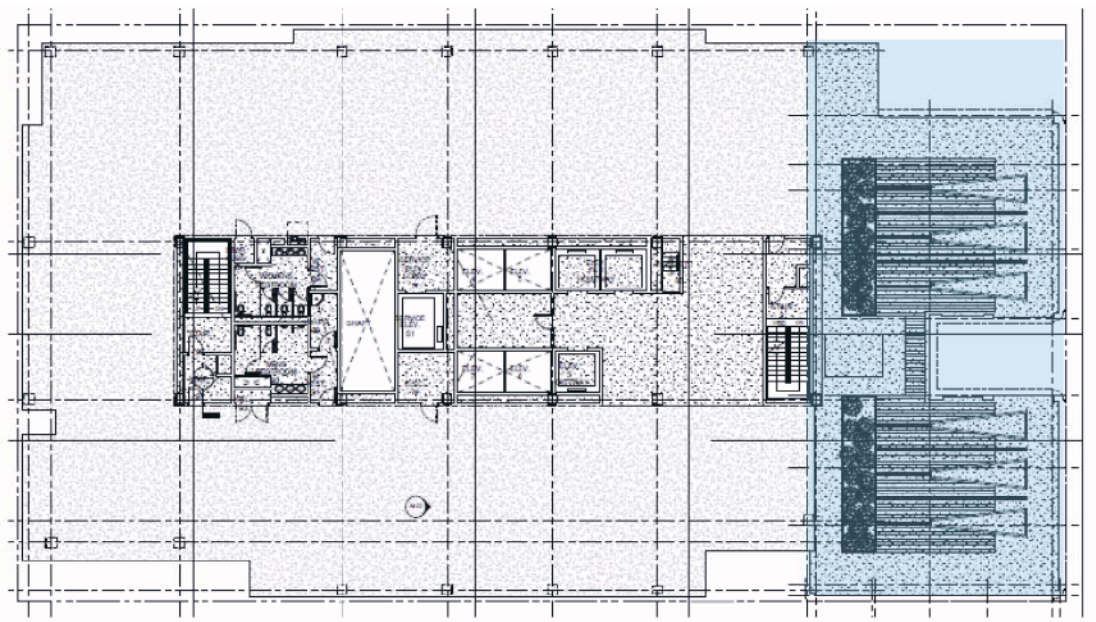
BREADTH STUDIES

Introduction

The geometry of 1100 Broadway's architecture provides the perfect opportunity to incorporate a green roof into its design. At the 9th level a large set back occurs where the Key System Building portion of 1100 Broadway terminates. The Key System Building was a 37,000 square foot historic office building which was damaged in the 1989 Loma Prieta earthquake and has remained vacant ever since. It is now a National Historic Landmark and its facade is incorporated into the design of the first eight floors of 1100 Broadway.

The original project is only in the design development phase but there are intentions to create a green roof at this level to help contribute to the sustainable goals of the building. Details on the existing green roof design are not available and therefore both breadth studies will focus on this portion of the design. See Figure 40 below.

Figure 40: Level 9 floor plan with focus area highlighted in blue



In pursuit of achieving a LEED Gold rating or higher, sustainability was a major focus in the design of 1100 Broadway. Green roofs provide many sustainable benefits such as rainwater retention from plant and soil absorption that would otherwise be directed to downspouts. They increase the thermal resistance of the roof system and prevent UV damage to the roofing membrane, ultimately increasing the longevity of the roof system. Green roofs also reduce the urban heat island effect but perhaps the largest benefit for the occupants is providing a habitable green space for lunch breaks and gatherings which would otherwise be an unused hard-surfaced area.

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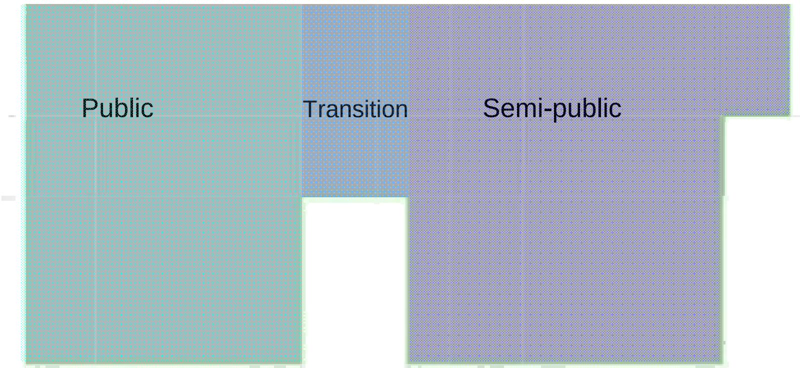
When the structural system was redesigned an allowance for the weight of the green roof was made. The allowance was based on an extensive green roof system but after studying the space it was determined that it was well suited for an intensive green roof system. An intensive system was also chosen for study because it provided more of a design challenge. Therefore it should be noted that the loads placed on the structure are significantly higher than those accounted for in the redesign due to a much larger soil depth and if the intensive system were to be installed the structure would have to be significantly upsized to handle the higher load demands.

Architectural Breadth

The goal of the architectural breadth was to provide a space for occupants to relax and socialize and therefore an intensive green roof system has been designed. The intensive system functions more as a roof garden and requires constant maintenance. It was chosen over an extensive roof system which is typically composed of low growing sedum plants and is basically maintenance free. An extensive roof is also not intended to be occupiable space.

For the architectural breadth most of the focus was on the actual design of the plan and the plant selection. All plans were created in Adobe Photoshop. The space was divided into three zones public, transition, and semi-public. See Figure 41 below.

Figure 41: Zones



The completed plan can be seen in Figure 42 and a magnified view of each zone can be seen in Figures 43-45. The public zone features a large deck in the center to encourage socializing and gathering of coworkers during breaks. The transition zone acts as a buffer between the two spaces and contains terraced plant beds and an overhead trellis. The semi-public zone is a more personal space and offers areas with more privacy.

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Figure 42: Completed plan

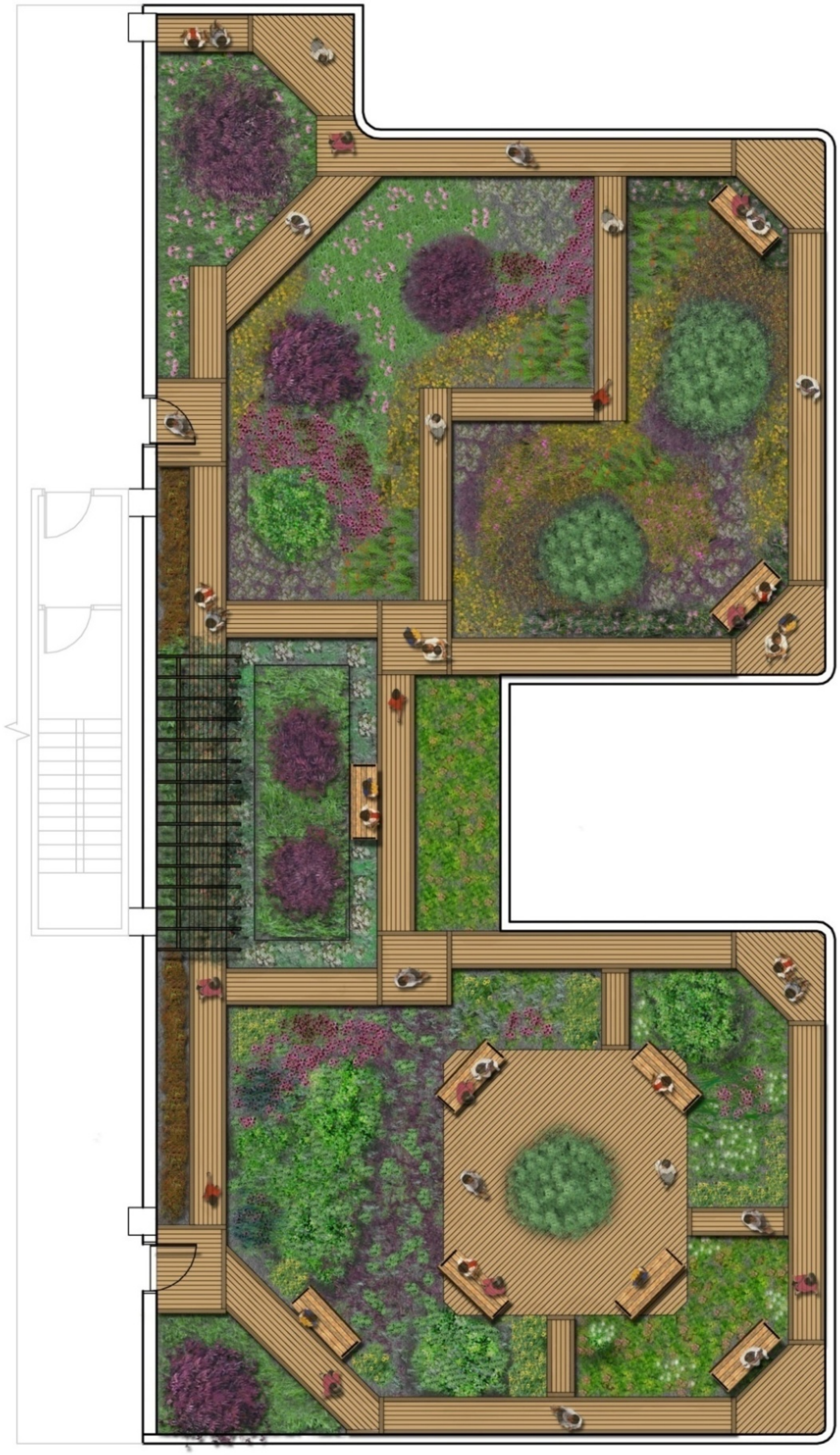

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Figure 43: Enlarged view of the Public Zone

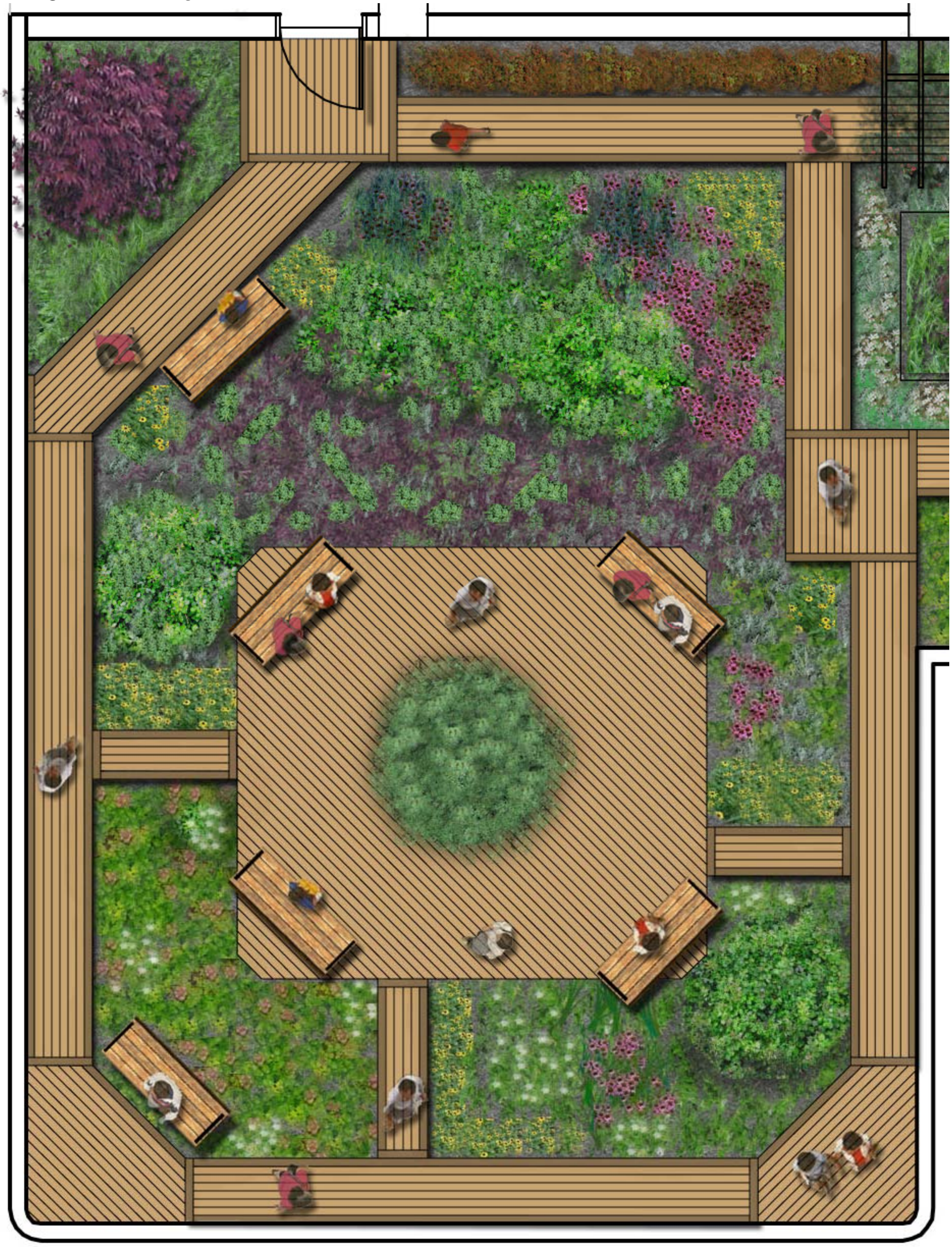

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Figure 44: Enlarged view of the Transition Zone

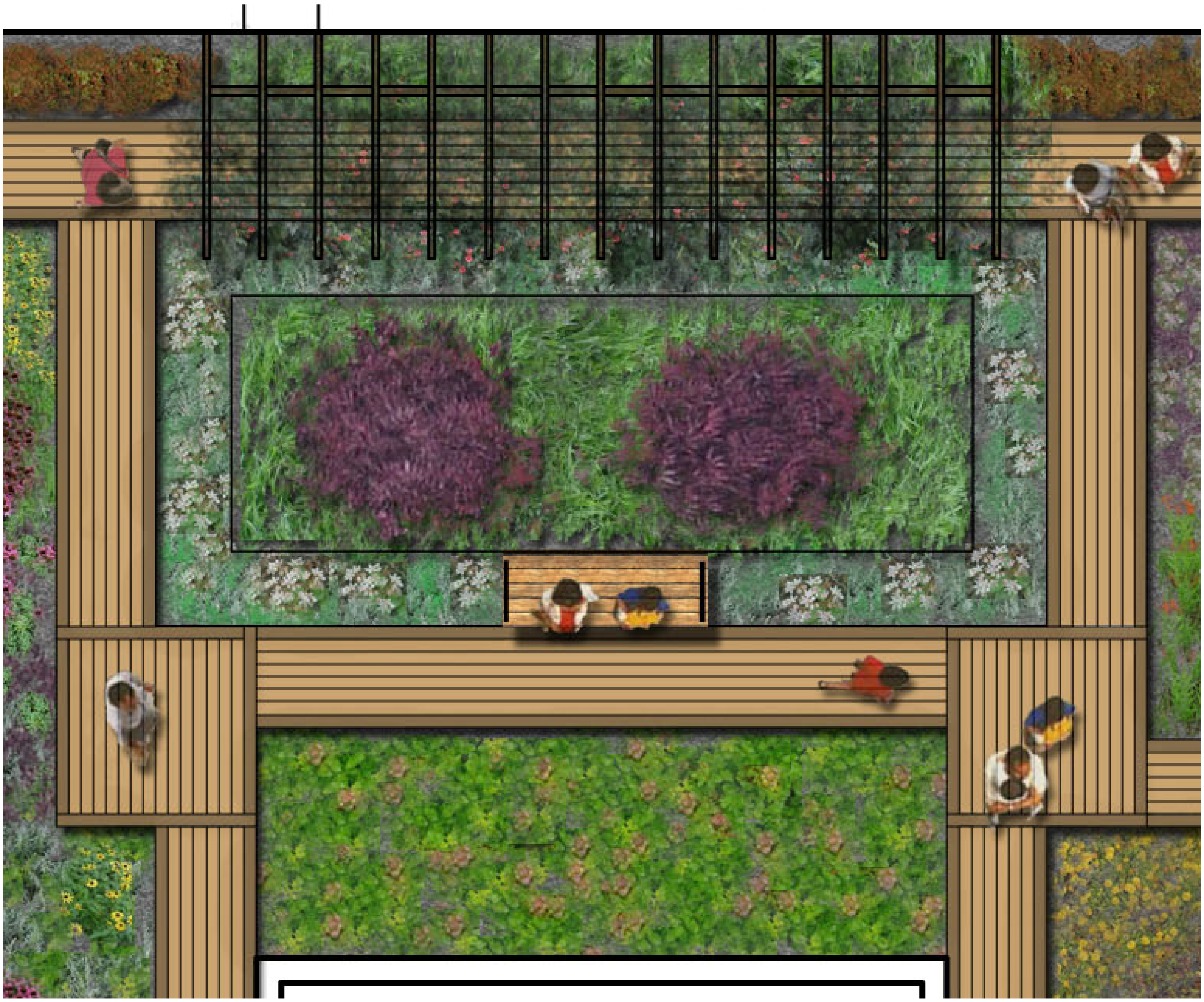

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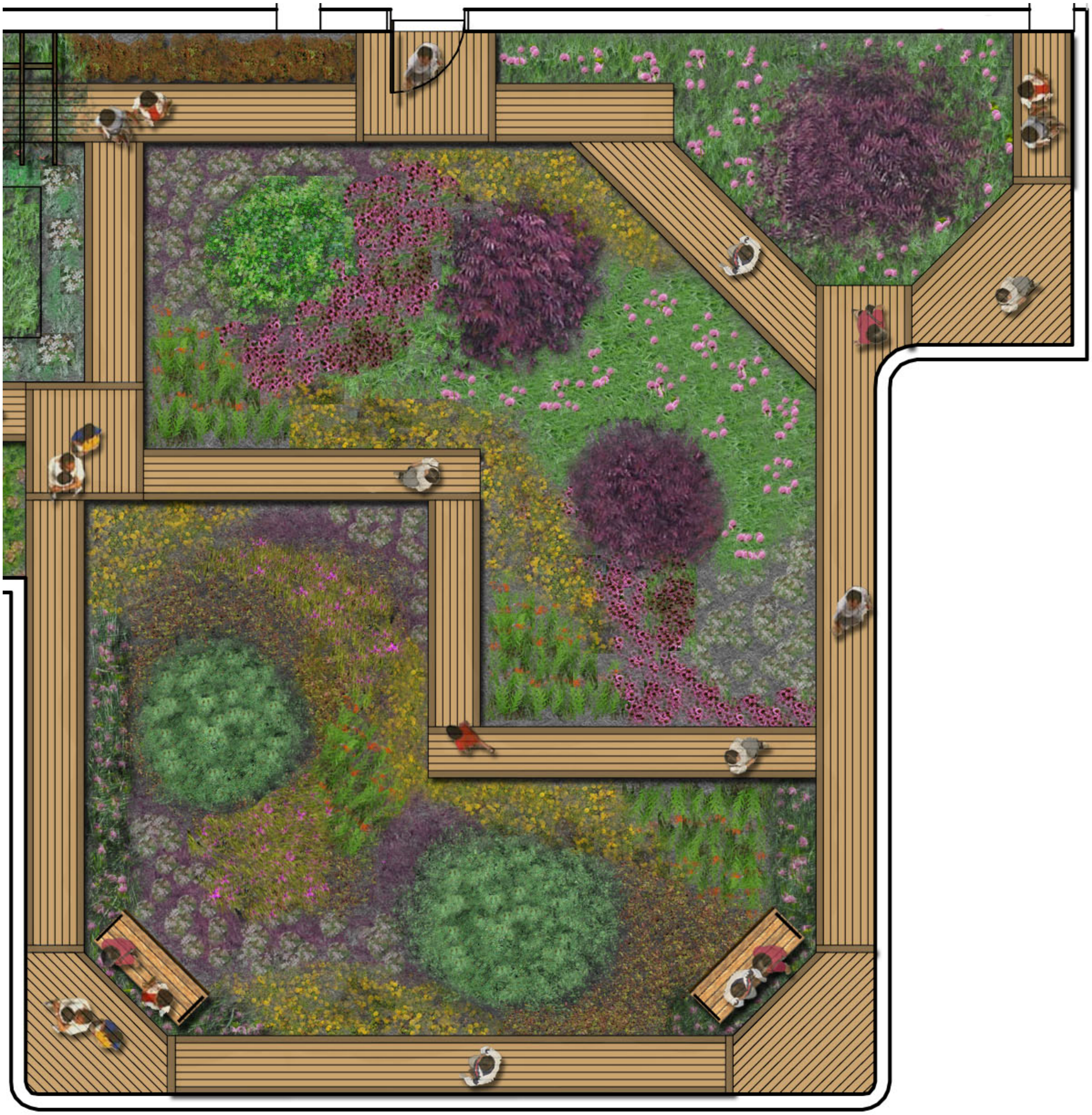
Figure 44: Enlarged view of the Semi-Public Zone



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Planting Plans

Plants were specifically selected for the climate in Columbus, Ohio and plans are provided detailing plant species and location. Species not specifically called out in the planting plans are sedums and grasses including Virginia wild rye (Elymus virginicus), ice plant (Delosperma nubigenum), and kamtschaticum sedum (Sedum kamtschaticum). See Figures 46-49 for planting plans.

Figure 46: Planting Plan 1

Fragrant Sumac *(Rhus aromatica)*
http://www.pottedliners.com

Japanese Maple *(Acer palmatum)*
image: http://www.dirtdoctor.com

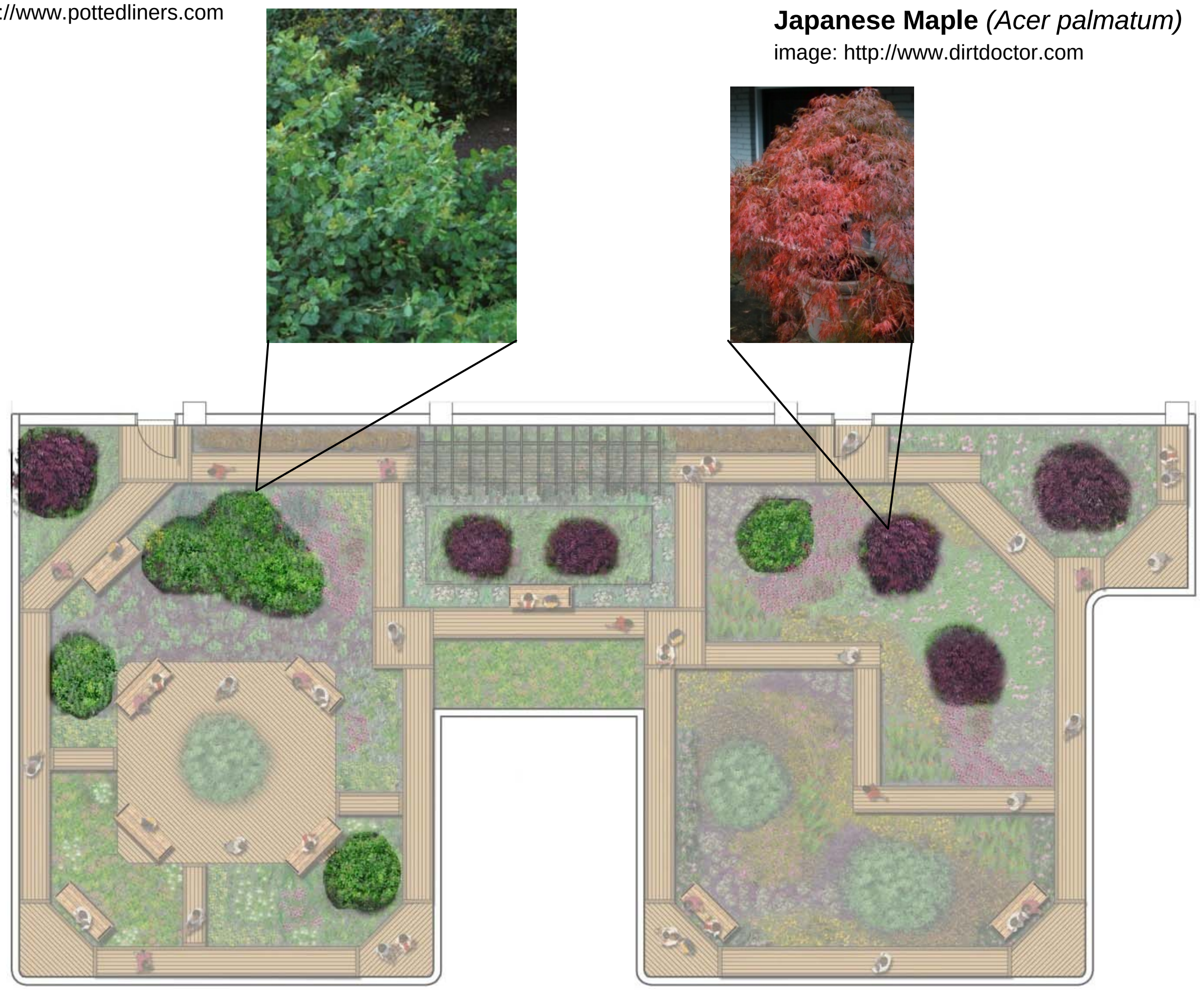

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Figure 47: Planting Plan 2

Chive (*Allium schoenoprasum*)
http://4.bp.blogspot.com

Trumpet vine *(Campsis radicans)*
http://www.hramornursery.com

Nodding Onion (*Allium cernuum*)
http://image02.webshots.com

Purple Coneflower (*Echinacea purpurea*)
http://www.springcreekforest.org

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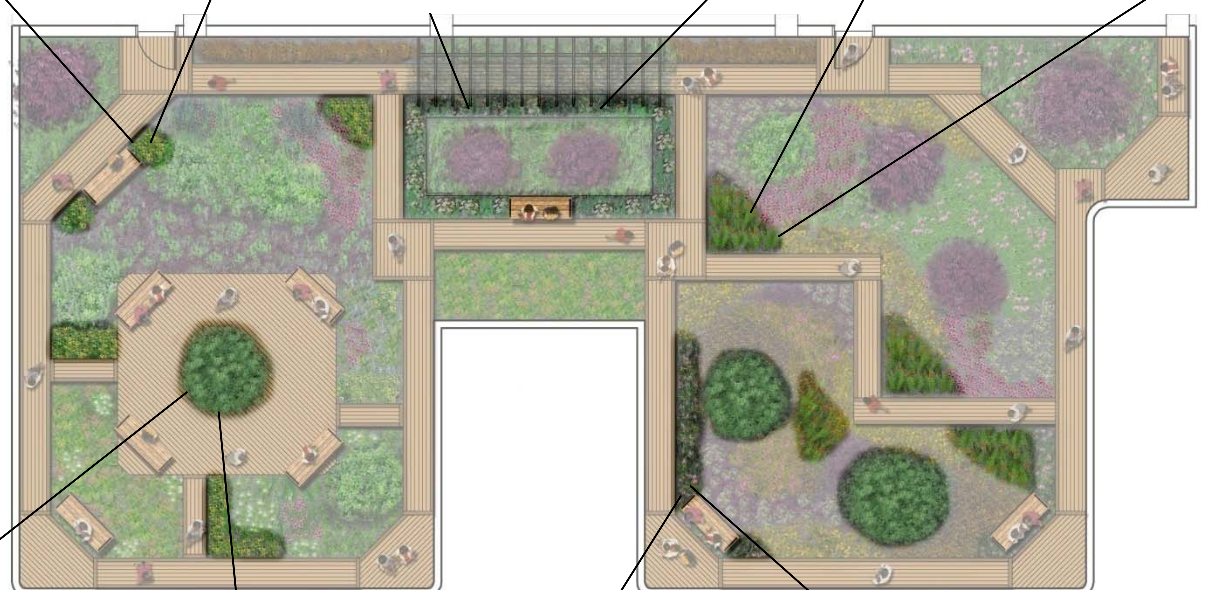
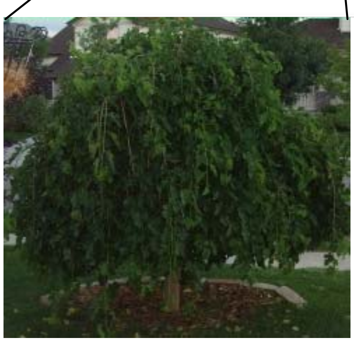
Figure 48: Planting Plan 3

Butterfly Milkweed (*Asclepias tuberosa*)
http://www.wildflower.org

Black-eyed Susan (*Rubeckia hirta*)
http://images.google.com

Yarrow (Achillea millefolium)
http://media.photobucket.com





Fruitless Mulberry (*Morus alba*)
http://www.francescaowens.com

Wild Pink (*Silene carolinian*)
http://images.google.com

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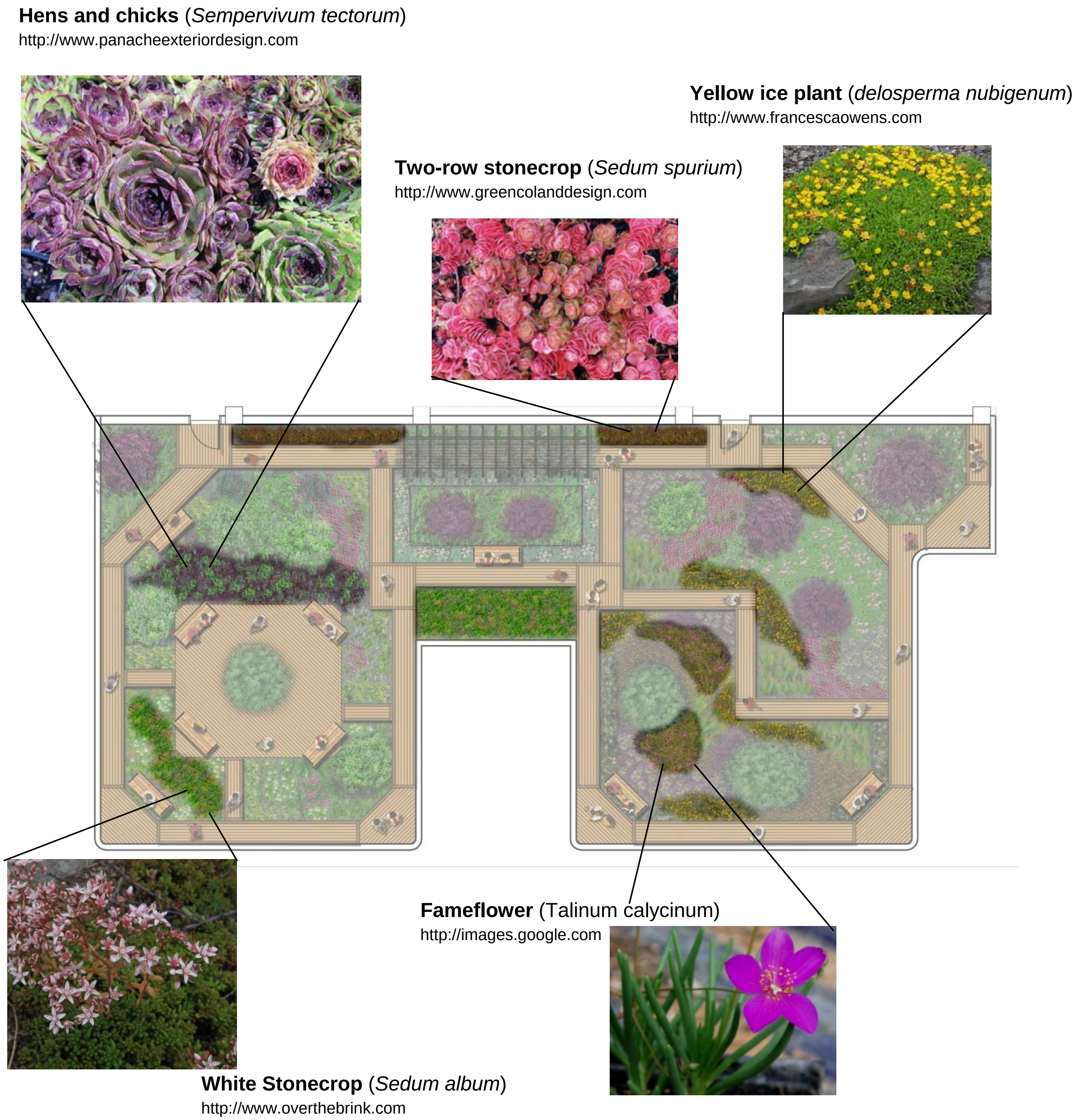
Figure 49: Planting Plan 4



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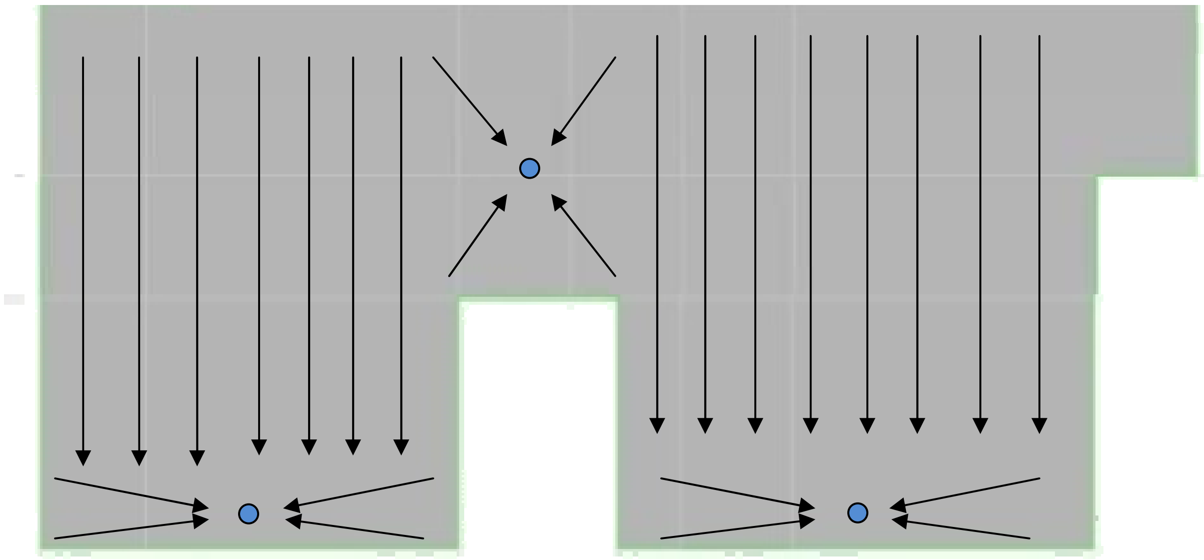
Building Enclosure Breadth

The goal of the building enclosure breadth was to integrate the green roof system with the building envelope and control the flow of heat and moisture between the interior and exterior of the building. Research was performed to determine the best roofing system and a system appropriate for 1100 Broadway was designed.

Drainage

According to the 1997 Uniform Building Code, a minimum slope of 2% should be provided for drainage of weather-exposed areas. For good design practice this value should be doubled and therefore a 4% slope to all roof drains has been provided. This ensures that the 2% slope will be achieved after the system is constructed. Ideally drains should not be placed directly above structural supports. Deflections are largest at midspan and therefore if possible drains should be placed accordingly. Water on the roof was directed towards the exterior of the building. See Figure 50 below for a drainage slope plan.

Figure 50: Sloping plan to drains



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Waterproofing

An Inverted Roof Membrane Assembly (IRMA) was chosen for the roofing system. In this type of assembly the insulation layer is placed above the waterproofing membrane rather than typical roof systems which place the insulation below the waterproofing membrane. The insulation offers some protection for the membrane from damage during construction and exposure to corrosive elements. The first layer on the roof is perhaps the most critical layer. It acts as the last line of defense against moisture trying to enter the interior. The first layer of the roof system was built up using layers of fabric and hot rubberized asphalt. This layer acts as the underlying waterproofing membrane.

Root barrier

To keep plant roots from penetrating through the waterproofing membrane and causing perforations in the building envelope a root barrier should be the next layer in the roofing system. The root barrier should be placed on the rubberized asphalt layer while it is still warm to achieve a strong bond. The root barrier comes packaged as a roll and consists of more rubberized asphalt reinforced with polyester fibers and treated with a root-repelling agent. After the root barrier has been placed it's crucial that all seams are torch welded to prevent root penetration.

Insulation

To reduce the amount of heat loss through the roof, insulation is the next required layer. The design features extruded polystyrene rigid insulation boards.

Aeration

Standing water on a roof can be detrimental to its insulation capacity. To allow for any standing water to dry out an aeration layer is necessary. Therefore a 1/4" thick aeration and drain mat was laid on top of the rigid insulation. This essentially creates a 1/4" air space for drying out any water that may be contained in the insulation after a storm.

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Water-retention and Drainage mat

Although it's undesirable to have water standing on the insulation, one of the main advantages of a green roof is its ability to retain water and reduce storm water runoff. Water retention can be very beneficial as long as it's not contained in the insulation. Another mat containing egg shaped voids was overlaid on the aeration mat with the function of retaining water for the plants. The mat is 2.5" thick and is filled with expanded shale and acts as a reservoir to hydrate the above plants.

Filter Fabric

Filter fabric is the last synthetic layer of the roofing system. It is permeable and allows for root penetration into the water retention and drainage mat below. The filter fabric is then topped with an engineered soil mix. Typically the mix consists of 75-80% inorganic matter, which includes expanded slate and crushed clay, and 20-25% organic matter, which includes humus and topsoil. See Figure 51 below for a section view of the roof system.

Figure 51: Roof section
Image from http://mcdsconstruction.org