City Roots at Dupont Circle:
A Plan for the Sustainable Redevelopment of the Dupont Circle Trolley Station

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Spring 2010

General University Honors

Abstract:

Early in 2010 the District government issued a request for proposals for the redevelopment of the historic Dupont Trolley Station located beneath the street at Dupont Circle. This Capstone sought to create a proposal for a sustainable redevelopment of the space that was both visionary and grounded in the history, culture, and expectations of the Dupont Circle community. Research into the history and human psychology of subterranean spaces and the history of Dupont Circle, as well as interviews with the leaders of local community and business associations, resulted in a proposal for a subterranean garden and commercial composting facility titled City Roots. In addition to an emphasis on local food production, the proposal embodies other criteria of sustainable building and neighborhood design including the provision of a vibrant public space, carbon-neutral power production, and promotion of education and the arts. The culmination of this capstone is the development of a virtual 3D model of the plan and presentation of the proposal to officials from the District Office of the Deputy Mayor for Planning and Economic Development.

Overview:

Hidden just a few feet below the heavy traffic at Dupont Circle is one of Washington, D.C.'s best kept secrets. There, in 1975, work crews finished sealing off the tunnels that had carried electric streetcars on the Connecticut Avenue line beneath the congested circle since the completion of the Dupont Trolley Station in 1949. The station, consisting of two curving platforms beneath the street of the circle and narrow tunnels extending North and South along Connecticut Avenue, has lain largely abandoned for the last thirty five years but for a brief use as a bomb shelter during the 1960s and the opening of remarkably short-lived food court in 1995. In early 2010, rumors that the City would open the space for redevelopment were confirmed and the official Request for Proposals (RFP) was released by the Office of the Deputy Mayor for Planning and Economic Development (DMPED) in April. The winning proposal is expected to be decided upon and announced in June, 2010.

As a student of environmentalism and sustainability generally, and specifically of a class on sustainable urban design at the time, the potential redevelopment of the Dupont

Trolley Station presented a unique opportunity to apply many of the theories and principles of sustainable urbanism I was engaging with in the classroom. As it turns out, it may also have resulted in the exciting opportunity to influence the actual future of the space, if only in a small way. Given the host of serious problems associated with currently predominant patterns of urban development, including accelerating degradation or loss of natural habitat due to sprawl, significant contributions to climate change via heavy emissions of greenhouse gasses, and the encouragement of increasingly sedentary, stressful, and unhealthy lifestyles among urban inhabitants, I believe there is an urgent need for creative new solutions in urban design. It was thus my hope to produce a proposal for the redevelopment of the Dupont Trolley Station that was both visionary in its attempt to address some of the common problems and shortcomings of ordinary neighborhood and building design and realistically and practically achievable.

Developing such a vision for the Dupont Trolley Station posed an interesting challenge for a number of reasons. Looking into the history of the space, especially the failed Dupont Down Under food court, it became clear from the start that understanding and addressing the challenges (and opportunities) inherent in an underground space would be essential in creating a successful design, and the results of my inquiry along these lines forms the first section of this proposal. From the beginning it was also important to me as well that the boundaries of the design not stop at the walls of the structure but extend into the neighborhood and city beyond. I felt a successful proposal must surely take into account the unique qualities and characteristics of the Dupont Circle neighborhood, leading me to examine the history and demographics of the neighborhood and to seek out input from powerful voices in the community. Closely tied with the

concept of achieving integration with the local community was the requirement that a decision making framework be adopted to identify the stakeholders who would shape and steward the project from the initial stages on into the future.

The final criterion I set for myself was that the design should embrace and promote a holistic definition of sustainability. Given that sustainability is such a plural concept, this involved settling upon a definition of my own that gave weight not only to environmental sustainability but also to social and economic sustainability. The creation of a decision-making framework and the requirement that the overall design be integrated into the fabric of the community represented important steps towards achieving social sustainability. With regards to environmental sustainability, it was clear from the start that simply including a few energy efficient appliances or environmentally friendly practices would represent insufficient progress towards addressing the serious environmental challenges that arise from traditional urbanism. Rather, a broad array of environmental considerations including energy use, water management, and waste management, should be deeply ingrained in an integrated design process from the very beginning. The proposal should not only embody principles of environmental sustainability but also incorporate environmental education as an integral part of its mission. Finally, in terms of economic sustainability, it was my goal that the proposal could be realistically funded and financially self-sustaining, and that it contribute to the overall economic health of the neighborhood.

Armed with the findings of my inquiry into the challenges of underground spaces and the history and characteristics of the Dupont Circle neighborhood, and bearing in mind the aforementioned criteria, I set out to think of an appropriate use for the space.

The result is a proposal entailing an underground garden and public concourse and a large-scale commercial composting facility designed to handle the majority of the organic waste produced by local restaurants to be called City Roots. The relationship between the functions of the two halves, as well as the relationship the whole facility shares with the neighborhood, is heavily influenced by the principle that waste should equal food. Plant matter from the garden and food waste from neighboring restaurants will become "food" for a biogas generator that will meet the heating and lighting demands of the entire facility, or be converted into compost, "food" for future plants. Stormwater from the streetscape and will be collected by the facility where it will be purified by a unique biofiltration system before being utilized in the garden. Produce grown under lights powered by food scraps can in turn be sold back to restaurants and local residents to begin the cycle anew. If realized, this proposal would represent a remarkable step in improving the overall sustainability criteria of the Dupont Circle neighborhood, and would serve as a hub for social gatherings, the arts, "green jobs," and environmental education and research. What follows is a synthesis of the research that contributed to this proposal and a more detailed account of its specific goals and elements.

Challenges of Subterranean Space

*"*Underground *is in many cultures a metaphor for a virtual host of negative associations: death, darkness, cold, dampness, deceit, anti-establishmentarianism, and, not least, evil. This [preconception] is almost universal worldwide. It is deeply embedded in the psychology of most people."* - David J. Bennett, FAIA

"The development of the underground - and therefore the birth of the 3D city – will only succeed if the way is paved psychologically. Users will have to learn to perceive subterranean space as being of equal value to that above ground level." – Jaap Huisman

To be certain, many of the unique characteristics of the old Dupont trolley station pose tough challenges to a successful repurposed design. Not least among these challenges are its strikingly long and narrow shape and a somewhat troubled history of use. Yet there is one obstacle that must surely present one of, if not *the,* most important challenge to overcome if another failure is to be avoided. It is, to put it bluntly, that the station quite obviously happens to be underground. As indicated by the first quote above, for most people from most cultures the very word "underground" is readily accompanied by a host of negative or unpleasant associations. The key question and challenge, then, is this: "How does one design an underground space that overcomes (or utilizes or manipulates) people's perceptions of the underground in order to make it inviting and appealing?" Indeed, failure, perhaps, to ask this question and certainly failure to answer it, seems to me to have been one of the key reasons for the rapid demise of the 1996 Dupont Down Under development. Those who remember the ill-fated food court recall a dark and dingy atmosphere that was uninviting. On online public comment boards many have wondered why anyone would want to go underground given that the surface at Dupont Circle is so pleasant.

In order to answer, or at least attempt to answer these questions, I believed it was necessary to delve into the history and psychology of underground spaces. The result of this inquiry, I am happy to say, was a near complete shift in attitude away from focusing on the challenges presented by an underground space to the recognition and embrace of opportunities. To be sure, there are many examples of similarly failed or unrealized subterranean designs. There are many more examples, however, of successful, purposeful, pragmatic, and even beautiful and visionary underground spaces. As I hope it will

become apparent, underground buildings enjoy many opportunities and advantages that conventional surface buildings lack, and while our anxiety of underground spaces is often deeply rooted, fear and disgust are by no means the only, or necessarily even the predominant, emotions evoked by the underground, nor do there seem to be cases in which such sentiments cannot be challenged and overcome.

A Brief Introduction to the Underground:

The utilization of underground spaces and the development of stories and metaphors that influence human perceptions of them has gone on for almost as long as our species has roamed the earth. The underground figures prominently, for instance, in our attempts to order and understand the world around us. The conception of a three-tiered vertical cosmos, usually divided between heaven, earth, and the underworld, is ancient and near universal across peoples and cultures. For much of human history vertical travel was understood to have a much more profound significance than horizontal travel (Williams 1990, 8). Common among many cultures and traditions is the conception of the underworld as the destination of the afterlife, often as a place of punishment for those who committed great crimes and evil actions in life. Burial is also one of mankind's oldest and most widespread traditions. During the 18th and 19th centuries, technological advances allowed for the effective mining of coal, giving rise to the industrial revolution. Miners and the men who worked on excavation projects necessary for the new infrastructure of great industrial cities worked in dark, damp, and horrifically dangerous conditions (still much the case today). Excavation symbolized both the advance of civilization, but also its descent, as tall buildings and dirty smoke choked out the sun and early industrial cities began to resemble the mines that fed them (Williams 1990, 52).

Undoubtedly, these traditions continue to strongly inform negative perceptions of the underground, yet they are not the only influences.

Ancient too, is the concept of the sacredness or spiritual significance of the solid earth, as well as of underground spaces. For many centuries the practice of mining was widely stigmatized, reserved for criminals and slaves and practiced remote locations, as it was viewed as something akin to the rape of a living earth (Williams 1990, 24). Caves and underground chambers have long thus been places of great religious or spiritual significance. It is believed, for instance that the prehistoric paintings found in caves all over the world indicate that symbolic and ritualistic use of such sites. In ancient Greece, pilgrims to the Temple of Apollo at Delphi sought to hear the prophesies of the Pythia, or Delphic Oracle, who was housed in an underground chamber and was said to inhale mysterious vapors emanating from a deep crack in the solid earth (Delphi). In East Asia, Buddhist and Hindu artisans carved magnificent temples and sculptures out of solid stone, and in the Middle East early Christians excavated impressive cathedrals. Rather than seeming frightening, underground rooms can often be quite calming due to the feeling of closeness to the earth and the lack of noise and visual stimuli. In the words of Dutch underground enthusiast Ernst von Meijenfeldt, “It is natural to find peace in an underground room. The inward, enclosed quality invites you to retreat inside yourself. In our restless society, it is perhaps only there that one can find real tranquility”(Meijenfeldt et al., 22).

Great scientific discoveries and contributions to our understanding of ourselves as a species and of the world around us have also come from descent into the earth. It was through digging that early geologists and archeologists literally unearthed great

revelations about the age and makeup of our earth and the histories of species and human civilizations (Williams 1990, 22-50). Even as the power of the idea of the vertical cosmos had begun to weaken by the time of the 19th century, the stream of remarkable discoveries linked to excavation spawned a new wave of literature and narratives, perhaps epitomized by the works of Jules Verne, that preserved and reinforced the idea of the underworld as a place of adventure and fantastic discovery. As Rosalind Williams writes, "If we imagine going underground, we not only imagine an environment where organic nature is largely absent; we also retrace a journey that is one of the most enduring and powerful cultural traditions of humankind, a metaphorical journey of discovery through descent below the surface" (8).

Our perceptions of underground spaces are shaped not only by ideas and metaphor, but also by an equally long history of practical utilization of caves and subterranean structures. From the earliest times humans have utilized the earth for shelter and defense. As one enthusiast for underground architecture writes, "Knowledge of the protection offered by the underground is as old as humanity itself. Human communities have lived and sheltered in natural caves for at least 100,000 years" (qtd. in Meijenfeldt et al., 19). In the Cappadocia region of Turkey, early Christians fleeing persecution from Rome carved entire cities and villages into and beneath the region's remarkable stone spires, complete with ventilation shafts, grain storehouses, and security checkpoints where boulders could be rolled into place to block intruders (Derinkuyu Underground City). Much later, during the cold war, countries around the world underwent an underground construction boom as governments ands individuals alike excavated bomb shelters intended to protect against the threat of catastrophe in the age of nuclear war. In

fact, not long after the trolleys stopped running at Dupont, the old trolley station was designated as such a structure and stocked with emergency food and medical supplies (Williams 2000, 37).

In addition to defense against humans, underground and earth sheltered structures can provide ideal shelter against the elements and have been adapted to many climates for thousands of years. Underground, as well as thick, earthen walled structures enjoy relatively moderate and stable temperatures regardless of the location or season. While the insular properties of thick walls help to prevent cold or hot air escaping, it is really the high thermal mass of most earthen materials that contributes most to the beneficial thermal qualities of underground spaces. Put simply, thermal mass is the capacity of a material to store heat. In the context of a building, thermal mass provides inertia against temperature fluctuations, sometimes known as the thermal flywheel effect. During the day (the entire warm season in truly underground structures) the large thermal mass of the earth absorbs heat, preventing it from entering the structure, and then radiates the stored heat during the night (or cold season). In conjunction with smart passive solar design and natural ventilation systems, many modern underground and earth sheltered homes and buildings can drastically reduce or even eliminate the need for electric heating and cooling. Indeed, long before the invention of air conditioners the indigenous peoples of northern Mexico and the American southwest proved to be masters of these qualities in the construction of cliff face dwellings and adobe homes that remain cool and comfortable even in the searing daytime heat. In cities with harsh winters, such as Montreal and Toronto in Canada, large networks of underground tunnels connecting mass

transit, shopping, and offices shield residents from the elements and bitter cold for long stretches of the year.

Many other practical reasons for building underground have arisen from the challenges presented by modern cities. To quote from H.G. Wells' *The Time Machine* "There is a tendency to utilize underground space for the less ornamental purposes of civilization" (56). Excavation for the construction of sewers systems and roads, and more recently to bury telephone and electrical wires and other elements of modern infrastructure, has been an integral part of the rise of great cities across time and space. In addition to the thermal advantages of underground structures, many other industries and sectors have realized the benefits of increased insulation against vibration and noise. Manufacturers of precision instruments, for instance, can avoid the need to relocate to remote vibration-free areas by burying their factory floors in the ground. Dozens of schools located near airports have also eliminated the distraction of airplane noise by burying their campuses. Today, as the negative effects of urban sprawl become increasingly apparent, city planners are increasingly realizing the underutilized potential of the underground to increase density and expand the range of use offerings in urban neighborhoods.

Challenge or Opportunity?

As I learned about some of the unique characteristics of underground buildings and came across more and more examples of both common and extraordinary subterranean structures it became apparent that the fact that the Dupont Trolley Station is underground need not be viewed solely as a problem or challenge. From a sustainability standpoint, it already offered a number of advantages. To start, it offered the potential for

the reuse of an existing space in an urban setting, eliminating the need for the expensive and resource intensive construction of a new shell. Furthermore, as a general rule, underground structures commonly achieve energy savings ranging from 50 to 80 percent over conventional buildings (Hall, 6). As the site was quite unobtrusive by nature, it occurred to me that it might also present an interesting opportunity to delicately reintroduce a certain type (or types) of use typically reserved for the periphery of cities. Even the challenge of people's preconceptions of underground spaces, exacerbated in this case by the memory of the failure of Dupont Down Under by many long term Dupont residents, no longer seemed insurmountable.

Undoubtedly, negative emotions associated with the underground play a significant role in shaping peoples' responses to underground buildings. Yet as we have seen, underground spaces can also be associated with adventure and discovery, the exotic, or even tranquility. With the right design and execution, the novelty of an underground location might easily become an asset. While the initial emotional response to underground spaces is often highly subject to personal experience, other responses to underground buildings are more universal. Apprehension caused by the lack of visual cues about the form and function is a fairly universal human response (Hall, 21). The entrance, a crucial design element in any building, is thus particularly important for underground spaces. As one veteran designer of underground buildings writes, "With negative expectations and associations, such as those generated by entirely underground spaces, high levels of arousal are more likely to evoke unpleasant rather than pleasant moods. Designers can compensate by, for example, designing entrances with naturally 'arousal-reducing' effects. But designers can also exploit increased alertness to create

striking, impressive environments. An underground space then quickly becomes a place of fantasy instead of merely unpleasant" (Meijenfeldt et al. 2003, 169).

Expectations that underground spaces will be poorly lit, stuffy, and visually bleak are common as well, yet are often easily challenged. For instance, research has shown that most people consider lack of daylight to be the greatest problem with underground buildings, but as Samwel argues, "When making a comparison with aboveground buildings, it becomes clear that this is not the real reason. In offices people make do with far less light than they actually need, although there are fewer complaints there about the limited daylight. The real problem with being underground is the lack of views of a dynamic environment. People need to see movement and activity in the outside world" (qtd. In Meijenfeldt et al., 171-172). The solution is often simply to provide ample lighting and visual stimuli. Strategies such as the use of plants, internal windows, and other interesting visual stimuli are often effective in reducing feelings of boredom or stuffiness. Many other studies have shown that the quality of the indoor environment is far more important than the fact that it is underground (Hall, 18). Admittedly, the reuse of an existing space placed limitations on the freedom to employ certain strategies aimed at inviting people into an unfamiliar space. Nevertheless, it seemed this was no reason to dwell on problems and ignore the incredible potential of the space. Consideration of many of the unique opportunities and strategies for overcoming preconceptions just outlined thus played a critical roll throughout the rest of the process of creating a proposal for the reuse of the Dupont Trolley Station.

A Brief History of Dupont Circle and the Dupont Underground:

Today, Dupont Circle is known to DC residents as one of the city's most vibrant, eclectic, and well-to-do, neighborhoods. After a push by residents, the neighborhood achieved designation as a historic district in 1977 with a listing in the National Register of Historic Places, but though the history of the neighborhood is certainly rich, it is perhaps not as long as one might expect. The area that makes up present day Dupont Circle was in fact included in the outermost boundaries of city architect Pierre L'Enfant's 1971 plan for the new Federal City, however, the land was not included in the original purchase by George Washington and the fledgling Federal Government. As local historian Paul Williams notes, the land destined for the intersection of Massachusetts, Connecticut, and New Hampshire Avenues and Nineteenth and P Streets hardly a mile from the White House was to remain "marshy, wooded, and devoid of development, with the exception of large country estates, until the 1870s (7).

At that time, under the leadership of Alexander "Boss" Shepherd of the city board of public works, the city undertook a massive public works improvements project in order to accommodate an expanding population in the wake of the Civil War. Between 1871 and 1873 paved roads and other public infrastructure were extended to the area and the circle was constructed largely in accordance with L'Enfants plans. Smart land speculators and developers immediately bought up property in the area, and many wealthy residents of Georgetown, Capitol Hill, and Logan Circle quickly relocated, lured by the opportunity to construct palatial mansions on the grand tree-lined avenues. By the 1980's the neighborhood was already home to a wealthy and diverse crowd including past and future Presidents, foreign dignitaries, wealthy socialites, and powerful industrialists (Williams 2000, 7). Prior to the 1980s the circle itself was at first nameless,

and later referred to as Pacific Circle. Many present day residents correctly guess that the current name of the circle refers to the DuPont family of the chemical company fame. In 1982, the circle was officially designated as Dupont Circle after Union naval admiral Samuel F. DuPont of the DuPont family, then owners of the largest gun powder company in the country. In 1984 a statue of DuPont was erected in the center of the circle and more than 850 ornamental trees and flowering shrubs were planted in the newly landscaped park (U.S. NPS, 26-27).

In 1921, the DuPonts decided to have the statue relocated to their private residence in Wilmington, Delaware, prompting the commissioning of the present-day memorial. The fountain that now graces the park, erected in 1922, was designed by architect Henry Bacon and executed by sculptor Daniel Charles French, who was also overseeing completion of the Lincoln Memorial at the time (Williams 2000, 19). The Dupont Circle area continued to thrive in the early decades of the 20th century, and by mid-century the neighborhood was struggling to cope with the challenges of a new population boom resulting from the influx of people to support the war effort. During this time many large homes were converted into rooming houses and others were demolished to make way for apartment high-rises and commercial buildings, signaling a shift towards a slightly more commercial and working class character of the neighborhood.

By 1947 it is reported that more than 52,000 vehicles were passing through the circle per day, creating horrible traffic jams (Williams 2000, 8). At the time, automobiles shared the circle with many of the city's busiest streetcar lines. Traffic was particularly bad on the Western half of the circle between Connecticut Avenue and P Street where cars shared the road with both the north- and southbound rails of the Cabin John streetcar

line (Smith). Talk of an underpass to help ease the traffic situation at the circle had begun as early as the 1930s, however the project was pigeon-holed as a result of the outbreak of World War II. In 1943 Congress directed that planning for an underpass be resumed and an initial budget of $500,000 was allocated for the project (U.S. NPS, 49). Construction of the trolley station and the Connecticut Avenue vehicular underpass began late in 1948, leading to massive traffic delays and the temporary upheaval of the park and removal of the memorial fountain. Construction of the trolley station concluded late in 1949 and the highway underpass was finished in 1950. During the 1960s, competition from busses and the newly constructed Metro led the city to phase out the street cars and the Dupont trolley underpass was abandoned in 1975, only twenty five years after its completion (Williams 2000, 37).

During this time period, the Dupont Circle neighborhood continued to bear witness to significant changes, summed up in the opening paragraphs of a 1967 report commissioned by the National Park Service:

> Just as Lafayette Park is known as the Number 1 park area of the Nation's Capital because of its associations with the White House and as the site of large-scale demonstrations on current administration policies, so Dupont Circle has become known as the Number 2 park area of the city because it is now the scene of smaller-sized demonstrations on current administration policies, and the locale of numerous gatherings during the past few years reflecting some nationwide social movements, such as that of Civil Rights groups and those of the "hippie" generation. Furthermore, Dupont Circle is the site of one of the most profound social changes in the life of Washington. From its nineteenth century status as one of the most fashionable residential areas of the city, Dupont Circle has become one of the city's leading traffic crossroads surrounded by an increasing number of high rise apartments, modern office buildings, and deteriorating rooming houses, the latter being the form homes of fashionable residents, long since deceased. These are the facts which longtime residents of the area, and associations dedicated to preserving its former tranquil atmosphere seem unable to accept (U.S. NPS, i).

By the end of the 1960s the fountain had become a major gathering place for concerts and demonstrations by Civil Rights and anti-Vietnam war activists, much to the dismay of many of the neighborhood's older residents. The area fell on slightly hard times in later decades of the 20th Century, as many businesses and affluent residents fled in the wake of the 1968 race riots, though continued to play a role in many major social movements. Lambda Rising, the city's first gay book store was established on Connecticut Ave not far from the circle by Deacon Macubbin in 1974, for instance, and the neighborhood became a hotspot for gay culture and activism. The circle is also closely linked with one of the milestone moments of the environmental movement. In 1969, at the behest of Sen. Gaylord Nelson, a group of young graduate students planned and organized the first Earth Day celebration in 1970 from an office at 2000 P St. NW (Farhenthold and Eilperin).

The neighborhood underwent a revival of sorts in the 1980s as many of the young residents who had come to the area as activists and stayed began working to preserve the historic buildings and character of the neighborhood in response to widespread demolition (Williams 8). As mentioned earlier, community members succeeded in their efforts to have the neighborhood designated as a DC Historic District, and the circle is now well-known for its historic architecture, host of embassies, and thriving restaurant, café, and retail scene. The fate of the trolley underpass has been less happy. After brief designation as an emergency bomb shelter in 1966, the tunnels remained empty until 1995 when a food court named Dupont Down Under opened in the former West platform under the ownership of developer Geary Simon, who had signed a 20 year lease on the space 3 years earlier. The dimly lit food court struggled to attract patrons, and in September 1996 the District evicted Simon, citing failure to pay rent and other breaches

of contract (Madigan). According to an interview with ANC 2B chairman Mike Silverstein, the facility was poorly sealed and quickly became a gathering place for the local homeless population and a place of refuge for perpetrators of muggings and other petty crimes. Sporadic interest in redeveloping the space continued, including a proposal for a health and fitness club and a proposal by City Council Member Jim Graham that gay strip clubs forced to close due to the construction of the baseball stadium be relocated there, though none were able to garner sufficient support.

In more recent years, a group known as the Arts Coalition for the Dupont Underground, led by architect and local resident Julian Hunt, emerged with a plan to revitalize the local arts scene by turning the space into a hip underground art gallery, and began to actively lobby the District government to accept proposals (Shaver). According to Mr. Silverstein, representatives from ODMPED approached the ANC late in 2009 expressing their desire to issue a Request for Proposals in the near future. This prompted a minor backlash, as the ANC and other citizens groups voiced concern that the RFP was being rushed and that they hadn't been adequately consulted. The ODMPED Project Manager, Mr. Neil Goradia, agreed, and extra time to gather public comments was granted. The "RFP to Redevelop the Historic Dupont Trolley Station" was formally released in early April, 2010 and included letters from the ANC 2B, The Dupont Circle Merchants and Professionals Association (DC MAP), and Historic Dupont Circle Main Streets (HDCMS), as well as an additional document of public comments attached as an appendix.

Assessing the Desires of the Dupont Community

A number of the desires of the community conveyed in the aforementioned letters and comments, as well as in interviews with ANC 2B Chairman Mike Silverstein and Ed Grandis, Executive Director of the DC MAP, influenced my proposal and are thus worth mentioning briefly. Interestingly, the ANC letter opens with a paraphrase of the widely recognized definition of sustainability put forth in the 1987 report of the U.N. World Commission on Environment and Development entitled *Our Common Future*. The letter reads: "Fundamental must be the recognition that whatever is done must meet the needs of the present without compromising the capacity of the future generations to answer theirs." Also expressed in the ANC letter is the desire that the space be welcoming, safe, and accessible to all citizens, and that priority should be given to a use that "draws people to the neighborhood so as to benefit the local economy" (ANC 2B Letter). Similarly, the letter on behalf of DC MAP begins by stipulating that "The activity below grade should not be an 'isolated' venture which will not feed the economy above ground," and also expresses the desire that "the underground venture will serve as a significant destination/attraction to increase foot traffic to the commercial district surrounding the Circle." The DC MAP letter also wisely asserts that a new proposal must acknowledge the previous failure and how the elements that contributed to it will be addressed, and smartly suggests that strong consideration be given to the question of how the underground is to be physically connected to the above ground (DC MAP Letter).

During telephone interviews, both Mr. Silverstein and Mr. Grandis reiterated many of the desires put forth in the written letters. Both men echoed the desire that a use that reflected and reinforced the unique character of the neighborhood be found, and also expressed the sentiment that "no use at all is far better than another failure." Curiously,

both men also expressed a strong bias towards preservation of the space for a future use for mass transit (Interview with Mike Silverstein; Interview with Edward Grandis). Admittedly, this desire is one I ultimately decided to disregard in its entirety. Some justification for this may be found in the fact that in a letter of public suggestions regarding the reuse of the trolley station compiled by Historic Dupont Circle Main Streets a majority responded unfavorably to the question "Would you like to see a use of the space that could in the future revert to a functioning trolley station?" (HDCMS Letter). Dupont Circle is already served by no less than 6 independent bus lines connecting it to virtually every quadrant of the city. It is therefore sufficiently served by busses and Metro's Red Line such that a revival of a Connecticut Avenue streetcar line need not be a high priority. Furthermore, while I would happily support a renewal of other streetcar lines serving Dupont, it seems to me that such an undertaking should be integrated with efforts to reduce personal automobile use (reducing the problem of competition for surface lanes) and that the benefits to local businesses would be maximized if the lines ran on street level.

In addition to responding to the desires of the immediate community, it also was important to take into account many of the requirements put forth by the City in the official Request for Proposals. Many of the expectations put forth in the RFP were already largely in line with the criteria advanced by the Dupont community and myself. The introduction of the RFP, for instance, specifies that "DMPED expects that the selected Offeror(s) will fully engage local residents and other stakeholders during the process of redeveloping the Dupont Trolley Station. DMPED also expects that the Offeror will commit to the District's policy goals of creating contracting and investment

opportunities for local, small, and disadvantaged businesses, and jobs for District residents," and concludes with "The District seeks a creative, yet sustainable use that will turn this vacant property into a destination for District residents" (RFP, 3). According to the RFP, offerors must explain how the vision will integrate with and enhance the surrounding neighborhood and compliment existing businesses, as well as present an approach that ensures "meaningful involvement in the development process by stakeholders and members of the local community who might be affected by…the development" (11).

Towards a Truly Sustainable Proposal

Having familiarized myself with some of the history and theory of underground design, and bearing in mind what I had learned about the Dupont neighborhood, it was time to develop my own plan for a sustainable reuse of the Dupont trolley station. But what exactly would it mean for the proposal to be "sustainable?" The RFP asked for a proposal that was "sustainable" but offered no definition. The Dupont Circle ANC, as mentioned, echoed the oft-quoted definition of sustainable development put forth by the WCED's 1987 Brundtland Report, which reads: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED). This definition served as a broad guide but did little to offer specific goals. In order to arrive at a more workable definition of sustainability, it was useful to consider some of the most *unsustainable* aspects of much of present day urban development.

We live in a time of unprecedented urban growth. In the year 1800, just 3 percent of the world's population lived in cities. By 1900 the percentage had grown to roughly 14.

In 2008 the percentage of the world's urban and rural populations was split evenly for the first time, and by 2009 the balance had shifted in favor of the urban population. By 2050, it is estimated that close to 70 percent of the world's population will live in urban areas, representing a gain of 2.9 billion new urban residents (U. N. Department of Economic and Social Affairs Population Division). The vast majority of future urban population growth will occur in the developing world, much of it concentrated in slums located on the peripheries of cities and plagued by rampant poverty, crime, unemployment, and appalling sanitary conditions (Davis). While these problems are often worse in developing nations, they are by no means exclusive to the developing world.

Residents of cities in wealthy industrialized nations are all too familiar with the problems of crime, poverty, hunger, and high levels of racial and socioeconomic disparity. Furthermore, while environmental problems such as water and air pollution, lack of adequate waste disposal measures, and habit loss due to sprawl and intensive resource use seem to take on a special urgency in the developing world, the same problems too often remain largely unsolved in wealthy nations. Rather, they have simply been pushed largely out of sight and out of mind. For instance, given the great deal of attention paid to the greenhouse gas emissions of the transportation sector, many are surprised to learn that buildings are the single greatest contributor to global climate change though energy consumption. Data from the US Energy Information Administration illustrates that buildings are responsible for almost half (48%) of all energy consumption and greenhouse gas emissions annually; globally the percentage is even greater, with 76% of all power plant-generated electricity used just to operate buildings (US EIA).

The impact of urban development on local hydrology is similarly vast. Though improved regulation has eliminated many of the most egregious examples of water pollution in developed countries, urban development continues to have severe adverse impacts on surrounding aquatic ecosystems. As Patchett, Price, and Simone note,

> Rainwater is often treated as a waste product in urban and suburban environments, to be eliminated from where it falls as quickly and efficiently as the local jurisdiction allows….Rainwater that flows across driveways, streets, sidewalks, parking lots, turf grass lawns, and other impervious surfaces picks up urban and agricultural pollutants and carries them into our waterways, where they can damage habitat for aquatic organisms as well as render the waterways unsuitable for recreational activities such as swimming, boating, and fishing (in Farr, 176).

In many cities, aging sewer infrastructure is increasingly unable to meet the demands of dense urban populations, frequently leading to raw sewage overflows into rivers, lakes, and oceans. In Washington, D.C., for instance, less than an inch of rain is required to precipitate the discharge of raw sewage directly into the Potomac and Anacostia Rivers in areas served by the combined sewer system (DC WASA). In addition to the problems of pollution, the prevalence of wholly or largely impervious surfaces in the urban environment often contributes to severe flooding and soil erosion downstream as excess water is rapidly funneled into nearby rivers and streams rather than being efficiently captured and stored in the soil.

As with water, so too has the problem of our waste been made largely invisible. According to recent data from the U.S. EPA, the average American generates a surprising 4.5 lbs. of trash per day, and in 2008 Americans generated 250 million tons of municipal solid wasted, only a third of which was recycled or composted. Roughly 13 percent of the total waste was combusted, achieving some energy recovery, while the other 54% (135 million tons) made its way to landfills (U.S. EPA), contributing to greenhouse gas

emissions and threatening to leech harmful toxins into the soil and water tables of surrounding areas. Most residents of cities and suburban areas, of course, remain blissfully ignorant of the fate of their trash bags and the impact of their waste on the natural environment.

Another indicator of unsustainability of great personal interest to me is the relationship (or lack thereof) most Americans, and urban Americans in particular, share with their food. Our ignorance with regards to our waste should hardly come as surprising given our ever-expanding disconnect with the natural processes that deliver the very foods that sustain us. The image of the small family farm complete with a full compliment of barnyard animals and carefully tended fields that comes to mind for many Americans if prompted to think about the origin of their food (if any comes at all) is increasingly woefully inaccurate. Such farms have been replaced by vast monoculture fields and factory feedlots capable of "efficiently" churning out massive quantities of inexpensive food thanks to equally massive inputs of chemicals and fossil fuels. Energy is consumed at every step of modern industrial food systems, from natural gas-rich nitrogen fertilizers, to electricity for processing and irrigation pumping, to fuels for trucks and tractors. At present, 20 percent of current U.S. fossil fuel consumption goes into the growing, processing, and distribution of food. Worldwide, agriculture contributes 15 percent of total greenhouse gas emissions, including almost one-quarter of the carbon dioxide emissions, two-thirds of methane emissions, and nearly all nitrous oxide emissions (Imhoff 102-103).

Almost all of this food production occurs increasingly far from the cities where the majority of Americans now live, often even on different continents. While the effects

of this system of agriculture on our health are quite visible in the form of rising rates of dietary-related illnesses such as obesity, heart disease, and diabetes, the environmental effects including loss of habitat and biodiversity, severely polluted rivers and streams, rapidly eroding topsoil, and significant contributions to global climate change remain out of sight. Lost too, as a result of our reliance on industrial agriculture, is the vast and irreplaceable accumulated knowledge of generations of farmers (Love), as well as the valuable social bonds between grower and consumer. Moreover, despite the existence of an industrial food system capable of churning out massive quantities of cheap calories, in cities and rural areas alike hundreds of thousands of people suffer from hunger and poor nutrition, deprived of access to fresh and healthy food. Here in the nation's Capital, for instance, it is estimated that one in eight households was affected by hunger in 2009. Approximately 110,000 District residents (more than one in six) participated in the Federal Supplemental Nutrition Assistance Program (food stamps), and 17,500 received District-funded Women, Infants, and Children food subsidy checks. Food deserts, low-income areas with limited access to full service grocery stores, cover broad swaths of Wards 5,6, 7, and 8 (D.C. Hunger Solutions).

It seems clear, then, that our conventional patterns of urban development have resulted in ever-increasing alienation from and harm to the natural environment. As Douglas Farr writes, "Conventional urbanism obliterates virtually all the systems of nature it comes into contact with" (48). Given the multitude of increasingly potent social and environmental ills currently associated with prevailing patterns of urban development, there is an urgent need to seek new patterns of urban development that will guide us into a brighter future. In the past few decades, increasing environmental consciousness and

the simple recognition that many aspects of cities are simply not working has given rise to a number of architecture and urban design reform movements, some promising, and others less so. Many are perhaps familiar with the strong anti-sprawl philosophy of Smart Growth, with its emphasis on compact and transit-oriented development. In 1993 a number of architects and urban planners, reacting against the promotion of segregated land use, automobile dependency, and one-size-fits-all solutions characteristic of early 20th century urban design, came together to form the Congress for the New Urbanism. The *Charter for the New Urbanism* that guides New Urbanist planning states that:

> "Neighborhoods should be diverse in use and population; communities should be designed for the pedestrian and transit as well as the car; cities and towns should be shaped by physically defined and universally accessible public spaces and community institutions; urban places should be framed by architecture and landscape design that celebrate local history, climate, ecology, and building practice (Charter of the New Urbanism).

Developments influenced by New Urbanism, in addition to incorporating elements of Smart Growth, are thus typically associated with the promotion of mixed-use neighborhoods, walkable street grids, and diverse traditional building and architectural styles.

Another movement that has grown rapidly in recent years is the green building movement, increasingly governed by rating systems such as Energy Star and the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) building rating system. Much of the focus of green building design has been placed on increasing building efficiency, generally covering everything from environmentally friendly construction materials to energy and water use and waste production. An emphasis is also placed on improving the health and happiness of building occupants by

providing an increased sense of connection with the outdoors and personal control over temperature and lighting, and use of environmentally friendly building materials.

In his book *Sustainable Urbanism: Urban Design with Nature*, Doug Farr, makes a case for a new, more comprehensive urban design movement. Farr argues that while the smart growth, New Urbanism, and green building movements have offered valuable contributions to the broader quest for sustainability, each is troubled by flaws or a narrow focus. The smart growth movement suffers from vagueness, and has been marred by developments that, while nominally influenced by smart growth principles, have not been all that smart (Farr, 30). New Urbanism has unfortunately taken a spot based approach, its proponents usually only succeeding in convincing regulators and planning boards to make exceptions for New Urbanist developments rather than sweeping changes to the rules that incentivize bad growth (Farr, 35). Lastly, the green building movement, despite its increasing success at catching the attention of the public and raising general awareness about many of the problems inherent in our contemporary built environment, is criticized for its narrow building-centric approach. The most efficient, environmentally friendly building imaginable is not truly sustainable if it is built on an ecologically sensitive site, or if it requires all of its occupants and visitors to drive to it, for instance.

The philosophy of Sustainable Urbanism advocated by Farr and currently in its infancy, is heavily influenced by the Smart Growth, New Urbanism, and Green Building movements, and integrates many of their aims. “Reduced to its most basic tenets, sustainable urbanism is walkable and transit-served urbanism integrated with high-performance buildings and high-performance infrastructure” (Farr 42). Other core principles of sustainable urbanism not included in the quote, density and human access to

nature, are also important core values of sustainable urbanism for Farr. Sustainable urbanism thus aims to integrate and maximize the social and economic benefits of the promotion of complete, transit-served neighborhoods with affordable mixed-income housing, as well as the environmental benefits of reduced sprawl and resource efficient and environmentally friendly buildings offered by the smart growth, New Urbanism, and green building movements. Added as well are the social, environmental, and economic benefits that arise from high density and concentrated mix-use neighborhoods that can support district energy systems and support a rich variety of plants and animals.

Finally, there are two more approaches to sustainability that influenced my own conception of sustainability which are worth mentioning briefly. The objectives of the green building movement, and to an extent, many of those of the broader movements just mentioned, may be said to fall under the umbrella of "eco-efficiency." Coined by the World Business Council for Sustainable Development in the 1992 publication "Changing Course," and endorsed at the 1992 United Nations Conference on Environment and Development in Rio de Janeiro, the term eco-efficiency was first defined as the delivery of "competitively priced goods and services that satisfy human needs and bring quality of life while progressively reducing environmental impacts of goods and resource intensity throughout the entire life-cycle to a level at least in line with the Earth's estimated carrying capacity" (Schmidheiny). Put simply, eco-efficiency refers to increasing productivity while using fewer resources and producing less waste. This philosophy has arguably become a dominant force in shaping the way many people, governments, businesses, and other organizations think about environmentalism and what it means to

be sustainable. For my own definition of sustainability, however, it does not go far enough.

In their influential book *Cradle to Cradle,* sustainable design visionaries William McDonough and Michael Braungart delivery a stinging critique of the eco-efficiency approach. For them, eco-efficiency represents little more than being less bad. "It works within the same system that caused the problem in the first place, merely slowing it down with moral proscriptions and punitive measures. It presents little more than an illusion of change" (McDonough and Braungart, 61). The alternative approach proposed by McDonough and Braungart is one of eco-effectiveness. "The key is not to make human industries and systems smaller…but to design them to get bigger and better in a way that replenishes, restores, and nourishes the rest of the world. Thus the 'right things'; for manufacturers and industrialists to do are those that lead to good growth – more niches, healthy, nourishment, diversity, intelligence, and abundance, for this generation of inhabits on the planet and for generations to come (McDonough and Braungart, 78). City planners and architects would do well to embrace such design goals as well.

Central to McDonough and Braungart's concept of eco-efficiency and good growth is the recognition that "waste equals food." In natural (biological) systems, they note, the waste produced by one organism is always used by another or perhaps many other organisms. Nutrients in the form of elements such as carbon, hydrogen, oxygen, and nitrogen, the building blocks of life, are constantly being cycled and recycled in a cradle-to-cradle system in which there is no such thing as waste (92). Many of the products of modern industry, on the other hand, can no longer be safely returned to natural cycles. Ideally, these substances should be contained in what McDonough and

Braungart refer to as the "technical cycle" (104), which is separate from the biological cycle. All products should be designed at the outset to fit solely within one or the other loop so that when they are no longer useful they can be efficiently reclaimed and provide nourishment for something new. "If humans are truly going to prosper," they write, "we will have to learn to imitate nature's highly effective cradle-to-cradle system of nutrient flows and metabolism, in which the very concept of waste does not exist" (103).

The Promise of Urban Agriculture

"There is a quiet revolution stirring in our food system. It is not happening so much on the distant farms that still provide us with the majority of our food; it is happening in cities, neighborhoods, and towns. It has evolved out of the basic need that every person has to know their food, and to have some sense of control over its safety and security. It is a revolution that is providing poor people with an important safety net where they can grow some nourishment and income for themselves and their families. And it is providing an oasis for the human spirit where urban people can gather, preserve something of their culture through native seeds and foods, and teach their children about food and the earth. The revolution is taking place in small gardens, under railroad tracks and power lines, on rooftops, at farmers' markets, ***and in the most unlikely of places****. It is a movement that has the potential to address a multitude of issues: economic, environmental, personal health, and cultural."*
- Michael Ableman

The above quote, taken from an essay titled "The Quiet Revolution: Urban Agriculture – Feeding the Body, Feeding the Soul" eloquently sums up one of the most promising solutions to the industrial food problem. Urban agriculture activities were once a significant part of life and the economy in many American cities. During World War II, for instance, Americans produced nearly 10 million pounds of fruit and vegetables a year in backyard and neighborhood "victory gardens," accounting for roughly 44 percent of total national produce production, in backyard and community Victory Gardens (Victory Gardens). Though agricultural activities in U.S. cities declined sharply after the 1940s, urban agriculture is currently undergoing a renaissance as individuals, communities, and local governments in cities and urban communities across the U.S. are rediscovering the many benefits of urban food production.

The benefits or urban agriculture are indeed significant and many. Urban agriculture takes many forms, from large-scale commercial gardening to community and backyard gardens, or even something as simple as growing herbs on a windowsill, yet all of these activities help to reduce reliance on industrial agriculture and improve the human and environmental health of cities. In addition to improving local food security through the production of affordable and more nutritious food and providing an alternative to an industrial food system increasingly vulnerable to disruption from fossil fuel shortages or

harmful contamination, urban gardening provides many environmental services within cities, such as stormwater management and erosion control, air purification, carbon sequestration, and habitat for native wildlife species. Agriculture can provide an excellent use for unused and blighted urban land, and, through composting and water collection opportunities, can help to turn much of a city's waste into a valuable resource (Brown et al).

Urban agriculture also offers significant public health benefits. Locally and organically produced fruits and vegetables have been shown to have a greater nutritional value than industrially produced produce. Practical experience with food growing and harvesting, and purchasing locally grown food in stores and at farm stands has been associated with improved dietary knowledge and eating habits and studies have also shown that, for young and old alike, gardening is an excellent and attractive source of exercise (Bellows, Brown, and Smit). Organizations involved in community gardening initiatives have long been aware of the community building power of gardening, and its ability to improve the overall safety and resilience of a neighborhood. People interested in establishing community gardens must learn community organizing skills as they seek to overcome hurdles of regulation, funding, maintenance, and safety, often leading them to develop closer relationships with local government, police, and charitable organizations. Gardening also provides fun and engaging educational opportunities for adults and youth as well as a place for neighbors to gather and socialize.

The rapid growth of urban gardening initiatives in recent years is all the more impressive for the many regulatory and cultural hurdles that would be urban gardeners must still struggle to overcome. Zoning codes in many urban areas prohibit many forms of agriculture, and, though gardening was one considered an acceptable urban practice, the idea of lawns and vacant lots sprouting vegetables instead of turf grass is now alien to many urban and suburban dwellers. Nevertheless, the future is promising for urban agriculture. As city governments, including the District Government, increasingly recognize the value of the environmental and public services provided by urban agriculture, laws and zoning codes are being rewritten to accommodate and incentivize urban gardening. As successful gardening and urban agriculture initiatives spread, more and more people will revise their opinions about the appropriate place for agriculture.

It is likely that in the future, urban agriculture will indeed occur in what today might seem "the most unlikely of places." Dickson Despommier, entrepreneur and founder of the Vertical Farm Project, for instance, envisions massive skyscrapers devoted to food production in cities around the world, and is currently gathering funds to build the first prototype. An even less obvious option, farming below the ground, has already become a reality in Tokyo, Japan, where employees of the Pasona 02 farm tend over 100 different crop varieties beneath LED lights in a 1000 square foot space that was formerly a bank vault (Farm Thrives in City Basement). In the U.S., researchers at Purdue

University in Indiana have managed to achieve higher yields of corn over conventional surface growing methods in an underground artificially controlled growing facility (Cutraro). The promise of such seemingly far-fetched growing systems will be greatest if such ideas are cultivated and realized in a manner supportive and consistent with the culture and values of less sophisticated forms of urban agriculture.

A Broad Definition of Sustainability

My own sustainability goals and criteria for the Dupont Trolley Station were thus influenced less so by the maxim of meeting the needs of the present generation without compromising the ability of future generations to meet their own needs, than by the more progressive philosophies of eco-efficiency and waste equals food, and the principles of sustainable urbanism. Problems such as high energy and water use, waste, and separation from nature that contribute to urban unsustainability became challenges to address. Of particular import as well was my belief that the ability to produce healthy and affordable food in an ethical manner should be a key criterion of sustainability for any residential neighborhood. Even in a neighborhood like Dupont Circle where access to grocery stores is not a problem for many residents, local food production serves to reduce reliance on an environmentally and socially destructive and unhealthy system of industrial agriculture. Urban food production provides wonderful educational opportunities and contributes to the overall health of neighborhoods as well as an increased sense of community and connection to the natural world. A few broad design goals were thus as follows:

- **A proposal that fits with the neighborhood, its history, and its people, not only in terms of physical appearance by also culturally and**

philosophically. My proposal recognizes that the Dupont community has embraced the values and culture of the local food movement, as evidenced by the marked success of the Dupont Circle Farmer's market, and seeks to reinforce Dupont Circle's claim to city leadership in that regard. It recognizes as well the history of progressive opinion and activism of Dupont residents. Many of the young and highly educated residents of today recognize the problems associated with industrial agriculture and are ready to support a proposal that will make their neighborhood more sustainable in a unique and pioneering way.

- **A building that is productive, rather than merely efficient.** Thus, my design focuses on the production of food, compost, energy, clean water, the arts, and a stronger, more resilient community.
- **A building that generates all or most of its own power.** I have incorporated a bio-gas fed combined heating and power plant that will use organic matter from the facility and nearby restaurants to supply the energy needs of the building.
- **A building that solves the water problem rather than minimizing it.** My design incorporates a unique and beautiful water purification system that collects graywater from the facility and stormwater from the streets and utilizes plants, fish, snails, algae, and many other microorganisms to filter and purify for use in the garden.
- **A building that produces healthy, affordable food, in an ethical manner.**
- **A building that is educational by design and function.**
- **A building that reinforces human connection with the natural world.**

A guiding question then, to paraphrase from McDonough and Braungart, was "What would it mean to design a building that was 100% good instead of just being less bad?" Another, perhaps, might be "Would it be possible to create a proposal that not only met the needs of current and future generations of Dupont Residents, but exceeded them?"

Current State of the Dupont Trolley Station:

Before describing the vision in detail, it may be useful at this point to provide a brief description of the Dupont trolley station as it exists at present. The trolley station consists of two semi-circular platforms located beneath the traffic circle and tunnels extending north and south along Connecticut Avenue. It is possible to walk from one platform to the other using the tunnels, which connect shortly before the point where they used to return to street level. The structure is mostly bare concrete, however the walls of the platforms retain their original tiling. The platforms are each approximately 500 feet long and 27 feet wide. The tunnels are narrower, approximately 18 feet wide, and extend 700 feet to the north and 300 feet to the south. Each platform is approximately 13,420 square feet, for a combined East and West platform area of 26,840 square feet. There are 9 entrances that serve the station, generally located at each of the major roads on both the East and West sides of the circle. The largest entrances are located at in the triangular spaces between Massachusetts Avenue and P street on either side of the circle. Remnants of the 1995 food court remain in the West platform and all of the electrical wiring has since been salvaged by the homeless population. The West platform also contains two small restrooms. In addition to lighting, renovation of the site will require installation of a new HVAC system. A visit to the site confirmed that though dark, the majority of the site

remains in excellent condition. High ceilings throughout help to give the tunnels a more open feeling rather than one of confinement.

City Roots at Dupont Circle Proposal

The Vision:

Imagine descending a staircase between the intersection of Massachusetts Avenue and P St. on the West side of Dupont Circle. Planters filled with ornamental grasses and colorful flowers line the sides. After entering through glass double doors you are confronted with a lush garden oasis. A few feet in front of you a raised stream, its surface spotted with beautiful aquatic plants, divides the length of a gently curving room. On the other side of the stream, staff tend to a diverse array of plants growing in a mix of high-tech hydroponics beds and conventional soil planters. Transparent dividing walls separate the verdant tunnel into unique microclimates, each replete with diverse plant species. Walking through the rooms offers sights of dozens of different flowers, herbs, vegetables, and even dwarf fruit trees and exotic ornamentals, hundreds of species in all, thriving beneath super high-efficiency lights. The stream that separates the outer concourse from the gardens is actually an Eco Machine, a unique ecologically-based wastewater treatment system that utilizes a series of carefully designed micro-ecosystems (complete with microorganisms, fish, and plants) to purify wastewater collected from the facility and runoff from the streets and buildings above.

Near the entrance a staff member prepares to lead a group of young school students on a tour through the underground garden and adjoining innovative composting facility. Other visitors have gathered here to sit, read, and socialize in front of the small

organic café and flower shop and on benches lining the pedestrian walkway. Many will be back later for classes on gardening and other topics on green living. For now, when their attention is not turned to the plants it is directed instead to colorful murals that line the outer walls along the concourse. The artwork is painted with environmentally-friendly natural paints and dyes, and changes frequently. At the far end, another staff person pushes a cart laden with plant trimmings through a door on her way to feed the center's power plant. Here on the other side of the facility, plant matter from the garden and organic waste from nearby restaurants and private homes is fed into dozens of large composters where it is efficiently converted into valuable compost for use in urban plantings and sale to nearby gardens and farms. This process is not only safe and odorless, but also generates power and heat for the facility and other nearby buildings.

This is “City Roots”, the new “green” hub of Dupont Circle and the city beyond. Here, supported by the abundant human and social capital of one of Washington, D.C.’s most dynamic neighborhoods, the seed of a pioneering experiment in the future of urban sustainability has sprouted and grown. This unique space now forms the root system by which the vital “nutrients” of public space, art, education, and essential ecological and municipal services are drawn up to feed a flourishing, vibrant, healthy, and prosperous neighborhood above.

Key Elements:

A Remarkable Underground Garden - The dynamic and highly educated population of Dupont Circle have made the Dupont Circle Farmer's Market one of the most vibrant and successful Sunday markets in the nation. Dupont Circle residents know the value of local food. Now a farm is coming to the neighborhood permanently. Hundreds of varieties of

fruits, vegetables, flowers, and more will be grown beneath the circle, supplying produce for local restaurants and the farmer's market, and a source of delight for visitors. Growing in a closed system means that no pesticides or herbicides are required and any water not taken up by the plants can be captured and re-circulated in a closed loop. Natural light for growing plants below ground is, of course, in short supply. The plants below Dupont Circle will instead receive light from extremely efficient LED and metal halide lamps, technology already being employed in commercial greenhouses all over the world, not to mention an existing underground garden in Tokyo, Japan. Electricity for the lights and HVAC system will be produced onsite by a biogas generator fed with organic waste from the garden and the neighborhood above.

Water Collection and Purification - Stormwater from the streets and nearby buildings around Dupont Circle will be redirected to the facility to be purified by an efficient and aesthetically-pleasing biological wastewater treatment system known as an Eco Machine, before being utilized in the garden and restrooms or temporarily stored and returned to the sewer system hazard-free. As Dupont Circle is located in Washington's combined sewer area, this system will help to reduce the risk of combined sewer overflows and basement sewage backups in the neighborhood. The center itself will be extremely water efficient, drawing from the city water mains only potable water for drinking.

Organic Waste Collection, Composting, and Power Supply - Every day more than 100 restaurants, coffee shops, and other specialty eateries within a half mile of Dupont Circle produce more than 10 tons of waste, much of it organic, that will end up rotting and producing greenhouse gasses in rapidly filling landfills. Instead, all of that organic waste can be converted into a value-added product that is good for business and good for the

environment, while simultaneously supplying carbon neutral energy to the facility and nearby buildings. The East platform of City Roots will be devoted to a large scale composting center capable of receiving nearly 100% of the organic waste produced by local restaurants. Every day tons of organic waste will be received at the east entrances and transferred to massive composters and vermiculture bins. Some of the finished compost will be used in the garden and the excess can be sold to other local community gardens, farmers, and to the city for beautification campaigns and erosion control. Some organic waste will be diverted to large anaerobic digesters for conversion to bio-gas used to power an onsite combined heating and power (CHP) plant capable of meeting the energy needs of the entire facility, and eventually, producing power and heat for nearby buildings as well.

Growing Local Businesses - Local businesses will benefit from a highly synergistic relationship with the garden and compost center. All local merchants stand to gain from increased foot traffic from visitors drawn to an exciting new destination. Local restaurants will have access to organic produce throughout the year. Additionally, they will be able to significantly cut their waste disposal costs (up to 30% or more of restaurant garbage is food waste) by separating and diverting compostable materials from their waste stream to an extremely convenient collection facility. A growing environmental consciousness among consumers means that advertising "green" business behaviors can bring big profits for Dupont merchants.

A Vibrant and Educational Public Space - The garden space will be surrounded by a beautiful public concourse accented by changing murals painted by local artists, students, and community volunteers. A small cafe and flower shop will offer organic treats from

the garden. The garden, like the circle above, should be a vibrant public space where people come to meet, relax, and enjoy their surroundings. Educational displays, tours, and special classes and workshops, and the facility as a whole will encourage people of all ages to learn about the technological and biological systems at work and the benefits derived by the community.

Green Jobs and Leadership in the Green Economy - Washington, D.C. has embarked on an ambitious plan to become a globally competitive city in sustainability and green jobs creation. As exciting urban sustainability initiatives including intensive urban agriculture programs and neighborhood-based heating and power supply systems take off around the world, Dupont Circle will be leading the charge. The facility will create green jobs at all skill levels and serve as a center for research and expertise on both high and low-tech urban agriculture and power generation. Additionally, the center will reach out to dozens of local public and private k-12 schools and universities, thus serving as an educational facility for the next generation of urban sustainability experts and entrepreneurs.

Funding – Constructing such a center will not necessarily be cheap. Once operational, it is imperative that City Roots be financially self-sustaining. Initial funding for City Roots will likely come from private investors and grants, aided, perhaps, by small support from Dupont Circle mainstays convinced of the synergistic benefits that will come from it. Once operational, City Roots will cover its operating costs through the sale of produce and compost, class fees, and through a compost collection fee for restaurants (calculated so as to be cheaper than conventional waste collection fees). Additionally, City Roots may be able to sell its stormwater collection services, collecting a small fee from

businesses in the catchment area that benefit under the DCWASA's new stormwater management fee system. As mentioned, the facility is designed to be energy self sufficient, and nearly water self sufficient, drastically reducing utility costs. Space for an expansion of the facilities bio-mass CHP plant will be included in the plan with the goal of becoming a net energy producer, capable of selling electricity back to the grid, or directly to neighboring buildings as a district energy utility.

A Community Based Decision Making Framework:

Without a wise decision making framework and smart planning, a project that is sustainable on paper and during construction may fail to live up to its potential in operation. Furthermore, if a building and business is viewed as unattractive and unresponsive to the community around it, no amount of green technology can make it truly sustainable. For these reasons, I believed it was essential to start with an encompassing and comprehensive planning and decision making framework.

From the start the decision making framework will incorporate voices from a comprehensive set of stakeholders including but not limited to:

Representatives from Design and Construction:

- The Architect and Designers
- Developer
- Contractors
- LEED and Environmental Consultants
- Tech and Biological Consultants

Representatives from the Community:

- Dupont Circle Advisory Neighborhood Commission (ANC)
- Dupont Circle Citizens Association (DCCA)
- Dupont Circle Merchants and Professionals Association (DC MAP)
- Historic Dupont Circle Main Streets (HDCMS)
- Dupont Circle Conservancy (DCC)
- DC Coalition for the Arts
- Partner Schools and Universities

Representatives from the Government and Utilities:

- Office of the Deputy Mayor for Planning and Economic Development (ODMPED)
- Metropolitan Police Department
- Washington Metro Area Transit Authority
- Department of Public Works
- DC Water and Sewer Authority
- Pepco

Representatives from Operations:

- Board of Trustees
- Staff - Research, Facilities, Outreach, Retail, Janitorial
- Volunteers/Interns

As the project progresses representatives from the identified stakeholders will be added or subtracted as relevant. During the design phase the developer and designers will meet regularly in an open public forum to receive input from other designated representatives and the community at large before settling on a final design and operations plan.

During construction the parties will continue to meet regularly and update the public on progress and any changes in construction and planning. Great care will be taken to ensure that renovation of the space will be as minimally intrusive to neighborhood traffic and activities as possible.

Part of the planning and design phase will necessarily include the drafting of detailed plans for the operations, maintenance, and future expansion or change of mission for the project. Once operations have commenced, regular evaluations of the performance of the facility will be undertaken. Additionally, the leadership will continue to solicit input from the community in order to meet existing demands and anticipate and plan progressively for the future.

The Right Fit for Dupont Circle:

It is my hope that in the future centers such as this, whether above ground or below, will exist in neighborhoods in cities and towns around the world. There are many reasons, however, why the old trolley station beneath Dupont Circle is the ideal site to construct the first. The location at the heart of one of the most vibrant neighborhoods in the nation's capital is right for many reasons. First and foremost, Dupont Circle is home to a cosmopolitan, affluent (median household disposable income was $50,609 in 2009), and highly educated (85% of residents 25+ have a bachelor's degree or higher) population (Washington D.C. Economic Partnership). The citizens of this neighborhood support a thriving retail and restaurant community, not to mention one of the busiest farmer's markets in the city. That fact, not to mention years-long waiting lists for plots at every public community garden in the immediate vicinity show that Dupont Circle residents understand the value of local food.

What's more, Dupont Circle is one of the most accessible and pedestrian friendly neighborhoods in Washington. Weekday Metrorail count at the Dupont Circle station is 47,925, and increases to 49,315 on weekends (Washington D.C. Economic Partnership). Large numbers of Dupont residents report walking or biking (42%) or utilizing public transit (31%) to get to work, and the fountain at Dupont Circle is well known as a popular destination for people on their lunch break. These statistics ensure that the center will have no shortage of daily visitors. A plethora of already prosperous businesses and restaurants stand to reap the rewards of investment in this project, as do half a dozen nearby schools and the biology and environmental science departments of some of the nation's top universities.

Lastly, the metaphor provided by the location beneath such a busy and historic circle is extremely apt. Just as vehicles and people from all over the city converge on the surface of the circle, so too will people and ideas from many neighborhoods, sectors, and walks of life converge to fertilize the undertaking below. The circle is an eloquent visual metaphor for the concept of "waste equals food" embodied in so many ways by this plan, and perhaps too for the history of the space itself. Once a vital link in an efficient transportation network and later driven into decline and disuse by the advent of the automobile, the Dupont Underground will be reborn as an important part of the infrastructure of a promising new wave of urban sustainability. Dupont Circle has been an important gathering place in social movements of the past, from the anti-war and gay rights movements to the environmental movement. It is time that Dupont Circle become an important place once again in the urban agriculture and sustainability revolution.

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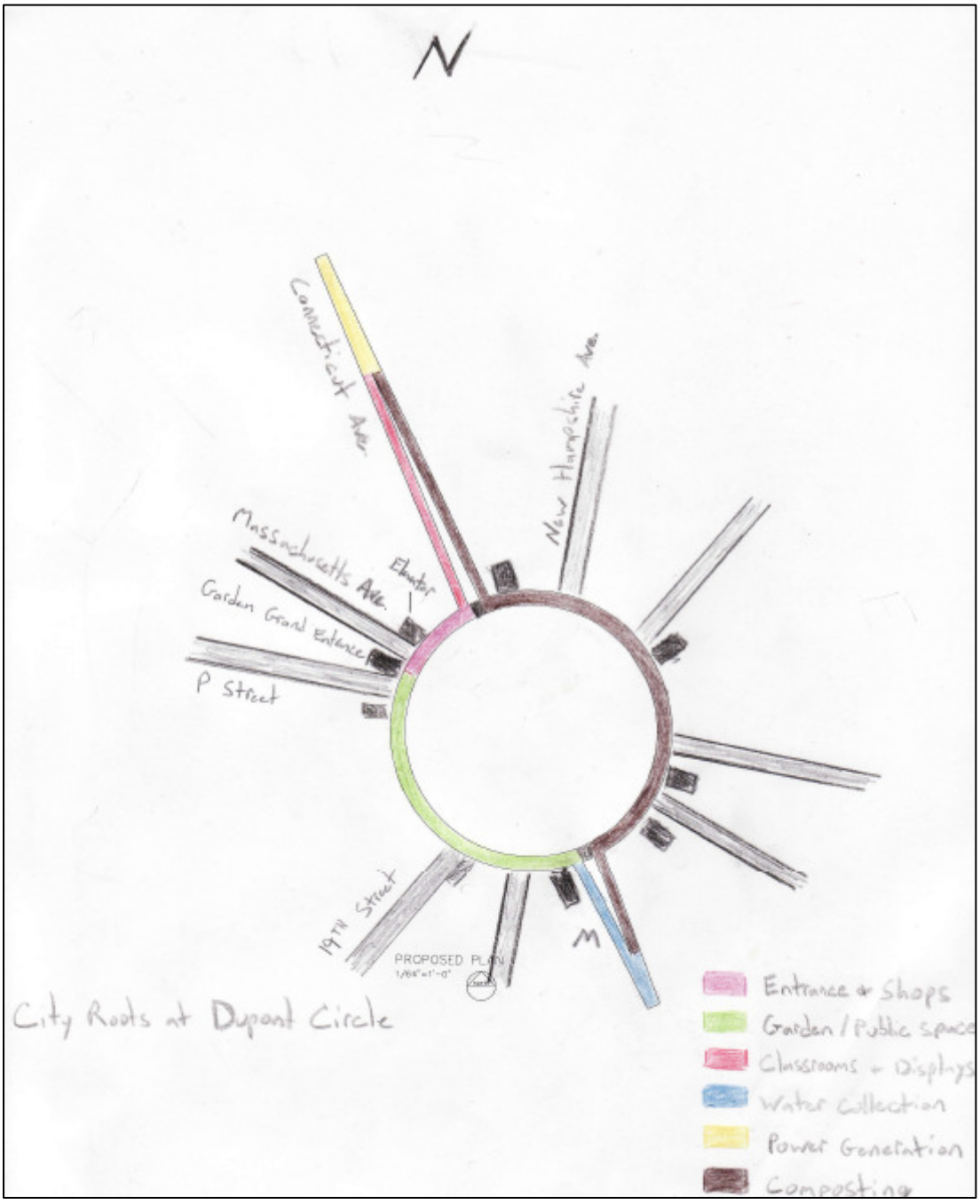
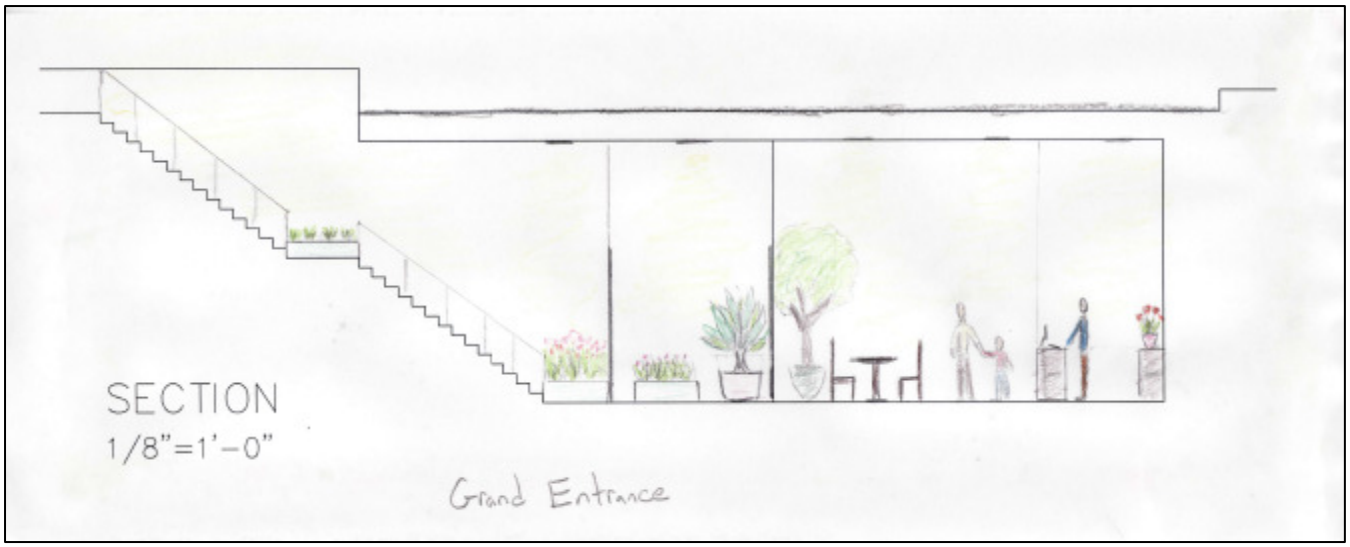
Appendix:

Drawings

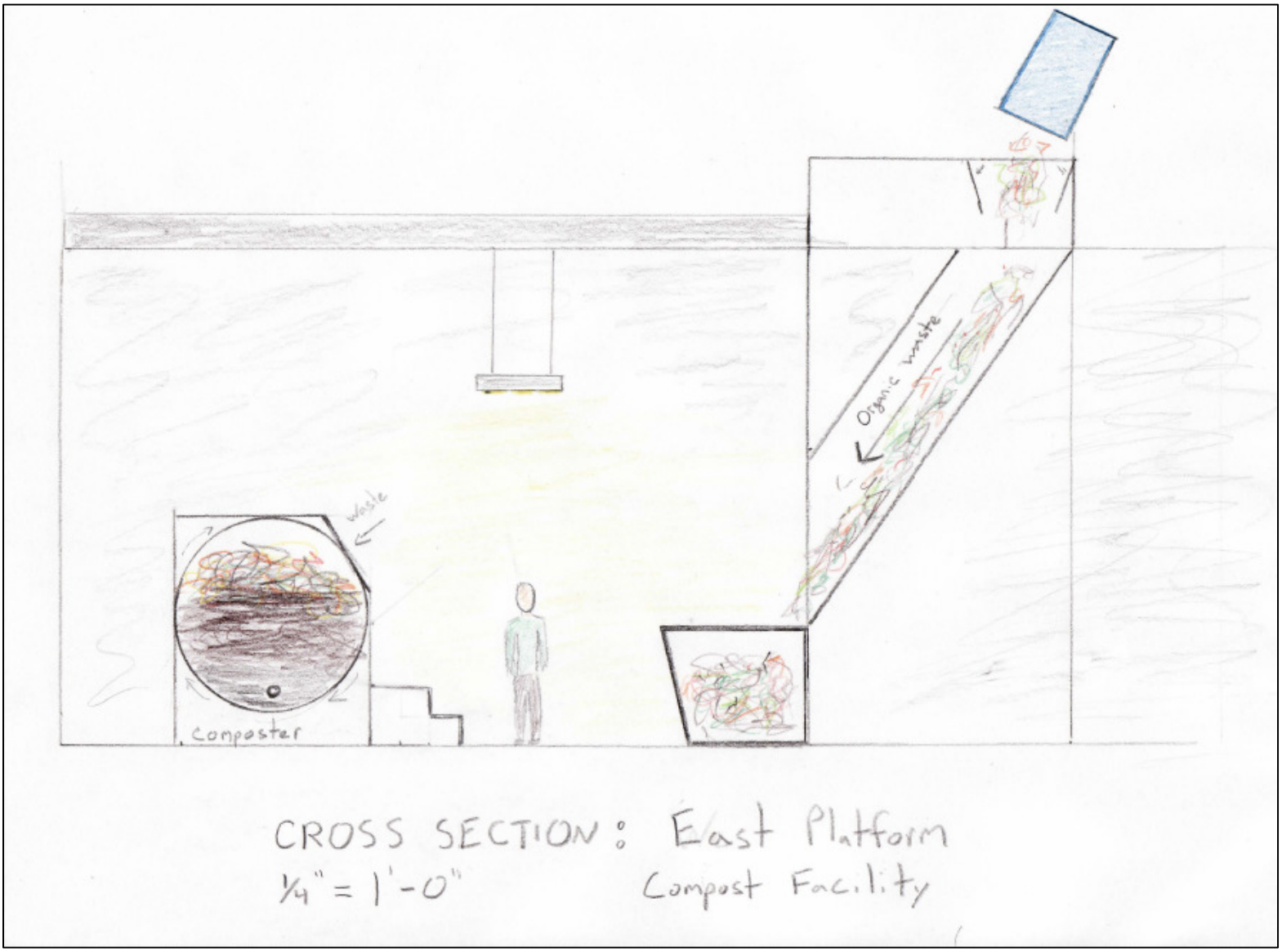
Plan:





A section of the main entrance to be located at the triangle between Massachusetts Ave. and P St. on the Western side of the circle. The stairway will be lined with low plants and be open and flooded with natural light. Visitors will enter into a well-lit foyer complete with a welcome center, café area, and fountain.

Cross section of the garden/public concourse. Visible from left to right: a vertical garden, public concourse, biofiltration stream, soil planter, hydroponics systems.



CROSS SECTION: East Platform

1/4" = 1'-0" Compost Facility

Cross section of West platform composting facility. Organic waste from the surface can be delivered via gravity using the existing entrances. After processing, finished compost will have to be returned to the surface via elevator.

Other Elements

- Gave presentation on underground buildings to the class and uploaded PPT to blackboard site

- Conducted interviews with Dupont ANC 2B Chair Mike Silverstein and Dupont Circle Merchants and Professionals Association executive director Edward Grandis and uploaded transcripts to blackboard

- Coordinated garden group proposal team and delivered presentation of proposal to class panels.

- Created a scale 3D model of the facility with completed entrance area and garden room using Google SketchUp software.