data from diverse sources. Geosyntec specializes in developing systems that bring order to the data; allow environmental/site conditions to be visualized; provide technical context for the conditions observed; and provide a forum for decision makers, regulators, interested stakeholders, and the public to find a common understanding of complex site conditions.

Geosyntec provides GIS, data management, analysis, and visualization services for a broad range of project applications including:

- Ecological restoration;
- Stormwater management;
- Risk assessment;
- Disaster loss estimation; and
- Litigation support.

Our GIS and data management professionals specialize in application development, data visualization, and statistical analyses using a range of technologies including:

- Desktop and enterprise relational databases;
- Systems for analyzing geographically-referenced information; and
- 2, 3, and 4D data modeling and visualization software.

We apply these technologies as projects move through the stages of data collection and use, including:

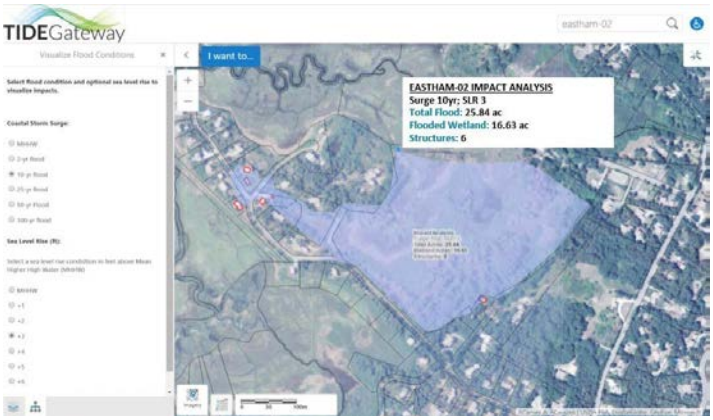
- Maps, figures, animations, and interactive user applications to communicate the data's story in an effective manner;
- Electronic field data collection which allows efficient data entry, data transmission, and real-time data quality control;
- Custom database verification and assembly routines to automatically screen and normalize data; and
- Database systems accessible via the internet or through other electronic file sharing protocols.

Geosyntec has emerged as an industry leader in the use of automated feature extraction processes with 4- and 8-band multi-spectral imagery. We provide services related to:

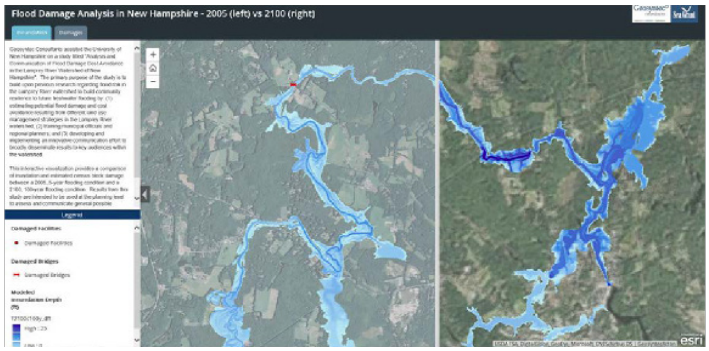
- Multi-band imagery acquisition;
- Automated features extraction using remote sensing; and
- Image interpretation and spectral analysis.

Most of our water resources projects have a significant GIS component; some innovative examples are depicted below:

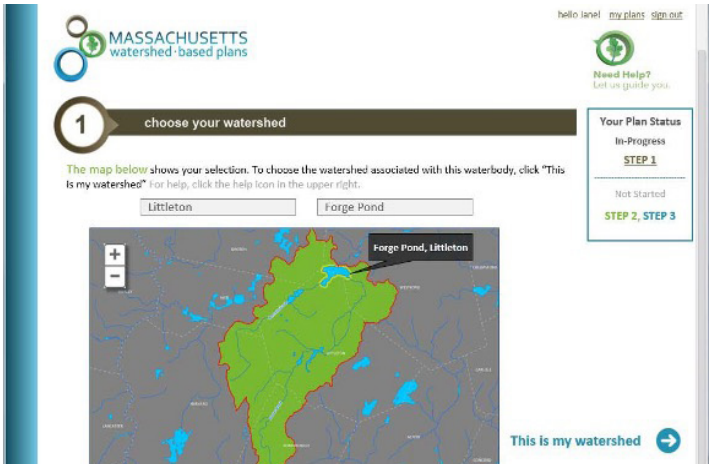
MASSACHUSETTS INTERACTIVE INFRASTRUCTURE DATABASE AND CLIMATE CHANGE ASSESSMENT TOOL



WEB-BASED STORY MAP TO COMPARE FLOOD INUNDATIONS



MASSACHUSETTS WEB-BASED WATERSHED ASSESSMENT TOOL



CONTACT

Nigel Pickering, Ph.D., P.E. (Minnesota)
Senior Engineer
612-253-8214
npickering@geosyntec.com

David Richardson, P.E., P.G. (Minnesota)
Senior Engineer
612-253-8204
drichardson@geosyntec.com

Rica Enriquez, Ph.D., P.E. (Minnesota)
Project Engineer
612-253-8208
renriquez@geosyntec.com

David Kein, B.S., P.E. (Minnesota)
Project Engineer
630-203-3367
dkein@geosyntec.com

Matthew Bardol, P.E., CFM, CPESC, D.WRE (Illinois)
Senior Principal
630-203-3368
mbardol@geosyntec.com

Rishab Mahajan, P.E., CFM, CPSWQ (Illinois)
Senior Engineer
630-203-3361
rmahajan@geosyntec.com

Adrienne Nemura, P.E. (Ohio)
Principal
614-468-0425
anemura@geosyntec.com

Jacob Krall, Ph.D., P.E. (Oregon)
Senior Engineer
971-271-5910
jkrall@geosyntec.com

Aaron Poresky, P.E. (Oregon)
Principal
971-271-5891
aporesky@geosyntec.com

Thomas Amstadt, P.E., CFM (Florida)
Principal
321-249-9361
tamstadt@geosyntec.com

Mike Hardin, Ph.D., P.E., CFM (Florida)
Principal
321-244-1464
mhardin@geosyntec.com

Renee Bourdeau, P.E. (New Hampshire)
Senior Engineer
603-205-8057
rbourdeau@geosyntec.com

David Vance, P.G. (Georgia)
Principal
678-202-9612
dvance@geosyntec.com

Joe Kula, P.E. (Maryland)
Senior Principal
301-318-6731
jkula@geosyntec.com

Julie Chambon, Ph.D., P.E. (California)
Senior Engineer
510-285-2657
jchambon@geosyntec.com

Ken Susilo, P.E., D.WRE, ENV SP (California)
Senior Principal
310-957-6111
ksusilo@geosyntec.com

Mark Hanna, Ph.D., P.E., LEED AP (California)
Senior Principal
310-957-6113
mhanna@geosyntec.com

Geosyntec Consultants is a consulting firm with engineers, geologists, environmental scientists, and other technical and project staff based in offices throughout North America, and at select locations in Australia, Ireland and the United Kingdom. We address new ventures and complex problems involving our environment, natural resources, and civil infrastructure.

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