

STREAM DAYLIGHTING IN KARST TERRAIN USING NATURAL STREAM CHANNEL STABILIZATION DESIGN

¹Thomas A. Graupensperger

¹Director of Environmental Services, GTS Technologies, Inc., 441 Friendship Road, Harrisburg, PA 17111, **Phone:** (717) 920-7007; **Email:** tgraup@gtstech.com
www.gtstech.com

GTS Technologies, Inc. (GTS) assisted Herbert, Rowland & Grubic in the design permitting and construction for the daylighting and restoration of approximately 1,740 lineal feet of stream channel within an area of known Karst activity on a 15-acre site located in Derry Township, Dauphin County, Pennsylvania.

The project is the development of the Hershey Center for Applied Research with a research facility that will be part of the Penn State Hershey Medical Center Campus. The segment of the unnamed tributary that was previously piped was daylighted and additional stream restoration was implemented as a part of the project. The project area is known to be sited on karst topography. Drainage patterns in the area are either dendritic or karstic.

GTS reviewed historical USGS topographic maps and historic aerial photographs to determine the former path and stability of the stream. These items suggest that the unnamed tributary has not seen the light of day since at least 1892. Aerial photographs from the years 1950, 1956, 1963, and 1970 were reviewed and all of the photographs confirmed that the stream was piped and was not visible. Chemical, physical and biotic characterization of the existing stream was performed.

Detailed geotechnical/Karst terrain analyses, including fracture trace investigations and geophysics, coupled with soil investigations, hydrologic and hydraulic analyses, and fluvial-geomorphological (sediment transport) characterization of the site, were performed to determine the appropriate restoration plan, profile and channel dimensions for the proposed stream daylighting. HEC-RAS hydraulic modeling is calibrated to bankfull features and discharges are determined hydraulically by obtaining a best-fit match to bankfull elevations from the stream model developed for the site by varying the discharge. Natural stream channel design (NSCD) approaches and criteria are used to quantify and qualify the channel stability concerns, and provide design guidance for channel stabilization approaches. Rivermorph modeling is developed from the HEC-RAS derived bankfull discharges and geometry to develop natural stream channel stabilization designs, and verify the appropriate restoration/stabilization measures for the daylighted flow.

Final grading plans were prepared. The initial stage of construction included removing existing soils at the proposed site to allow installation of a subsurface geosynthetic clay layer provided to prevent stream flow loss in geophysically identified zones containing karst features along the channel. The clay liner created a perched stream channel and flood-prone area adjacent to the channel. Soils were placed in accordance with the final grading plans. GTS provided input into the planting plan prepared by HRG that guided the landscape contractor in the proper care, placement, and maintenance of vegetative material types and forms. Summary specifications for soil stabilization, amendments, planting, stream stabilization and mulching placement were developed. Materials, methods of placement, and equipment specifications were outlined to assure proper completion of the stream daylighting and stabilization.

Hershey Center for Applied Research
Derry Township, Dauphin County

GTS Technologies, Inc. (GTS) performed design permitting and construction oversight for the restoration of approximately 1,740 lineal feet of stream channel within a known Karst area. The project, at the Hershey Center for Applied Research, is on the Penn State Hershey Medical Center Campus. A 1200 foot long segment of an unnamed piped tributary was daylighted and an additional 540 feet of existing channel was restored.

GTS reviewed historical topographic maps and aerial photographs to assess the stability of the stream. These items suggested that the unnamed tributary had been piped since after at least 1892. Chemical, physical and biotic characterization was also performed.

A detailed geotechnical/Karst terrain analyses, including fracture trace investigations and geophysics coupled with soil investigations, H&H analyses, and FGM characterization of the site, was performed to determine the appropriate channel restoration. HEC-RAS modeling was used to calibrate bankfull discharges by obtaining a best-fit hydraulic match to existing downstream bankfull elevations. Natural stream channel design (NSCD) approaches and criteria were used to quantify and qualify the channel stability concerns and provide guidance for channel stabilization. Rivermorph modeling was developed from the HEC-RAS bankfull discharge analysis to develop natural stream channel designs and verify the appropriate restoration/stabilization measures.

The initial stage of construction included the installation of a geosynthetic clay layer to prevent stream flow loss of geophysically identified karst features along the channel, which created a perched stream channel and flood-prone area. Soils were placed in accordance with the final grading plans, and GTS provided input into the planting plan prepared by an RLA that guided the landscape contractor in the proper care, placement, and maintenance of vegetative material types and forms. Specifications for soil stabilization, amendments, planting, stream stabilization and mulch placement were jointly developed. Materials, methods of placement, and equipment specifications were outlined to assure proper completion of the stream daylighting and restoration. GTS provided constant monitoring during construction to ensure timely adjustment to the methods of construction.

