STORMWATER ALTERNATIVES ANALYSIS
MILWAUKIE NORTH MAIN MIXED-USE DEVELOPMENT

prepared for:
Metro Regional Government
October 21, 2004

prepared by:
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STORMWATER OPTIONS ANALYSIS

MILWAUKIE NORTH MAIN - Mixed Use Development

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Overview

The following information includes an analysis of the impact of utilizing integrated stormwater into a highly developed site in the city of Milwaukie. The goal of the process is to look at implementation of stormwater infrastructure into site landscaping & amenities and see what costs can be offset in doing so. The focus, as it is the only measure we can utilize at this point, is construction costs. Thus life-cycle costs, incentives, and other long-term costs are not factored into the equations.

The results are summarized in following sections, including a narrative for each option, a drawing showing the water system specified, and a cost-breakdown of elements utilizing estimated cost ranges. This gives the ability to compare 3 distinctly divergent alternatives & look at the most effective methods of achieving the most benefit for the least construction costs.

Cost estimates are based on the most readily available sources, and due to the small number of constructed projects, reflect the best information at this time. As more projects implement stormwater infrastructure in not traditional ways, costs will be more readily available & per industry trends costs will come down as well.

Scenario #1:

Base Case - Mechanical Stormwater Treatment & Traditional Landscaping

The base case scenario develops stormwater infrastructure for the site based on the traditional building practices, meeting the minimum level of storage, treatment, & conveyance required by the City of Milwaukie. This provides a datum in which to compare additional scenarios, both in terms of performance and costs (both design and construction).

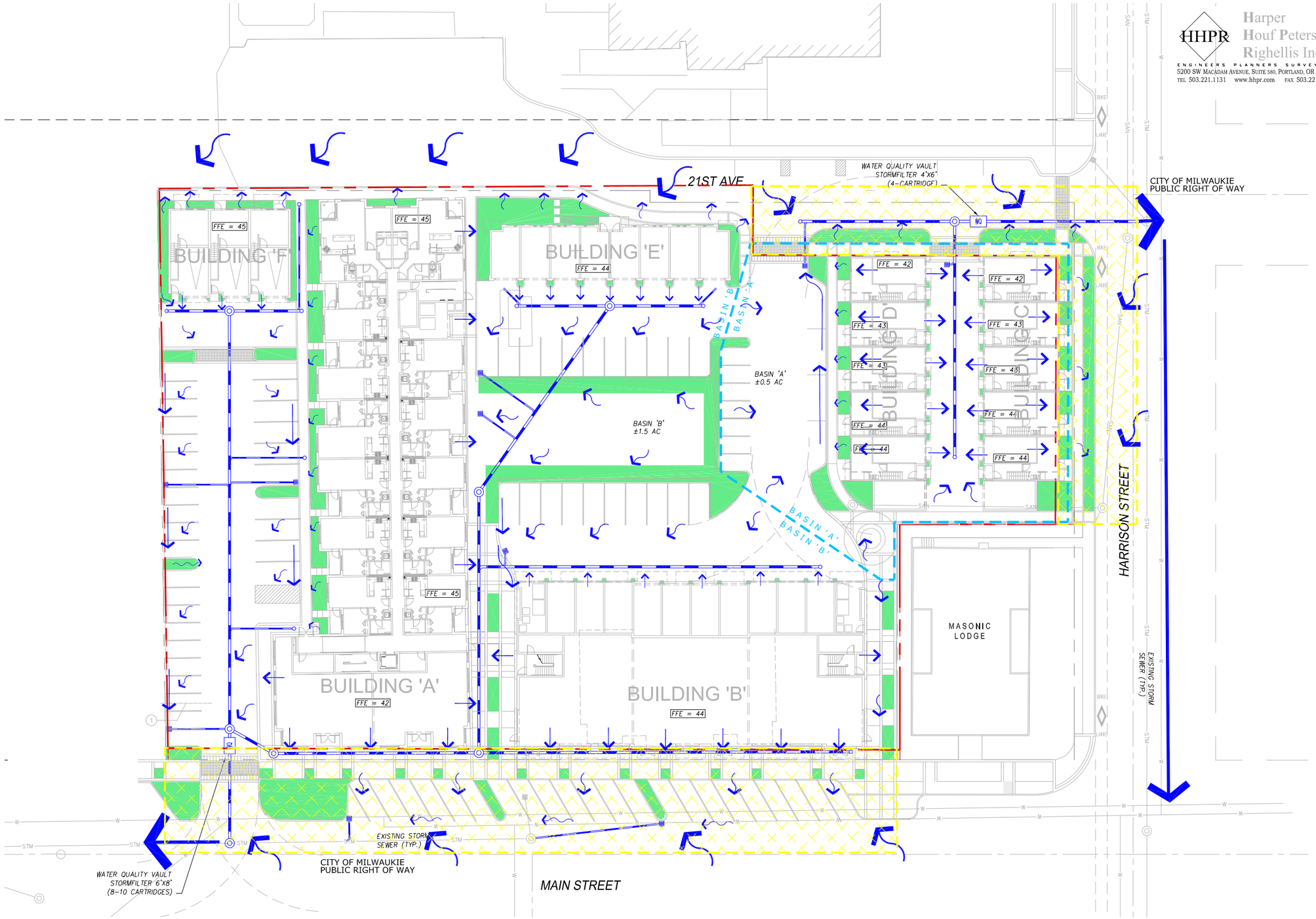
HHPR developed this scenario, based on initial discussions with the design team, specific requirements of the City of Milwaukie, and the site topography & layout. Their analysis identified two basins within the site, draining in opposite directions from a high point.

Basin A is approximately 0.5 acres, and encompasses part of the east entry drive, and parking, as well as the entirety of Buildings C & D. This basin drains at the SE corner of the site at the corner of Harrison Street & 21st Avenue, where it connects to the existing storm sewer system on Harrison Street.

Basin B includes the remaining 1.5 acres of site area, including Buildings A, B, E, & F. These are treatment with on surface flow collected in drains & catch basins, as well as typical downspouts from buildings, exiting into the city storm sewer in the NW corner along Main Street. Both systems utilize mechanical systems for water quality & treatment.

The benefits of scenario #1 is that it provides the minimum amount of infrastructure to meet the needs of the city. It also utilizes existing standard details & methods that require little to no modification to adapt to the site. Disadvantages of this scenario are that the water is immediately shunted into the stormwater system and contributes to problems associated with peak flows. Also there are no opportunities present to see water or use it as an amenity. Additionally, there are no opportunities to utilize the offer of financial incentives from the City of Milwaukie to contribute to infrastructure in the public right-of-way.

Cost Impact:
None



LEGEND (PROPOSED)
STORM SEWER
MANHOLE
CLEANOUT
WQ — WATER QUALITY VAULT (STORMFILTER)
CATCH BASIN

LANDSCAPED AREA

PIPES

SHEET FLOW

DIRECTED FLOW

NORTH

SCALE 1"=20'

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MILWAUKIE MAIN STREET MIXED-USE DEVELOPMENT
MILWAUKIE, OREGON

REGISTERED 204 LAUREL A. MACDONALD OREGON LANDSCAPE ARCHITECT

STORMWATER OPTIONS MECHANICAL BASE CASE

Designed:	JAK
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Cost Projections - Case #1 Base Mechanical Case
Milwaukie North Main - Mixed Use Development
Integrated Stormwater System

PRIVATE DEVELOPMENT AREA

Type of Component	units	unit cost [1]	quantity	est. cost	base cost [2]	cost offset (+/-) [3]
Landscaping						
Trees & Landscaping	sf	$ 2.00	4,450	$ 8,900.00	$ 8,900.00	$ -
Plaza & Detailed Paving	sf	$ 10.00	2,600	$ 26,000.00	$ 26,000.00	$ -
				$ 34,900.00	$ 34,900.00	$ -
			7,050 s.f. ##	$ 34,900.00	$ 34,900.00	$ -
			cost/s.f.	$ 4.95	$ 4.95	$ -

PUBLIC RIGHT-OF-WAY

Type of Component	units	unit cost [1]	quantity	est. cost	base cost [2]	cost offset (+/-) [3]
Landscaping						
Streetscape (ROW)	sf	$ 2.00	2,742	$ 5,484.00	$ 5,484.00	$ -
				$ 5,484.00	$ 5,484.00	$ -
			2,742 s.f.	$ 5,484.00	$ 5,484.00	$ -
			cost/s.f.	$ 2.00	$ 2.00	$ -

SUMMARY - Case #1 Base Case

Estimated Case #1 Cost

			Site Amenity	Engineering	Total
Private	7,050	sf	$ 34,900.00	$ 148,853.00	$ 183,753.00
Public	2,742	sf	$ 5,484.00	$ 18,392.00	$ 23,876.00
Total	9,792	sf		Project Total	$ 207,629.00

Estimated Base Cost

			Site Amenity	Engineering	Total
Private	7,050	sf	$ 34,900.00	$ 148,853.00	$ 183,753.00
Public	2,742	sf	$ 5,484.00	$ 18,392.00	$ 23,876.00
Total	9,792	sf		Base Total	$ 207,629.00
				Additional Cost	**$ -**

Scenario #2:

Integrated Stormwater: All potential Stormwater Options integrated with Site Landscaping

The goal of this scenario was to investigate on a site-specific scale all of the potential options that could be utilized to provide an integrated approach to stormwater infrastructure. The basins are similar to the base case scenario due to physical site constraints - as well as to compare the two systems more directly in both design and construction costs.

MEP developed this scenario, based on meeting with Myhre Group, Metro, & HHPR to discuss options. This worked off the previous meeting with City of Milwaukie and integrated the known information and constraints into a integrated plan. The idea was to look at two factors 1) how site flows could be directed with minimal pipe conveyance and 2) maximizing retention/detention, treatment, & infiltration potential at all possible points. The way the water works its way through the site is very similar to the base case, and the outfall points are consistent as well, happening at the NW & SE site corners. The difference comes with the introduction of a combination of surface conveyance, filters & planters that utilize soft-surface and landscaping to hold & treat water.

Basin A consists of a system utilizing three types of infrastructure as well as a landmark/art opportunity along the east-west corridor. There is also an opportunity to integrate the infrastructure into the public zone with bioswale/green street along 21st Avenue. A summary of the components include:

Private:

Buildings C & D

- Flow through Planters along the north side of building D. These will collect water from downspouts, filter it, and transmit it to the street edge through a hard swale.
- Permeable paving on the parking adjacent to the sidewalk along the north of building D.
- Art Opportunity and visual landmark visible from Main Street to cue pedestrian traffic into site and complete visual connection to Library. This can be fed either from building roof runoff, work from rainfall only, or be a static sculptural element.
- Permeable paving in driveway to garage access behind Buildings C&D

Public:

21st Avenue/Harrison ROW

- Public ROW of 21st Avenue as a bioswale that collects water from street and basin B and provides infiltration & treatment prior to exiting site from SE corner
- Street Trees along Harrison Street.
- Art Opportunities along Harrison Street (Building C) to accentuate the zero-setback urban feel to the building frontage.

Basin B encompasses the remainder of the site, and provides the majority of opportunities for visible water, art integration, and soft stormwater solutions. There is a natural site flow that can be accentuated with grading to exit the site at the NW corner along Main Street, where it can connect into the storm sewer at this point. This is similar to the base case in replicating where the water is leaving the site, but with multiple interventions, the water will be much cleaner and in lower quantities. In addition, the entire frontage along main and the public ROW can be utilized as a modified 'green street' to provide an urban example of stormwater treatment that can be utilized in other developments as well. A summary of elements is included and divided by building type.

Private:

Building E

- Landscaping will accentuate buildings around 21st Avenue frontage and parking entrance, and include permeable areas and trees to intercept stormwater in local areas

- Ecoroof on building (approx 2400 sf) would slow down & filter roof water at the upper point of the basin, which will help in peak events & overall outflow. The ecoroof can also increase energy efficiency, roof longevity, and offer many other life-cycle benefits
- Combination cisterns/stormwater planters to the west garage entrances can provide infiltration, point source filtering, and retention prior to release onto paving, while also providing aesthetically pleasing landscaping to building façade and entrances

Plaza

- The focal point of the site, the central plaza is accomplishing many divergent functions at once, while maintaining a level of aesthetics & usability. The overall grading of the plaza is lower than surrounding parking & building finished floor elevations, making it a central location for all water to pass through prior to exiting to the west.
- Parking areas to the east and west get double treatment through the use of permeable paving in the parking stalls and a vegetated filter strip to reduce pollutant load as water is integrated into the central feature. The vegetated filter strip will also provide the plaza with vegetated buffering from views of the cars.
- The art/landmark opportunity works off of the roof water from Building A, and provides a kinetic opportunity to utilize the water that is being collected, along with gravity to create an 'event' that will provide visual interest to the space. This spot can have a cistern to hold water, and outfalls that utilize natural pressure to provide water movement. The water will run through the plaza, accentuating this movement and providing visual excitement through the entire space
- The central plaza area will collect, display, and move water in multiple ways. Inputs of water will come in the form of partially treated street/parking runoff, as well as rain runoff from the roof of Building A. The feature will be graded to convey water through the entire space prior to outfall to the NW corner. In addition, dependent on events, the central pockets will provide a measure of detention, holding water for a period of time until it is slowly input to the rest of the system. The entire space will be usable in any season, with a variety and change of experience dependent on summer (more open usable space, shade, seating, colorful plants), and winter (visible water, pedestrian access, seating, plantings).

Building B

- The pitched rooflines of this building direct water to all four sides. This will be dealt with in different ways as fits the site and use
- The runoff of the east will work into combination cisterns/stormwater planters (similar to Building E) providing infiltration, point source filtering, and retention prior to release onto paving, while also providing aesthetically pleasing landscaping to building façade and garage entrances
- The west side includes street trees along Main Street, as well as art opportunities along similar to Building C, to accentuate the zero-setback urban feel to the building frontage. This will interface with the modified green street that runs the entirety of the public ROW along Main street.
- North and south outfalls will be collected into flow through planters (at or above grade depending on function) that will serve dual purposes. They will provide an aesthetically pleasing and welcoming gateway to pedestrian traffic through the two main access points from Main Street through plantings, seat walls, and paving. Also, they will provide additional treatment & infiltration of roof water. The planter to the north will also be the collection point for the water from the Plaza, as well as potential piped overflow dependant on runoff levels.

Building A

- Building A will consist of traditional landscaping and urban frontage along the central spaces and Main street. This will provide additional opportunities for permeable surfacing and landscaping to handle local surface runoff.
- The roof water will be collected from the 5 roof drains and directed to one central point adjacent to the Plaza for an art/cistern/conveyance event. (see Plaza description)

- Parking along the north of building A will consist of permeable paving & vegetated filter strips (see Building F description)

Building F

- Landscaping will accentuate buildings around 21st Avenue & Library parking frontage, and include permeable areas and trees to intercept stormwater in local areas
- Ecoroof on building (approx 2150 sf) would slow down & filter roof water at the upper point of the basin, which will help in peak events & overall outflow. The ecoroof can also increase energy efficiency, roof longevity, and offer many other life-cycle benefits
- The parking area to the west of the building can have permeable paving on stalls to increase site infiltration in a normally very impervious area.
- Grading can be manipulated to run water through a series of vegetated filter strips in medians to hold, infiltrate & filter water prior to release.
- The wall at the west end of the parking lot (due to grading) is an opportunity for art/visible water prior to connection to public ROW

Public:

Main Street ROW

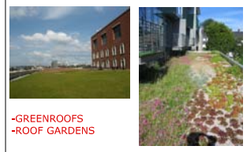
- Due to natural grading & its location at the end of the basin, the ROW is a perfect opportunity for an urban interpretation of a 'green street' utilizing a number of potential options.
- Street trees in wells along the entirety to intercept rainwater & provide shade/scale to building & pedestrians
- Accentuate visual gateways into plaza and sidewalk/cut-through to Library
- Provide a pipe-free treatment and conveyance to handle site runoff and partial runoff from Main Street through vegetated tree wells, underground filtration systems, and vegetated filters in landscape islands.
- Toward the north end of the system at the outfall point, there can be additional detention in larger islands, as well as bioswales for holding & treatment.
- The bus-stop can be a model for the city with permable paving, water art, detention, & ecoroof on structure
- The final collection point can include additional detention, mechanical backup (if necessary), and landscaping, prior to release into the City of Milwaukie system.

Cost Impact:
Additional $51,548 to construction costs

Additional construction investment needed to offset costs of implementation. This does not take into account water savings or life cycle costs. The majority of this additional cost occurred due to implementation of eco-roofs, which have significant long-term benefits v. costs. See attached cost breakdown for details.

STORMWATER OPTIONS

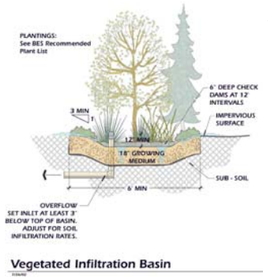
ECOROOF



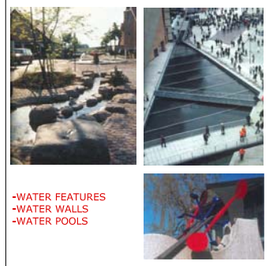
-GREENROOFS
-ROOF GARDENS

VEGETATED FILTER STRIP

-VEGETATED INFILTRATION BASIN



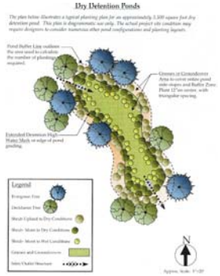
STORMWATER ART



-WATER FEATURES
-WATER WALLS
-WATER POOLS

DETENTION AREA

-DRY DETENTION PONDS
-WET DETENTION PONDS



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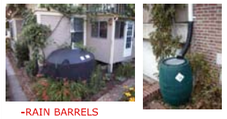
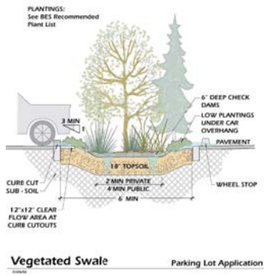


-RAIN BARRELS

BIOSWALE

-VEGETATED SWALE
-GRASSY SWALE

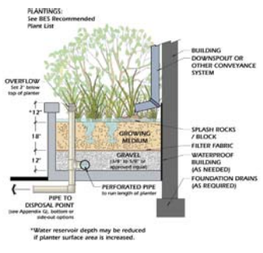


PERMEABLE PAVING

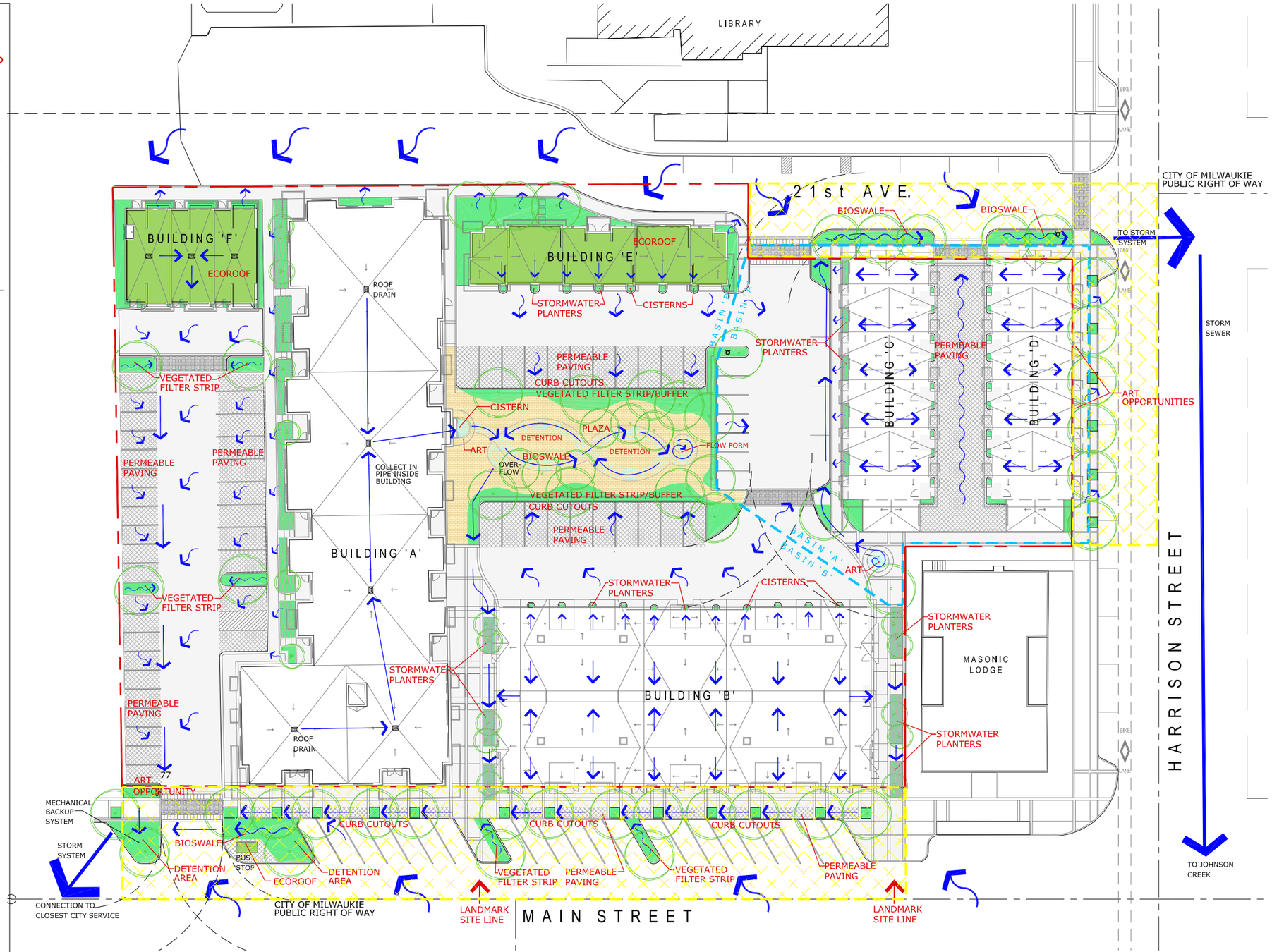
-GRASSY PAVERS
-POROUS PAVERS
-CURB CUTOUTS

STORMWATER PLANTERS

-CONTAINED PLANTERS
-INFILTRATION PLANTERS
-FLOW THROUGH PLANTERS



SOURCES: PORTLAND STORMWATER MANAGEMENT MANUAL, WATERSCAPES- DREISEITL, MACDONALD ENVIRONMENTAL PLANNING, PC



PERMEABLE PAVERS | STORMWATER PLANTERS | LANDSCAPED AREA | ECOROOF | SHEET FLOW | DIRECTED FLOW

NORTH

SCALE 1"=20'

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MILWAUKIE MAIN STREET
MIXED-USE DEVELOPMENT
MILWAUKIE, OREGON

REGISTERED 204
LAUREL A. MACDONALD
OREGON
LANDSCAPE ARCHITECT

STORMWATER OPTIONS
POTENTIAL ALTERNATIVES

Designed:	JAK
Drawn:	ADS
Checked:	LMB
10.21.04	
Project No:	2417

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Cost Projections - Case #2 Potential Alternatives
Milwaukie North Main - Mixed Use Development
Integrated Stormwater System

PRIVATE DEVELOPMENT AREA

Type of Component	units	unit cost [1]	quantity	est. cost	base cost [2]	cost offset (+/-) [3]
Green/Ecoroof						
Building E	sf	$ 12.00	2,407	$ 28,884.00	$ -	$ 28,884.00
Building F	sf	$ 12.00	2,138	$ 25,656.00	$ -	$ 25,656.00
				$ 54,540.00	$ -	$ 54,540.00
Permeable Paving						
Building F	sf	$ 10.00	4,200	$ 42,000.00	$ 33,600.00	$ 8,400.00
Plaza Area	sf	$ 10.00	3,319	$ 33,190.00	$ 26,552.00	$ 6,638.00
Building D & C	sf	$ 10.00	2,174	$ 21,740.00	$ 17,392.00	$ 4,348.00
				$ 96,930.00	$ 77,544.00	$ 19,386.00
Cisterns						
Plaza	gallons	$ 1.00	10,000	$ 10,000.00	$ -	$ 10,000.00
Building B	gallons	$ 1.50	600	$ 900.00	$ -	$ 900.00
Building E	gallons	$ 1.50	800	$ 1,200.00	$ -	$ 1,200.00
				$ 12,100.00	$ -	$ 12,100.00
Filter Strip						
Vegetated by Plaza	sf	$ 7.00	1,272	$ 8,904.00	$ 2,544.00	$ 6,360.00
North Parking Area	sf	$ 7.00	395	$ 2,765.00	$ 790.00	$ 1,975.00
				$ 11,669.00	$ 3,334.00	$ 8,335.00
Stormwater Planters						
Building D	sf	$ 12.50	190	$ 2,375.00	$ 380.00	$ 1,995.00
Building B North	sf	$ 10.00	217	$ 2,170.00	$ 434.00	$ 1,736.00
Building B South	sf	$ 10.00	271	$ 2,710.00	$ 542.00	$ 2,168.00
Building B East	sf	$ 12.50	33	$ 412.50	$ 66.00	$ 346.50
Building E West	sf	$ 12.50	171	$ 2,137.50	$ 342.00	$ 1,795.50
				$ 7,255.00	$ 1,356.00	$ 8,041.00
Detention Areas						
Plaza	sf	$ 12.00	668	$ 8,016.00	$ 1,336.00	$ 6,680.00
				$ 8,016.00	$ 1,336.00	$ 6,680.00
Bioswales						
Plaza	sf	$ 10.00	517	$ 5,170.00	$ 1,034.00	$ 4,136.00
				$ 5,170.00	$ 1,034.00	$ 4,136.00
Landscaping						
Trees & Landscaping	sf	$ 2.00	2,117	$ 4,234.00	$ 4,234.00	$ -
Plaza & Detailed Paving	sf	$ 10.00	2,445	$ 24,450.00	$ 24,450.00	$ -
				$ 28,684.00	$ 28,684.00	$ -
			22,534 s.f. #	$ 224,364.00	$ 113,288.00	$ 113,218.00
			cost/s.f.	$ 9.96	$ 5.03	$ 5.02

PUBLIC RIGHT-OF-WAY

Type of Component	units	unit cost [1]	quantity	est. cost	base cost [2]	cost offset (+/-) [3]
Green/Ecoroof						
Bus Stop	sf	$ 12.00	36	$ 432.00	$ -	$ 432.00
				$ 432.00	$ -	$ 432.00
Filter Strip						
Modified Green Street (Main)	sf	$ 10.00	1,347	$ 13,470.00	$ 2,694.00	$ 10,776.00
Vegetated Extension (Main)	sf	$ 7.00	175	$ 1,225.00	$ 350.00	$ 875.00
				$ 14,695.00	$ 3,044.00	$ 11,651.00
Detention Areas						
Main St. ROW	sf	$ 6.50	623	$ 4,049.50	$ 1,246.00	$ 2,803.50
				$ 4,049.50	$ 1,246.00	$ 2,803.50
Bioswales						
21st Avenue	sf	$ 7.50	459	$ 3,442.50	$ 918.00	$ 2,524.50
				$ 3,442.50	$ 918.00	$ 2,524.50
Landscaping						
Streetscape (ROW)	sf	$ 5.00	102	$ 510.00	$ 204.00	$ 306.00
				$ 510.00	$ 204.00	$ 306.00
			2,742 s.f.	$ 23,129.00	$ 5,412.00	$ 17,717.00
			cost/s.f.	$ 8.44	$ 1.97	$ 6.46

SUMMARY - Case #2 Potential Alternatives

Estimated Case #2 Cost

			Site Amenity	Engineering	Total
Private	22,534	sf	$ 224,364.00	$ 60,000.00	$ 284,364.00
Public	2,742	sf	$ 23,129.00	$ 30,000.00	$ 53,129.00
Total	25,276	sf		Project Total	$ 337,493.00

Estimated Base Cost

			Site Amenity	Engineering	Total
Private	22,534	sf	$ 113,288.00	$ 148,853.00	$ 262,141.00
Public	2,742	sf	$ 5,412.00	$ 18,392.00	$ 23,804.00
Total	25,276	sf		Base Total	$ 285,945.00
				Additional Cost	**$ 51,548.00**

Scenario #3:

Applied Stormwater: Viable options integrated with Site Infrastructure & Amenities

The goal of this scenario was a viable mix of design that maximized the use of the site while implementing as many types of stormwater interventions as possible. We looked specifically at which types of methods would offer the most performance at a cost that was similar to the traditional civil infrastructure costs. In addition, much focus was put on the central plaza as an opportunity.

The division of public & private is important as they are being developed separately, but each contribute in positive ways to each other. Through looking at the best fit for each area, we reduced the amout of demand the site will make on the public system by holding and treating the maximum amount of water as feasible on-site. Conversely, utilizing public ROW green streets & swales, we reduced the amount of on-site stormwater treatment that was necessary on-site. The goal for both of these hinged on water quality, as it was a more pervasive issue than water quantity.

Basin A consists of a system utilizing three types of infrastructure (flow through planters, detention ponds & swales). There is also an opportunity to integrate the infrastructure into the public zone with bioswale/green street along 21st Avenue. A summary of the components include:

Private:

Buildings C & D

- Flow through Planters along the north side of building C. These will collect water from downspouts, filter it, and transmit it to the street edge through a hard swale.
- A water quality detention pond prior to distribution to off-site public bioswale.

Public:

21st Avenue/Harrison ROW

- Public ROW of 21st Avenue as a bioswale that collects water from street and basin B and provides infiltration & treatment prior to exiting site from SE corner
- Street Trees along Harrison Street.

Basin B focuses on the central plaza as a major opportunity to integrate site function and stormwater. There are some smaller methods used in other buildings, as well as integration of rain-fed water features, and site landscaping.

Private:

Building E

- Landscaping will accentuate buildings around 21st Avenue frontage and parking entrance, and include permeable areas and trees to intercept stormwater in local areas
- Water from downspouts will sheet flow to central plaza, eliminating collection pipe

Plaza

- The focal point of the site, the central plaza is accomplishing many divergent functions at once, while maintaining a level of aesthetics & usability. The overall grading of swales adjacent to the plaza is lower than surrounding parking & building finished floor elevations, making it a central location for all water to pass through prior to exiting to the west.
- Water from parking enter the plaza swales through openings in the at grade curb and raised curb-stops. The water will be treated through filter strips that will be located in the wheel overhangs - a space that needs low to no vegetation.
- The art/landmark opportunity works off of the roof water from Building A, and provides a kinetic opportunity to utilize the water that is being collected, along with gravity to create an 'event' that will provide visual interest to the space. The water will run through

elevated troughs, over the pedestrian pathway and spilling into basins located in the plaza. Water will then head into a central collection point through short water falls & underground pipes. Overflow will be channeled into the swales.

- The central plaza area will collect water through a sculptural water feature mimicking a regional stream. The idea being that when full of water it will look like a rushing stream, but when dry it will be aesthetically pleasing.
- Water will exit the stream and be detained in the lower reaches of the amphitheater, which will hold water & then slowly let it out through outlets to the swales. Swales run the length of the space on both sides, and double as screening from the parking areas adjacent.
- The entire space will be usable in any season, with a variety and change of experience dependent on summer (more open usable space, shade, seating, colorful plants), and winter (visible water, pedestrian access, seating, plantings).

Building B

- The runoff of the east will exit onto paving & sheet flow into the plaza to be treated and detained.
- North and south outfalls will be collected into pipes from the downspouts and will serve dual purposes. At each point, there will be a water feature that will be run with collected roof

Building A

- Building A will consist of traditional landscaping and urban frontage along the central spaces and Main street.
- The roof water will be collected from a portion of the roof drains and directed to one central point adjacent to the Plaza for an art/cistern/conveyance event. (see Plaza description)
- Flow-through planters will be implemented along the north side, then sheet flow into the parking lot to be collected mechanically.

Public:

Main Street ROW

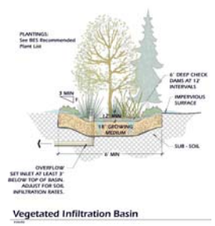
- Due to natural grading & its location at the end of the basin, the ROW is a perfect opportunity for an urban interpretation of a 'green street' utilizing a number of potential options.
- Street trees in wells along the entirety to intercept rainwater & provide shade/scale to building & pedestrians
- Accentuate visual gateways into plaza and sidewalk/cut-through to Library
- Provide a pipe-free treatment and conveyance to handle site runoff and partial runoff from Main Street through vegetated tree wells, underground filtration systems, and vegetated filters in landscape islands.
- Toward the north end of the system at the outfall point, there can be additional detention in larger islands, as well as bioswales for holding & treatment.
- The final collection point can include additional detention, mechanical backup (if necessary), and landscaping, prior to release into the City of Milwaukie system.

Cost Impact:
Savings of $13,136 for construction costs

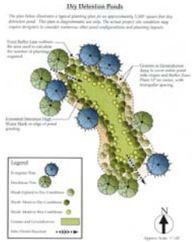
Construction offset of infrastructure & site amenity costs per costs of implementation. This does not take into account water savings or life cycle costs. See attached cost breakdown for details.

STORMWATER METHODS

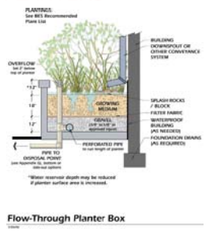
VEGETATED FILTER STRIP



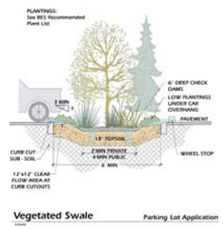
DETENTION AREA



STORMWATER PLANTERS



BIOSWALE



STORMWATER ART

PERMEABLE PAVING

FLOW-THROUGH PLANTERS

F1 FLOW THROUGH PLANTER #1
22" HT. AT SIDEWALK & WINDOW SILLS (TYP.)
PLANTER: 32" DEEP X 36" WIDE X 126" LONG
SOIL : 16" DEEP X 28" WIDE X 118" LONG (30.6 CF)
GRAVEL : 8" DEEP X 28" WIDE X 118" LONG (15.3 CF)

F2 FLOW THROUGH PLANTER #2
22" HT. AT SIDEWALK & WINDOW SILLS (TYP.)
PLANTER: 32" DEEP X 24" WIDE X 126" LONG
SOIL : 16" DEEP X 16" WIDE X 124" LONG (18.3 CF)
GRAVEL : 8" DEEP X 16" WIDE X 124" LONG (9.2 CF)
(VARIATION: 20" HT. @ SIDWALK & WINDOW SILLS)

F3 FLOW THROUGH PLANTER #3
22" HT. AT SIDEWALK & WINDOW SILLS (TYP.)
PLANTER: 32" DEEP X 52" WIDE X 144" LONG
SOIL : 16" DEEP X 44" WIDE X 136" LONG (55.4 CF)
GRAVEL : 8" DEEP X 44" WIDE X 136" LONG (27.2 CF)

SWALES/DETENTION

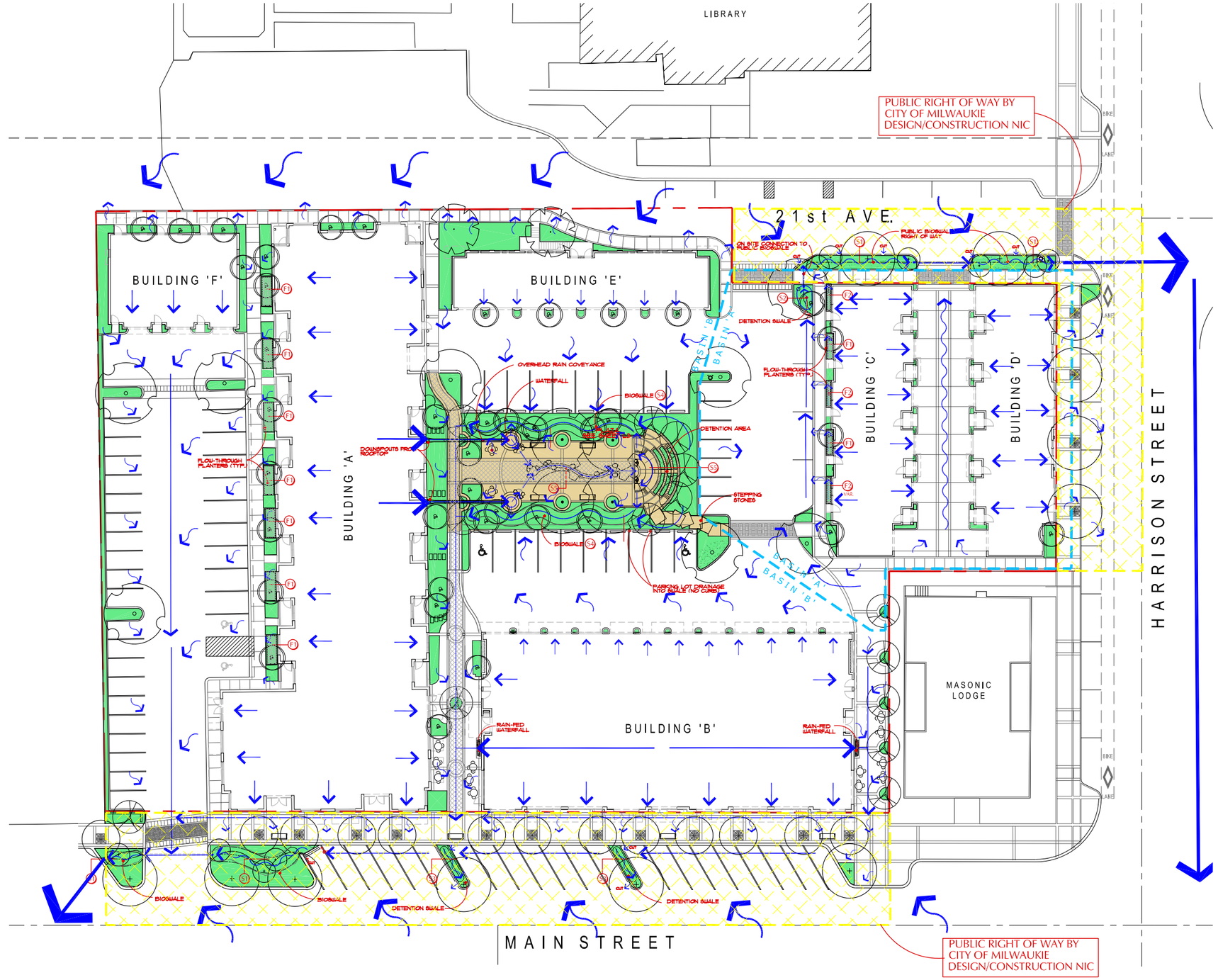
S1 GREEN STREET ROW SWALE
6' WIDE WITH 3:1 VEGETATED SIDE SLOPES

S2 SMALL DETENTION POND
3:1 SLOPE POND - OUTFALL TO PUBLIC ROW BIOSWALE

S3 GREEN STREET DETENTION ISLAND
3' WIDE, GRADED TO HOLD STREET SURFACE WATER

S4 PARKING FILTER/PLAZA BIOSWALE
VEGETATED SWALE (4:1 SLOPE ON PARKING SIDE
3:1 SLOPE ON PLAZA SIDE) WIDTH VARIES

S5 PLAZA DETENTION/SWALE
23" WIDE SCULPTURAL SWALE THROUGH PLAZA
DETENTION AREA IN AMPITHEATER



PERMEABLE PAVERS

STORMWATER PLANTERS

LANDSCAPED AREA

SHEET FLOW

DIRECTED FLOW

NORTH

SCALE 1"=20'

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NORTH MAIN MIXED-USE
MILWAUKIE, OREGON

REGISTERED 204 LAUREL A. MACDONALD OREGON LANDSCAPE ARCHITECT

STORMWATER OPTIONS
VIABLE APPLICATIONS

Designed:	JAK
Drawn:	JAK
Checked:	LMB
10.21.04	
Project No:	2417

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Cost Projections - Case #3 Viable Options
Milwaukie North Main - Mixed Use Development
Integrated Stormwater System

PRIVATE DEVELOPMENT AREA

Type of Component	units	unit cost [1]	quantity	est. cost	base cost [2]	cost offset (+/-) [3]
Permeable Paving						
Plaza Area	sf	$ 10.00	1,046	$ 10,460.00	$ 8,368.00	$ 2,092.00
Building A&B	sf	$ 10.00	561	$ 5,610.00	$ 4,488.00	$ 1,122.00
				$ 16,070.00	$ 12,856.00	$ 3,214.00
Filter Strip						
Vegetated by Plaza	sf	$ 7.00	434	$ 3,038.00	$ 868.00	$ 2,170.00
				$ 3,038.00	$ 868.00	$ 2,170.00
Stormwater Planters						
Building C	sf	$ 10.00	102	$ 1,020.00	$ 204.00	$ 816.00
Building A	sf	$ 12.50	280	$ 3,500.00	$ 560.00	$ 2,940.00
				$ 4,520.00	$ 764.00	$ 3,756.00
Detention Areas						
Plaza	sf	$ 15.00	200	$ 3,000.00	$ 400.00	$ 2,600.00
N. of Building C	sf	$ 10.00	72	$ 720.00	$ 144.00	$ 576.00
				$ 3,720.00	$ 544.00	$ 3,176.00
Bioswales						
Plaza	sf	$ 10.00	716	$ 7,160.00	$ 1,432.00	$ 5,728.00
				$ 7,160.00	$ 1,432.00	$ 5,728.00
Landscaping						
Trees & Landscaping	sf	$ 2.00	4,312	$ 8,624.00	$ 8,624.00	$ -
Plaza & Detailed Paving	sf	$ 10.00	1,250	$ 12,500.00	$ 12,500.00	$ -
				$ 21,124.00	$ 21,124.00	$ -
			8,973 s.f. ##	$ 55,632.00	$ 37,588.00	$ 18,044.00
			cost/s.f.	$ 6.20	$ 4.19	$ 2.01

PUBLIC RIGHT-OF-WAY

Type of Component	units	unit cost [1]	quantity	est. cost	base cost [2]	cost offset (+/-) [3]
Filter Strip						
Modified Green Street (Main)	sf	$ 10.00	350	$ 3,500.00	$ 700.00	$ 2,800.00
Vegetated Extension (Main)	sf	$ 7.00	148	$ 1,036.00	$ 296.00	$ 740.00
				$ 4,536.00	$ 996.00	$ 3,540.00
Bioswales						
21st Avenue	sf	$ 7.50	459	$ 3,442.50	$ 918.00	$ 2,524.50
				$ 3,442.50	$ 918.00	$ 2,524.50
Landscaping						
Streetscape (ROW)	sf	$ 2.00	400	$ 800.00	$ 800.00	$ -
(Detailed Paving not included)						
				$ 800.00	$ 800.00	$ -
			1,357 s.f.	$ 8,778.50	$ 2,714.00	$ 6,064.50
			cost/s.f.	$ 6.47	$ 2.00	$ 4.47

SUMMARY - Case #3 Viable Options

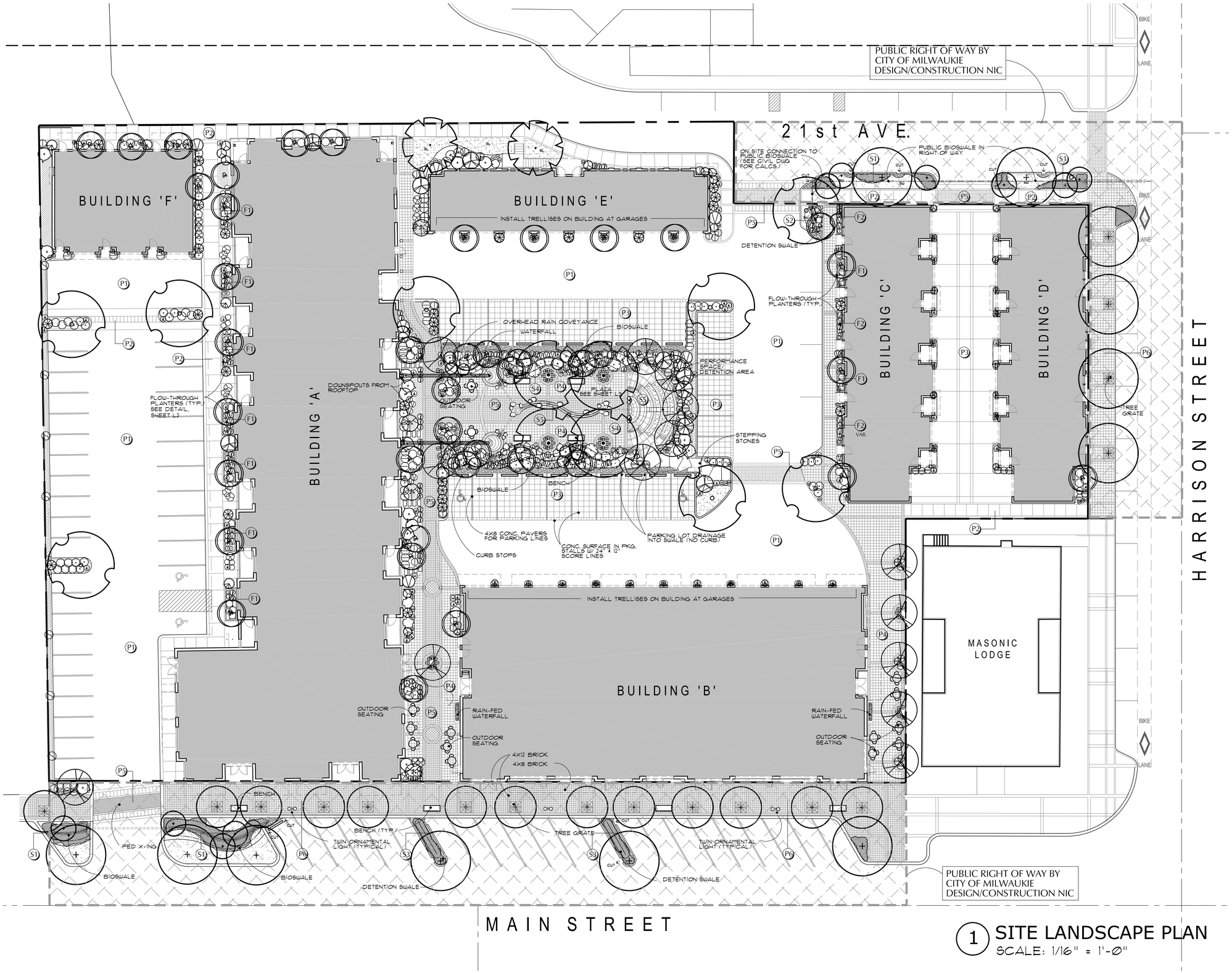
Estimated Case #3 Cost

			Site Amenity	Engineering	Total
Private	8,973	sf	$ 55,632.00	$ 100,000.00	$ 155,632.00
Public	1,357	sf	$ 8,778.50	$ 30,000.00	$ 38,778.50
Total	10,330	sf		Project Total	$ 194,410.50

Estimated Base Cost

			Site Amenity	Engineering	Total
Private	8,973	sf	$ 37,588.00	$ 148,853.00	$ 186,441.00
Public	1,357	sf	$ 2,714.00	$ 18,392.00	$ 21,106.00
Total	10,330	sf		Base Total	$ 207,547.00
				Reduced Cost	**$ (13,136.50)**

appendices



1 SITE LANDSCAPE PLAN
SCALE: 1/16" = 1'-0"

NORTH

FLOW-THROUGH PLANTERS

SEE SHEET L2 FOR TYPICAL DETAIL

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3:1 SLOPE ON PLAZA SIDE) WIDTH VARIES

S5 PLAZA DETENTION/SWALE
23" WIDE SCULPTURAL SWALE THROUGH PLAZA
DETENTION AREA IN AMPITHEATER

PAVING COMPONENTS

P1 ASPHALT PAVING
DRIVE AISLES AND PARKING STALLS

P2 CONCRETE PAVING
DRIVE AISLES AND PARKING STALLS

P3 DECORATIVE CONCRETE PARKING
CONC. SURFACE WITH SCORE LINES/FINISHES
PLAZA PARKING W/ PAVER FOR STALL LINES

P4 DECORATIVE CONCRETE PATHWAYS
CONC. SURFACING OF WALKS & PLAZA
W/ ACCENT PAVERS TO MATCH BRICK
MIX FINISHES AND POSSIBLE COLOR

P5 INTERLOCKING PERMEABLE PAVERS
SELECTED WALKWAYS & PLAZA SURFACES
MATCH COLOR TO PAVERS/BRICK

P6 PAVING PER CITY REQUIREMENTS
SEE NOTES FOR TYPE/CONFIGURATION

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NORTH MAIN MIXED-USE
MILWAUKIE, OREGON

REGISTERED 204
LAUREL A. MACDONALD
OREGON
LANDSCAPE ARCHITECT

OVERALL SITE LANDSCAPE PLAN

Designed:	JAK
Drawn:	JAK
Checked:	LMB
10.15.04	
Project No:	2417

L1

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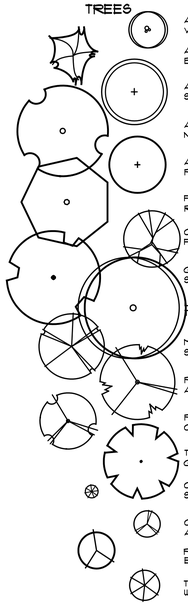
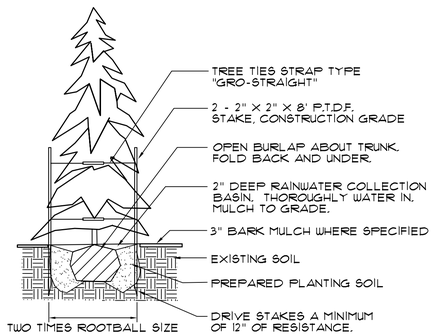
PLANT LEGEND



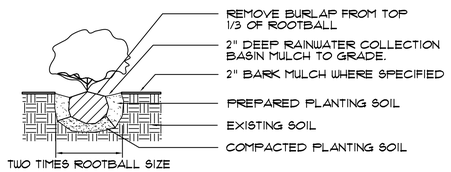
SYMBOL	PLANT NAME	SIZE	CONDITION
TREES			
	Acer circinatum Vine Maple	7-8'	B&B Multi-Stem 3 Trunk Min.
	Acer palmatum 'Bloodgood' Bloodgood Japanese Maple	8-10'	B&B Multi-Stem 3 Trunk Min.
	Acer rubrum 'Scarsen' Scarlet Sentinel Maple	1 ¾" cal.	B&B
	Acer trunc. x plat. 'Keithsform' Norwegian Sunset Maple	2" cal.	B&B
	Acer trunc. x plat. 'Warrenred' Pacific Sunset Maple	2" cal.	B&B
	Fraxinus oxycarpa 'Raywoodi' Raywood Ash	1 1/2" cal.	B&B
	Cornus florida Flowering Dogwood	1 ¾" cal.	B&B
	Gleditsia triacanthos 'Skyline' Skyline Honey Locust	1 ¾" cal.	B&B
	Liriodendron tulipifera Tulip Tree	3" cal.	B&B
	Magnolia x soulangiana Saucer Magnolia	7-8'	B&B
	Prunus x yedoensis 'Akebono' Akebono Cherry	1 1/2" cal.	B&B
	Pyrus calleryana 'Chanticleer' Chanticleer Pear	1 ¾" cal.	B&B
	Tilia cordata 'Greenspire' Greenspire Little Leaf Linden	2"" cal.	B&B
	Chamaecyparis o. 'Gracilis' Slender Hinoki Cypress	42-48"	B&B Single Leader
	Chamaecyparis nootkatensis Alaska Cedar	6-7'	B&B
	Pinus strobus Eastern White Pine	8-10'	B&B
	Thuja plicata Western Red Cedar	6-7'	B&B

SYMBOL	PLANT NAME	SIZE	CONDITION
SHRUBS			
	Berberis thun. 'Crimson Pygmy' Crimson Pygmy Barberry	2 gal.	Container
	Euonymus japonica 'Grandifolia' Japanese Euonymus	5 gal.	Container
	Gaultheria shallon Salal	2 gal.	Container
	Ilex crenata 'Convexa' Japanese Holly	3 gal.	Container
	Magnolia stellata 'Royal Star' Royal Star Magnolia	4-5'	B&B
	Osmanthus delavayi Delavay Holly Olive	3 gal.	Container
	Pieris japonica Japanese Andromeda	21-24"	B&B
	Prunus laurocerasus 'Zable's' Zable's Laurel	3 gal.	Container
	Prunus lusitanica Portuguese Laurel	24-30"	B&B
	Rhododendron 'Linda' Linda Rhododendron	12-15"	Container
	Rhododendron 'PJM' PJM Rhododendron	18-21"	Container
	Spirea x bumalda 'Goldmound' Goldmound Spirea	2 gal.	Container
	Vaccinium ovatum Evergreen Huckleberry	2 gal.	Container
	Viburnum davidii David Viburnum	2 gal.	Container
	Viburnum p. t. 'Mariesii' Mariesii Doubleflile Viburnum	5 gal.	Container
	Viburnum tinus 'Compacta' Spring Bouquet Viburnum	3 gal.	Container
GROUND COVERS			
	Arctostaphylos uva-ursi Kinnick Kinnick	4" pot	24" o.c. Tri-Space
SWG	Swale Grass - Hobbs & Hopkins Pro-Time #420 Native Seed Mix		
SL	Seeded Lawn		



CONIFER TREE PLANTING DETAIL

N.T.S.



SHRUB PLANTING DETAIL

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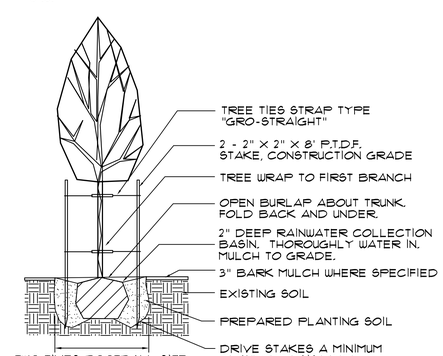
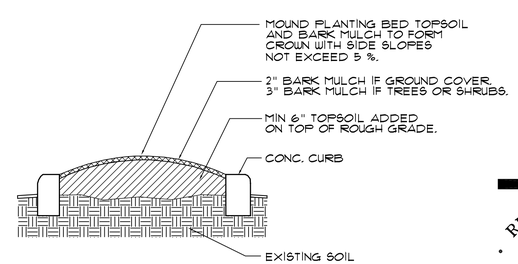


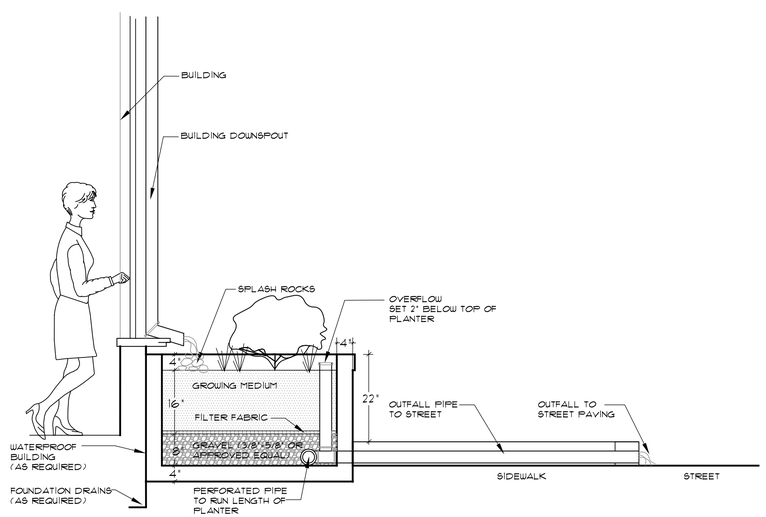
DECIDUOUS TREE PLANTING

N.T.S.



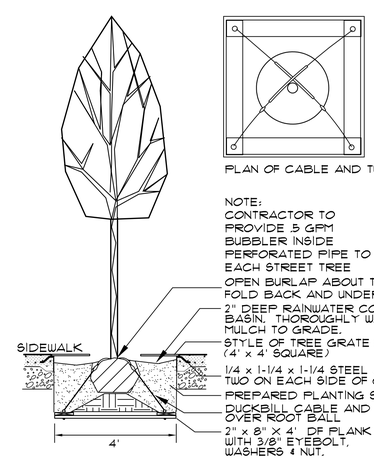
PLANTING ISLAND DETAIL

N.T.S.



FLOW THROUGH PLANTER BOX

WIDTH VARIES, REFER TO PLAN



PLAN OF CABLE AND TURNBUCKLE

DECIDUOUS TREE WITH TREE GRATE

N.T.S.

GENERAL NOTES

THE CONTRACTOR SHALL INSTALL PLANT MATERIALS USING TOPSOIL WHICH CONSISTS OF ONE PART COMPOST AND TWO PARTS SANDY LOAM, AS INDICATED ON THE DETAILS.

ALL PLANTING AREAS SHALL RECEIVE A MINIMUM OF TWO INCHES OF MEDIUM, FINE AND NON-TOXIC BARK MULCH.

FERTILIZER SHALL BE STANDARD APPROVED BRAND, DELIVERED IN ORIGINAL CONTAINERS DRY AND FREE FLOWING BEARING GUARANTEED ANALYSIS OF THE MANUFACTURER. THE ORGANIC BASE SHALL BE 16-16-16.

COMPACT PREPARED SOIL MIX AND FLOAT LANDSCAPE AREAS TO PERIMETER ELEVATIONS REPRESENTED BY CURBS AND WALKS.

TOPSOIL SHALL BE FREE OF NOXIOUS WEEDS AND WEED SEEDS. CONTRACTOR SHALL GUARANTEE THAT WEEDS HAVE BEEN REMOVED PRIOR TO INSTALLATION.

ALL PLANTS SELECTED SHALL BE CONSISTENT WITH CURRENT AMERICAN NURSERYMEN'S STANDARDS. ANY PLANTS THAT ARE DISEASED, DEFORMED, ROOT BOUND, POORLY SHAPED OR DEFICIENT OF HEALTHY CHARACTERISTICS SHALL NOT BE ACCEPTED.

ALL PLANT MATERIAL SHALL BE WARRANTED FOR A PERIOD OF ONE YEAR AND SHALL BE IN A HEALTHY CONDITION AT THAT TIME. ALL PLANTS DEAD OR EXHIBITING UNHEALTHY CHARACTERISTICS SHALL BE REPLACED AT NO EXPENSE TO THE OWNER.

CONTRACTOR TO DESIGN AND TO INSTALL AN IRRIGATION SYSTEM PER MANUFACTURER'S SPECIFICATION, PROVIDING COMPLETE COVERAGE.

GUY ALL CONIFERS TALLER THAN 8' & ALL DECIDUOUS TREES 4" CAL. OR LARGER. STAKE ALL OTHER TREES.

QUANTITY OF PLANTS ON THE PLAN TAKES PRECEDENCE OVER QUANTITY OF PLANTS IN THE PLANT SCHEDULE.

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NORTH MAIN MIXED-USE
MILWAUKIE, OREGON

REGISTERED 204
LAUREL A. MACDONALD
OREGON
LANDSCAPE ARCHITECT

PLANT LIST & DETAILS

Designed:	JAK
Drawn:	JAK
Checked:	LMB
10.15.04	
Project No:	2417

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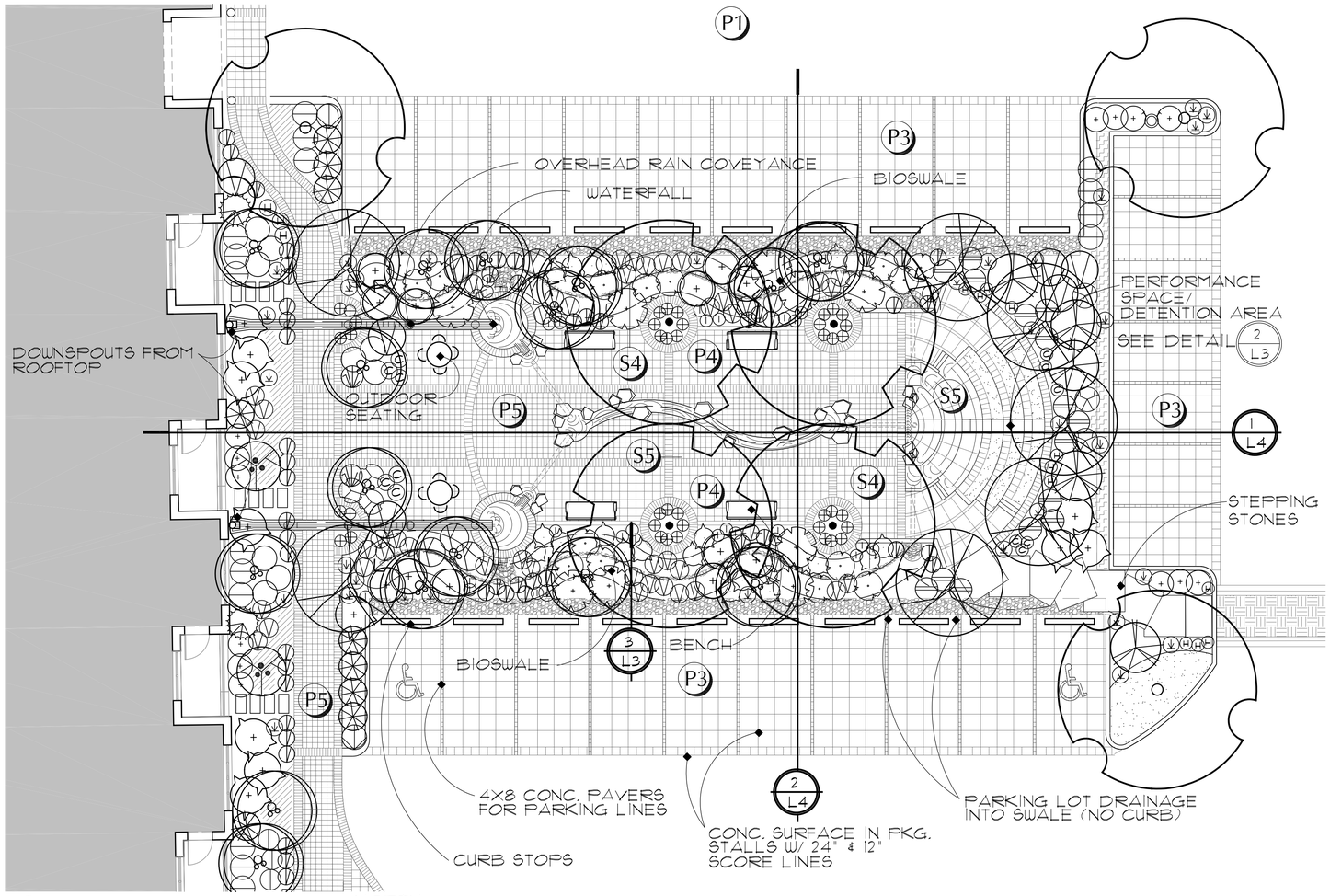
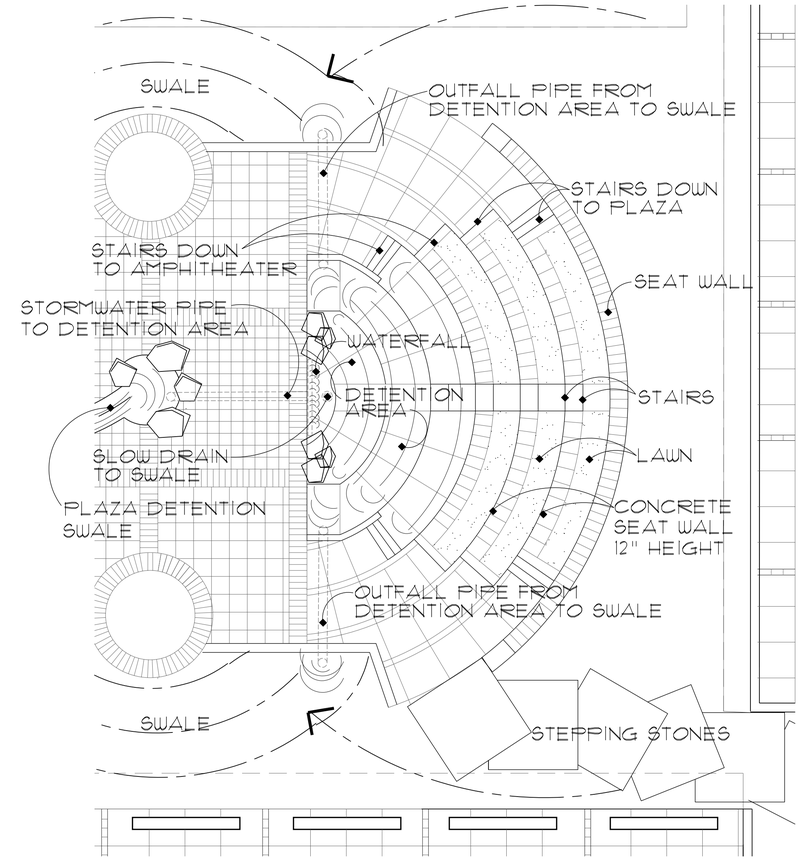
L2



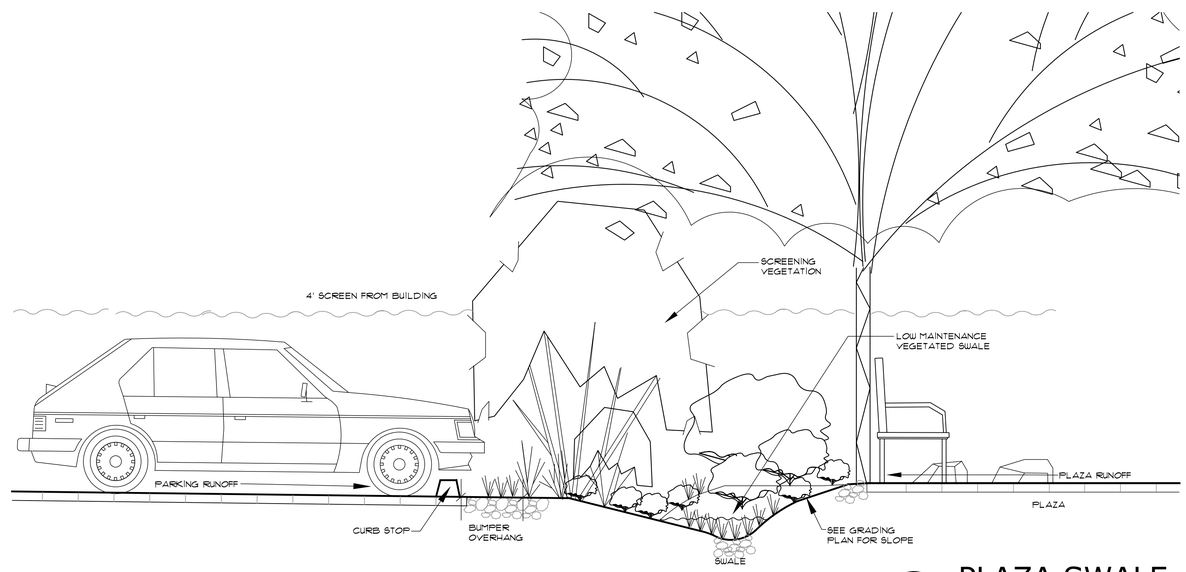
1 CENTRAL PLAZA
SCALE: 1/8" = 1'-0"

FOR (P-) AND (S-) SEE LEGEND, SHEET L1

FOR PLANT LIST SEE LEGEND, SHEET L2



2 AMPITHEATER
SCALE: 1/4" = 1'-0"



3 PLAZA SWALE
SCALE: 1/2" = 1'-0"

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NORTH MAIN MIXED-USE
MILWAUKIE, OREGON

REGISTERED 204
LAUREL A. MACDONALD
OREGON
LANDSCAPE ARCHITECT

PLAZA LAYOUT
ENLARGED PLANS

Designed:	JAK
Drawn:	JAK
Checked:	LMB
10.15.04	
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L3

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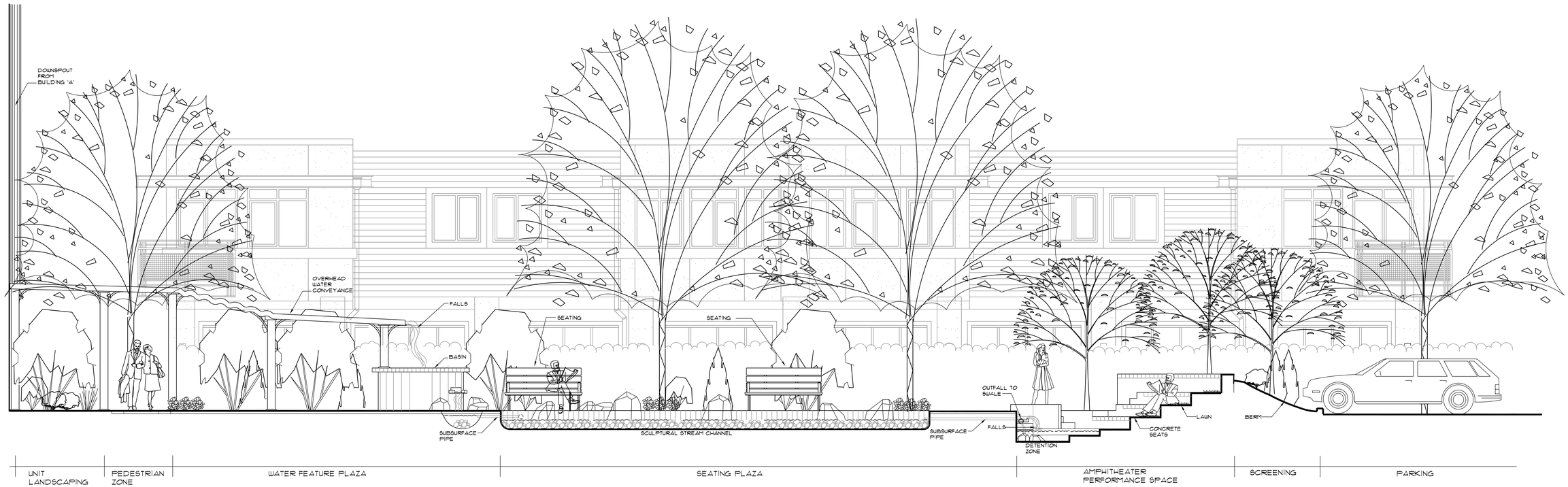
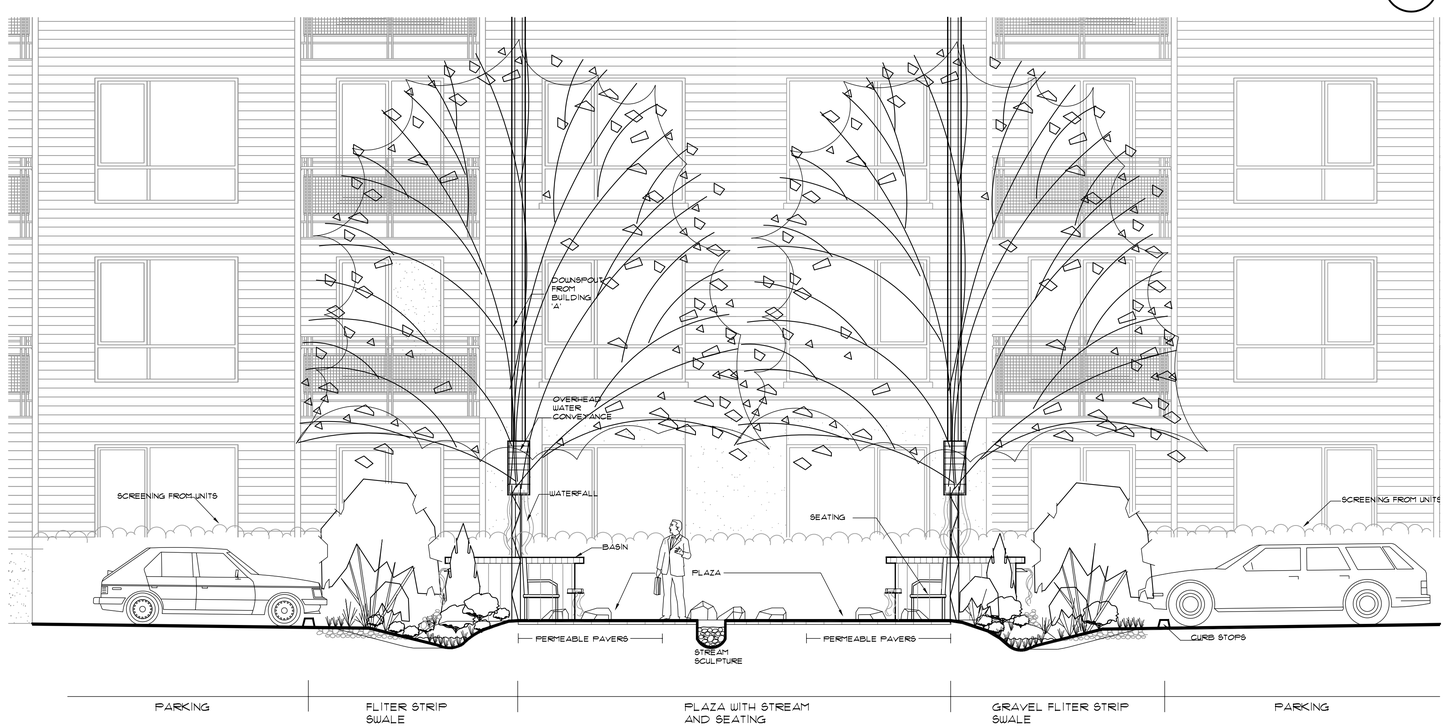


1 PLAZA SECTION A

SCALE: 1/4" = 1'-0"

NORTH



2 PLAZA SECTION B

SCALE: 1/4" = 1'-0"

NORTH

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NORTH MAIN MIXED-USE
MILWAUKIE, OREGON

REGISTERED 204
LAUREL A. MACDONALD
OREGON
LANDSCAPE ARCHITECT

PLAZA SECTIONS

Designed:	JAK
Drawn:	JAK
Checked:	LMB
10.15.04	
Project No:	2417

L4

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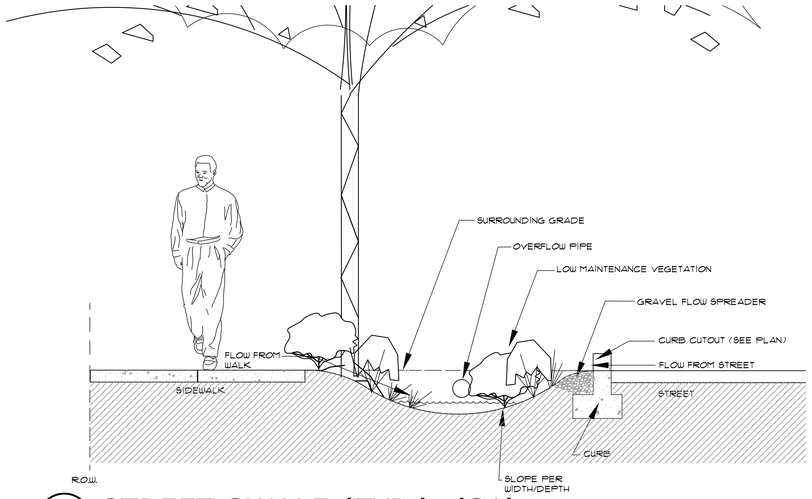
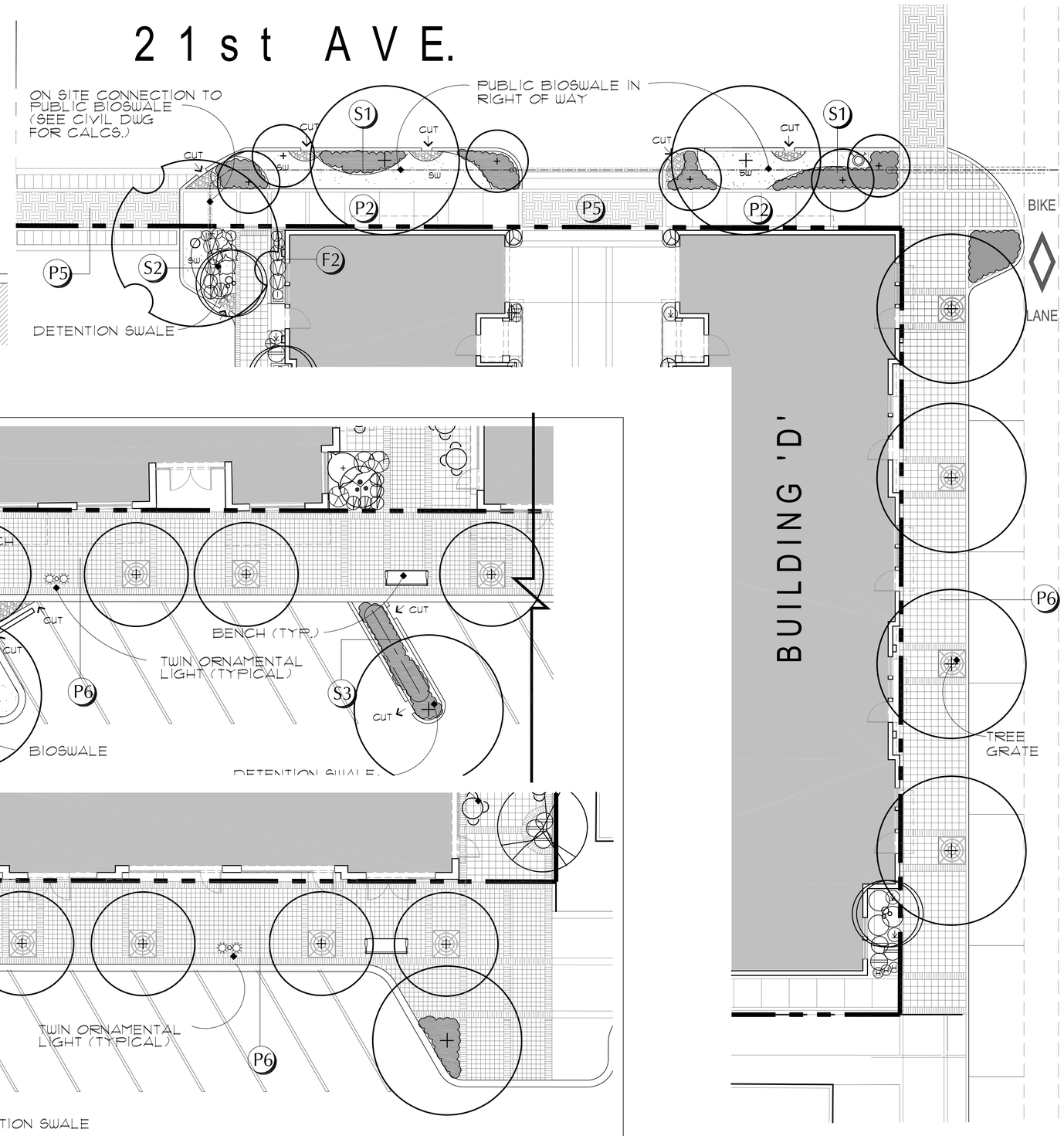


1 STREET SWALE (TYP.) (S1)
SCALE: 1/2" = 1'-0"



2 MAIN STREET
SCALE: 1/8" = 1'-0"

3 21ST & HARRISON
SCALE: 1/8" = 1'-0"

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NORTH MAIN MIXED-USE
MILWAUKIE, OREGON

REGISTERED 204 LAUREL A. MACDONALD OREGON LANDSCAPE ARCHITECT

PRELIMINARY
R.O.W. CONCEPTS

Designed:	JAK
Drawn:	JAK
Checked:	LMB
10.15.04	
Project No:	2417

L5

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Preliminary Water Collections Calculations

Milwaukie Main Mixed Use

Basin A

Table 1. Total Rainfall Potential

		Building C 4,088	Building D 4,088	Paving 11,408	Paths 2,552	Plant Bed 175
	Mean Precip in inches (1)	Rainfall Potential in Gallons	Rainfall Potential in Gallons	Rainfall Potential in Gallons	Rainfall Potential in Gallons	Rainfall Potential in Gallons
Jan	5.67	14,371	14,371	40,104	8,971	615
Feb	4.87	12,343	12,343	34,445	7,706	528
Mar	4.38	11,101	11,101	30,980	6,930	475
Apr	2.78	7,046	7,046	19,663	4,399	302
May	2.43	6,159	6,159	17,187	3,845	264
Jun	1.64	4,157	4,157	11,600	2,595	178
Jul	0.94	2,382	2,382	6,649	1,487	102
Aug	1.24	3,143	3,143	8,770	1,962	135
Sep	1.94	4,917	4,917	13,722	3,070	210
Oct	2.82	7,147	7,147	19,946	4,462	306
Nov	6.19	15,689	15,689	43,782	9,794	672
Dec	5.91	14,979	14,979	41,801	9,351	641
		103,435	103,435	288,647	64,571	4,428

Roof Rainfall Potential Gallons	206,871
Hard Surface Rainfall Pot. Gallons	353,219
Soft Surface Rainfall Pot. Gallons	4,428
Total Rainfall Potential in Gallons:	**564,517**

(1) Data from Oregon Climate Service- Testing Station at KGW

*formula:.62 x inches of precip x sq ft of area

Source: Texas guide to rainwater harvesting

Preliminary Water Collections Calculations

Milwaukie Main Mixed Use

BASIN A

Table 2. Peak Event Potential

		Building C 4,088	Building D 4,088	Paving 11,408	Paths 2,522	Plant Bed 175	Total Gallons
	Extreme Precip. in inches (2)	Rainfall Potential in Gallons	Rainfall Potential in Gallons	Rainfall Potential in Gallons	Rainfall Potential in Gallons	Rainfall Potential in Gallons	
Jan	2.52	6,387	6,387	17,824	3,940	273	34,812
Feb	2.08	5,272	5,272	14,712	3,252	226	28,734
Mar	1.52	3,853	3,853	10,751	2,377	165	20,998
Apr	1.16	2,940	2,940	8,205	1,814	126	16,024
May	0.95	2,408	2,408	6,719	1,485	103	13,124
Jun	1.40	3,548	3,548	9,902	2,189	152	19,340
Jul	1.27	3,219	3,219	8,983	1,986	138	17,544
Aug	1.36	3,447	3,447	9,619	2,127	148	18,787
Sep	1.44	3,650	3,650	10,185	2,252	156	19,892
Oct	1.73	4,385	4,385	12,236	2,705	188	23,899
Nov	2.77	7,021	7,021	19,592	4,331	301	38,265
Dec	2.00	5,069	5,069	14,146	3,127	217	27,628

Worst Case Day(Nov) total gallons	**38,265**
Worst Case Day(Nov) gallons off roof	**14,041**

(2) Max ammount in 24 hour perid- Peak Event

*formula:.62 x inches of precip x sq ft of area

Source: Texas guide to rainwater harvesting

Preliminary Water Collections Calculations

Milwaukie Main Mixed Use

Basin B

Table 1. Total Rainfall Potential

		Building A 14,514	Building B 11,688	Building E 2,407	Building F 2,138	Paving 21,397	Paths 5,977	Plaza 4,312	Plant Bed 1455
	Mean Precip in inches (1)	Rainfall Potential in Gallons*	Rainfall Potential in Gallons	Rainfall Potential in Gallons	Rainfall Potential in Gallons	Rainfall Potential in Gallons	Rainfall Potential in Gallons	Rainfall Potential in Gallons	Rainfall Potential in Gallons
Jan	5.67	51,023	41,088	8,462	7,516	75,219	21,012	15,158	5,115
Feb	4.87	43,824	35,291	7,268	6,455	64,606	18,047	13,020	4,393
Mar	4.38	39,414	31,740	6,536	5,806	58,106	16,231	11,710	3,951
Apr	2.78	25,016	20,145	4,149	3,685	36,880	10,302	7,432	2,508
May	2.43	21,867	17,609	3,626	3,221	32,237	9,005	6,496	2,192
Jun	1.64	14,758	11,884	2,447	2,174	21,756	6,077	4,384	1,479
Jul	0.94	8,459	6,812	1,403	1,246	12,470	3,483	2,513	848
Aug	1.24	11,158	8,986	1,851	1,644	16,450	4,595	3,315	1,119
Sep	1.94	17,457	14,058	2,895	2,572	25,736	7,189	5,186	1,750
Oct	2.82	25,376	20,435	4,208	3,738	37,411	10,450	7,539	2,544
Nov	6.19	55,702	44,856	9,238	8,205	82,117	22,939	16,549	5,584
Dec	5.91	53,182	42,827	8,820	7,834	78,403	21,901	15,800	5,331
Total		367,236	295,732	60,902	54,096	541,391	151,231	109,103	36,815

Roof Rainfall Potential Gallons	777,967
Hard Surface Rainfall Pot. Gallons	801,726
Soft Surface Rainfall Pot. Gallons	36,815
Total Rainfall Potential in Gallons:	**1,616,507**

(1) Data from Oregon Climate Service- Testing Station at KGW

*formula:.62 x inches of precip x sq ft of area

Source: Texas guide to rainwater harvesting

Preliminary Water Collections Calculations

Milwaukie Main Mixed Use

BASIN B

Table 2. Peak Event Potential

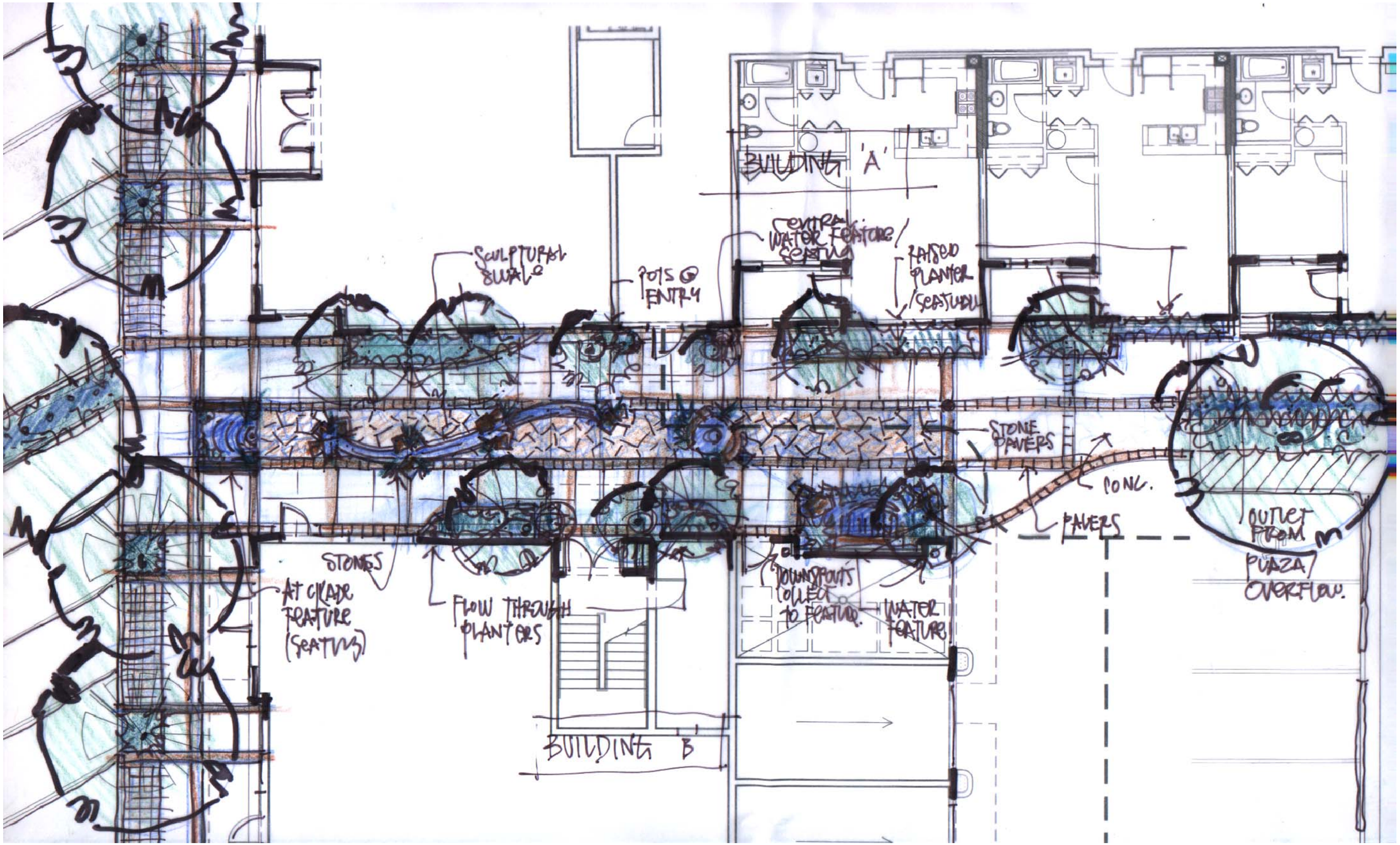
		Building A 14,514	Building B 11,688	Building E 2,407	Building F 2,138	Paving 21,397	Paths 5,977	Plaza 4,312	Plant Bed 1455	Total Gallons
	Extreme Precip. in inches (2)	Rainfall Potential in Gallons	Rainfall Potential in Gallons	Rainfall Potential in Gallons	Rainfall Potential in Gallons	Rainfall Potential in Gallons	Rainfall Potential in Gallons	Rainfall Potential in Gallons	Rainfall Potential in Gallons	
Jan	2.52	22,677	18,261	3,761	3,340	33,431	9,338	6,737	2,273	99,819
Feb	2.08	18,717	15,073	3,104	2,757	27,594	7,708	5,561	1,876	82,390
Mar	1.52	13,678	11,015	2,268	2,015	20,165	5,633	4,064	1,371	60,208
Apr	1.16	10,438	8,406	1,731	1,538	15,389	4,299	3,101	1,046	45,948
May	0.95	8,549	6,884	1,418	1,259	12,603	3,520	2,540	857	37,630
Jun	1.40	12,598	10,145	2,089	1,856	18,573	5,188	3,743	1,263	55,455
Jul	1.27	11,428	9,203	1,895	1,683	16,848	4,706	3,395	1,146	50,305
Aug	1.36	12,238	9,855	2,030	1,803	18,042	5,040	3,636	1,227	53,870
Sep	1.44	12,958	10,435	2,149	1,909	19,103	5,336	3,850	1,299	57,039
Oct	1.73	15,568	12,537	2,582	2,293	22,950	6,411	4,625	1,561	68,526
Nov	2.77	24,926	20,073	4,134	3,672	36,747	10,265	7,405	2,499	109,721
Dec	2.00	17,997	14,493	2,985	2,651	26,532	7,411	5,347	1,804	79,221

Worst Case Day(Nov) total gallons	**109,721**
Worst Case Day(Nov) gallons off roof	**52,805**

(2) Max ammount in 24 hour perid- Peak Event

*formula:.62 x inches of precip x sq ft of area

Source: Texas guide to rainwater harvesting



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Milwaukie Main Street
Mixed Use Development
Milwaukie, Oregon

Concept Sketch
Artistic Water

Date:	09/30/04
Project No:	2417

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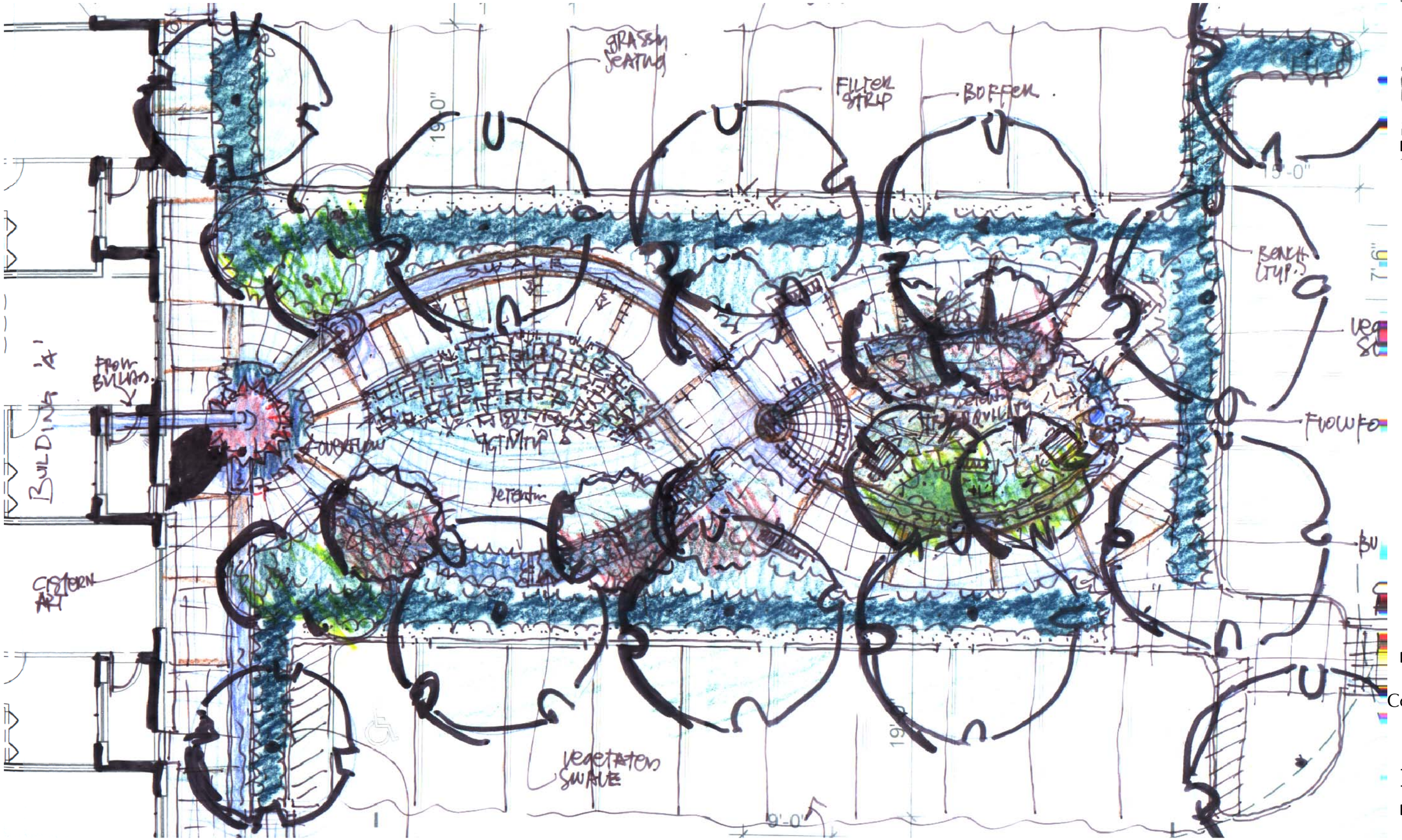

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Milwaukie Main Street Mixed Use Development

Milwaukie, Oregon

Concept Sketches
Central Plaza

Date:	09/30/04
Project No:	2417

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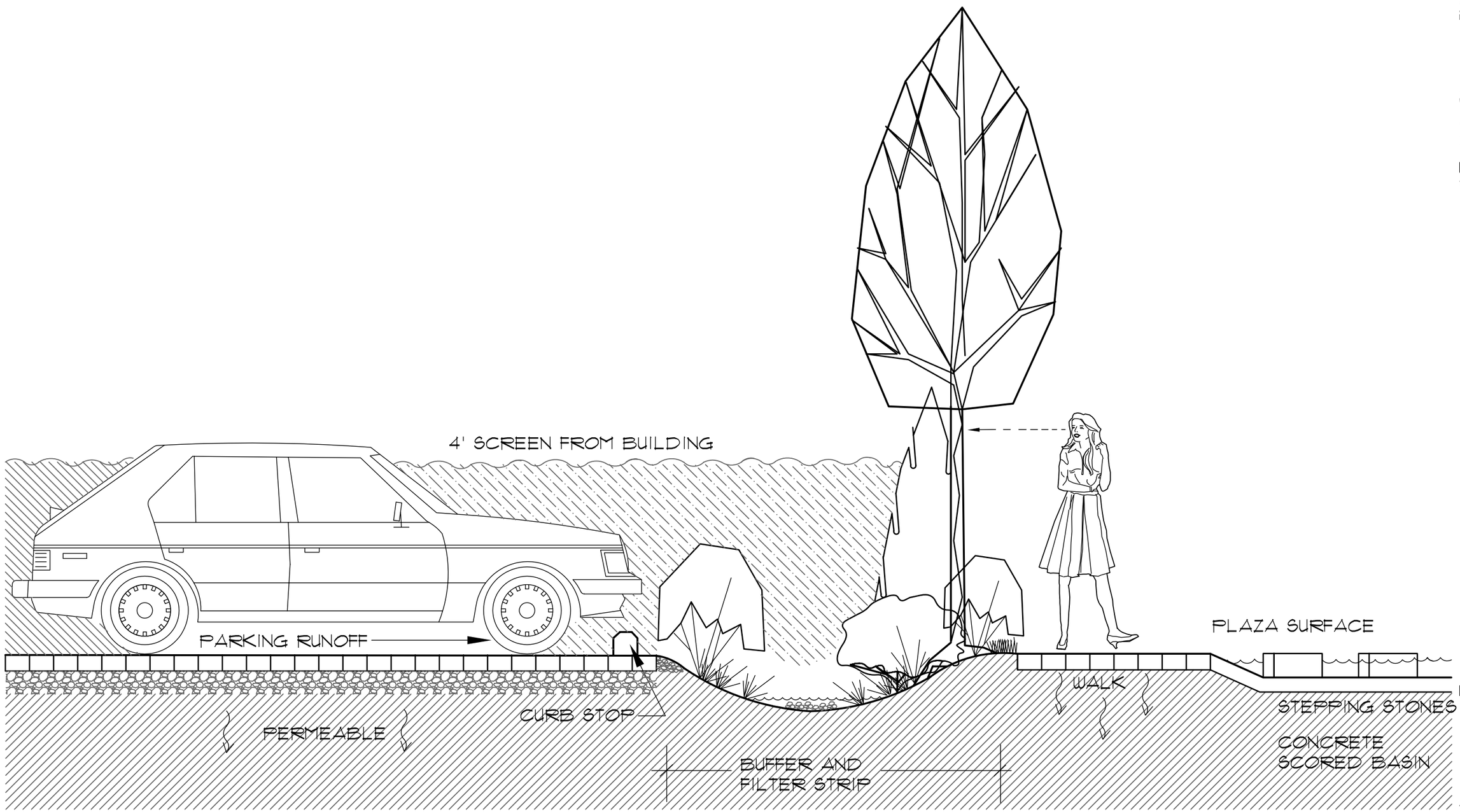
Milwaukie Main Street Mixed Use Development

Milwaukie, Oregon



Plaza Section

Date:	09/30/04
Project No:	2417

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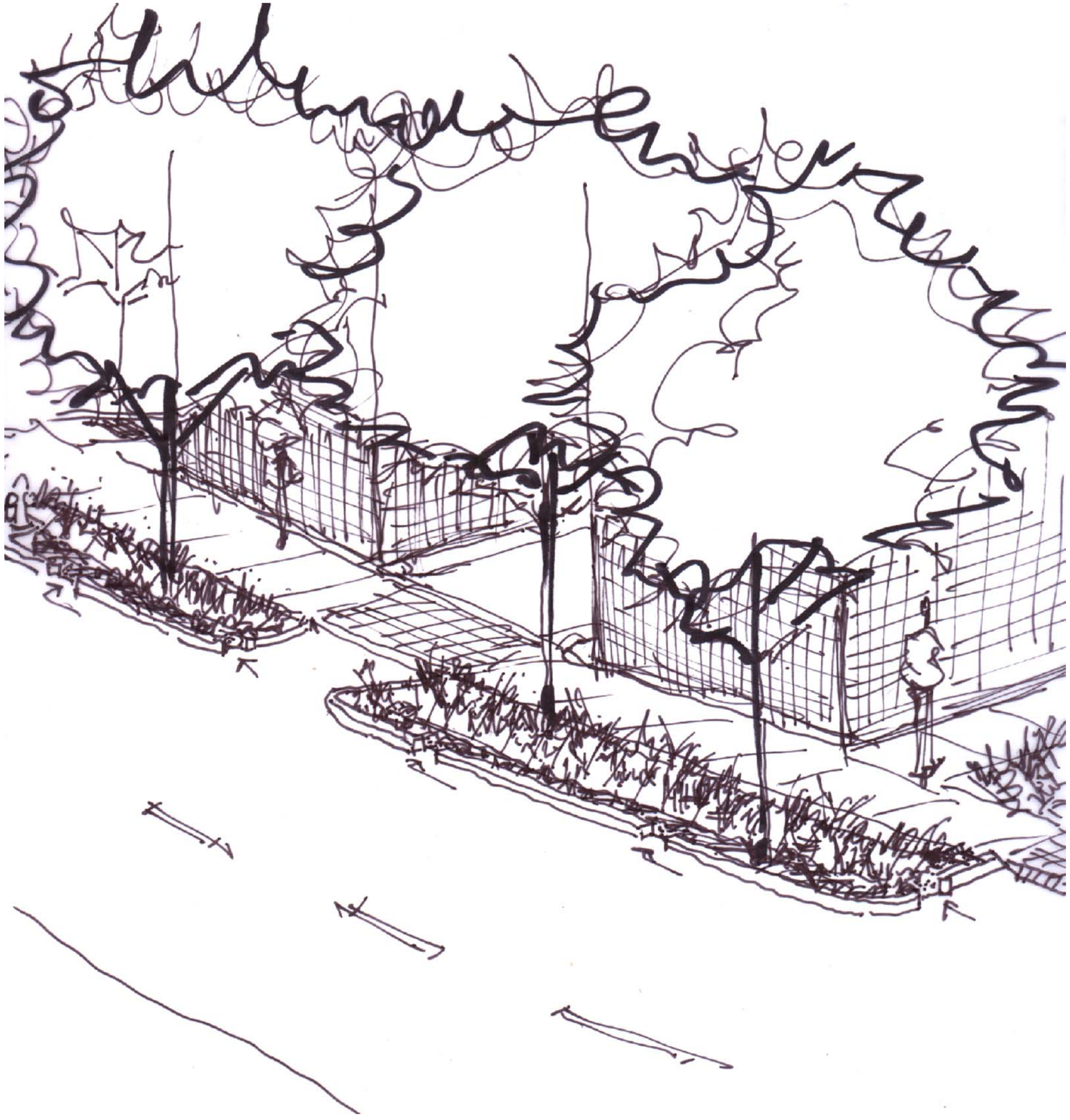

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Milwaukie Main Street
Mixed Use Development
Milwaukie, Oregon

21st Avenue
Perspective

Date:	09/30/04
Project No:	2417

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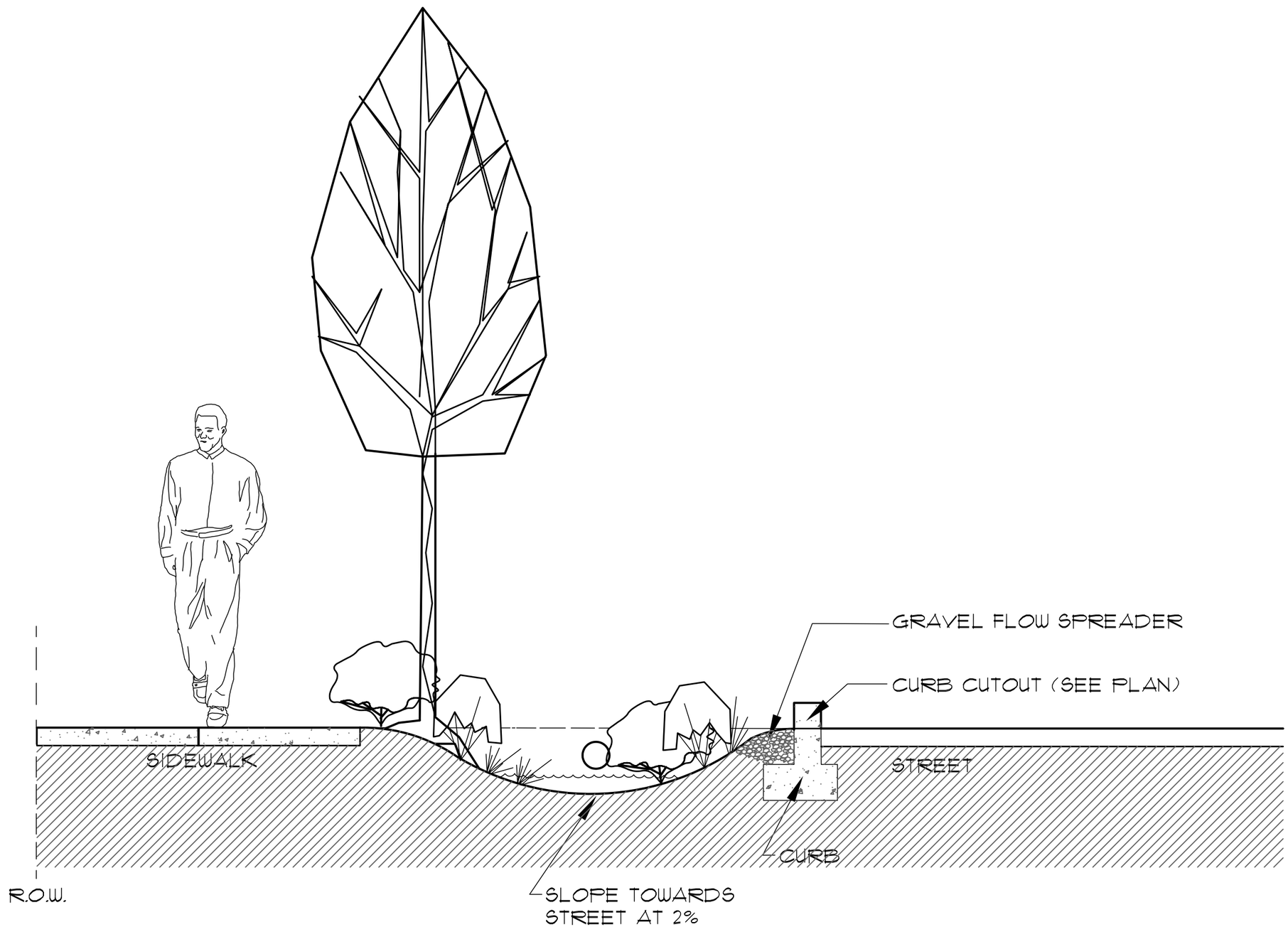

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Milwaukie Main Street
Mixed Use Development
Milwaukie, Oregon

21st. Avenue
Section

Date:	09/30/04
Project No:	2417

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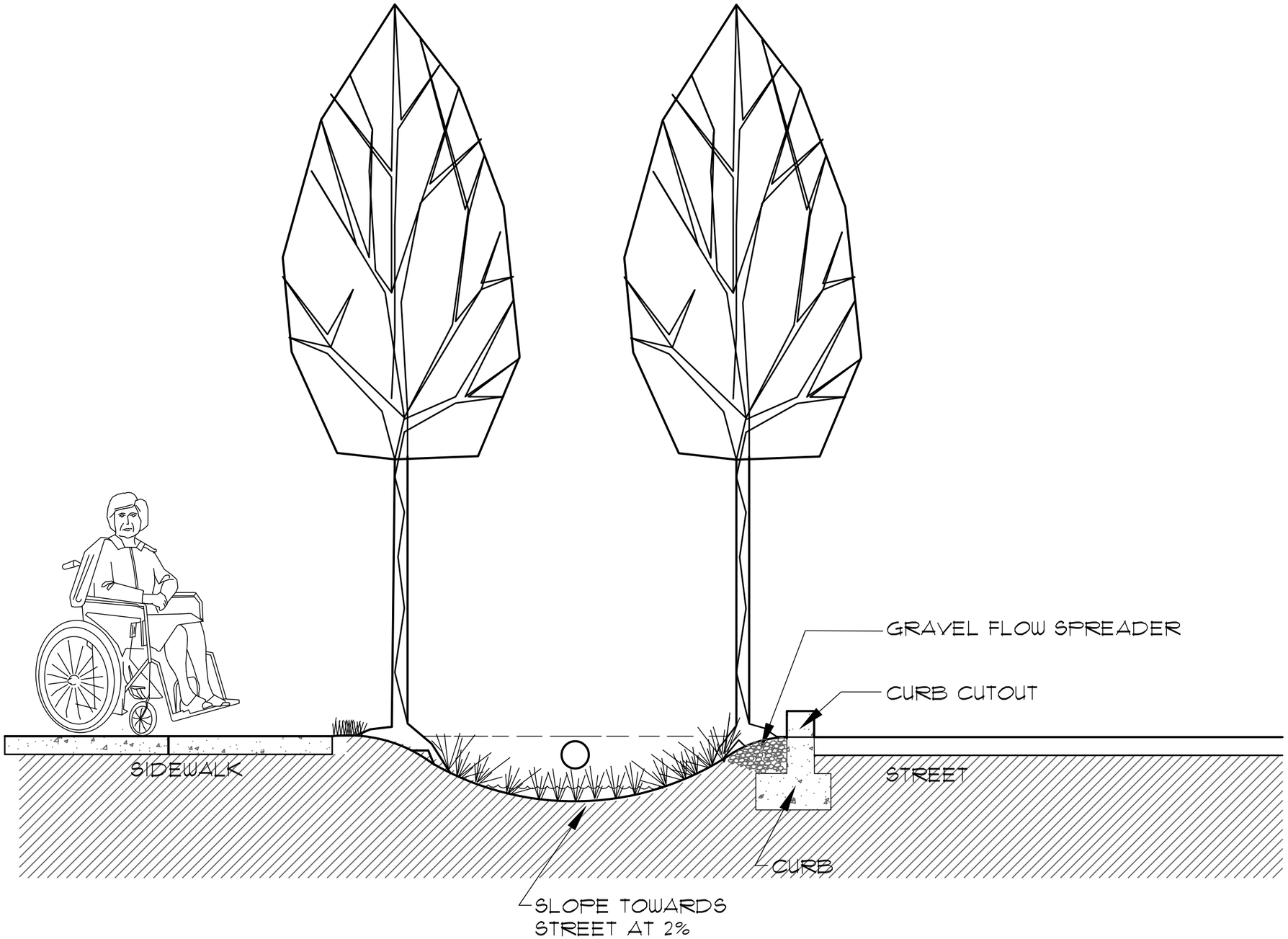

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Milwaukie Main Street
Mixed Use Development
Milwaukie, Oregon

21st Avenue
Grass Swale Alt.

Date:	09/30/04
Project No:	2417

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STORMWATER PROJECTS DATABASE

Type	Name	Location	Notes
ecoroof	Multnomah Building Green Roof	501 SE Hawthorne	11893 sf
ecoroof	Hamiton West Apartments		
ecoroof	Fire Station #12	8655 NE Sandy Blvd	1600 sf
ecoroof	Hawthorne Hostel		
ecoroof	Clean Water Services	2025 SW Merlo Ct. (Beaverton)	8000 sf
ecoroof	Hawthorne Condominiums		1500 sf
ecoroof	People's Food Coop		
ecoroof	Jean Vollum Natural Capital Center	721 NW 9th Ave.	5500 sf
ecoroof	B&O Building Test Plots	107 SE Washington St.	4000 sf
ecoroof	Orpinela Residence		
ecoroof	Brewery Blocks - Block 4	1120 NW Couch Street	14000 sf
ecoroof	Mosaic Condominiums	1410 SW 11th Avenue	3373 sf
ecoroof	Broadway Building (PSU)	625 SW Jackson St.	under construction
ecoroof	Sokol Blosser Winery	5000 Sokol Blosser Ln. (Dundee)	5805 sf
ecoroof	Native American Student & Community Center (PSU)	710 SW Jackson St.	4000 sf
ecoroof	Buckman Terrace	303 NE 16th St.	
roof garden	Museum Places Lofts & Townhouses	1030 SW Jefferson St.	11000 sf
roof garden	Office Building	SW 2nd & Market St.	
roof garden			
swale	Arata Creek School	Troutdale	vegetated; parking lot runoff
swale	BES Water Pollution Control Laboratory	6543 N Burlington	vegetated swale
swale	Glencoe Elementary School	825 SE 51st Ave	vegetated; parking lot runoff
swale	Hawthorne Ridge Subdivision	SE 162nd & Foster	vegetated swale
swale	Jean Vollum Natural Capital Center	721 NW 9th Ave.	vegetated; parking lot runoff
swale	OMSI Parking Lot Bioswales	1945 SE Water Avenue	vegetated; parking lot runoff
swale	PCC Annex	SE Water Avenue	vegetated; parking lot runoff
swale	Reed College	SE 28th Avenue	grassy swale
swale	Residence	7123 SE Powell	soakage trench
swale	Russell Pond	NE 88th & Fremont	grassy swale
swale	Street Swale	SW Scholls Ferry Rd	grassy swale
swale	Starbucks (Division St.)		
green street	Siskiyou Demonstration Project	NE 35th & Siskiyou St.	
green street	Street Swale/curb cuts & overflow	N Leadbetter Road	
green street	New Seasons Division		
green street	Sand Filter & Street Swale	SW Lodi Lane & Shattuck Rd.	
green street	SEA Street Demostration Project	Seattle	
permeable paving	Multnomah Arts Center		eco-stone pavers
permeable paving	Lucky Lab Brew Pub		eco-stone pavers
permeable paving	ONRC Headquarters	5825 N Greeley	pavers
permeable paving	Pump Station	NE 94th & Broadway	pervious concrete
permeable paving	Clean Water Services	2025 SW Merlo Ct. (Beaverton)	pervious concrete
permeable paving	Roadway	SE 162nd & Foster	pervious asphalt
permeable paving	Jean Vollum Natural Capital Center	721 NW 9th Ave.	pervious asphalt
permeable paving	Los Jardines de la Paz		grass pavers (walkway)
permeable paving	Villas de Mariposas		open cell pavers w/ gravel
permeable paving	Street Paving	2100 Block of SE Knapp (at Rex)	conc. Pavers

permeable paving	Tualatin Police Station Parking Lot		conc. Pavers
permeable paving	School LaCenter, WA		conc. Pavers
permeable paving	Merlo Yard Parking Lot		pervious concrete
permeable paving	Mt. Angel Site Parking Lot	?	pervious concrete
permeable paving	Sherwood Elementary School		pervious concrete
permeable paving	Street Paving	N. Gay Avenue	pervious conc. & asphalt
vegetated filter	SW Community Center	6820 SW 45th Ave.	detention
vegetated filter	Buckman Heights Courtyard	430 NE 16th Ave.	infiltration basins
vegetated filter	Glencoe Elementary School - Rain Garden	825 SE 51st Ave.	infiltration basins
vegetated filter	Macintyre Estates Subdivision	SE 139th & Steele	pond
vegetated filter	Wattles Boys & Girls Club	9330 SE Harold	pond
vegetated filter	Cascade Station	NE Airport Way & I-205	sand filter w/ rock
stormwater planter	Wattles Boys & Girls Club	9330 SE Harold	at grade; infiltration planter
stormwater planter	Portland State	PSU ?	at grade; infiltration planter
stormwater planter	Buckman Terrace Apartments	303 NE 16th Ave	flow through; above grade
stormwater planter	Ritzdorf Apartments	SE 12th & Belmont	flow through; above grade
stormwater planter	Liberty Center Parking Garage	650 NE Holladay	flow through; at grade
stormwater planter	Villas de Mariposas (North)		flow through; above grade
stormwater planter	Buckman Heights Apartments		
detention ponds	BES Water Pollution Control Lab	6543 N Burlington	
detention ponds	Davinci Middle School - Water Garden	2508 NE Everett	
detention ponds	Mill Pond	NW Mill Pond Rd (Forest Heights)	
detention ponds	Arata Creek School	Troutdale	
detention ponds	Hawthorne Ridge Subdivision	SE 162nd & Foster Rd	
detention ponds	Russell Pond	NE 88th & Fremont	constructed wetland
detention ponds	Villas de Mariposas		small sand filters
detention ponds	Willamette Falls Hospital	Oregon City	swales & pond in existing stream channel
detention ponds	Oleson Woods Apartments		wet pond
detention ponds	Trinity Lutheran Church	Hillsboro	wet pond
detention ponds	ONRC Headquarters	5825 N Greeley	vegetated
cistern	ONRC Headquarters	5825 N Greeley	underground cistern
cistern	Ersson Residence		
cistern	People's Food Coop		
cistern	Davinci Middle School - Water Garden	2508 NE Everett	
harvesting			
art examples	N. Interstate Max Art	Delta Park/Vanport Station	art installation by Linda Wysong
art examples	N. Interstate Max Art	N Prescott Station	art installation by Brian Borrello; Valeri Otani
art examples	New Seasons (Division)		kinetic rain sculpture
art examples	Davinci Middle School - Water Garden	2508 NE Everett	