ABSTRACT

Title of Thesis: Architecture Beyond Waste

Degree Candidate: Stanley Mathurin

Degree and Year: Master Of Architecture, 2010

Thesis directed by: Assistant Professor Hooman Koliji, Chair
Assistant Professor Micheal Ambrose
Professor Emeritus Ralph D. Bennett, AIA

The rate of our consumption is rapidly transforming our planet's biomass into human mass, which equals more trash. The U.S. is estimated to generate 225 million tons of trash a year. Each one of us generates about 4.3 pounds of waste per day. As a country we generate more garbage than any other country by far. About one-third of American garbage will be recycled or composted, leaving about 150 million tons of garbage to be managed by other methods.

This thesis aims to foster new developments in the design, construction and operation of municipal systems in urban areas. This architecture will respond to the cities rate of consumption and the disposal of waste by alternative methods that produce energy, such as turning waste into fertilizer, biogas, electricity, recyclable materials and distributing it back into the surrounding community.

Architecture Beyond Waste:
Redirecting Urban Consumption

By

Stanley Mathurin

Thesis submitted to the Faculty of the Graduate School of the
University of Maryland, College Park, in partial fulfillment
of the requirements for the degree of
Master of Architecture
2010

Advisory Committee:
Assistant Professor Hooman Koliji, Chair
Assistant Professor Micheal Ambrose
Professor Emeritus Ralph D. Bennett, AIA
Lecturer Brian Grieb, AIA, LEED AP

Dedication

To Emily, my family and friends for their enduring support over the years. I could not have done this without you.

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Introduction

The rate of our consumption is rapidly transforming our planet's biomass into human mass, which equals more trash. This results in the filling of many landfills to capacity, while adding needless pressures on third world countries by exporting first world refuse to be stored on their lands. Ecosystems and cultures throughout the world are being devastated from these actions. This consumption race is a race against ourselves that deals with energy, which directly influences the demand that we put on the worlds resources.

Fig. 1 World waste generation[1]

It is understood that no ecosystem stands alone and that all ecosystems are open systems, not closed. In order to integrate with nature it is imperative that the energy and materials that are drawn from nature be able to be returned as it was found. The bottom line is, the waste that is released from our built

[1] http://baltidome.com/reduce_your_waste.html

environment at one place is transferred to other areas on the globe due to the interconnectivity in the biosphere.

Municipal solid waste is recognized by the Environmental Protection Agency as a renewable fuel. In fact, trash has been an alternative source of energy for at least a century. Today, with our nation burning 14 percent of its solid waste, incineration is the most common form of waste-to-energy processing.

Waste To Energy

The proposed 'Waste-to-Energy plant' promotes an architecture that can be woven back into the fabric of the city facilitating the awareness of the relationship between sustainability, energy, consumption and community. The

Fig. 2 US Waste Production[2]

energy plant reflects and expresses the metabolism of the community by recycling and redistributing the energy that it produces from the waste of the community, back to the community. The intent is to design a system to be as independent of the larger 'grid of consumption' as possible. The energy plant's role as the center of the community is supported by the revitalization of the stream and Jones Falls park connection. The infrastructure of the facility encourages a community to transition from 'Down-cycling' to becoming truly Eco-efficient.

2 http://www.garbage.org/articles/

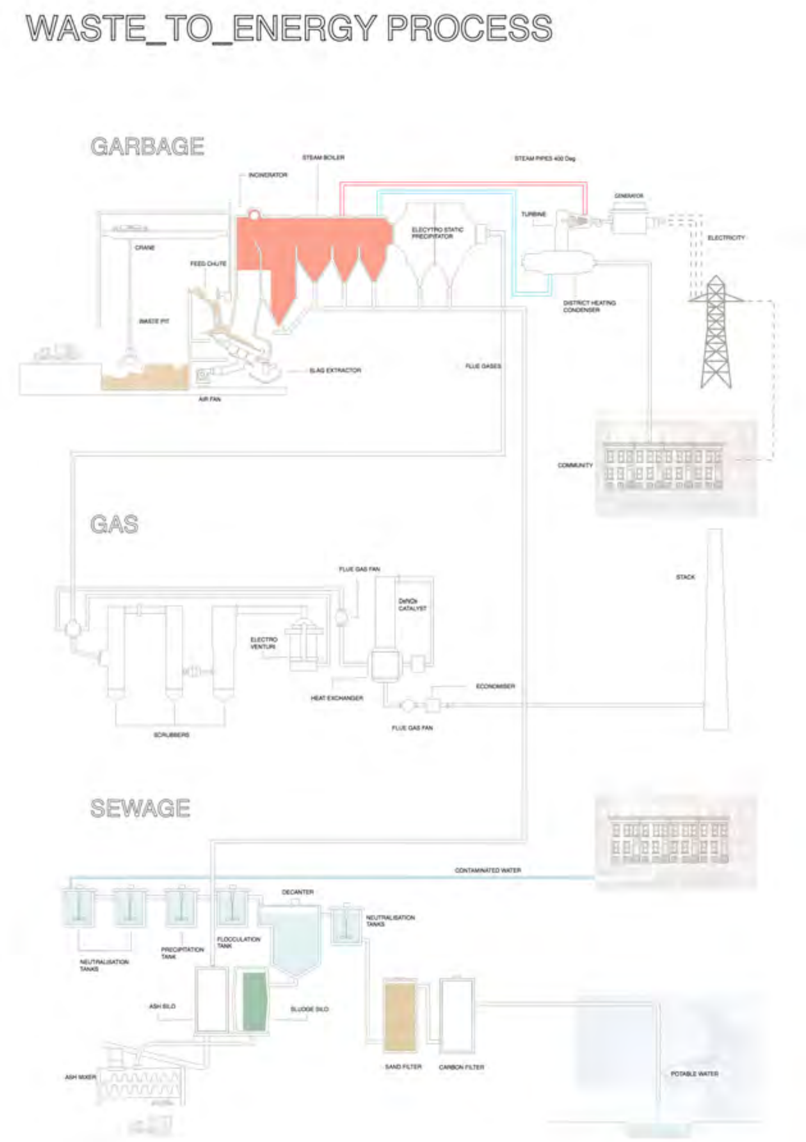

Fig. 3 Waste-To-Energy Process

The site chosen to test this thesis is located in the Baltimore neighborhood of Remington. This location proves to be ideal for a WTE plant because it is nestled between five areas that can be seen as potential fuel for the site. These areas are the neighborhood of Remington, Hampden, Druid Hill Park, Wymann Park and Reservoir Hill. Existing on this site is the city water treatment plant, local sanitation (citizen drop off center), and a small warehouse that houses a Community Supported Agriculture distribution center called the Mill Valley Garden Center. This imagines new potentials to merge three systems into a program that turns an infrastructure of waste into a resource that is fueled by and serves the surrounding communities.

Presently, Sweden's use of district heating has accounted for half of the heat energy they consume. The energy that is distributed from the heating plants comes from household refuse, manufacturing and logging surplus. The heating source is centrally located in order to maintain flexibility in how they use their fuel. The energy is distributed through insulated pipe systems. This system has proven to be environmentally conscious and an efficient type of heating. The system allows for rapid assimilation of new technologies that influence climatic systems and other environmental factors[3].

[3] Krutmeijer, Eva. *Facing The Future: Sustainability The Swedish way*. Sweden: The Swedish Institute, 2008. print.

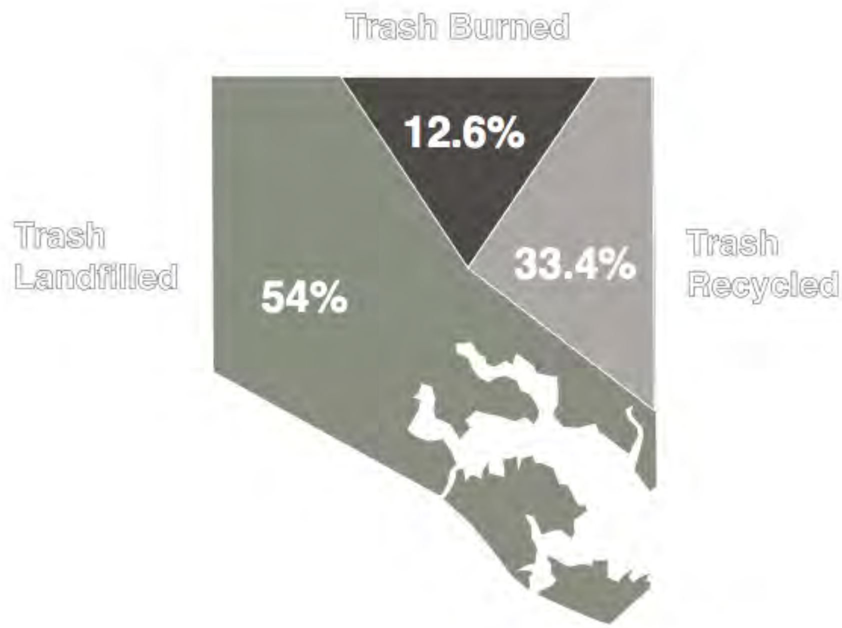

Fig. 4 US Trash Allocations[4]

Burning garbage, oil, natural gas, wood – result in the production of environmental pollutants, like mercury, dioxin, smog, soot, acid gasses and greenhouse gasses. In the 1980s, 'waste to energy' plants were one of the top producers of mercury and dioxin in the environment. But, in the mid-90s the Environmental protection Agency (EPA) issued new standards, and since then, waste to energy plants have made dramatic improvements. Research shows that mercury emissions from the country's waste to energy plants have plummeted, from 80 tons annually in 1989, to about two tons in 2000[5].

Present technological advances have rendered European waste to energy plants far cleaner than conventional incinerators that are found in US waste to

4 http://www.garbage.org/articles/

5 http://www.green.wikia.com/wiki/dioxin

energy plants. This technology involves dozens of filters that catch pollutants, from mercury to dioxin that would have been expelled from its smokestack. Plants like those found in Denmark, find themselves becoming a central component of garbage disposal and source of fuel to the country. Denmark has found there to be a reduction in the country's energy costs and reliance on oil and gas, but also benefited the environment, diminishing the use of landfills and cutting carbon dioxide emissions[6].

Common knowledge informs us of the practical benefits of ecologically and economically recycling paper and plastics, instead of incinerating it. It does not make sense to take oil, turn it into one of many of our thoughtless plastic containers, use it once and then burn it. However, Waste to Energy plants do perform when it comes to how you treat human sewage, waste from live stock and waste from the surplus of food. Working in conjunction with our existing recycling programs we can improve our energy savings by how we deal with consumption, waste and recycling.

The European Union has already made a decision about what to do with that waste by the door. It should not be land filled. Member countries must cut back their land filled waste by 65 percent. And what they'll be allowed to landfill must be non-recyclable and non-combustible[7].

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6 hhtp://viewr.zmags.com/showing.php?mid=wsds

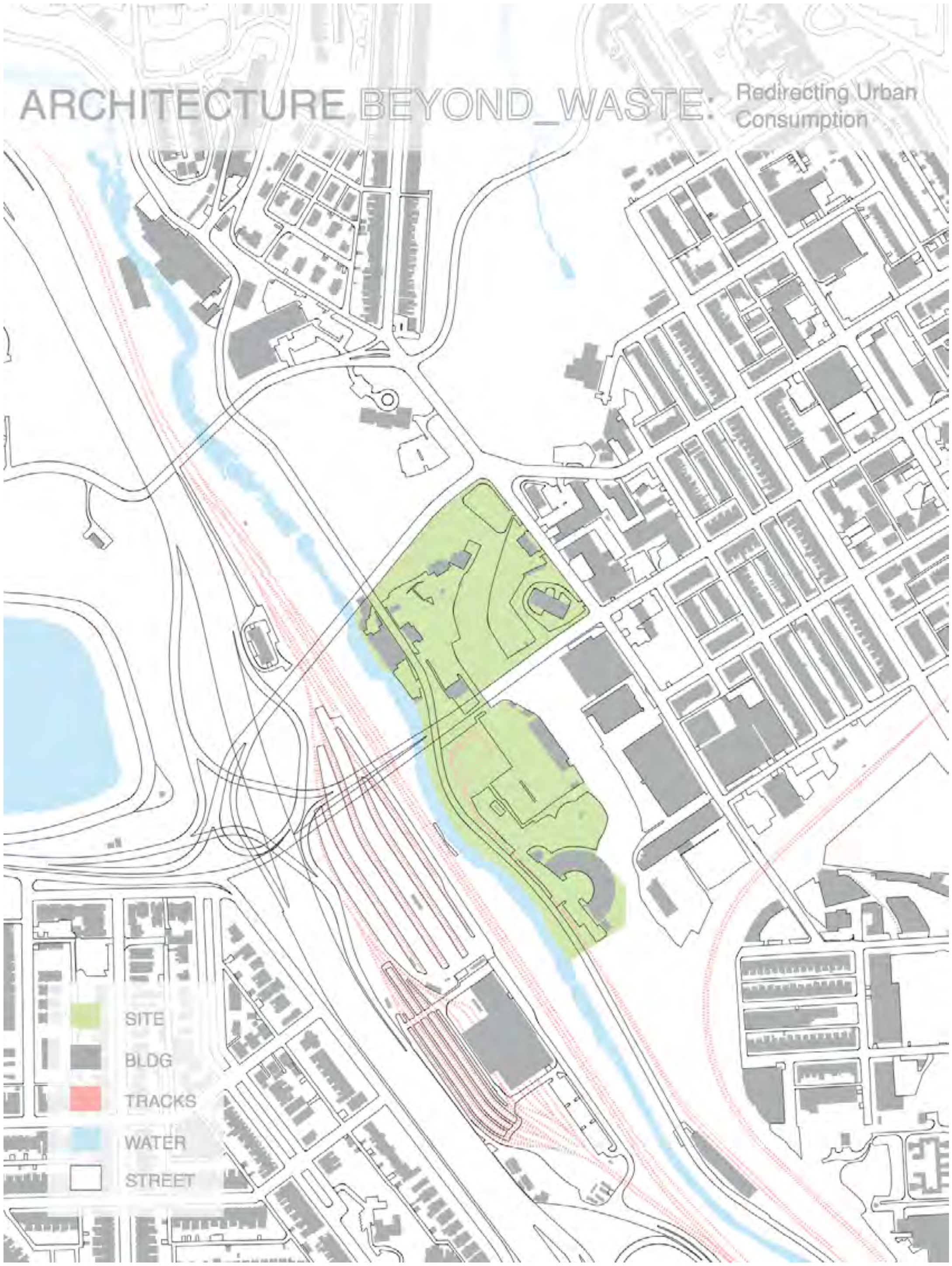
7 http://www.eea.europa.eu/waste

Site Analysis

Fig. 5 Site Panorama from 28th street Bridge.

Fig. 6 Site panorama from 29th street Bridge.

Context



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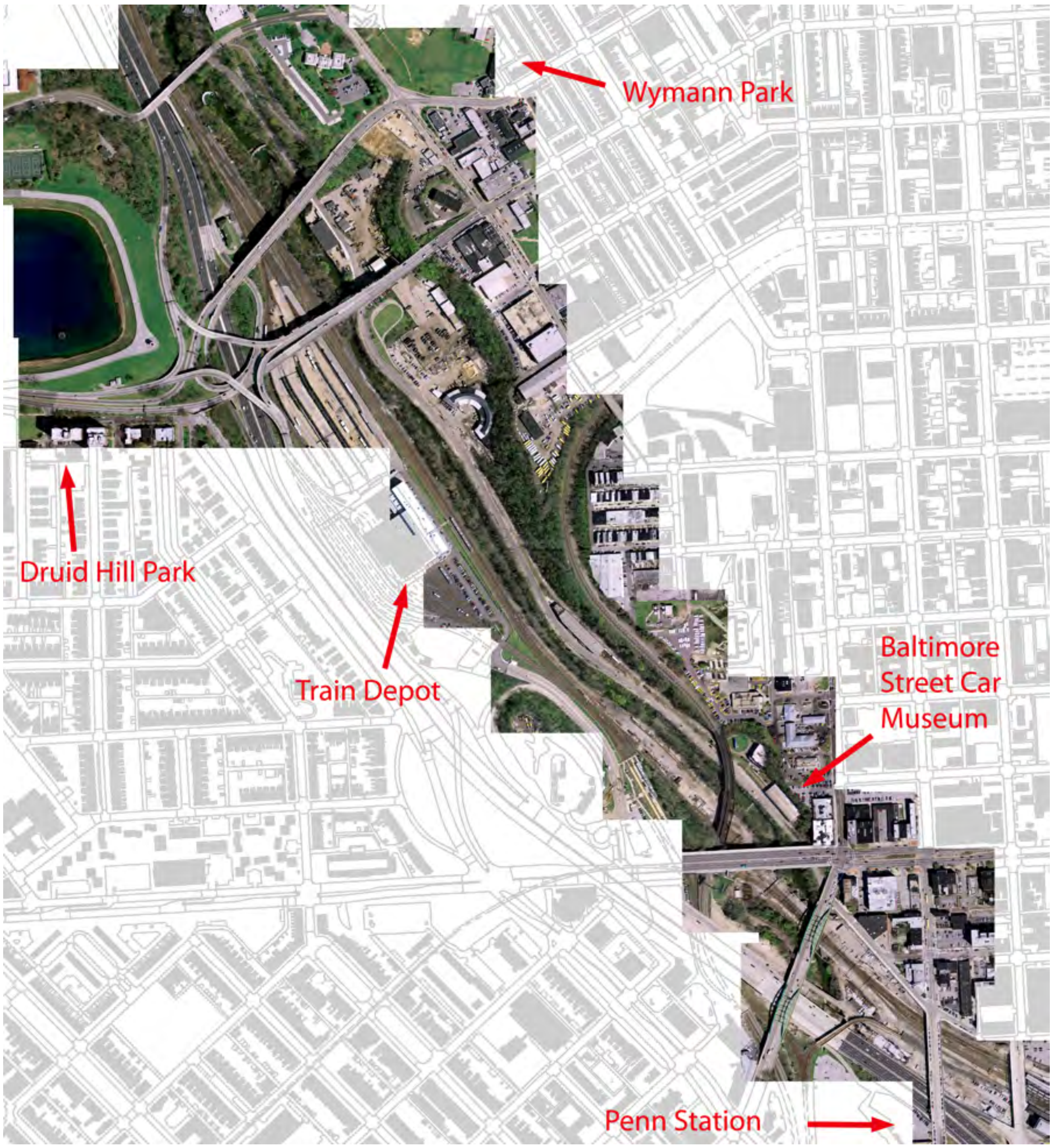

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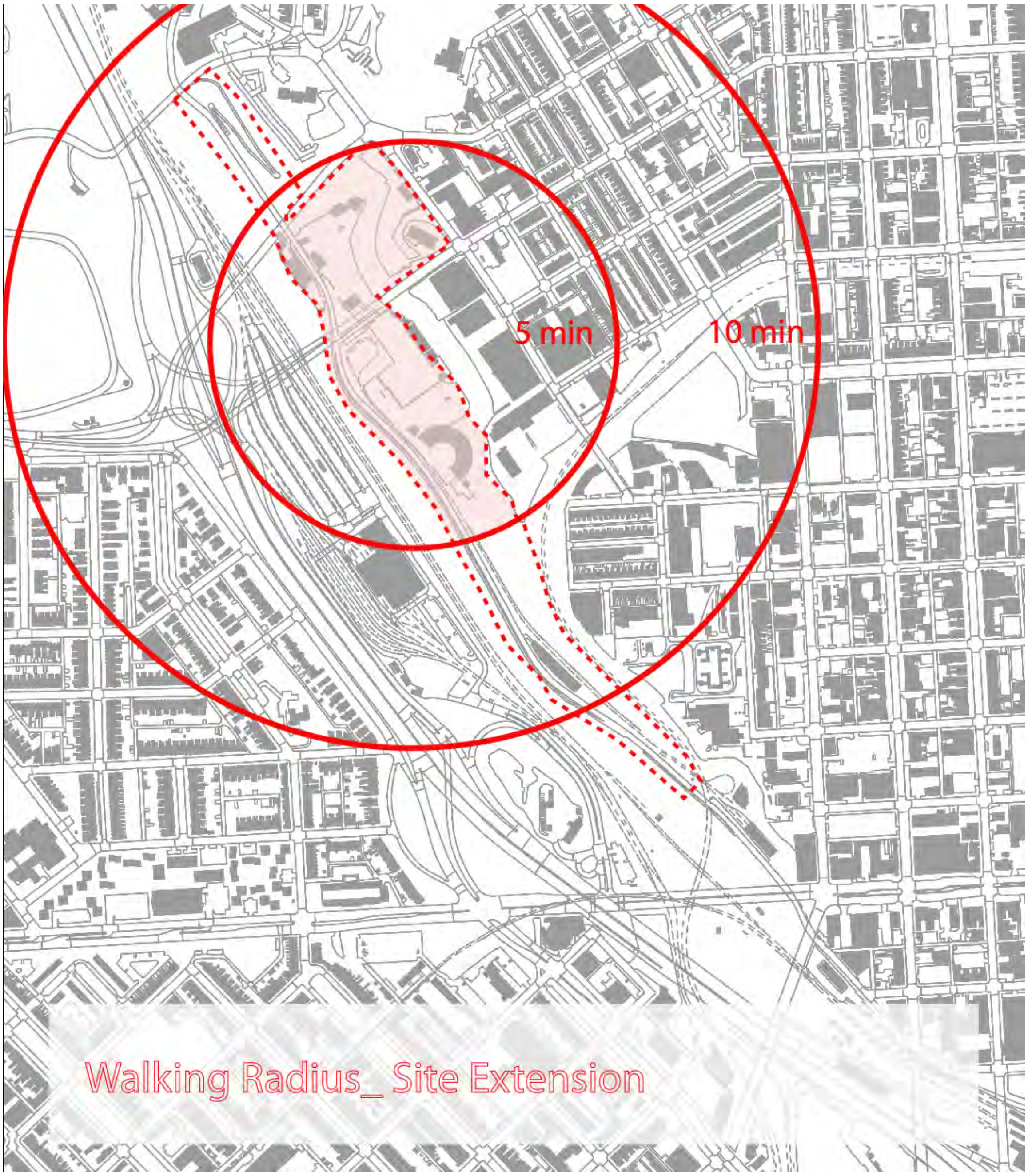

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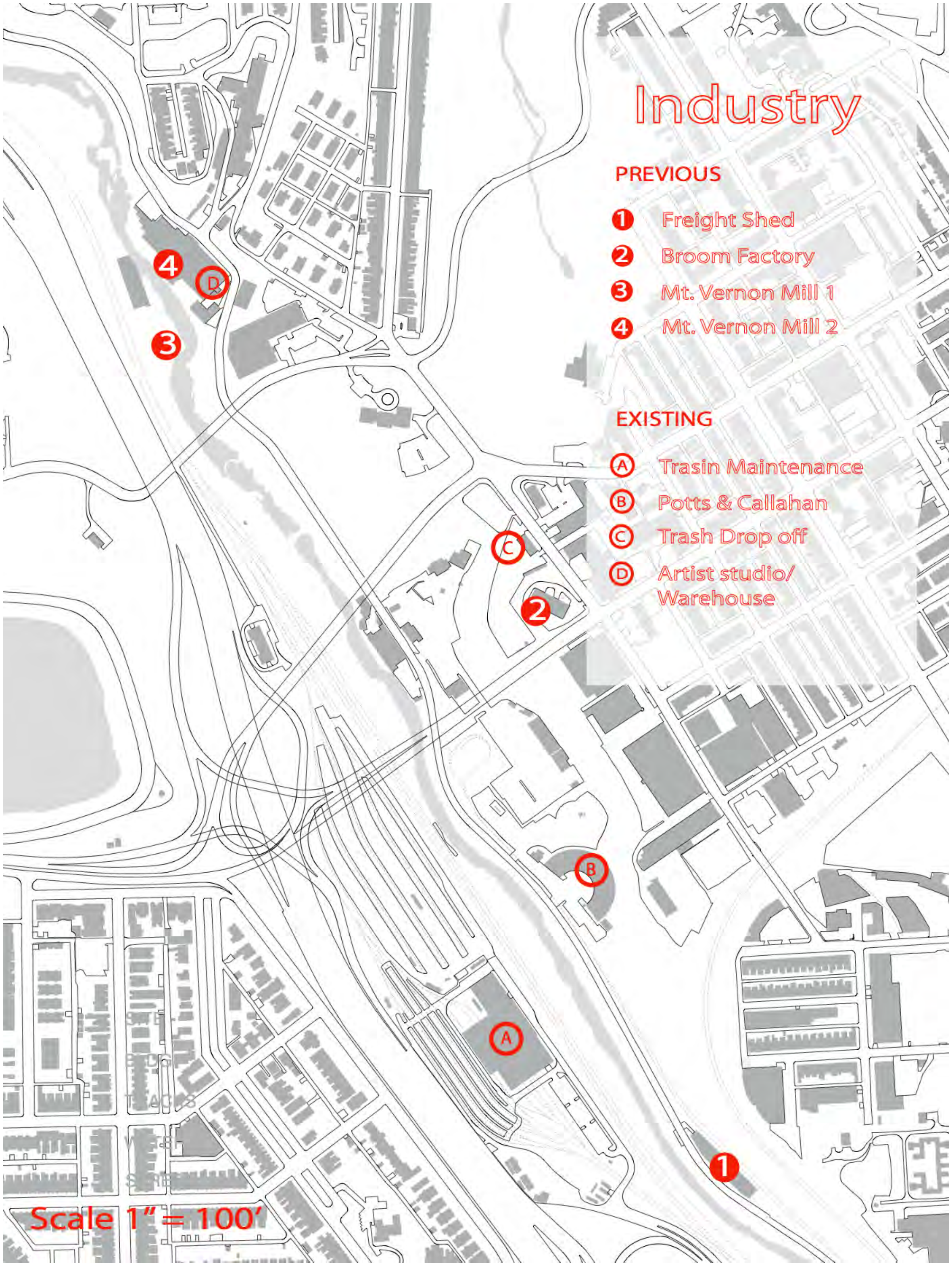

Fig. 10 Previous and existing industry.

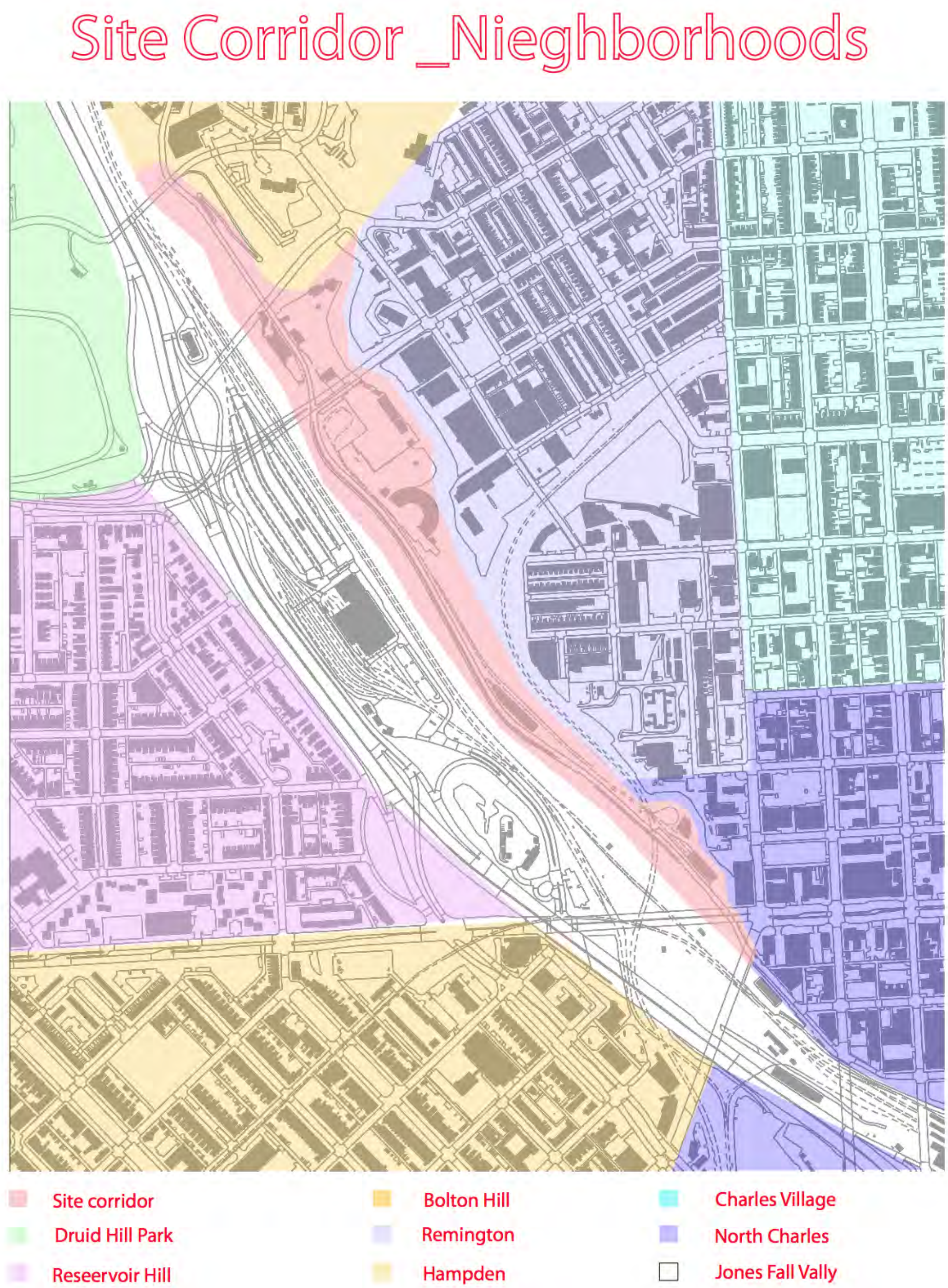

Fig. 11 Site Corridors and surrounding neighborhoods.

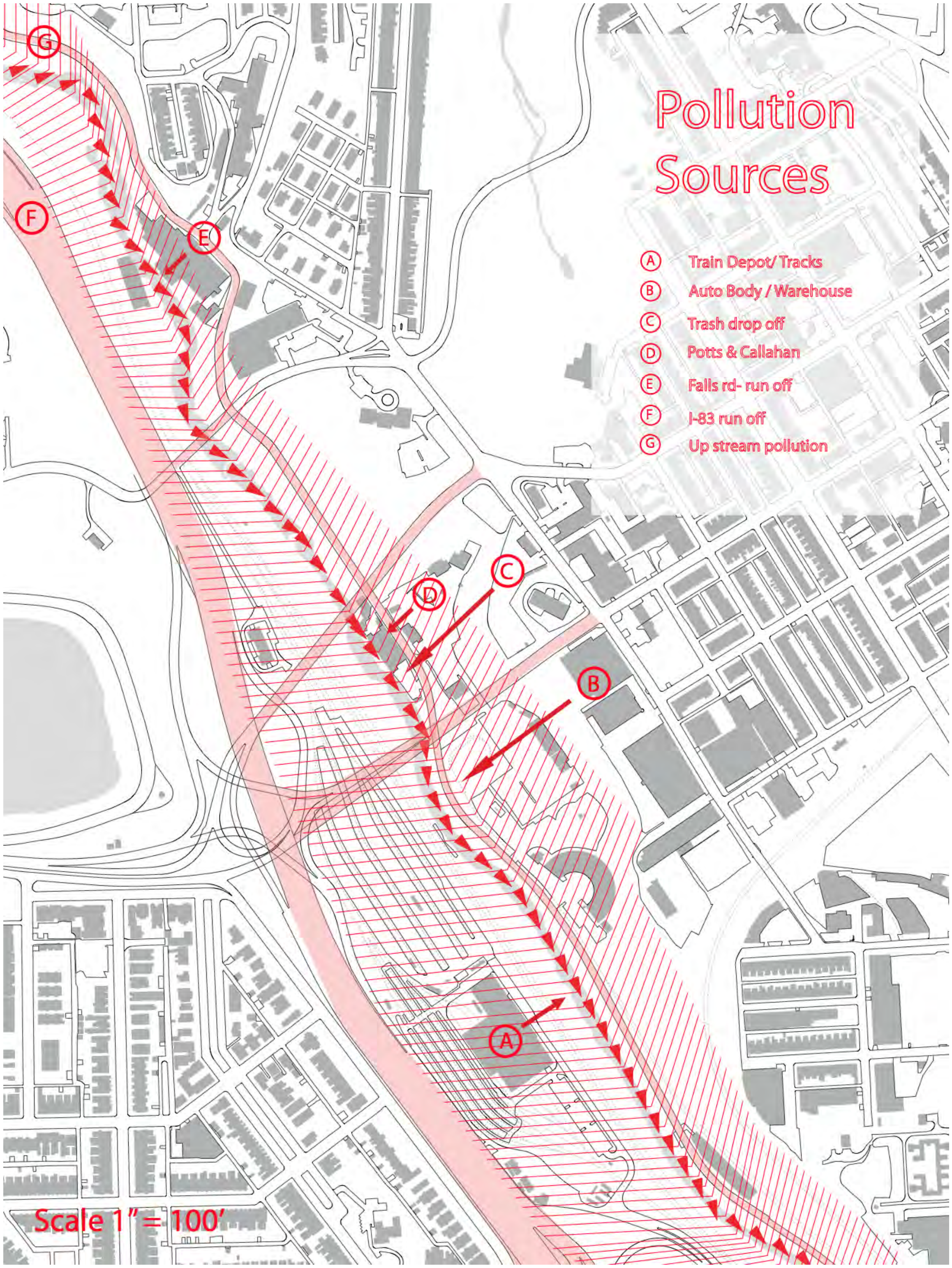

Fig. 12 Pollution sources.

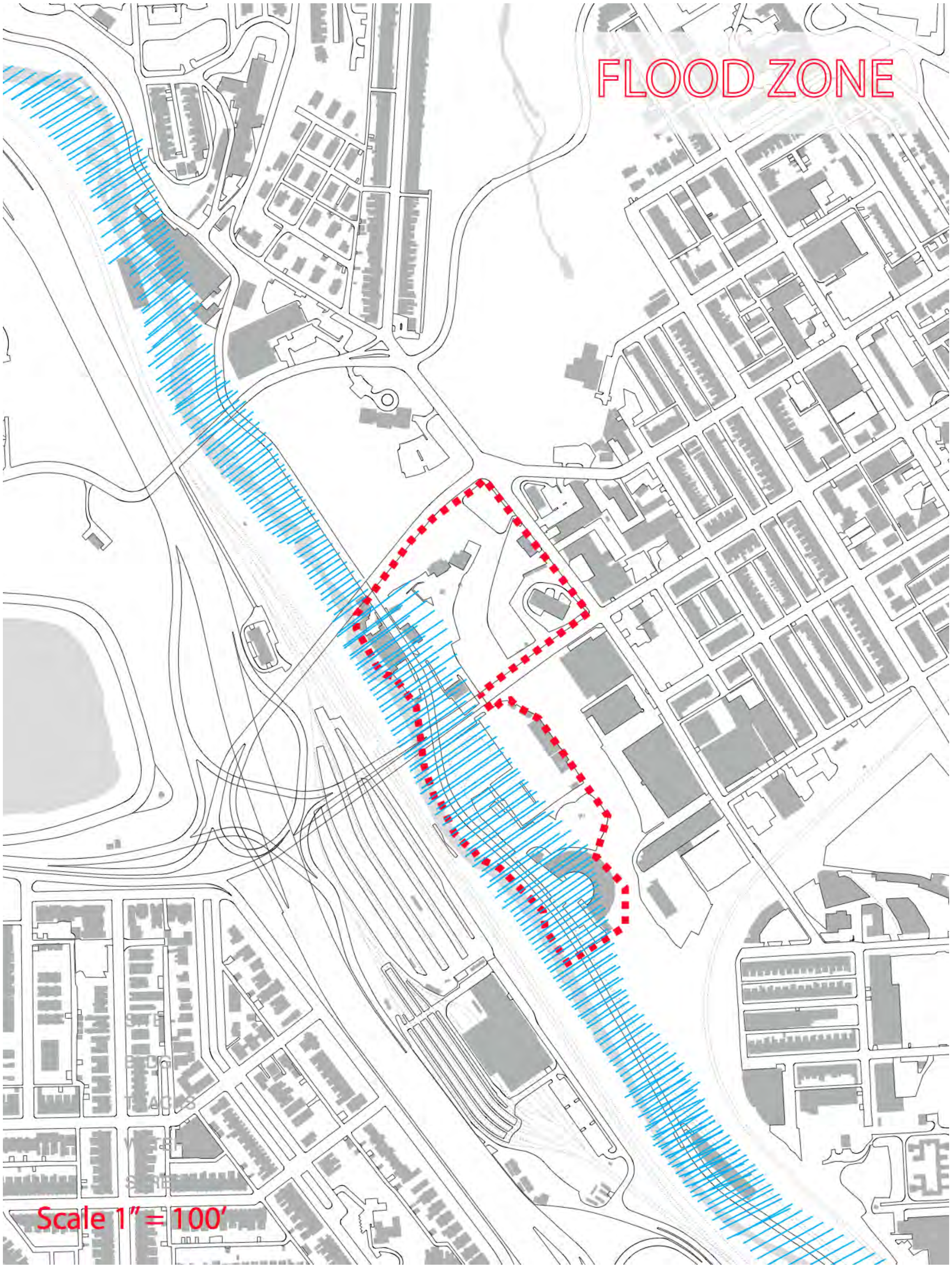

Fig. 13 Flood zone.

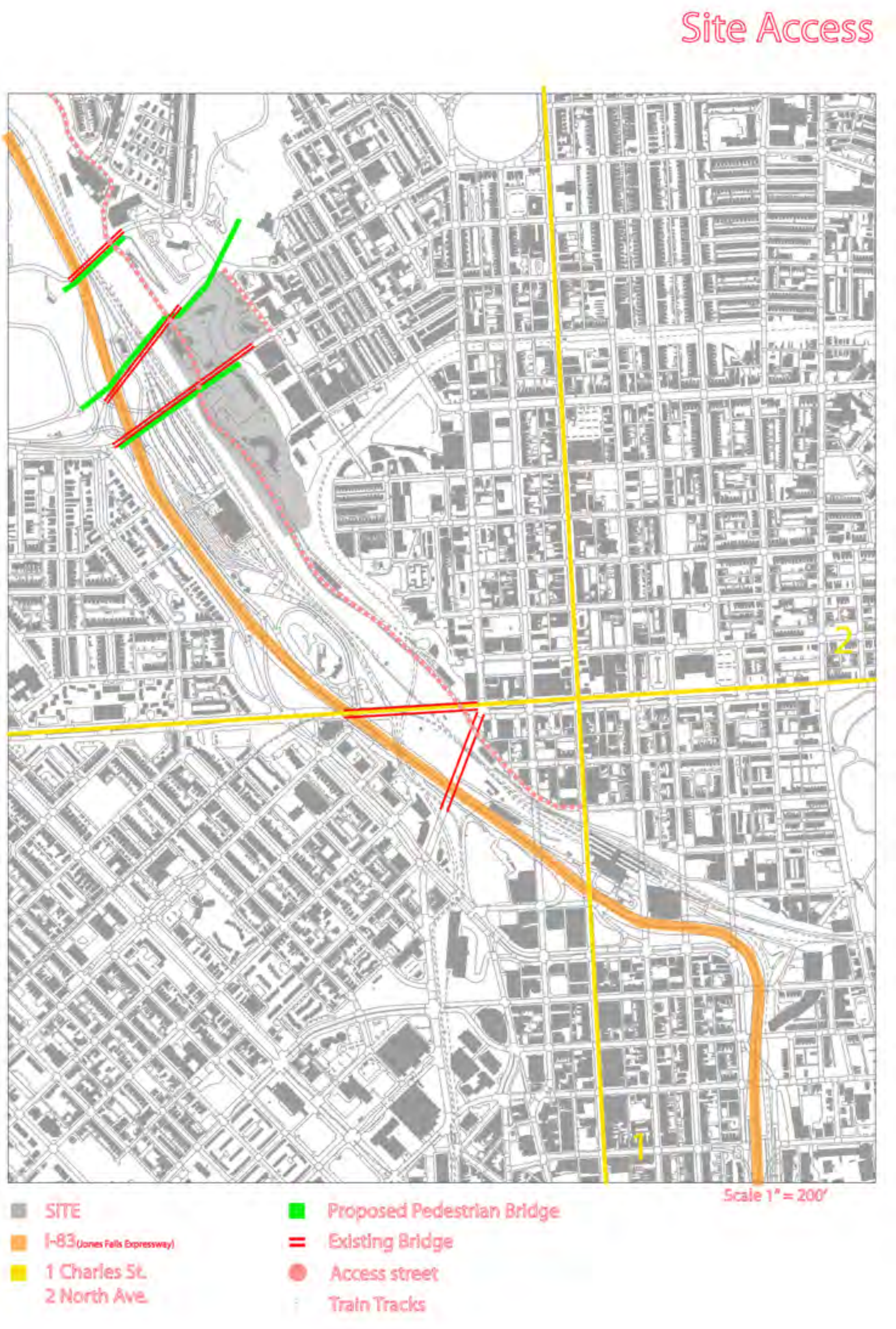

Fig. 14 Site Access.

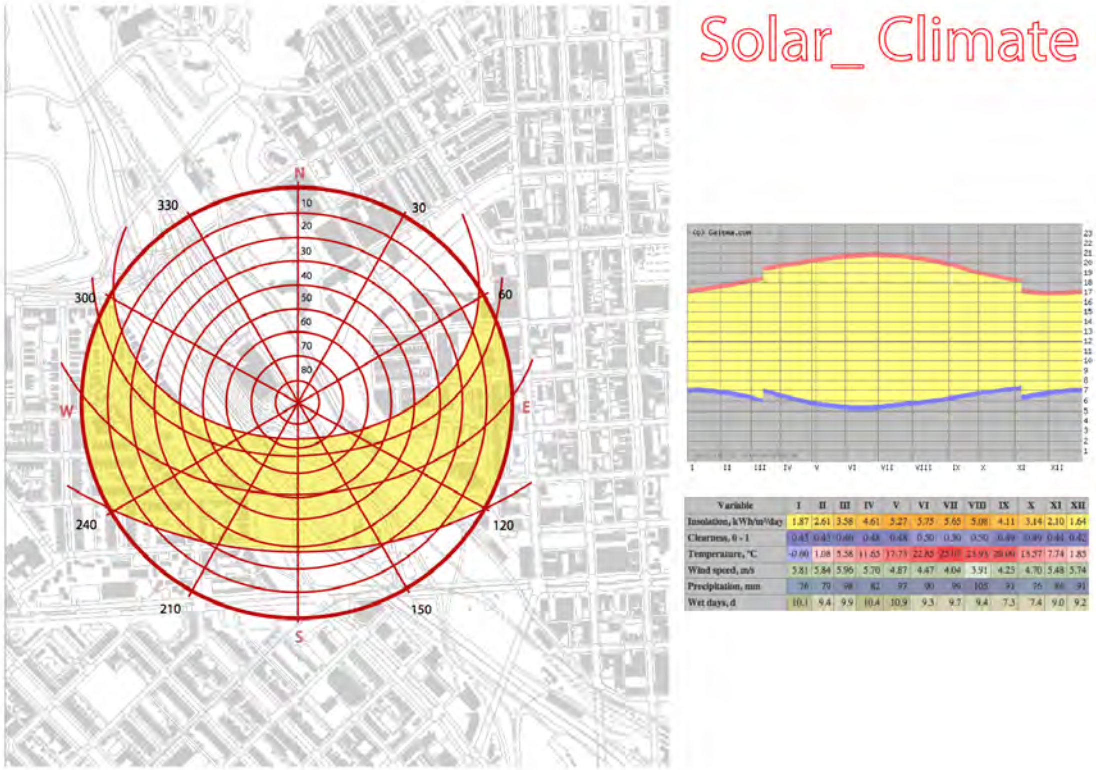

Fig. 15 Solar and climate chart[8].

8 http://gaisma.com/en/location/baltimore-maryland.html

The Baltimore Park System

The surrounding areas play an integral role in sustaining the WTE plant in its development. The Jones Falls, Wymann Park, Druid Hill Park communities will in essence be producing resources in the form of recyclable trash, water run-off and foot traffic that the plant will be turning into energy, then redistributing it to the community. Studying the history of these park systems and how they function at a greater scale within the Baltimore park systems is also a very important issue. This research helps establish ideas on how to reinvigorate the communities by connecting all of the Baltimore park systems through proposed park systems and the creation of green corridors. Understanding how the park systems were established in the past and what they have endured through time allows us to learn from the mistakes that have been made by industry, pollution and the growth of human population.

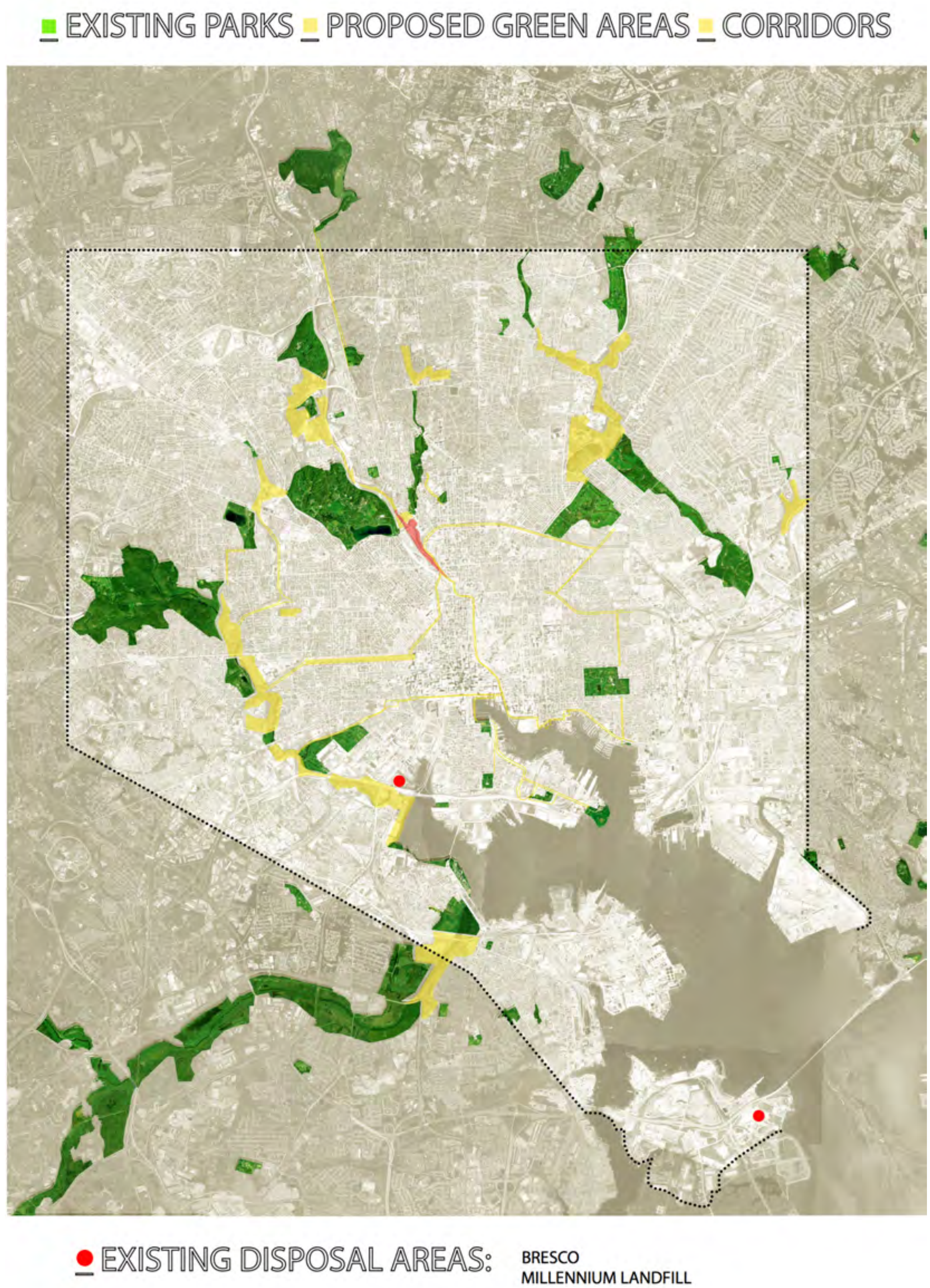

Fig. 16 Existing Parks, Proposed Green areas and Corridors.

History: **Jones Falls**

The **Jones Falls** is a stream in Maryland. It flows through Lake Roland before running through the city of Baltimore and finally emptying into the Baltimore Inner Harbor. The Jones Falls valley has a long history in the city of Baltimore as a transportation corridor. The valley of the Jones Falls carries Falls Road, the tracks for the Amtrak Northeast Corridor, the Jones Falls Expressway of Interstate 83, and the Baltimore Light Rail. The Baltimore Penn Station also rests on an elevated platform in the valley. It also carries tracks for a historic rail line, which is currently served by the Baltimore Streetcar Museum. The MTA Maryland Route 27 also once provided transportation on Falls Road before being moved to city streets.

Many bridges within Baltimore City's borders span the Jones Falls, and oftentimes the Jones Falls Expressway rests directly above the river.

The Jones Falls was named after one of the first European pioneers, David Jones, who settled in 1661 on 380 acres along the eastern banks of the river. Jonestown was formed soon after, and the town of Baltimore was formed in 1729 on the western banks. In 1745 the two towns were united to form the city of Baltimore. As the city built up and pushed closer to the river's natural territory, the river became an inconvenience, splitting the city into halves. In 1766, Harrison Marsh was filled in, Harrison Street was developed, and a canal was built to divert the river from its natural horseshoe-shaped bend. The first recorded flood in 1786 swept away any new construction. The canal was deepened in 1805. On July 14, 1837, the river reached 20 feet above its bed. Few bridges survived the flood, and the raging waters also killed an estimated 19 people. A flood in 1868 was one of the worst for the Jones Falls. Flooding on the Jones Falls has occurred as recently as Hurricane David and Hurricane Agnes in the late 1970's.

The city understood and took advantage of the opportunities that the Jones Falls provided. Jonathan Hanson built the first mill on the river. There were 12 mills powered by the Jones Falls in by 1803. Soon after, Baltimore became the leading flour-milling city in the world by 1825. Baltimore also produced great amounts of cotton duck canvas for sails, and the production of canvas for covered wagons, tents, and military equipment continued into the early 20th century. The Mills in Baltimore also produced industrial parts for steam engines and other technology during the time. Railroads became built up along the Jones falls for the mill industries; the Baltimore and Susquehanna Railroad laid tracks down first, and shortly after the Northern Central Railway and Maryland and Pennsylvania Railroads ran lines. However, all the mills closed by 1970, and the railroad operation ended in 1980. The MTA later adopted the Northern Central rail beds for light rail.

Additionally, the Jones Falls provided the city with its drinking water for many generations. The Chattolanee Spring Water Company bottled water from the falls. In 1807, the Jones Falls was used as the water supply for Baltimore, although in the mid-1800 the polluted river was an inadequate water source. In 1865 Lake Roland was created to provide the water for the city. However, the river began tracking in great amounts of sedimentation from the erosion of the riverbanks. Lake Roland lost much of its water storage capacity, and the reservoir was abandoned in 1901. The bottled water company closed its doors in 1975. The city could no longer receive its water supply from the polluted river and had to tap elsewhere.

By 1910, the Jones Falls was completely polluted. Sewage ran into the river, and the factories and mills along its banks had poured remnants of their industrial waste into its water. Baltimore had attained the highest typhoid rate in the country, and public health officials encouraged the conversion of the last two miles of the river into an underground sewer. A major engineering operation of its time was set into affect and the river was channeled into three large tubes, which reduced to one that emerged shortly before entering the Chesapeake Bay. The project was completed by 1915, and at the dedication the master of ceremonies Henry Barton Jacobs claimed he had come to “bury the Jones Falls—not to praise it”. The Jones Falls Expressway was built along side the river and on top of the tunnel. Runoff from the expressway has further polluted the river.

The river only became more polluted from the many farms that span its banks upstream from the city. In Park Heights, cattle often cause the breakdown of the stream banks. Fields made for produce or cattle promote less trees, which decreases shade which would naturally cool the river, resulting in a rise of river temperature. Nitrification, excess nitrogen runoff from manure and fertilizers, encourages algae growth, which further depletes the stream of dissolved oxygen. Sedimentation from erosion, causing higher riverbeds and sandbars, creates stagnant, oxygen-depleted areas of the stream. Fish lose breeding grounds as well as the dissolved oxygen they need. Non-point-source pollution inundates the river with toxic runoff after each rain; the river absorbs pesticides and chemicals from lawns, oil and runoff from roads, bacteria, and toxic metals, often broken down from acid rain. By 1983, the water quality was so poor the EPA was led to name Baltimore's storm water as the most contaminated of 28 metropolitan regions. Additionally, the old pipes of Baltimore's approximate 3,000 miles of raw sewage pipes would often break down, and raw sewage is poured into the tributary streams and groundwater. The river became so polluted it was dangerously unhealthy to swim in or eat the fish caught in the river. The Jones Falls Watershed Association was formed in 1997 to protect and restore the river and its tributaries. It is a volunteer-driven grassroots organization credited with bringing attention back to the river and building awareness of the stream and stream valley as natural resource assets for the community.

A watershed is a segment of land that's runoff water drains into a common waterway. The Jones Falls Watershed encomhpasses 58 square miles within

Baltimore County and Baltimore City and is the most urban of the three watersheds contributing to the Inner Harbor.[9]

Baltimore Park systems: **Druid Hill Park**

Druid Hill Park in northwest Baltimore, Maryland, United States, ranks with Central Park in New York, begun in 1859, and Fairmount Park in Philadelphia as the oldest landscaped public parks in the United States. Druid Hill Park is a 745-acre (3.01 km^2) urban park. The land was originally part of "Auchentorlie", the estate of George Buchanan, one of the seven commissioners responsible for the establishment of Baltimore City; Buchanan's country estate included 579 of the 745 acres (3.01 km^2) that comprise Druid Hill Park today. Renamed "Druid Hill" by Nicholas Rogers, who married Eleanor Buchanan, it was purchased in 1860 by the city of Baltimore from Lloyd Rogers with the revenue derived from a one-cent park tax on the nickel horsecar fares. Druid Hill Park was inaugurated by Baltimore Mayor Thomas Swann on October 19, 1860. It is listed on the National Register of Historic Places.

Howard Daniels, Baltimore Park Commissioners' landscape designer, designed the park and John H. B. Latrobe, who designed the gateways to the park and the alterations made to the early-19th century Nicholas Rogers mansion that

9 http://jonesfalls.org/our_water#5c3f39

already stood in the site. George A. Frederick, the very young Baltimore architect who won the commission for Baltimore City Hall in 1860, provided designs for architectural features in the park. Among Frederick's playful structures for Druid Hill in Moorish and Chinese styles is the Chinese Station erected in 1864 and the Moorish Station, which were stops on a narrow-gauge railroad that once wound through the park. The "Mansion House" now functions as the main administration building of The Maryland Zoo.[10]

Baltimore Park System: **Wyman Park**

The community of Wyman Park is a border community that links Hampden to Roland Park. The general boundaries consist of the area from south to north between 33rd Street and 40th Streets and west to east from Keswick Road to Wyman Park. South of 40th Street, garden apartments, multi-story apartment buildings and single-family residences have been built.

Throughout the eighteenth and nineteenth centuries, this land remained attached to large rural estates, and the only settlement of note occurred in the adjacent Stony Run valley. Here, along the stream's west bank, two flour mills once operated.

10 http://druidhillpark.org

Most construction took place in the 1920s and continued into the 1960s with the development of several small garden apartments.[11]

[11] http://wymanparkcommunity.org/neighborhood/history.php

Precedent Analysis

The precedents for this project addresses the potentials of industrial and post industrial structures as a didactic architecture that is integrated into the fabric of an active community. The precedents presented in this case polarize from strictly an industrial use or towards becoming a park system existing in the post-industrial era. The value in the study of these precedents lends itself towards creating a structure that maintains its relevance to the community that it serves by existing within a super-position in the community without changing its reason for being as a result of time. One of the goals of the Plant is to function as both, a true public park and a WTE plant to maintain relevance with in the metabolism of the Baltimore area.

Duisburg-Nord Landscape Park, Germany 1990-2002

Fig. 17. Thyssen Steelworks' Duisburg Meiderich Iron Mill.[12]

The Landscape park in Duisburg Nord speaks towards the potential of how a plant of sorts can be integrated with the public and its activities. The Thyssen steelworks no longer functions at the same capacity. It is seen as setting a new standard for the remediation, reuse and continued management of former industrial complexes. The park was once Thyssen Steelworks, which was part of Germany industrial powerhouse. The park was designed by Latz + Partner who envisioned an alternative approach to providing essential public green space and leisure facilities to the Ruhr Valley community in western Germany. Duisburg Nord stands out by allowing the landscape, and the diversity of it's uses to gradually transform the site. This allowed for the effective integration of the park into the local community's and allowed for a much smaller budget.

Fig. 18 Duisberg-Nord Plaza with Cherry Trees.[13]

12 Reed, Peter. *Groundswell*. New York: The Museum of Modern Art. 2005. Print.

The 570-acre park still is home to existing engine houses, mill buildings, bridges, gas tanks, empty coke and ore bunkers, and traces of rail lines. These structures are all incorporated into the park as awesome monumental sculptures and landforms to serve new programmatic activities and as reminders of the site's history. Recognizing that the combination of industry and nature results in an experience rich with memories, associations, and feelings, The project has expanded the idea of what a park can be, and set new standards for similar environmental, economic, and social transformations happening around the region. Latz's general concept plan takes its cue from the existing infrastructure: the network of rail lines that gives coherence to the system of paths. steel catwalks, a canal, and monumental bunkers, all of which are transformed from their previous practical uses into landscape features.

Olympic Sculpture Park, Seattle Art Museum

Fig. 19 Olympic Sculpture park, aerial view[14].

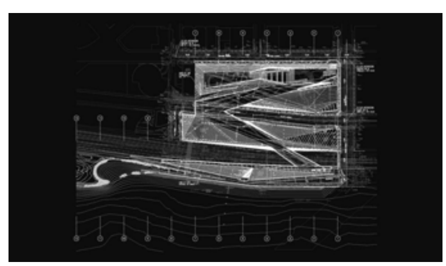

Fig. 20 Olympic Sculpture park, contour plan[15].

[13] Reed, Peter. *Groundswell*. New York: The Museum of Modern Art. 2005. Print.

[14] Reed, Peter. *Groundswell*. New York: The Museum of Modern Art. 2005. Print.

The Olympic Sculpture Park, located in Seattle, Washington (2001-06), is the product of Weiss/Manfredi Architects. The inspiring landscape of the Olympic Sculpture Park sparked at its core a multitude of design solutions that I decided to adapt to the site. Dealing with severe grade changes, the problem of bring people from one elevation to the next was an issue. The park was also designed to be a landscape that facilitates outdoor exhibitions from the museum's permanent collection.

[15] Reed, Peter. *Groundswell*. New York: The Museum of Modern Art. 2005. Print.

Wheelabrator, Baltimore MD

Fig. 21 BRESCO PLANT, Baltimore City Md.

B.R.E.S.C.O. is a Waste-to-energy plant in Baltimore that converts the waste produced in the general area into energy. B.R.E.S.CO. Stands for, Baltimore refuse energy systems company. The plant generates clean renewable electricity for sale to the local utility. The plant also provides steam to the downtown Baltimore Area.

Fig. 22 Bresco refuse pit.

Fig. 23 Electrical control room .

Program: Waste to Energy

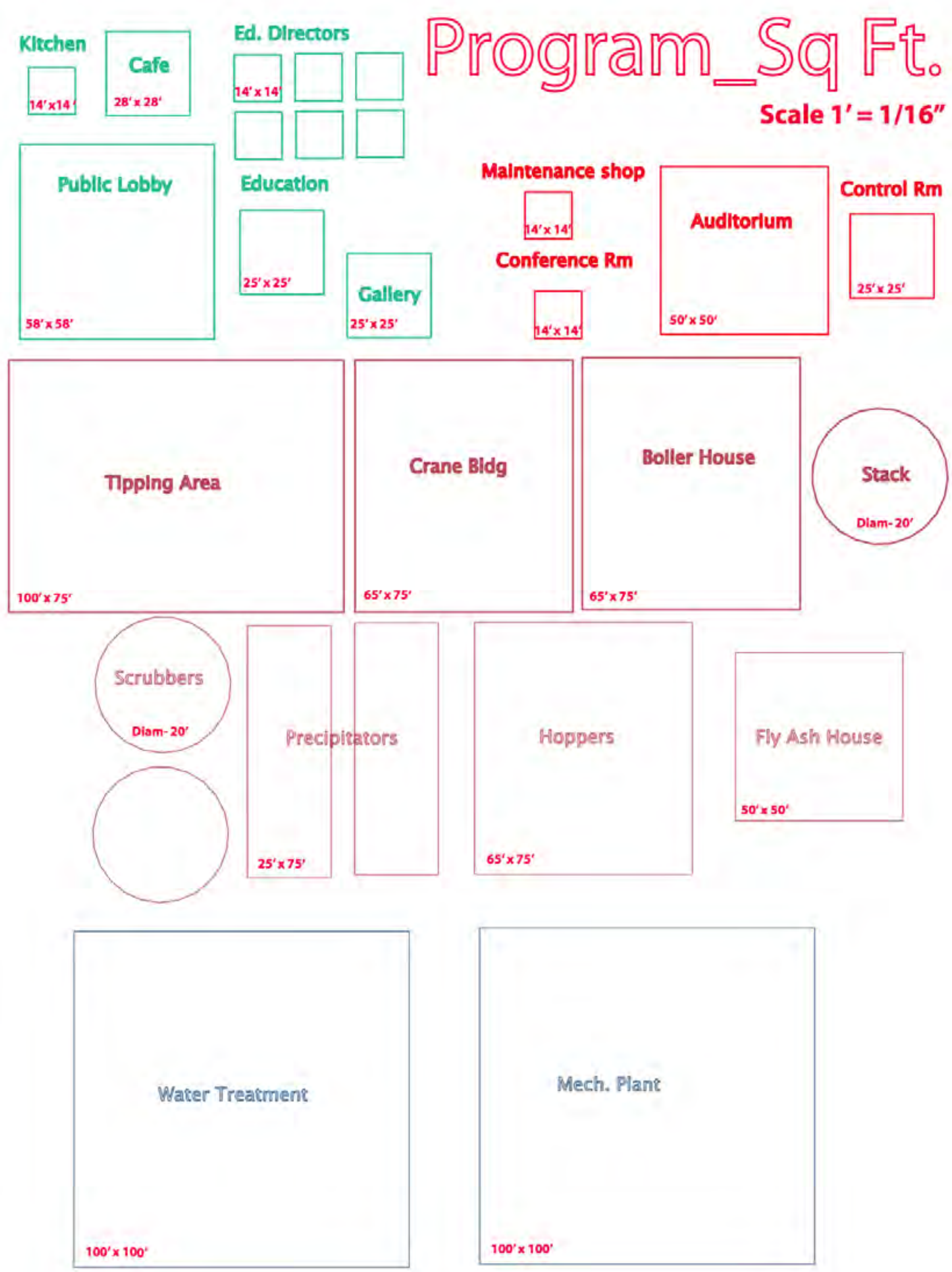

Fig. 24 Program square footage diagram.

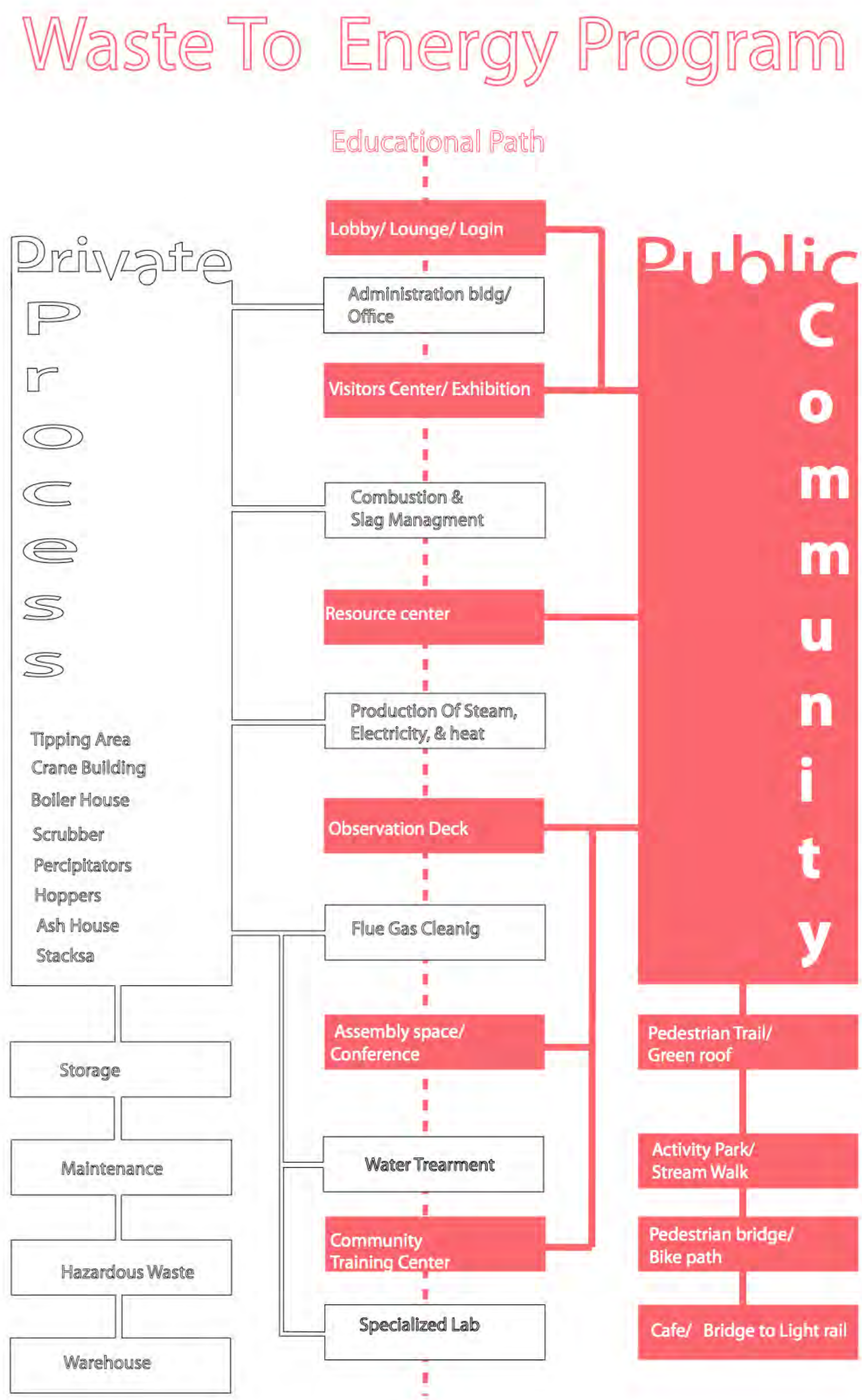

Fig. 25 Connectivity diagram.

MASSING

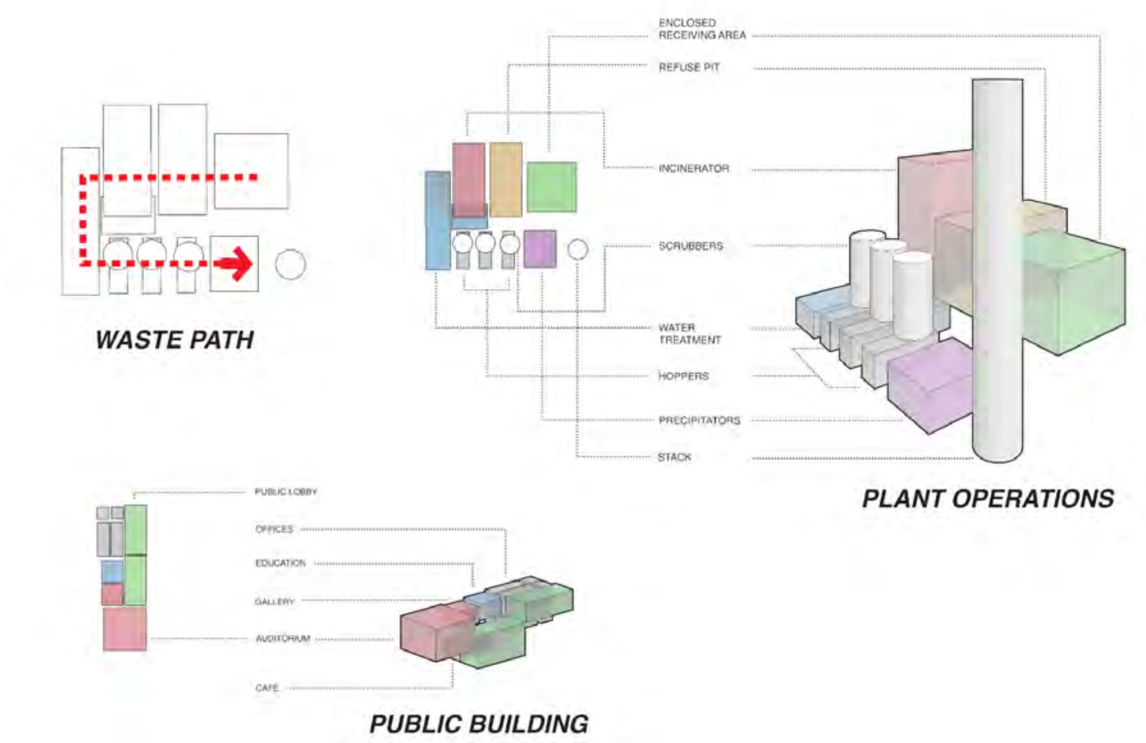

Fig. 26 Massing diagrams.

Design Approach

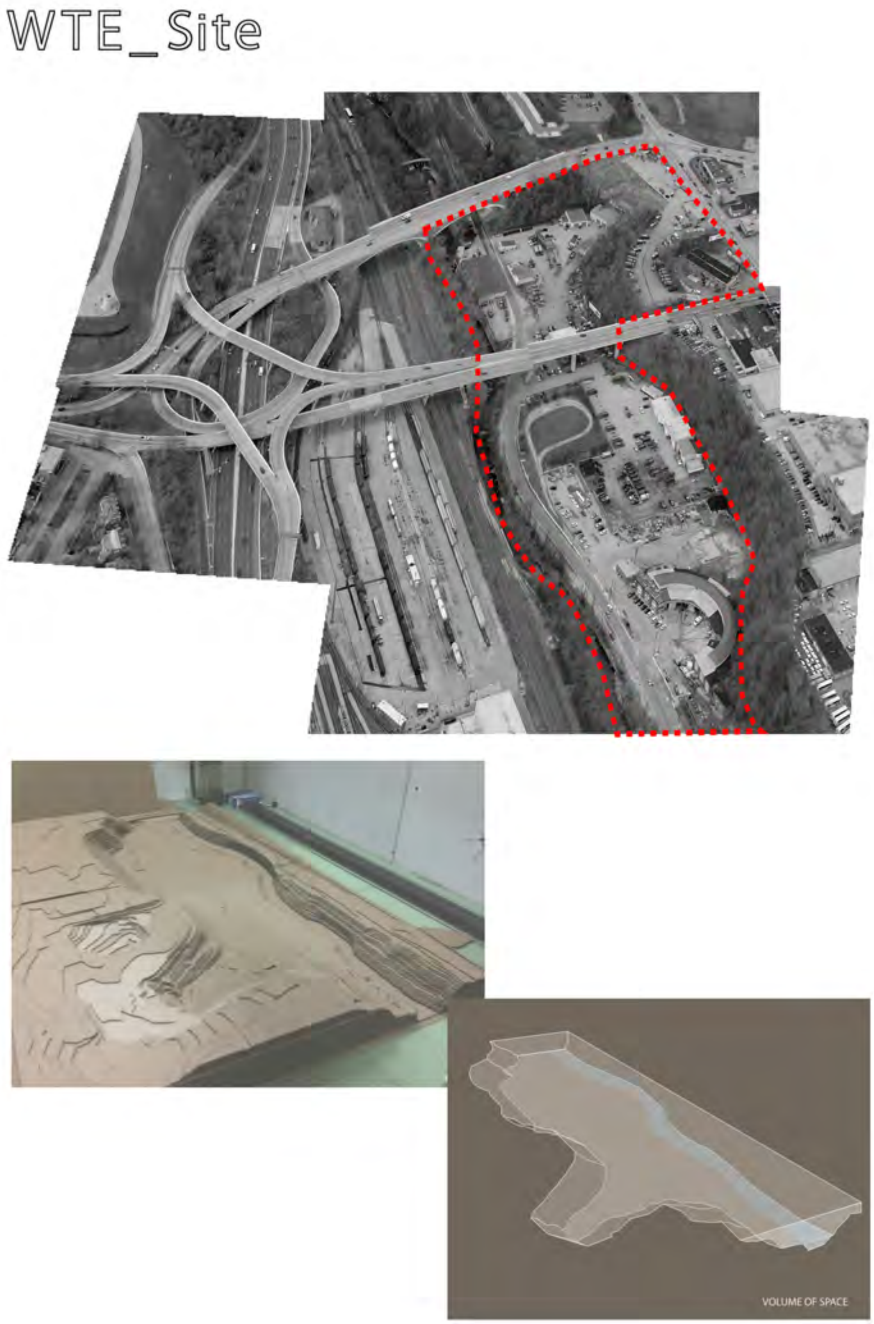

Fig. 27 Perimeter and volumetric diagram.

Feasibility Study

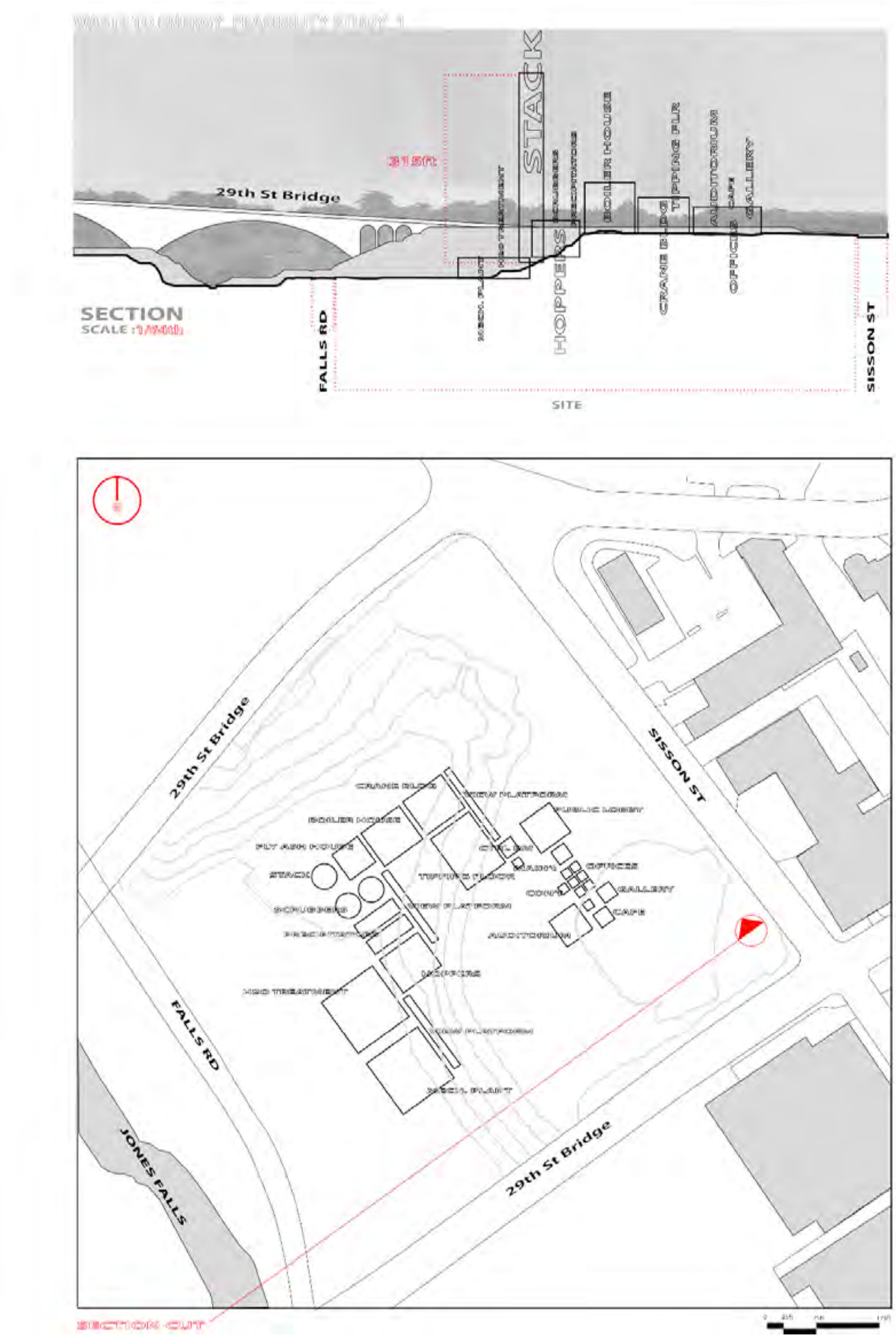

Fig. 28 Preliminary feasibility study.

Concept Translation

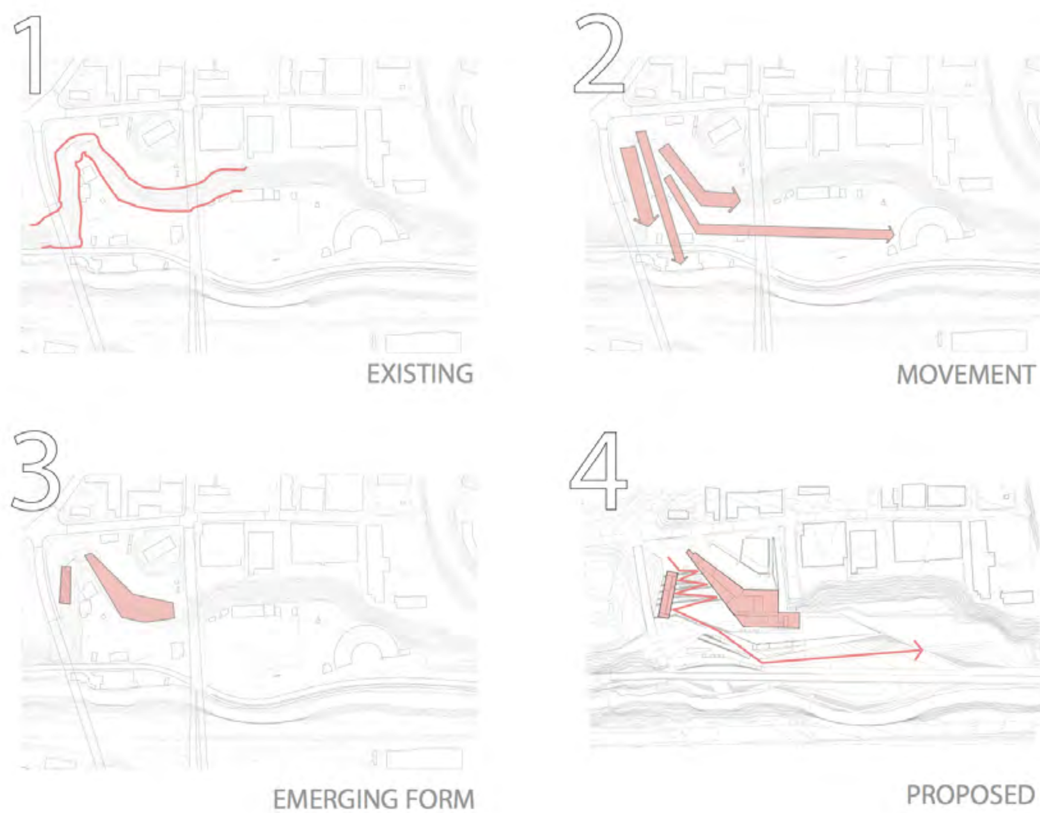

Fig. 29 Conceptual design diagram.

Plan Development

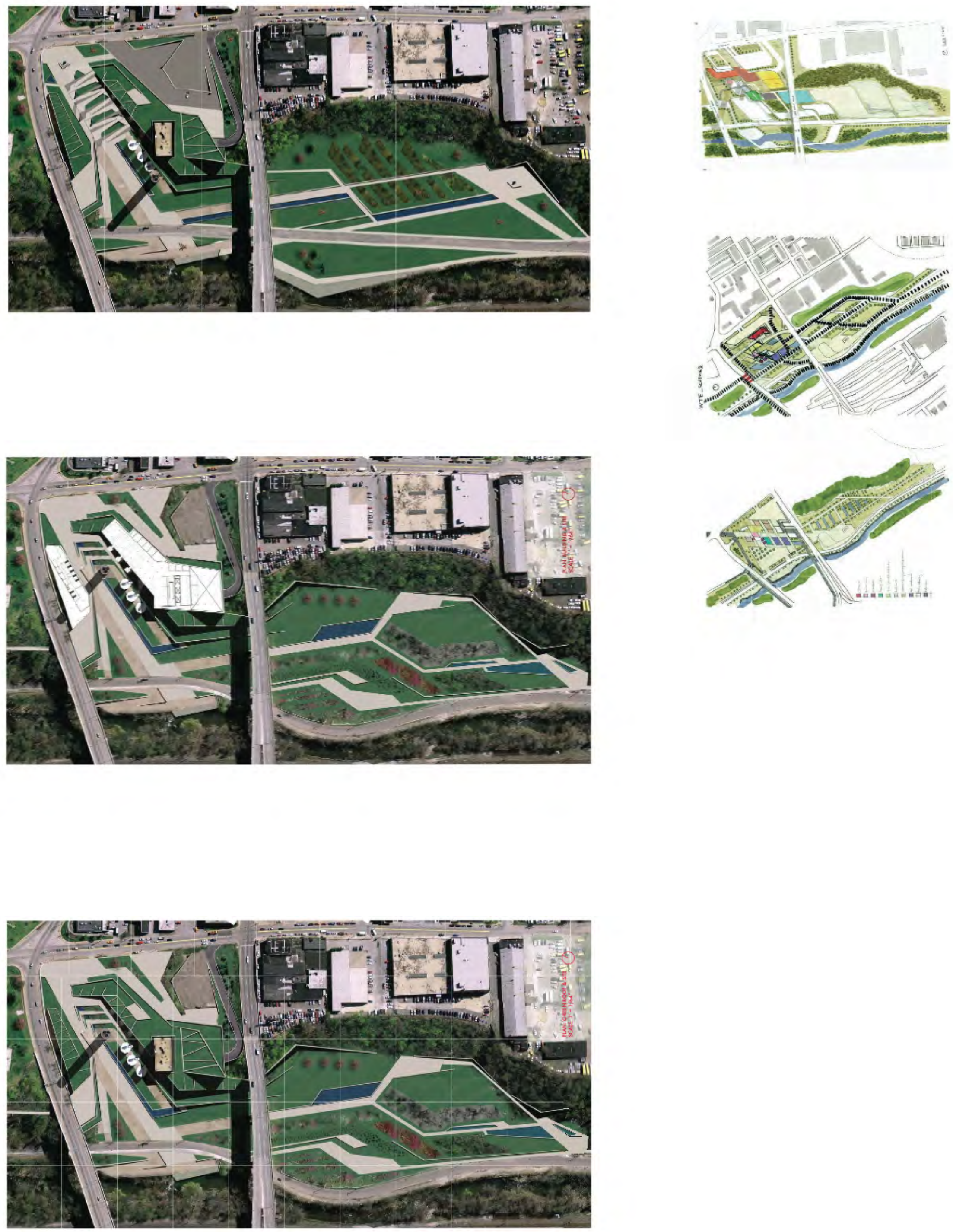

Fig. 30 Preliminary Site plan development.

Proposed Site Plan

Fig. 31. Site Plan

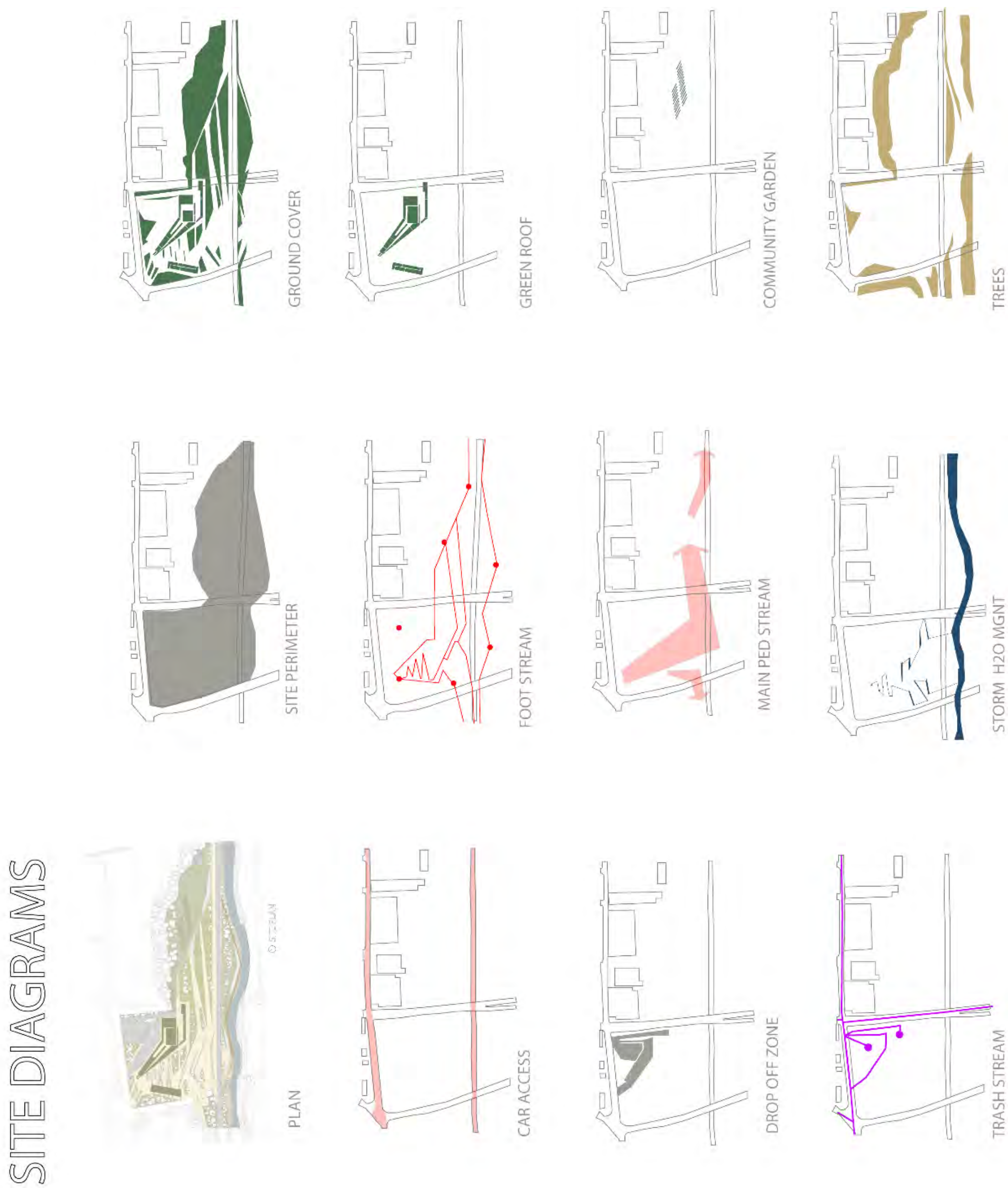

Fig. 32 Site Diagram of functions.

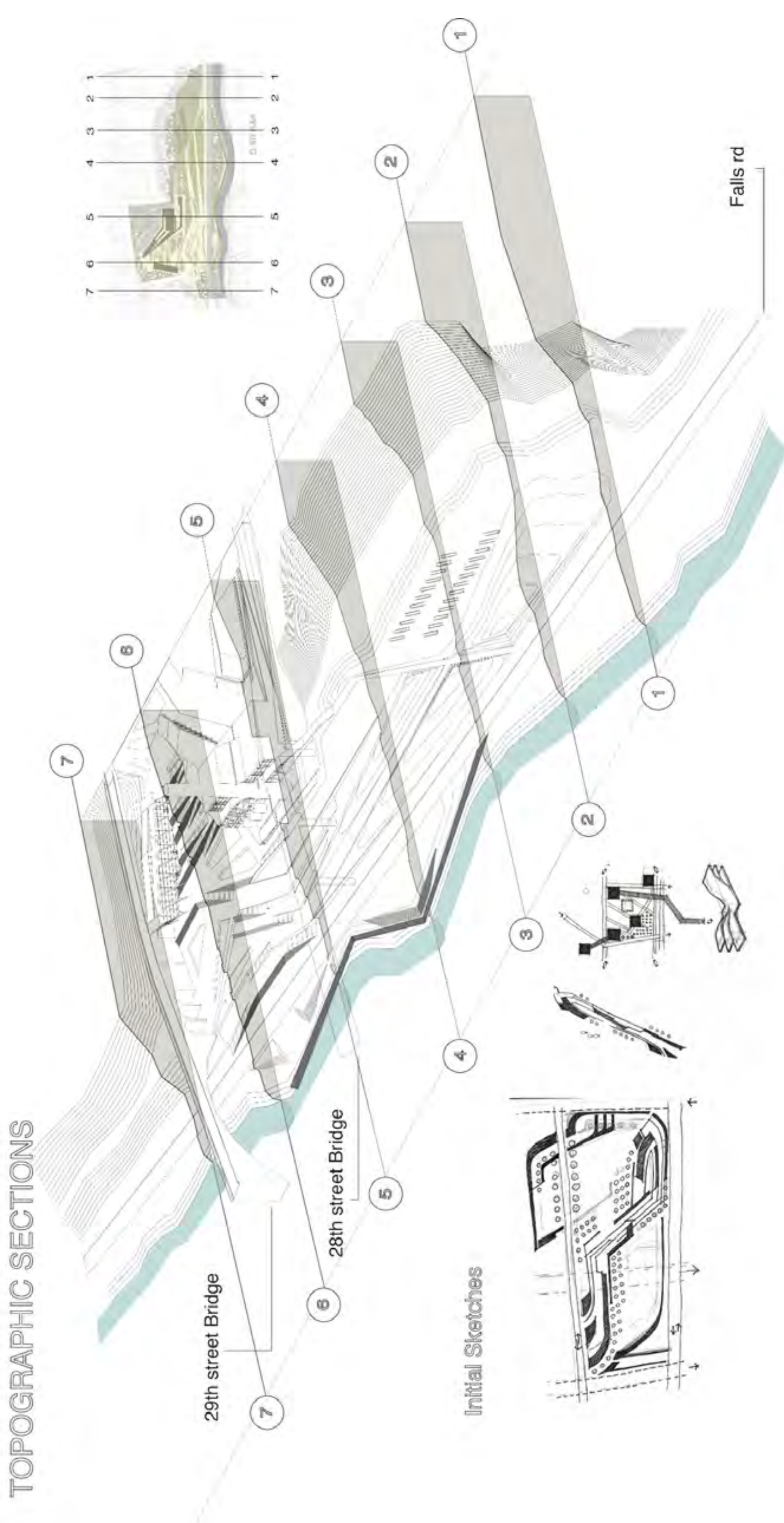

Fig. 33 Topographical sections and sketches.

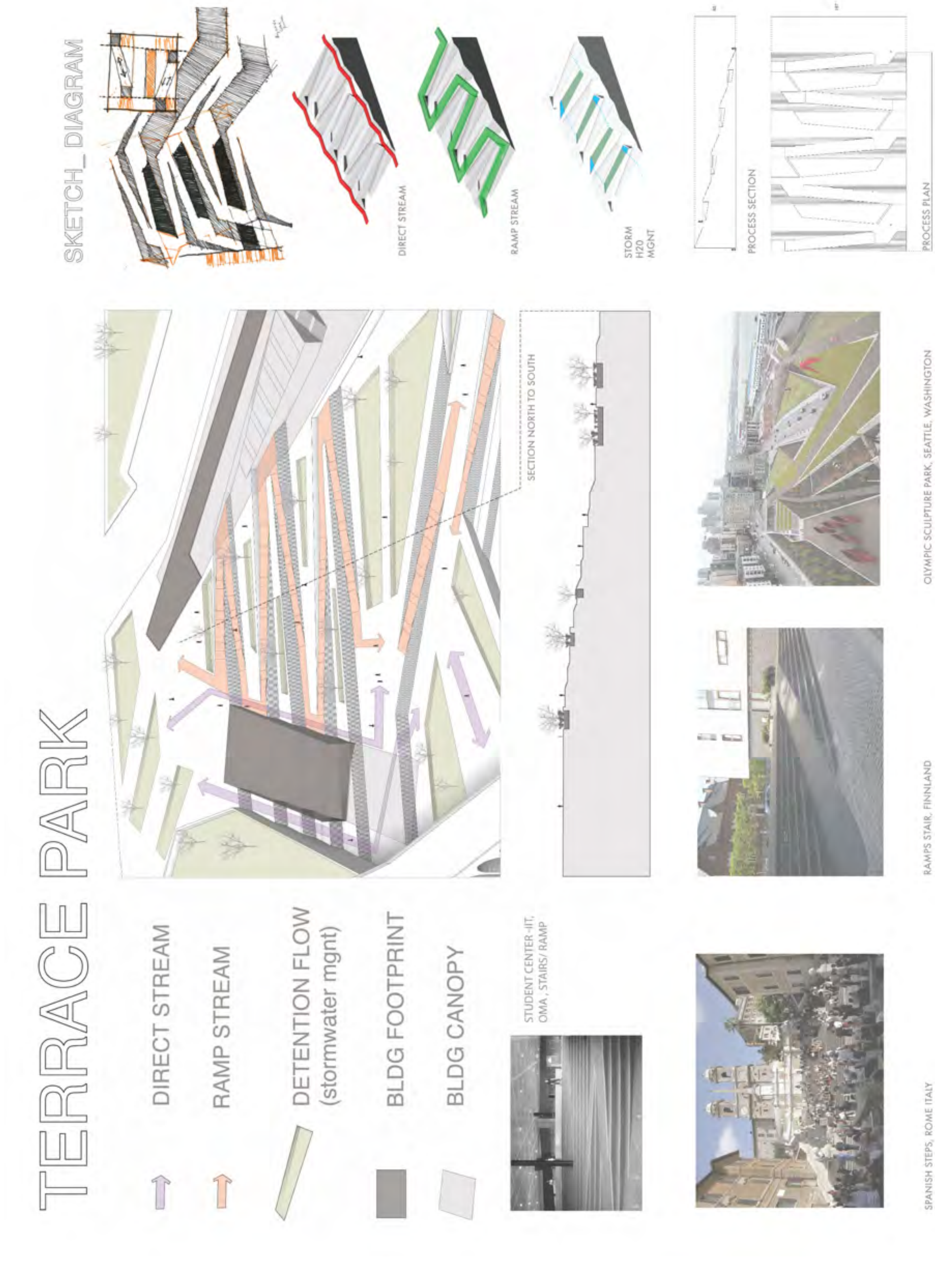

Fig. 34 Terrace Park precedent and Preliminary development.

Fig. 35 Section 1.

Fig. 36 Section 2.

Fig. 37 Section3.

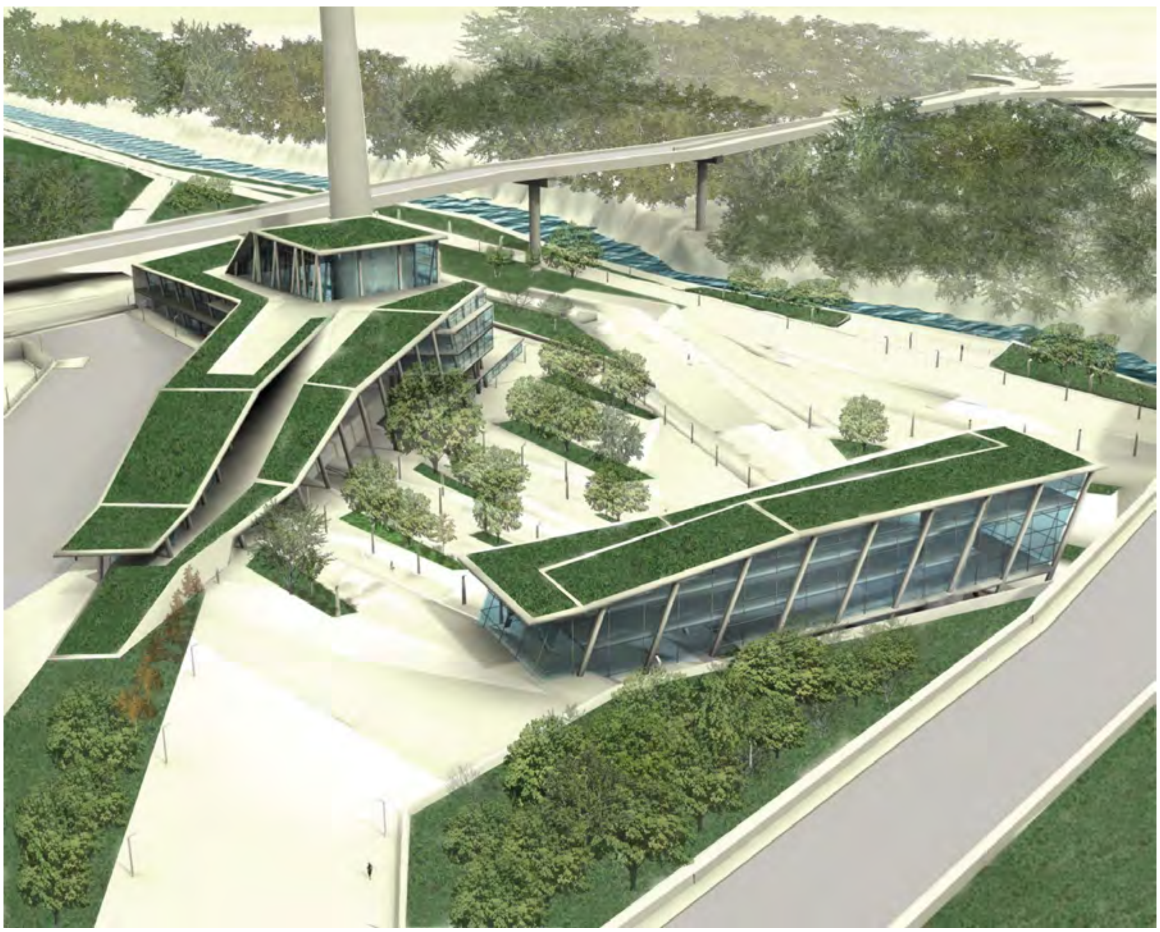

Fig. 38 Aerial Perspective of Entrance to park.

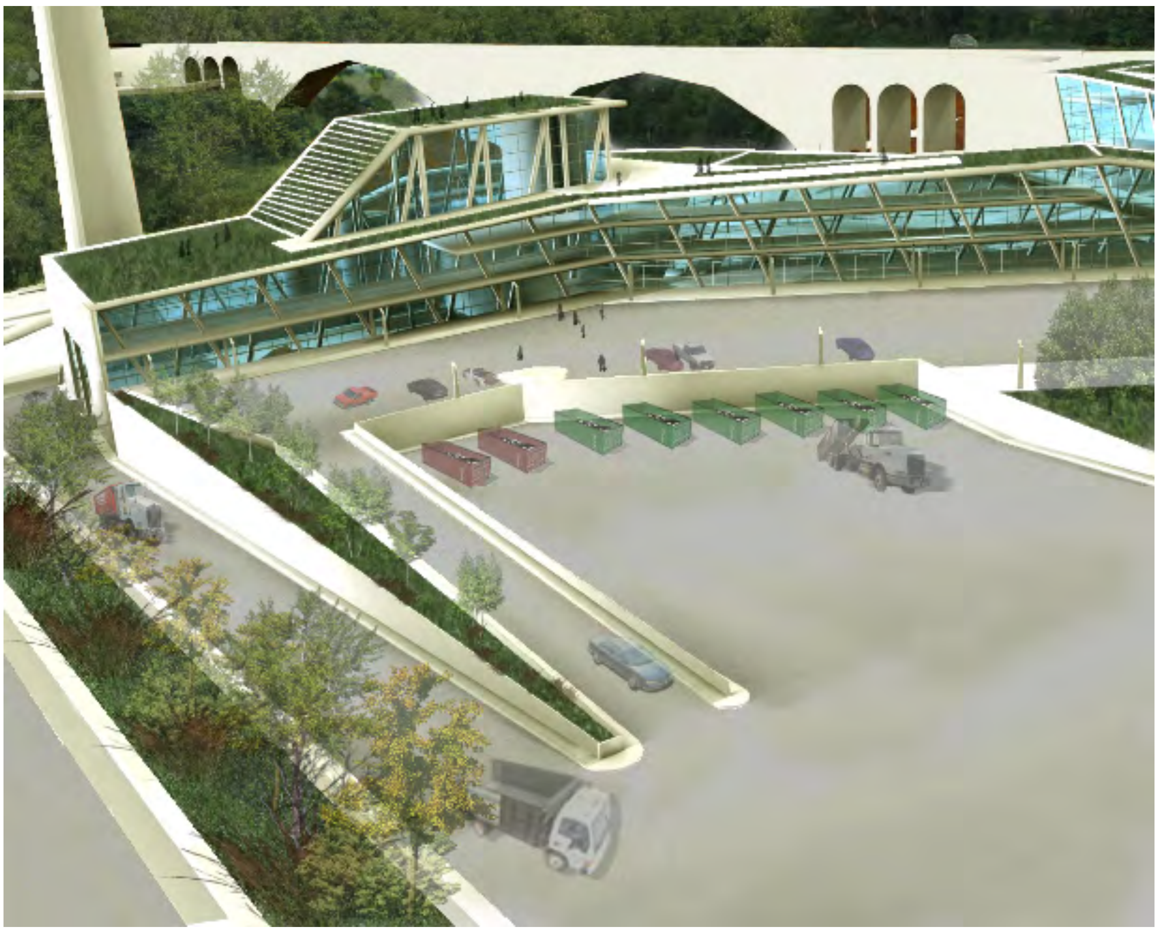

Fig. 39 Refuse Drop off and Recycling Zone.

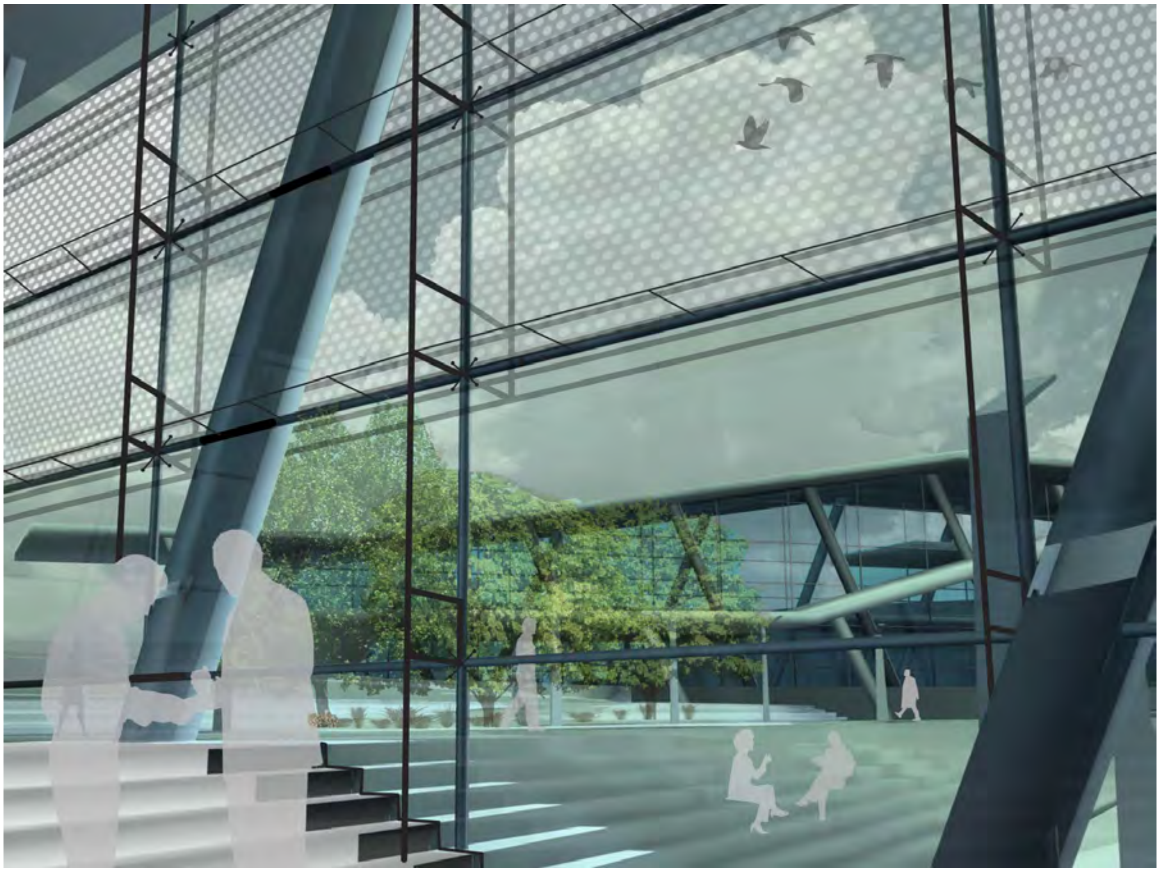

Fig. 40 Interior Public building perspective looking out through Terrace Parkand onto Plant building .

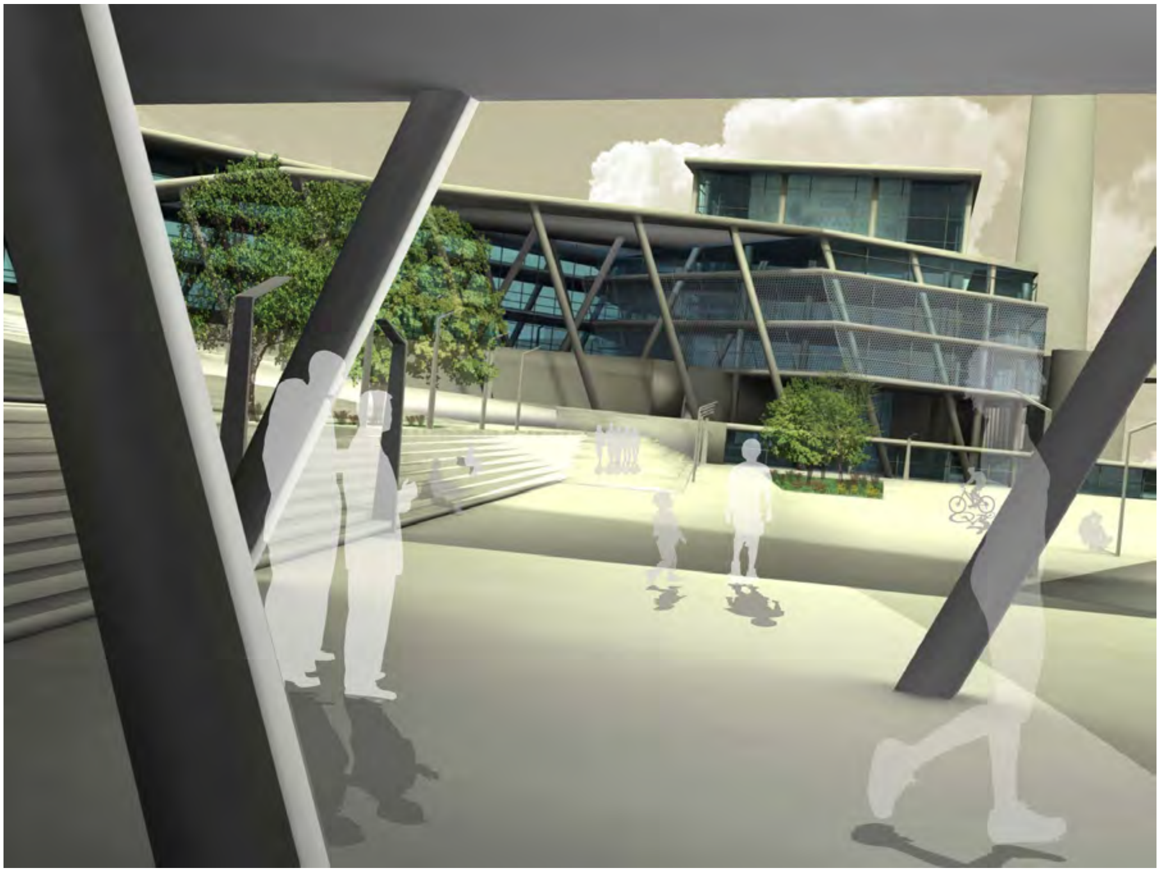

Fig. 41 Underneath Public Building gathering area.

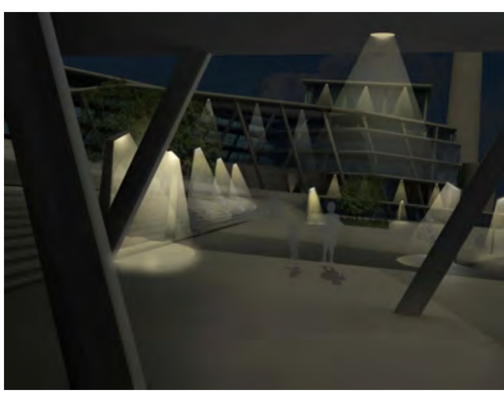

Fig. 42 Night render

Fig. 43 Bottom of Terrace Park

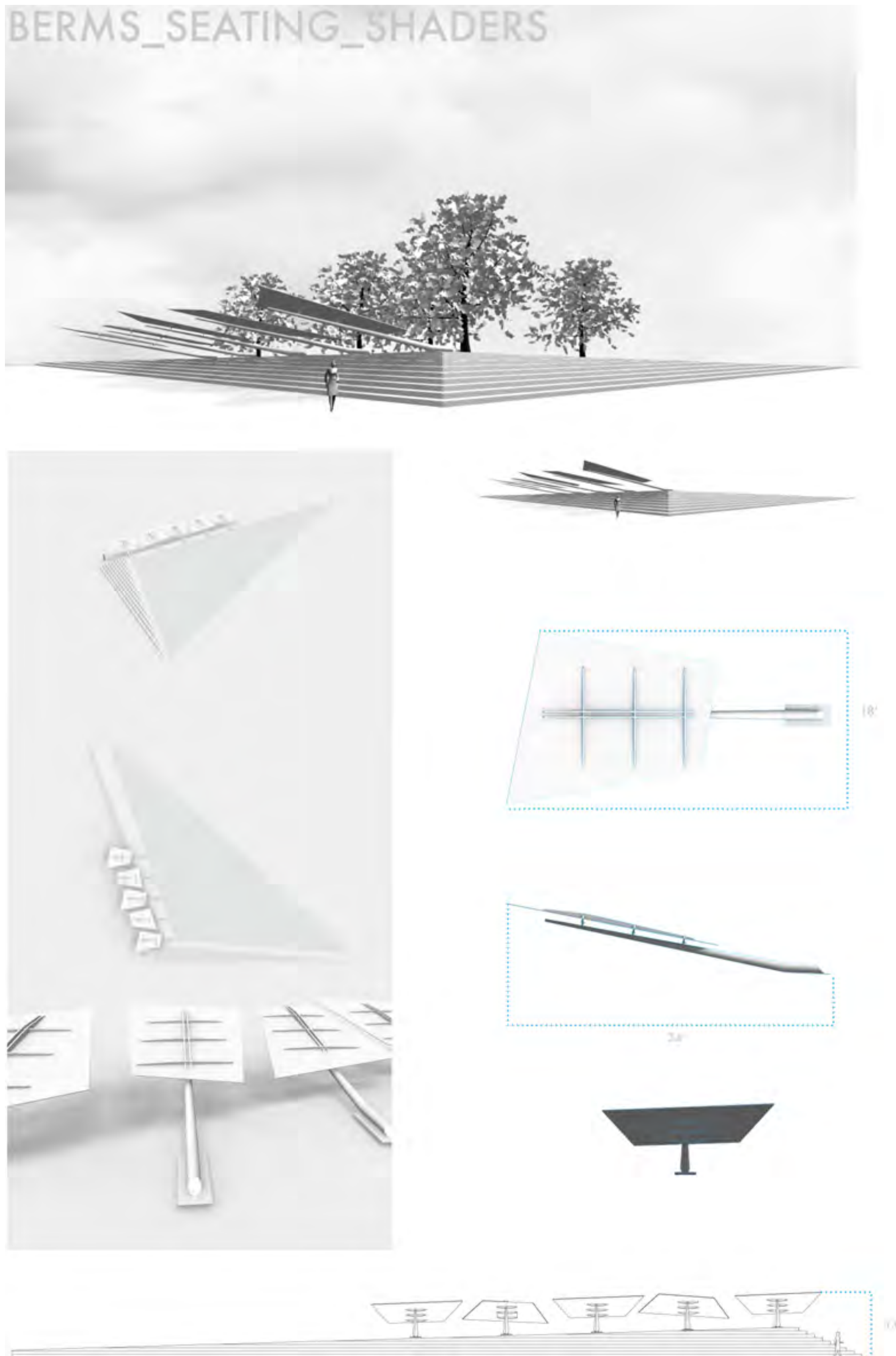

Fig. 44 Berm seating and Shading devices.

Conclusion

The intent of this thesis was to analyze and develop an architecture that responds to a community on a socio-economic, environmental and cultural level by way of awareness, impact, and integration. Preliminary investigations seem to limit research to superficial issues pertaining to consumption and program placement. After further analysis, the initiation of architectural ideas incorporating a sustainable holistic view to development started to emerge. Designing with the idea of fostering an inter-communication with nature and people became the new focus. This also meant that the design would rely heavily on the integration of Landscape and Architecture creating an even deeper didactic presence in mind, bringing a consciousness to the way that we experience the space.

The interim brought about certain challenges that slowed, but never stopped the discoveries in the design process. Lofty expectations led to extended explorations in new territories such as Maya (3d animation program) and the world of Landscape architecture. These proved to be technical areas that needed to be supplemented with adequate training that time did not allow for.

This research provided an opportunity to tackle unfamiliar territories in Architecture and ambitious concepts within our society. This research has erected the scaffolding of change by way of questioning the role of architecture and Landscape, and how it can rebuild environmental awareness within a culture while raising social consciousness.

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