Avenue V Force Main Project / NYC DEP Contract PS-79F



The Avenue V Force Main public infrastructure project was proposed in 2002 to resolve several environmental issues. The Avenue V Sewage Pumping Station in the Coney Island / Gravesend section of Brooklyn NY was in extreme disrepair. There was evidence that the lines leading to the Pumping Station were leaking into the Coney Island Creek salt marsh estuary, contaminating a local body of water that is directly connected to the Atlantic Ocean. In addition, the Pumping Station was designed at a time when the area supported a much smaller population. With current population expansion, it was no longer able to manage the extent of sewage input, resulting in overflows that again created raw waste contamination of the surrounding ocean environment.

The proposed Force Main project would upgrade the Pumping Station itself as well as create the sewage line connection between the Pumping Station and the Owls Head Sewage Treatment Plant with a hook-up just west of the Verrazano Bridge Brooklyn footing. (A force main is a pressurized sewer pipe that conveys wastewater under pressure from the discharge side of the pump located in low lying areas or across landscapes where deep excavation is not feasible - locations that require pumping to convey sewage forward to treatment plants that are situated at a higher elevation. Force mains are used where gravity is not enough to move sewage or stormwater runoff through a sewer line. Pumps or compressors are used to push the sewage through the force main from the lower to the higher elevation.)

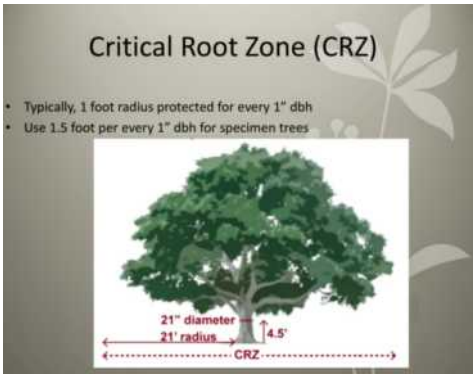
The line would run through the streets of Gravesend out into the Arterial Landscape of the westbound Belt Parkway, a major NYC highway connecting the Boroughs of Brooklyn and Queens. The reason some of NYC's highways are called Parkways is because the road has cut through publicly-owned Park land and the adjoining arterial landscape is still under the jurisdiction of NYC Department of Parks & Recreation (NYC DPR) and is managed jointly with the NYC Department of Transportation (NYC DOT).

The arterial landscape adjacent to this particular stretch of the westbound Parkway forms an extremely critical buffer for the residential community living immediately across the street. This well treed landscape reduces the environmental impacts of living so close to non-stop traffic and so, the ability to reduce landscape abuse and tree removals was looked on favorably by the NYC DOT Arterial Landscape Director and facilitated my ability, as the Project's Design Phase Consulting Arborist, to review, edit and author detailed specifications and to introduce new procedures, such as Radial Trenching, which had never before been used on a Public Infrastructure project in NY State.

The strategies that drove the revised General and Detailed Specifications are as follows:

Planning Phase

A complete ground-based inventory of all trees and the landscapes they populate within the Project footprint as well as those trees within close enough proximity as to have their Critical Root Zone (CRZ) - their critical structural and fine roots - within the Project work area, to be conducted by an experienced, professional tree expert, such as an Urban Forester or an Arborist.



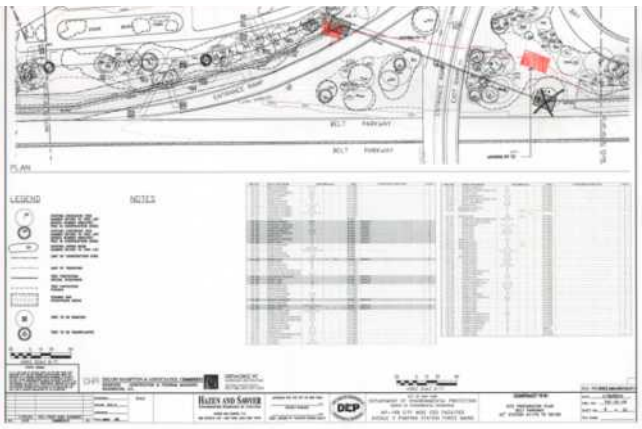
This inventory should not only include GPS /GIS-based location, species, structural metrics, parameters and condition, it should also include an i-Tree Eco assessment to determine the ES deliverable. Existing inventory data may be used but only if that data has been collected within the past 2 years. In addition, the soil must be assessed for existing levels of compaction.

The condition and structural stability of assessed trees are important determinants for retention. Our expert evaluation of collected data combined with the total value per tree will help determine protection, preservation and retention decisions and thus, inform where built structures / installations will be placed and how those installations will be constructed.

Design Phase

A thorough understanding of how the project can be built in conjunction with which trees must be protected, preserved and retained can contribute to discussions that will determine construction procedures and techniques which include construction equipment, its operating radius and requirements, essential drainage or grading changes, utility installation, storing of excavated soil and staging requirements including landscape protection through specified control of construction debris, spillage, washout, sediment and parking of project-related vehicles.

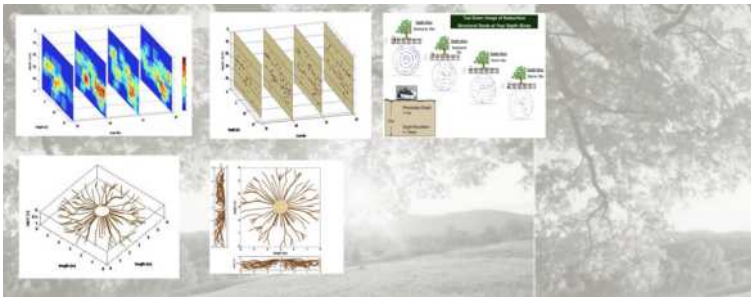
To install pipes, conduits, cables and the like, a tree and landscape-friendly design must



consider the use of trenchless technology construction techniques, normally only used to preserve hardscape features, to tunnel under roots. These techniques, which include micro-tunneling or jacking, require sending and receiving pits which must be well sited and be capable of receiving and sending so as to reduce the extent of environmental impacts. The dimensions of the excavation will also determine the need to sheet and shore to add structural integrity.

Horizontal directional drilling or auger boring, another form of trenchless technology, uses a surface to surface approach rather than a send - receive pit excavation. As with all such processes, adequate space for equipment operation must be pre-determined and defined, requiring a familiarity with the equipment and its operating criteria. Each technology has its pros and cons and the selection of a Project appropriate strategy, including the avoidance of soil heaving, will require knowledgeable, experienced partners.

The determination of which technology to use and exactly where to site the pipes or conduit can also be facilitated by the use of Ground Penetrating Radar (GPR) with tree root mapping software, to determine tree root location.

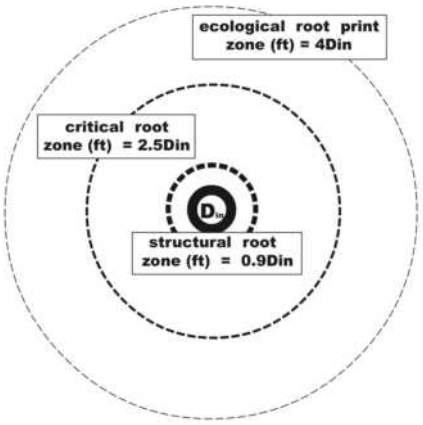


These Design Phase discussions might also lead to the decision to transplant trees that are deemed of critical importance but cannot be adequately protected. The successful transplanting of large, established trees requires a long term financial and labor-intensive commitment consisting of the use of GPR to determine an essential ecological root footprint, the creation of a pneumatically excavated demarcation trench to establish the extent of the root ball that will be created which then allows for the pruning of roots, the return of soil to the trench, an application of Compost Tea and thorough irrigation of the trenched area. A drip irrigation system must be installed to maintain constant access to moisture, essential for the re-growth of fine roots which will be included at harvest time. This procedure must be executed six months to one year preceding the digging of the tree to be transplanted, which will result in reduced trauma caused by root loss as well as transplant shock. Harvesting the tree for transplanting will require an oversized tree spade and a crane as well as untreated burlap with which to create a drum-laced root ball. This will be facilitated again with pneumatic excavation and proper root pruning. The pre-prepared relocation site must provide an adequate accessible volume of living soil that closely matches the pre-transplant soil in pH, texture and structure. The transplanting procedure must include removal of drum lacing, burlap from the top three-fourths of the root ball, the stabilizing of the root ball using a decomposing root ball staple as well as a drip irrigation installation which must be maintained for two years.

Pre-Construction Phase

Once the Project has been designed with the work footprint defined and set and trees and landscapes designated for protection and retention, the following actions must be required and included in project specifications:

• for trees within the Project work footprint, any and all excavation must exclude each tree's protected ecological root footprint according to Dr. Kim Coder's research parameters:



- DBH 15cm or less: a minimum of 4.5m from the dripline

- DBH > 15cm: a minimum of 7.6m from the dripline

- DBH > 1m: may require a minimum that exceeds 9.1m

• for treed landscapes at the defined perimeter of the Project's work footprint as well as for any areas that have been determined as requiring protection, a Tree / Landscape Protection Zone (TLPZ) must be established and a significant protection fence installed prior to the commencement of any and all work with the accompanying requirement that the fence can only be removed and the protected area accessed with prior written approval and in the presence of the overseeing Tree Expert. The TLPZ footprint as well as the fence must be noted on detail Plan drawings.

• once the design has been completed, the Project's construction work zone and the TLPZ perimeter defined, the structural (woody) roots of all protected trees that are determined to be within the work footprint should be accessed using Pneumatic Excavation (PE) such as an AirSpade® with a root diagnostic nozzle, along with an AirVac® to collect the removed soil, allowing for the removal and retention of soil without any harm to the tree's roots, enabling easy, fast, clean and accurate root pruning (perpendicular to the root's growth at the point of the cut), the wrapping of exposed roots using moist, untreated burlap and the immediate replacement of removed soil upon conclusion of root pruning. It is never recommended to root prune more than one root zone quadrant.

The entire impacted area must then be mulched and well irrigated. This enables work to proceed, unimpeded by and without concern for protected trees having roots within the work footprint which could be damaged.

• all root pruning work must be followed by the thorough irrigation of any and all protected trees and the landscapes they populate 4 - 5 days preceding the commencement of construction activities. The thorough hydration of roots and sapwood improves the ability of protected trees to withstand the stress and trauma inflicted during preparation as well as construction activities.

• the completion of the **Design Phase** will also determine the equipment which will be used on the Project as well as its operating radius. Such equipment may warrant the need for clearance pruning, especially along the TLPZ fence-line.

While such work falls to the Landscape subcontractor, it is essential that the specification defines the expertise required to perform such tasks – professionally, a Certified Arborist or equivalent. In addition, the specification must require oversight from the Project Tree Expert during any and all such operations to ensure the use of Best Management Practices and the upholding of all tree / landscape protection criteria.

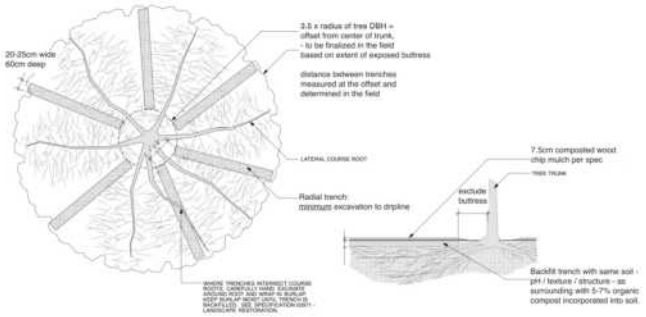
Construction Phase

• The need to access a TLPZ or traverse any tree populated landscape requires the oversight of the Project Tree Expert along with additional use-specific tree / landscape protection. The TPZ immediately around each tree should receive an installation of composted wood chip mulch, 7.5-10cm in depth with a setback of 15–30cm from the base of the trunk, to be determined in the field by the extent of the exposed buttress area.

If access to the TLPZ requires the use of heavy construction equipment, additional protection measures must be introduced in the form of ramped, interlocking Ground Protection Mats, installed over geotextile fabric + wood chips 30cm deep, the combination of which greatly reduces the probability of soil compaction. Ground Protection Mats have replaced the use of steel plates and plywood as they provide a much easier installation and a more modular approach to landscape protection.

It is highly recommended that utility service lines be placed in a conduit and located outside the existing as well as anticipated ecological tree root footprint of retained trees. The Project Tree Expert can facilitate this through his / her species-specific structural knowledge as well as the use of GPR.

Post Construction
Following completion of all Project work, an inspection must be conducted by the Project Tree Expert to determine the extent of any damage which may have occurred during the Project's execution, especially to the protected landscape in the form of soil compaction. Such damage will be based on the existing conditions documented during the initial inventory. Soil de-compaction which enables soil health as well as tree root growth is best accomplished by specifying Radial Trenching with the use of Pneumatic Excavation (PE), such as an AirSpade® with a root diagnostic nozzle.



The procedure uses PE to excavate radially aligned trenches around a tree, with a set-back equal to 3.5 times the radius of the tree's diameter. The soil from the trenches is removed and retained with the use of an attached AirVac® and, with organic compost added, returned to the radial trenches. This should be followed by a Compost Tea soil drench to add to and facilitate the living organism component.

Any tree that has been radially trenched should then receive a composted wood chip mulch installation, as previously detailed, and then deep-watered in.

In addition, it should also be determined if and where subsequent greening or green infrastructure installations such as bio-retention constructs might be included in post project site restoration as soil remediation measures should include those areas of the project footprint as well.

Planning and designing the built environment must be informed by an ecological perspective and that design and its outcomes has to support all aspects of life – not just human but the entirety, not just in a mindful way but synergistically, symbiotically, providing a catalyst for the concepts offered.

When we plan and design, it is critical that we give consideration to what exists, how it functions and how the resulting design supports all those functions.

If we add an ecological aspect to that design process, then the process has evolved and with that our possibilities. The sustained health and well-being of ALL inorganic and organic components of the urban ecosystem require an interdisciplinary incorporation of art, science, theory and practice into every aspect of spatial development. Ecologically resilient and sustainable planning and design must focus on implementing creative solutions if we are to reduce resulting environmental impacts and, at the same time, GROW our Urban Forest Ecosystem.

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Respect trees - trees have dignity too
Learn about trees and their associates
so that you can make better decisions
for their long term, high quality care
Dr. Alex Shigo