



University of Pennsylvania's South Bank Greenhouse Project
Description of Project
PSPE Award Nomination
Urban Engineers, Inc.

The project involved installation of a pre-manufactured climate controlled greenhouse on the South Bank campus of the University of Pennsylvania (UPenn). The 2,900-sf facility has sensitive climate controls that balance the use of daylight and heating or cooling with supplemental heating and cooling, and lights. The greenhouse is used for the groundbreaking research of UPenn's School of Dental Medicine's Dr. Henry Daniell. His research centers on a unique means of delivering drugs and vaccinations to the human body through plant-based vaccines and therapeutics. The plant-based vaccinations are used in treating nearly 30 conditions, from infectious diseases such as cholera, malaria, and anthrax, to autoimmune diseases such as diabetes and hemophilia. The state-of-the-art facility houses the plants that are the basis to make these "green" vaccines available to everyone worldwide, regardless of location, availability of refrigeration that is required for most vaccines, and cost. The facility utilizes drip irrigation to ensure each plant receives just the right amount of water. Humidity and temperatures are precisely monitored and can be accessed and modified remotely, and adjusted throughout the seasons to compensate for day durations, quantity of light, and other factors through adjustable panels, supplemental grow lights, and adjustable shades to provide light that matches solar radiation.

Opening the facility on time was critical to Dr. Daniell's ground breaking research. The University of Pennsylvania's Facilities and Real Estate Services (FRES) team selected a new site at the newly acquired South Bank campus, the site of a former Dupont Chemical research and manufacturing facility. While the building structure was a pre-manufactured building, the site grading and utilities, foundation, and building MEP and controls required significant design and coordination. The South Bank property, located along the Schuylkill River, was an industrial site dating back to the early 1900s. The previous uses on the site and the current soils classified the South Bank property as an Act 2 site by the Pennsylvania Department of Environmental Protection (PADEP), requiring all earth moving activities to be documented and soils needing to remain on the site or removed off the site and classified as contaminated, requiring specialized handling and disposal.

During construction several of the former building foundations on the site along with abandoned and covered rail tracks were discovered upon excavation for the greenhouse's foundation slab and the gas main, sanitary sewer, and stormwater discharge pipes. As a result, the alignments of the gas main and the stormwater and sanitary discharges had to be redesigned to minimize existing foundation removal and excavation. The gas main was relocated to the edge of the existing buried rail tracks. The stormwater discharge alignment was revised to route the runoff around numerous buried foundations. The location of the sanitary sewers on the site and the depth of sewer trunk line tie-in, however, hindered a similarly easy solution. Additionally, age, type of pipe material - vitreous clay (VCP), and the pipe depths presented challenges. Tying into VCP pipe has its issues, particularly when the pipe is over 40 years old, is 17 feet below grade. In addition, the location of the tie-in relative to the Schuylkill River presented a significant groundwater issue that could not be resolved by pumping due to the volume and the contamination of the groundwater as it passed through the site's contaminated soils. As a result, Urban and the contractors worked with the Philadelphia Water Department (PWD) to identify potential tie-in points at either a nearby manhole using an interior drop connection or through the use of direct saddle connections onto existing pipes. Both solutions

came with inherent problems, and since the site has contaminated soils, pumped groundwater had to be captured, tested, and disposed of as hazardous materials, similar to the soils. To overcome this, the team utilized a trenchless tie-in that created a seal around the saddle location and minimized both the need for a large shored excavation or pumping, testing, treatment or disposal of a significant amount of groundwater.

Inside the greenhouse, the mechanical, electrical, and lighting control systems are the heart of the facility, enabling the growth of the plants to continue year round. To ensure consistent growth of the research plants, the facility required a temperature variability of only a few degrees of ± 1 degree F from 73.4 deg F to 75.2 deg F. Due to the greenhouse's location in the City of Philadelphia, Urban modified the standard greenhouse mechanical systems with supplemental HVAC systems that were designed and installed to maintain constant temperature ranges. These supplemental systems coupled with new controller programming provided by Urban were utilized to coordinate and control the fans, cooling, heating, humidity levels, lighting, and the opening and closing of the roof and wall louvers. Urban coordinated the final controller settings with the contractor to ensure the temperature range was able to be maintained.

These issues were all overcome by the project team to meet the tight schedule.



Greenhouse Interior – Tobacco Plants Growing



Exterior View of Greenhouse



Dr. Henry Daniell



Greenhouse Mechanical Control Panels