Creating a Stormwater Park over an Interstate: Restoring Community Connections with a Highway Cap and Green Infrastructure

T.M. Batroney[1]*

[1]*HDR Engineering, 301 Grant St. Suite 1700 Pittsburgh, PA 15219*
**Corresponding author email: tom.batroney@gmail.com*

Highlights

- Provides a national history overview how the interstate system fractured urban communities.
- How highway cap parks can repair communities fractured by highways with a case study in Pittsburgh, PA.
- How green stormwater infrastructure can be incorporated as part of the design.

Introduction

The I-579 "Cap" Project and the creation of the new three-acre Frankie Pace Park provides a vital urban green space link between Pittsburgh's historic Hill District and the downtown business and cultural centers. Over 60 years ago, as part of 1950s and 60s national urban renewal initiatives, many Hill District residents were forcibly displaced by the construction of the new highway. Residents that remained were impacted by an eight-lane, 40-ft deep concrete canyon. The Interstate 579 "Cap" Urban Connector Project and creation of the new three-acre Frankie Pace Park provides a vital urban green space link and repairs broken community connections between Pittsburgh's historic Lower Hill District and the city's downtown business and cultural centers. The park incorporates stormwater control measures for water quality treatment and peak flow reduction.

Background

Highway Cap Structure

Fill depths of the park ranged from 1.5 to 5 feet deep on top of the structure. To limit span lengths and provide an economical bridge structure, the cap was divided into three separate bridge structures with either one or two supporting piers, depending on total bridge length as shown in Figure 1.

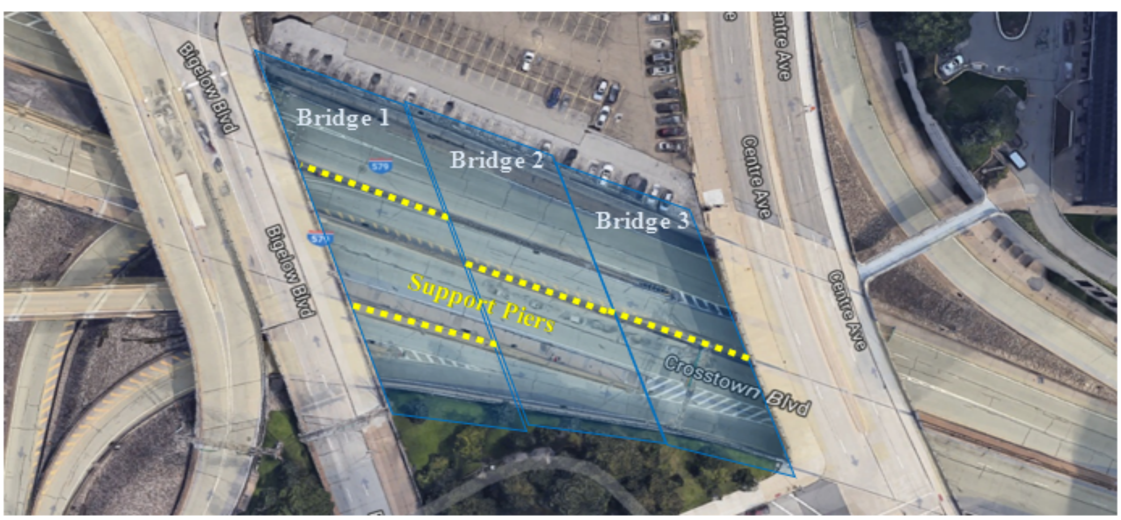

Figure 1. Highway Support Structure

Figure 2. Frankie Pace Highway Cap Park Before and After

Stormwater Performance

The park consists of over 250 newly planted trees, 4000 perennials, 0.7 acres of grass, six (6) terraced rain gardens, 300 linear feet of artistic surface trench drains, and over 500 CY of topsoil placed on top of the cap structure. This 52,000 SF cap over the interstate serves as one of the largest publicly funded green roof projects in the region. An estimated 2.5 million gallons of stormwater is managed annually in the park and the lawns can store up to 6 inches of rain during a single rainfall event. The park intertwines artistic and interpretive artwork from local artists allowing park users to learn the history of the Hill District and the importance of stormwater management.

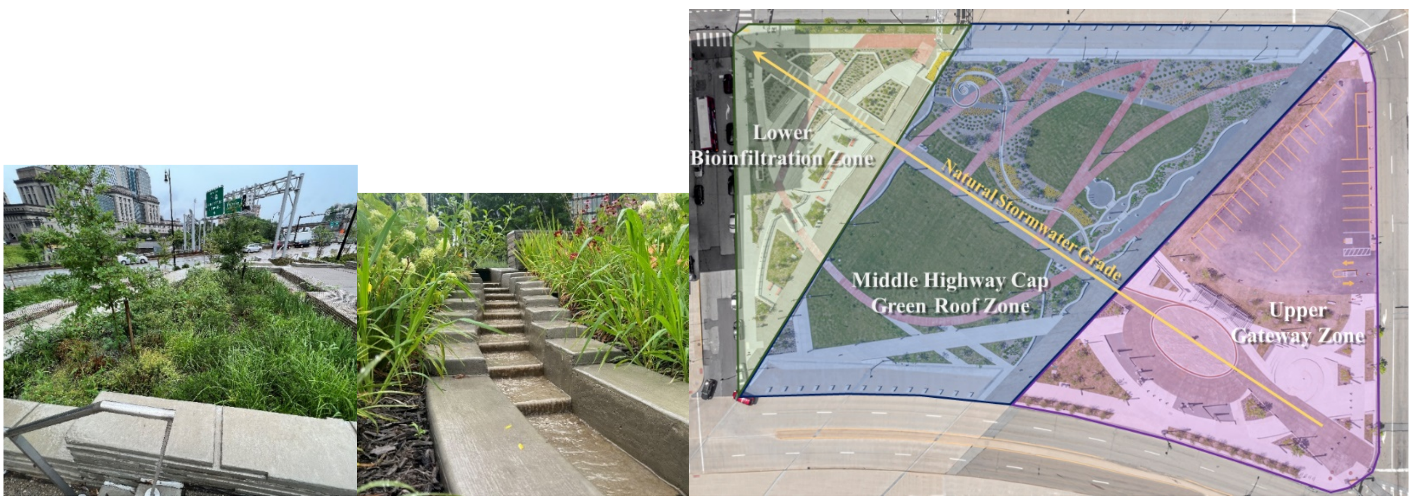

Figure 1. Stormwater

Each bioretention rain garden consists of 15.24 centimeters (6 inches) of surface ponding area, 60.96 centimeters (24 inches) of high-performing engineered soil and 30.48 centimeters (12 inches) of gravel. The six terraced rain gardens have a total volumetric storage capacity of 79.2 cubic meters (2,800 cubic feet), equivalent to approximately 4.8 centimeters (1.9 inches) of rain over the upstream drainage area.

Key Findings

Key findings of the project include:

1. Building community based project support is a critical component for success given the history of racial injustices with the construction of the original highway.
2. Pre-treatment in urban parks settings is needed for long term performance of the systems.

Stormwater Management Design for Linear Transportation Projects: Challenges and Lessons Learned

S. Carvajal Sanchez (P.E.), B. E. Kelly (P.E.)

Greenman-Pedersen, Inc. (GPI), 1650 Arch Street, Suite 2140, Philadelphia, PA 19103

**Corresponding author email: scarvajal@gpinet.com*

Highlights

- Green infrastructure challenges in large-scale linear transportation projects
- Geotechnical investigations and groundwater recharge
- Current stormwater management standards and applicability to large linear transportation projects

Introduction

Pennsylvania (PA) and New Jersey (NJ) residents continue to face threats from extreme rainfall events, which are expected to continue to intensify in frequency and severity due to Climate Change. Temperature and extreme precipitation continue to increase since the early 1900s as well increases in sea level rise and vulnerability to different Threatened and Endangered (T&E) species. Green Infrastructure (GI) has been the driving tool engineers and designers use to combat precipitation and stormwater runoff effects and protect the public, assets, and the economy from catastrophic flood events. According to the United States Environmental Protection Agency (US EPA), GI has the ability to reduce and treat stormwater at its source while delivering water quality benefits. In NJ, small-scale GI is the Best Management Practice (BMP) option required to meet groundwater recharge, water quantity and water quality requirements. The main limitation with small-scale GI is the contributory Drainage Area (DA) size which cannot exceed 2.5 acres. This standard can be extremely challenging for long linear transportation projects where Right-Of-Way (ROW) is limited and soil conditions are not often suitable for infiltration. The New Jersey Department of Environmental Protection (NJDEP) has acknowledged the challenges with GI for linear transportation projects and has included a waiver from strict compliance from the GI requirements for "*the enlargement of an existing public roadway or railroad, or the construction or enlargement of a public pedestrian access*" provided certain requirements are met. This study intends to explain the challenges found while implementing green infrastructure in linear transportation projects and summarize the lessons learned.

Stormwater Management Design Challenges and Key Components

Small-scale vs. large-scale GI

NJDEP divides GI BMPs in two categories: small-scale (NJDEP BMP Manual Chapter 9) and large-scale (NJDEP BMP Manual Chapter 10). The NJDEP BMP Manual states that the use of large-scale GI is only allowable with a waiver of variance from the NJDEP Stormwater Management Rules N.J.A.C. 7:8-5.3. Given the design constraints often present with large linear developments due to right of way, topography, surrounding sensitive environment, and soil suitability; the small-scale GI standards are not practically achievable. Strict compliance with the small-scale GI standards requires excessive additional geotechnical investigations and placement of basin locations which would impact property not currently owned by the client or transportation agency. This also results in additional tree clearing, impacts to T&E species and environmentally sensitive areas, and presents costs not financially practicable, solely to meet certain technicalities to comply with small-scale requirements such as a contributory drainage area threshold.

Geotechnical Investigation Needs and Soil Suitability for GI

The purpose of the soils testing is to determine whether the sites are suitable for various types of stormwater management BMPs, including detention basins, infiltration basins and/or bioretention basins. One of the primary goals is to determine whether recharge is feasible at any stormwater basins. Early in the design process, logical basin locations are identified based on proposed improvements, site topography, and environmental constraints.

Permeability tests occur in the most restrictive layer of the underlying soils within eight feet below the bottom of the basin and must meet the minimum required permeability rate of 1 inch/hour to achieve suitable permeability for an infiltration facility. On linear transportation projects, basins that meet small-scale GI thresholds would require substantially increased testing locations at close intervals, throughout the project corridor beyond what is favorable or practical based upon site topography.

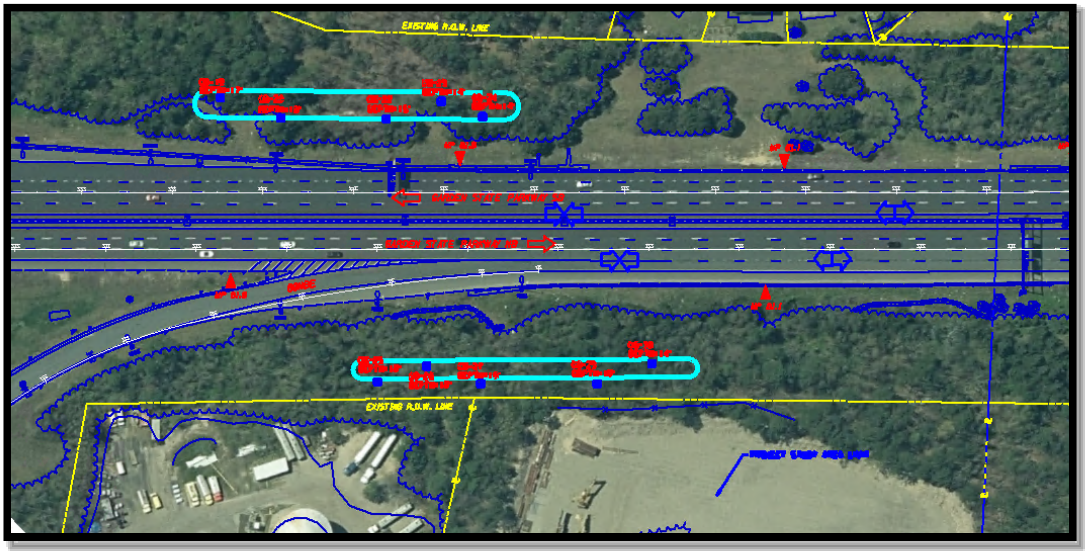

Figure 1. Geotechnical investigation example. Proposed based in aqua blue color, existing Right-of-Way lines in yellow. ROW is very limited and requiring significant amount of tree clearing.

Current Standards in New Jersey and applicability to large linear transportation projects

The NJDEP has recognized the difficulty that the Small-Scale GI standards present for linear transportation projects and has implemented a Linear Development Waiver process for public roadway projects defined at N.J.A.C. 7:8-5.2(e) for projects that cannot explicitly achieve strict compliance with GI or other SWM components. However, while some other government entities (i.e. New Jersey Pinelands Commission) adopt and reference the NJDEP SWM rules, they currently do not recognize the NJDEP Linear Development Waiver process, which NJDEP felt was necessary to accompany those rules for public transportation projects.

Key Findings

- Small-scale GI standards can be challenging for large transportation projects.
- Maintenance needs are extremely important for the correct functioning of stormwater BMPs, particularly for large transportation projects.
- Geotechnical investigation needed to successfully design infiltration BMP is costly and requires significant amount of coordination.
- While some state agencies recognize the need for tools or options such as linear development waivers, others have failed to include that within their regulations creating significant burden on public safety improvements.

Recommendations and Lessons Learned

- State agencies and organizations need to recognize the difference between linear transportation with compelling public safety needs and land development projects. The rules do not fit all cases and, therefore, linear development waivers are needed.
- The design of small-scale vs. large-scale GI should be further evaluated and contrasted between land development and large transportation projects.
- Geotechnical investigations should also be evaluated between land development and large transportation projects. Often, infiltration results in the vicinity of highways are not favorable and tests are located within environmentally sensitive areas.
- Weigh the pros vs. cons of removing trees and impacting the environment to meet rule technicalities which may not be practical.

Title Options:

Greenways – An Opportunity for Resiliency in a Broader Community

NV5 Abstract:

This presentation will use two case studies to show how, with the proper planning and community engagement, a long greenway project can be a unique opportunity to:

- Provide an overlay of green infrastructure along the greenway corridor.
- Think 'big picture' and build green infrastructure across municipal boundaries.
- Engage owners or entities along the corridor to expand upon the green infrastructure within their properties and use this as a tool for ongoing education and engagement with the public on flooding and water quality.
- Be the first line of defense against flooding along waterfronts since many greenways are along water bodies.

The first case study will be the Camden County LINK Trail, a 33-mile greenway traversing the entire county from the Delaware River to Cape May County. The greenway will go through the whole landscape transect, from a highly urbanized CSO community in the City of Camden to the natural areas of the Pinelands. This study will discuss how the project includes green infrastructure along the corridor. This study will highlight how one public high school has used the greenway project, which cuts through their property, to expand upon the green infrastructure within the school's campus and use this green infrastructure as a tool for education.

The second case study will be the Essex Hudson Greenway, a 9-mile linear park from Jersey City to Glen Ridge, NJ. The linear park contains a separated bicycle and pedestrian path system along an approximately 150-foot-wide former railroad right-of-way. The greenway goes through multiple CSO communities and neighborhoods that regularly experience flooding. This greenway design has taken a 'green-first' approach by interweaving green infrastructure into the fabric of the park and greenway to lessen combined sewer overflows and the impacts of flooding in the neighborhoods along the corridor.

Watershed-Scale Planning for Urban Water Quality Improvement: Navigating Nuance and Creating Balance with a Diversified Portfolio

Thom Epps, Craftwater Engineering

Regulatory requirements and the desire for improved urban water resource conditions are pointing watershed managers, jurisdictions, and agencies to pursue thoughtful planning approaches worldwide. At the root of these watershed management planning efforts in urban settings is the incorporation of stormwater control measures (SCMs) of a wide variety throughout the watershed, placed strategically to intercept impervious-generated runoff before it reaches storm drains or receiving waters to contribute to runoff treatment goals. How this is accomplished and the SCMs that are employed can be guided by regulatory requirements, agency-based guidance, community input, multi-benefit emphases, or a range of factors, all of which ultimately influence the watershed-scale solutions that plans recommend to collectively address receiving water impairment. Single SCMs treating a specific drainage area can be designed to address local hydrologic conditions or meet certain design requirements in a straightforward manner. But scaling up overall watershed-scale treatment efforts and coordinating them to collectively produce a program of water quality improvement that meets the needs of the receiving waters is more challenging due to several factors and considerations that must be accounted for. One of the most important factors is the guiding principles that plans are organized around. Differences in planning ideals, requirements, targets, and the scale of assessment are highly influential on the ultimate composition of solutions that move forward. These ideas are highlighted well in the Gateway Area Pathfinding (GAP) study conducted by Craftwater Engineering in Los Angeles on behalf of the Gateway Water Management Authority (GWMA) covering the Lower L.A. and San Gabriel Rivers for the Safe Clean Water Program's Scientific Studies Program. In this study, a range of regional planning ideals and needs were investigated and tested to provide the GWMA better clarity in the stormwater infrastructure decisions they need to make and to highlight the range of outcomes that could be expected under different planning ideals (most impactful projects first, maintenance-friendly options, distributed surface capture, etc.) as well as using a diversified portfolio employing the best projects from each of these ideals explored. Additionally, plans were evaluated using different metrics and critical conditions employed in the region to demonstrate the influence these have on planning outcomes and overall program composition. The results of this study are useful in demonstrating how different ideals or assumptions can propagate through the stormwater management planning process and how these different organizing principles change the ultimate form, cost, implementation, and success of infrastructure pursued.