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DEPARTMENT OF EARTH & ENVIRONMENTAL SCIENCE

COLLEGE OF LIBERAL AND PROFESSIONAL STUDIES

MASTER OF SCIENCE IN APPLIED GEOSCIENCES



HYDROGEOLOGY ABSTRACTS

HYDROGEOLOGICAL ASSESSMENT AND PRELIMINARY WETLAND DELINEATION OF PEATLAND ON NORTH SIDE OF CAMEL’S HUMP BETHLEHEM, PA

Michelle L. Barakat (2018)

Readers:

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On the north side of Camel’s Hump and south of Monocacy Creek in Bethlehem, PA lies a spring-fed peatland that was referred to as the “Detweiler peat deposit” and described as having about 4.5 feet of peat over clay, glacial till, and decomposed gneiss and limestone in Leroy et al. (1939). Today, part of this peatland is located on the property of Friends of Johnston, Inc. who require an understanding of the peatland hydrology and boundaries to aid in the implementation of a storm water management plan upstream of the wetland. Although the peatland underwent minor replanting and quality maintenance throughout the extent of this project, upstream hydrologic alterations could affect the character and limits of the peatland. In advance of the project, baseline information was gathered including a hydrology assessment and a preliminary wetland delineation. An electrical resistivity survey using SuperSting technology was conducted and revealed an intricate subsurface network of water flow, springs, and the piezometric tendencies characteristic of the karst topography found in the area. A preliminary wetland delineation was conducted using the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region (Version 2.0) (USACOE 2012) and determined the approximate upland/wetland boundaries that should be considered when implementing the storm water management plan. The bedrock geology was obtained from the most recent mapping of the area (Aaron and Drake 1997). Going forward, this information will be important to the engineers, scientists, and government officials who will be playing a part in the larger storm water management project. This study will serve as a reference to the City of Bethlehem, Pennsylvania as they attempt to restore the wetland and modify the surrounding land to better accommodate the storm water drainage entering the Monocacy Creek Watershed.

DETERMINATION OF REMEDIAL EFFECTIVENESS USING MATHEMATICS, SOFTWARE, AND FIELD OBSERVATIONS

John Breiner (2018)

Readers:

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The study area is a 100-plus acre fractured bedrock plume located in the Newark Basin in northern New Jersey. A VOC plume exists in the fractured bedrock and extends nearly 5,000-feet downgradient with multiple contributions from off-site sources. Bioaugmentation technology was applied near the source area to bioremediate chlorinated ethenes and methanes, primarily dissolved trichloroethene (TCE). Over 8,500-gallons of emulsified vegetable oil (EVO) was injected into distinct waterbearing bedrock fracture zones as part of the November 2015 Pilot Study Injections. The EVO contained a bacterial culture designed to augment the naturally existing bacterial populations and expedite reductive dechlorination. Six rounds of performance monitoring were conducted after the injections to understand the influence of the injections, evaluate the remedial effectiveness of the bioaugmentation, and determine groundwater flow velocities within the fracture units. The results of this injection will be utilized to develop a remedial approach and set remedial goals for the second phase of injections yet to be completed.

This study evaluated the performance monitoring data in three ways: 1) using historic Site data to complete engineering calculations that define remedial influence and impact, 2) using the Monitoring and Remediation Optimization Software (MAROS) program to evaluate trends, review sampling requirements, and assess attainment of remedial objectives, and 3) using contaminant concentrations, bacterial populations, and geochemical field observations collected during bioaugmentation performance monitoring.

Neither engineering calculations, MAROS analysis, or performance monitoring observations should be looked at independently of the others. Each of the methods investigated as part of this study provided distinctly different yet useful outputs in the evaluation of a remedial action and development of a conceptual site model. Some combination of institutional knowledge, software analytics, and field observations should be employed to create the most complete conceptual model of the site and assess the achievement of remedial goals. These lines of evidence bolster the defense of the model and certify its validity as a tool in designing and executing future work at the Site.

A GRAPHICAL APPROACH TO ANALYSIS OF INDIVIDUAL GSI PROJECT STORMWATER MITIGATION IN URBAN SETTINGS

Igor Bronz (2018)

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Within the field of Green Stormwater Infrastructure (GSI), a generalized, data-driven, quantitative approach into analyzing the stormwater mitigation efficiency of individual GSI projects with regard to their cost has not yet been published. Previous attempts have been made to determine the costs and benefits of using green infrastructure in certain municipalities, but these analyses quantify multiple aspects of green infrastructure, not just stormwater mitigation, and their conclusions are often specific to that municipality. To produce this missing component, a data table was created to break down the technical characteristics of interest for GSI projects and a graphing approach was used to compare the GSI projects to each other with the hopes of being able to make conclusions regarding the efficiency of certain projects at mitigating stormwater. Two types of linear-linear scale graphs were constructed: *stormwater mitigation capacity vs. cost* and *stormwater mitigation capacity vs. area of BMP*. The goal of the *stormwater mitigation capacity vs. cost* graph is to determine which GSI projects are better at mitigating stormwater for their cost. This would prove useful for developers who desire to meet certain stormwater goals and want to have an understanding of how GSI project cost can vary, and why. The goal of the *stormwater mitigation capacity vs. area of BMP* graph is to determine whether GSI projects with deeper substrates or better technology are more efficient at mitigating stormwater despite having a smaller footprint, irrespective of cost. This would be useful for understanding how the stormwater mitigation efficacy of smaller, but higher quality projects varies compared to projects with a larger footprint, and would be of particular interest to those who desire to meet certain stormwater goals but have space constraints. Both graph types demonstrate clear variation between different GSI projects and their efficiency. Their relationships to each other coincide well with the respective GSI projects' intent and physical characteristics.

HYDROGEOLOGICAL CHARACTERIZATION OF FOGLEND POINT, TIVERTON, RHODE ISLAND

Spencer B Harris (2018)

Reader:

Carl Mastropaolo, University of Pennsylvania

Seawater intrusion is a global problem for coastal communities that rely on groundwater. Excessive groundwater pumping along coastal regions has been shown to accelerate seawater intrusion and to have the potential to render critical water sources unusable. Domestic wells in Fogland Point, Tiverton, RI have recently experienced an increase in groundwater salinity, particularly during summer months. This project examines the hydrogeology of Fogland Point through field investigation, data analysis, and groundwater modeling. FloPy, a python package interface for MODFLOW, and SWI2, the seawater intrusion package were used to investigate the relationships between groundwater withdrawals and the position of the 50% interface between freshwater and seawater. The project employed the use of data transducers for the continuous measurement of water levels, temperature, specific conductivity, and salinity, field and lab measurements of water quality, local weather stations for precipitation, and local tide gauges. The results from field activities show high salinity concentrations in multiple wells on Fogland Point. The model supports the field observations with the presence of the 50% freshwater-seawater interface at approximately -145 feet MSL below the peninsula. The amount of groundwater withdrawals by wells are less of a factor on salinity concentrations than the total depth of the wells and seasonal changes in groundwater recharge. Shallow wells generally produce fresher water, unless being influenced by salinity from water treatment system brine disposal or increased deep-zone mixing from hydro-fracking.

UTILIZATION OF ARCGIS TO PRODUCE SURFACE WATER MAPS TO SUPPORT SURFACE WATER MANAGEMENT PLANS FOR AN ARIZONA COPPER MINE

Craig A. Pezak (2018)

Readers:

Melissa Volkmar, Freeport-McMoRan

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Monsoon season in the American Southwest brings torrential downpours in short time periods that could overflow stream banks and create fast-paced discharges through canyons and washes. In the open-pit mining process in the southwest, surface water from precipitation events flow down-slope to the pit-bottom from the surrounding valleys and mesas. This results in large discharges of water that create the need for adequate engineered drainage systems and retention ponds on the mesas at elevations above the mine pit. Utilizing ArcHydro in ArcGIS, a hydrogeologic model was created and surface water flow paths displayed natural drainage directions of surface water runoff on one of the mesas above a selected mine site. As a result, drainage ditches and engineered retention ponds were included in the model simulations to direct the natural flow paths. Using Web Soil Survey, soil parameters, such as infiltration rate, were identified for the mesa soils and along with topographic slope, runoff coefficients were assigned for drainage areas for the mesa. Using both the drainage areas and soil characteristics from Web Soil Survey, runoff volumes and heights were calculated based on both the average yearly precipitation events and extreme storms. Various areas and depths for the retention pond were examined based on the results of the calculations. Retention pond and drainage ditch designs were then created and recommended based on the water depth calculations and, ease of construction and maintenance using a conservative approach.

A DELIBERATION OF INUNDATION INDUCED BY HURRICANE HARVEY: A REMOTE SENSING APPLICATION

Trevor Shoemaker (2018)

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On August 25th, 2017 Hurricane Harvey touched down in Houston, Texas delivering a 500-year precipitation event that left the fourth most populated city in the United States with extensive flooding. Due to the rapid and geographically extensive nature of flood events, adequate in-situ data that characterizes the resulting regional and local inundation across Houston is largely deficient. In response to this circumstance, this study has investigated the inundation induced by Hurricane Harvey and is driven by the hypothesized notion that the distribution of inundation can be imaged and analyzed through the application of remote sensing. This research has employed multitemporal change detection and thresholding techniques that utilize Sentinel-1 synthetic aperture radar data, alongside multispectral band combination and manipulated digital elevation models to image, provide context to, and quantify the occurrence of inundation across Houston, Texas. In doing so, this study has developed a toolkit that is accessible and can be implemented by others interested in the distribution of inundation induced by Hurricane Harvey. The results of the study dictate the general tendencies associated with the detected inundation, provide an area based quantification, and highlight the associated risk of geohazardous conditions corresponding to a 500-year flood event. Ultimately the detected inundation aligns with hydrological expectation, with each case of inundation supported through the contextual narrative, serving as vindication for the study and potential applicability to further investigations of inundation.

HYDROLOGICAL MODELING IN AN ENGINEERED URBAN GREENSPACE: STORMWATER MANAGEMENT AT SHOEMAKER GREEN

Angus Welch (2018)

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Shoemaker Green is a 2.71-acre recreational greenspace on the University of Pennsylvania campus in Philadelphia, Pennsylvania. The property was designed to improve site-scale stormwater management by moderating runoff discharges to the local combined sewer system. This research project evaluated site runoff control mechanics and developed a daily-scale model to describe stormwater control performance in applicable areas from October 2012 through September 2016. The model indicated that the greenspace had managed approximately 94% of all precipitation events and 85% of total stormwater volume during the study period without overflowing to the combined sewer system. These results can serve as reference values for future runoff models at Shoemaker Green. The findings may also inform site stormwater modeling enhancements. Proposed improvements include enhanced subsurface stormwater monitoring and transpiration research to track hydrological releases from vegetation. The findings may also provide data to support environmental design and maintenance projects at the University of Pennsylvania.

PERFLUOROCTANE SULFONATE (PFOS) AND PERFLUOROCTANOIC ACID (PFOA) CONTAMINANTS IN DRINKING WATER: BACKGROUND, HEALTH EFFECTS, REGULATORY STATUS, EXPOSURE AND NEXT STEPS

Lillian Diehl (2017)

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The emerging contaminants, perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), have gained attention following certain highly publicized civil action cases involving exposure to communities via drinking water. The content of this report was developed by examining primary source documentation on the toxicology, manufacturing history, individual civil action cases, regulatory history, field and analytical testing techniques, and treatment technologies. Certain secondary sources were also examined to provide context for the public perception of these compounds. Specifically, the report addresses the following questions about PFOS and PFOA: (1) what are they and how are they used in industry; (2) what are the risks to human health following exposure; (3) what is the current regulatory status; (4) how widespread are they in drinking water; and, (5) what are the appropriate methods for testing and treatment in public drinking water sources? Drinking water supplies for more than six million U.S. residents exceed the United States Environmental Protection Agency (USEPA) Health Advisory (HA) of 0.07 ug/L for PFOS and PFOA. However, the HA and other regulatory decisions are being made based on results of animal studies, while studies on human health effects often appear to be somewhat inconclusive. Additional studies on the human health effects caused by exposure to PFOS and PFOA via drinking water are necessary before establishing federal regulations. Understanding the current status of PFOA and PFOS in both a toxicity and regulatory framework, can provide context for understanding the risk of other emerging contaminants as a whole.

IMPACTS DUE TO LONG TERM WATER WITHDRAWALS AT A SITE IN THE METAMORPHIC ROCKS OF SOUTHEASTERN PENNSYLVANIA

Stephen Huxta (2017)

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Aquifer testing and modelling was completed in the metamorphic rocks of southeastern Pennsylvania for the proposed development of a groundwater supply system. The work was completed to project if the proposed groundwater withdrawal of 30,000 gallons per day (GPD) would result in adverse impacts to surrounding surface water bodies or existing groundwater users. Testing included a 36-hour constant rate aquifer pump test, data analysis, and formation of a site conceptual model. The site conceptual model defines three layers including an unconfined aquifer, confining unit, and leaky confined aquifer. The leaky confined aquifer serves as the pumping aquifer.

This conceptual model was used to build a numeric model using GMS modelling software. The model was calibrated with background data and pump test data, then run at the proposed pumping rate of 30,000 GPD for 10 years. Modelling results indicate that long term withdrawal at the proposed pumping rate will result in lowered groundwater elevations around an onsite manmade pond and approximately 200 feet of a stream originating at the pond. No impact to groundwater elevation, and thereby groundwater discharging as baseflow to the stream is projected beyond the first 200 feet of the stream. Minor impacts to stream flow during extended periods absent of precipitation are likely but it is not anticipated these impacts would be differentiable from natural variation. This conclusion would require collection and analysis of data prior to and following the commencement of pumping. Significant drawdown within the leaky confined aquifer is confined to within the site with minimal drawdown beneath the closest residential properties, which are improved with private water supply wells. Given the hydrogeologic conditions present within the area, this minimal drawdown is not predicted to have adverse impacts on existing groundwater users.

AN INVESTIGATION INTO THE WATER QUALITY AND FUNCTIONALITY OF SHOEMAKER GREEN – A GREEN INFRASTRUCTURE (GI) CASE STUDY

Janelle Jesikiewicz (2017)

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Shoemaker Green is a state of the art green stormwater infrastructure site. As defined by the Philadelphia Water Department (PWD), “green stormwater infrastructure includes a range of soil-water-plant systems that intercept stormwater, infiltrate a fraction of it into the ground, evaporate a portion of it into the air, and in some cases, release a portion of it slowly back into the sewer system where it can ultimately be treated at a wastewater treatment plant” (PWD, 2011). Although officially completed, Shoemaker Green’s ability to capture and treat stormwater runoff has not been previously investigated. The purpose of this study was to evaluate the chemical loading and water quality passing through Shoemaker Green. Through stormwater monitoring and sample analysis, Shoemaker Green as a green infrastructure (GI) tool was evaluated. From June of 2015 to October 2016, thirty-two (32) samples were collected to represent seventeen (17) measurable storm events. Samples were analyzed for the following parameters: alkalinity, conductivity, hardness, pH, aluminum (Al), calcium (Ca), cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), potassium (K), magnesium (Mg), sodium (Na), nickel (Ni), lead (Pb), zinc (Zn), fluoride (F⁻), chloride (Cl⁻), nitrite (NO₂⁻), bromide (Br⁻), sulfate (SO₄²⁻), nitrate (NO₃⁻), phosphate (PO₄³⁻), and nitrite + nitrate (NO₂⁻ + NO₃⁻). Of the 32 samples collected, the following results exceeded the Pennsylvania Department of Environmental Protection (PADEP) or United States Environmental Protection Agency (USEPA) target values for dissolved analytes in freshwater: four (4) Al, one (1) Cr, three (3) Cu, four (4) Zn, and four (4) Pb samples, all from different sampling locations. Five (5) samples were outside of the recommended 6-9 pH range. Recommendations for future monitoring, operation, and maintenance were outlined.

HORIZONTAL SUB-SURFACE FLOW CONSTRUCTED WETLANDS FOR THE REMEDICATION OF MULTIPLE COMMON POLLUTANTS IN WASTE WATER: A LITERATURE REVIEW

Joel Mintzer (2017)

Readers:

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Horizontal sub-surface flow constructed wetlands (HFCW) were first developed in the 1950s, and have since been installed around the world for the treatment of waters contaminated by domestic waste, industrial discharge, acid mine drainage, abattoir discharge and agricultural runoff. HFCWs are appealing because they are passive design, gravity fed systems with low operating and maintenance costs. This review provides an overview of the technology, its general design parameters, and the efficiencies reported for removal of several common contaminants in wastewater. Although HFCWs are widely used in several European countries, they are far less common elsewhere, including North America, possibly due in part to the challenge of adopting an unfamiliar technology. The intent of this literature survey is to compile the necessary information to acquaint the reader with the fundamentals of HFCW systems, as well as the challenges and the benefits of installing such systems. Additionally, the review of removal efficiencies for common contaminants is intended to inform decision makers in business and local government considering installation of HFCWs. The reader should acquire sufficient understanding to formulate reasonable expectations about the removal efficiencies that can be expected for a variety of pollutants, given some general knowledge about the local climate, the contaminant constituents, and their average concentrations in the water to be treated.

IMPACTS OF LAND COVER CHANGES ON STORMWATER RUNOFF QUANTITY AND QUALITY IN WATERSHEDS OF CHESTER COUNTY, PA USING GIS

Britney Vazquez (2016)

Readers:

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Land cover changes are an important factor to consider in any watershed basin analysis. An increase in impervious areas due to urban development leads to increases in runoff, which in turn affect the health of watersheds. Geographic Information Systems, or GIS, was used to analyze the impacts of land cover changes in the watersheds of Chester County, PA on runoff generation using three different land cover layers: 1992, 2001, and 2011. The watersheds for each USGS gauge were also delineated using GIS. The SCS Runoff Curve Number (CN) method was used to determine the amount of runoff in the county. Water quality data was also collected in order to analyze any relationships between land cover changes and the health of the watersheds. Land cover was found to be significantly different between each year, with developed area increasing and vegetation decreasing from 1992 to 2011. In addition, runoff had significant increases from 1992 to 2011. Several USGS gauges also displayed significant increases in discharge, pH and specific conductivity, and decreases in turbidity from 1992 to 2011. Other studies support this study's finding that positive relationships exist between land development and runoff, pH and specific conductivity. However, when comparing precipitation data to these water quality parameters, only discharge had a strong correlation coefficient, suggesting that runoff is not directly influencing discharge data. Overall, this study finds that a positive relationship exists between land development and runoff generation.

COMPARISON OF WEST NILE VIRUS AND VECTOR MOSQUITO (*CULEX PIPIENS* AND *CULEX RESTUANS*) DISTRIBUTION AMONG VARYING HABITATS IN RESIDENTIAL STORMWATER BASINS

Caitlin Heffner (2015)

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The Berks County Conservation District (BCCD) in southeastern Pennsylvania has participated in DEP's West Nile Virus Control Program since 2001. BCCD technicians collect mosquito samples from approximately 100 sites from April to October each year. Some sites, particularly stormwater basins, stand out due to the high amount of adult and larval mosquitoes and West Nile virus positives, creating a troublesome environment in residential areas. DEP tests *Culex pipiens* and *Culex restuans* as they are the predominant vectors of West Nile virus in Pennsylvania, although other species are known vectors or bridge vectors. In 2015, BCCD will obtain a Growing Greener Grant to retrofit residential stormwater basins that are high priority West Nile virus sites. Sixteen selected stormwater basin sites were organized into 3 categories of basins, called "wetlands," "grass infiltration," and "combination," and data from a 5 year time period (2010-2014) has been analyzed to determine which basin or basins will be the most suitable to retrofit. The infection rate (IR) was highest in one wetland basin and one grass basin, but overall, the values were low for these categories. Combination basins have relatively constant moderate infection rates for all sites. They also tend to have consistently highest percent positive for West Nile virus and the most vector larvae per dip. Overall, combination basins provide the most viable habitat for vector mosquitoes due to shallow, marshy, poor-quality water that stands longer than 72 hours and thick, unmanaged vegetation that is not suitable for natural predators, and therefore are prime candidates for retrofit. Grassed basins yield the lowest West Nile virus positives and fewest vector mosquitoes due to lack of vegetation and periods of standing water that are too short to allow larvae to mature. Wetlands lie in the middle, yielding some positives but not a large percentage of mosquito abundance. Although wetlands provide permanent water, ideal for vector mosquitoes, they also provide adequate habitat for predators. Results from this project will be used beginning in 2015 to retrofit basins of concern in Berks County, reducing the threat of vector mosquitoes and positive pools of West Nile virus.

THE PROPOSED NORTHMET MINING PROJECT: EXAMINING WATER RESOURCE THREATS AND PROTECTION MEASURES

Aldis Kurmis (2015)

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PolyMet Mining Inc. has proposed a copper-nickel-PGE open-pit sulfide mine in northeastern Minnesota, referred to as the NorthMet Mining Project. Despite concerns about potential environmental impacts, the project's supplemental draft environmental impact statement (SDEIS) recently received a passing grade from the Environmental Protection Agency. Open-pit sulfide mines are known producers of acid mine drainage (AMD). The SDEIS proposes protection measures at both the mine and plant sites meant to prevent the contamination of water resources. However, subsequent technical reviews have outlined a host of deficiencies that indicate the SDEIS does not adequately protect said resources.

EVALUATING THE EFFICACY OF STREAM RESTORATION PROJECTS TO REDUCE POLLUTANT LOADING IN THE CHESAPEAKE BAY: AN ENVIRONMENTAL IMPACT ASSESSMENT

Alexandra Nawrot (2015)

Readers:

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Edward Doheny, PhD., Penn Earth & Env Science

In recent years mounting pressure has been placed upon local governments in the Chesapeake Bay Watershed to meet pollution reduction goals in compliance with EPA regulations. Under the Clean Water Act; concentrations of nitrogen, phosphorous, and total suspended solids need to be reduced to meet water quality standards. To comply with these demands each of the seven Bay watershed jurisdictions have developed a Watershed Implementation Plan (WIP) documenting how it will achieve and maintain these pollution reductions. One of the most expensive aspects of Bay clean-up is reducing pollution from urban and suburban areas. Many local municipalities are looking to stream restoration as one approach to achieve their pollution reduction goals. In-stream restoration projects have become a popular design strategy that aims to reestablish the ecological integrity of individual stream reaches and can reduce nutrient and sediment pollution. However, management strategies often lack sufficient monitoring plans necessary to assess stream channels post construction to determine if the projects are successful. In some cases extensive in-stream construction does not meet its goals of reestablishing ecological integrity in order to process pollutant loads, and imposes a large financial burden upon the local government. It is desirable, therefore, to establish a set of reliable principles to determine whether specific stream restoration projects will meet mitigation goals. The goal of this project is to create an environmental impact assessment that analyzes the combined variables of individual sites to determine whether a stream restoration approach is appropriate. Such a matrix can then be used by local entities to choose a suitable design strategy.

GEOCHEMICAL MODELING OF A DENITRIFICATION BIOREACTOR USED IN THE TREATMENT OF NITRATES IN ARTIFICIAL SUBSURFACE AGRICULTURAL RUNOFF

Morgan L. McGee-Solomon (2015)

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Denitrification bioreactors, also known as woodchip bioreactors, are the latest technology in the effort to counteract the negative water quality impacts from excessive nitrogen loss from agricultural sources. Denitrification bioreactors are an artificially engineered environment supporting anaerobic conditions for the optimization of reducing reactive nitrogen oxides (e.g. nitrate [NO₃⁻] or nitrite [NO₂⁻]) in artificial subsurface agricultural drainage to a stable nitrogen gas (N₂). The microbial-dependent geochemical process of denitrification occurring within this type of artificial anaerobic environment will be assessed using the geochemical modeling software, PHREEQC. This governmental freeware was first developed in the mid-1990s by the United States Geological Survey (USGS) using C and C++ programming language to simulate chemical reaction and transport processes in natural and contaminated water. Now in its third version, known as PHREEQC Interactive, the program has the capability to model kinetic reactive transport reactions in one dimension (1D). The microbial kinetics within a denitrification bioreactor will be modeled in PHREEQC using published nitrate concentration, temperature, dissolved oxygen (DO), and retention time data from an existing bioreactor at the Iowa State University Northeast Research and Demonstration Farm (NERF) in hopes that the information can be used to further maximize system performance efficiency.

MAPPING HUMAN AND ENVIRONMENTAL HEALTH IN OVERBROOK, WEST PHILADELPHIA

Selena Oleck (2015)

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The Overbrook section of West Philadelphia is a community that faces several environmental justice issues. The Overbrook Environmental Education Center (OEEC) is a community center that works to promote the health and wellness of citizens and the environment in Overbrook, consisting of zip codes 19131, 19139 and 19151. With a 2013 EPA EJ small grant, the OEEC investigated solutions to several of the environmental justice issues that local residents face. This project is one solution. The extent of this project included gathering health and environmental data, digitizing the data into maps using ArcGIS (a Geospatial Information Systems platform) and creating a database of PDFs for the OEEC to use in future promotional materials to inform and educate Overbrook residents. Sources of data included government documents, publically available GIS files from private companies and government agencies, and personally contacting knowledgeable sources. The data was digitized with ArcGIS, and variables were combined to show relationships between factors. The deliverable was a database of GIS files and PDFs of maps showing environmental and health factors relevant to Overbrook. Significant multi-variable maps include the relationship between green stormwater projects, combined sewer outlets, impervious surfaces, and local streams; access to healthy food as delineated by farmers markets, urban farms, healthy corner stores, and SEPTA routes; asthma rates compared to locations of air emission plants and smoking rates. Single focus maps were also significant, such as rates of asthma, obesity, and diabetes in Overbrook compared to citywide and national rates. Both map types were produced for use by the OEEC. These maps will be used to inform residents of health and environmental issues alongside actions residents can take as individuals and as a community to improve their health and wellness and that of their environment.

**REMEDIAL ACTION STUDY AND PLAN NORTH LAKE SWEET VALLEY,
LUZERNE COUNTY, PENNSYLVANIA**

Patrick Troy (2015)

Reader:

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Carl Mastropaolo, Penn Earth & Env Science

North Lake is a small, 40 acre lake located in Sweet Valley, Luzerene County, Pennsylvania. This lake has served as a modest summer retreat since the early 1900s and has slowly expanded in popularity over the last century. As a byproduct of this expansion, the lake has been encroached upon by human settlement and exposed to several waste products of human settlement, with the most concerning being septic discharge and fertilizer runoff. Since the early 1970s degrading conditions have been observed and documented, leaving residents and community members with increasingly unsafe recreational opportunities. Due to the low socioeconomic nature of the area, remedial efforts have been small, disorganized, and ineffective in the long term. With the proper direction and strategy, this issue can be remedied with thorough characterization, organized community involvement, and proper utilization of state, county, and federal funds.