Introduction

Clean Water Services and its member cities initiated a program to regularly inspect and support maintenance of privately owned water quality facilities. These facilities are constructed to protect precious water resources by removing pollution from stormwater runoff before it enters into local streams and the Tualatin River. Water quality facilities are required by law and must comply with Clean Water Services’ municipal stormwater (MS4) permit and Oregon Department of Environment Quality (DEQ) regulations.

The fact sheets and operations and maintenance plans to this guide explain proper operations and maintenance of common types of water quality facilities. These plans guide owners to the appropriate inspection frequency and recommend maintenance tasks for each type of facility. If you have questions or concerns, please feel free to call our trained staff for assistance at 503.681.3600. Your efforts to protect water resources are appreciated.
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Porous Pavement

Description
Porous pavement is a water-permeable structural groundcover that infiltrates precipitation, attenuates stormwater runoff flows and volumes, and reduces temperatures. Porous pavement provides a stable load-bearing surface without increasing a project’s total impervious area.

The two main categories of porous pavements are 1) pervious concrete and asphalt, and 2) permeable pavers. Pervious concrete and asphalt are poured in place and resemble their solid counterparts, except the fines (sand and finer material) are removed to create more void space for water to flow through. Permeable pavers are solid, discrete units typically made of pre-cast concrete, brick, stone, or cobbles and set to allow water to flow between them.

Application & Limitations
Porous pavement is not considered a water quality facility to provide treatment of runoff from other impervious surfaces. However, pollutants captured from direct rainfall on the porous pavement area are treated through filtration, absorption, and other microbial degradation actions in the subgrade. Porous pavement area may be considered 100% pervious in water quality calculations, thus reducing the size of required water quality facilities.

Pervious asphalt, pervious concrete, and permeable pavers can be used in most pedestrian areas, residential driveways, public sidewalks, and parking lots. Local jurisdictions may approve pervious asphalt and concrete for private streets and public roadways on a case-by-case basis.

Porous pavements should not be located over cisterns, utility vaults, underground parking or other impervious surfaces and should be applied only where the seasonal high water table is at least 10 feet beneath the facility’s bottom or drain rock layer. Porous pavement should not be applied in locations where there is a high risk of chemical spillage.
Design Factors

Sizing
Porous pavement replaces impervious area at a 1:1 ratio. All stormwater from the porous pavement surface must infiltrate directly into a crushed rock storage layer. To deter clogging over time, porous pavement should capture only direct rainfall. If approved by the local jurisdiction, detention storage may be constructed beneath the porous pavement and sized by approved calculation. Water quality treatment must be provided for any stormwater flowing from adjacent impervious areas across the porous pavement.

Slopes
In general, porous pavement should not be used on slopes greater than 20H: 1V.

Piping
As needed, and where existing soils have low permeability and an infiltration rate of 0.5” per hour or less, provide an under-drain to an approved outlet structure.

Setbacks
Check with the local building department to confirm site-specific requirements. Impermeable liners are recommended between base rock and adjacent foundations and conventional Asphalt Cement Concrete (ACC) or Portland Cement Concrete (PCC) pavement.

Porous Pavement Design
For specific design mix, use the following references:

- Pervious asphalt
  ODOT 2008 Standard Specification, or as updated.
  See National Asphalt Pavement Association Information Series 131 for additional information.
- Pervious concrete
  Stormwater Management Manual, Chapter 2, Pervious Pavement section, City of Portland Bureau of Environmental Services, 2008 or as updated.
- Pavers
  Interlocking Concrete Pavement Institute specifications and Portland Department of Transportation 2007 Standard Specification Section 00760.00 or as updated.
Design Factors (Continued)

Choker Course
The choker course beneath pervious asphalt or concrete pavement consists of 3/4" to 1/4" clean, crushed drain rock, minimum 2" depth.

Aggregate Base
The base course consists of clean, crushed 3/4" to 2" uniformly graded aggregate. The depth of the aggregate base course will vary per design.

Geotextile Fabric
Non-woven geotextile fabric should be placed between the subgrade (native soil) and the aggregate base for proper separation.

Subgrade
Excavate to the bed bottom elevation. Care should be taken to avoid compaction of the subgrade surface and all construction equipment should be kept off the subgrade. If based on the soil type, the excavation of the surface has been sealed, the surface should be lightly scarified or raked to provide infiltration values consistent with the design.

For traffic areas, compact the subgrade soil for public roadways, private streets, parking lots, and fire lanes to ensure structural stability and minimize rutting. Compaction should be to 95%. Because compaction reduces soil permeability it should be done with caution and scarified prior to setting the aggregate base. Protect the subgrade from truck traffic. It is imperative to protect the porous pavement subgrade from over-compaction. If the subgrade is to be compacted, infiltration testing should be conducted during design of porous pavement to adequately account for reduced soil permeability.

Construction
Porous pavement is to be protected from fines infiltration during site construction by covering with visqueen or similar impervious material.
Porous Pavement

Maintenance Assurance Period

- Check with the local jurisdiction about use of porous pavement for public facilities.
- If approved for use in the public right-of-way, the permittee must comply with local jurisdiction requirements for a maintenance assurance period.

Long Term Maintenance

- If private, the property owner is responsible for ongoing maintenance per a recorded maintenance agreement (see page 77 for example maintenance agreement).
- Porous pavement on private roads must be in a separate tract.
- Porous pavement requires regenerative air style vacuuming at least once a year, but twice a year is recommended to remove fine particulates from the infiltration spaces. Without this ongoing maintenance, the facility may become impervious.
- Over time, settling may occur and aggregate base, washed sand, and/or pavers may need to be replaced or repaired.
- Sealing is a common maintenance practice with conventional asphalt. Pervious asphalt must not be sealed or it will lose its pervious function. Owners should take extra care not to seal pervious asphalt pavement. If porous pavement is sealed, additional stormwater treatment may be required.
- For detailed Operation and Maintenance Plans that describe proper maintenance activities please refer to page 44.

References

- Clean Water Services Design and Construction Standards
Green Roof

Description

A green roof (or ecoroof) is a lightweight vegetated roof system with waterproofing material, drainage, growing medium, and specially selected plants. A green roof can reduce site impervious area and manage stormwater runoff. Green roofs reduce peak runoff to near pre-development rates and reduce annual runoff volume by at least 50% (Cost Benefit Evaluation of Ecoroofs, Portland Bureau of Environmental Services, 2008). Green roofs also help mitigate runoff temperatures by keeping roofs cool and retaining most of the runoff in dry seasons. Green roofs typically have thin layers of lightweight growing medium (4 to 8 inches) and low-growing succulent vegetation. Alternatively, roof gardens that are designed to be walked on have deeper soils (8+ inches) and are more heavily planted. Professional design consultation may be necessary to ensure the structural requirements of building codes are met. The design must be low maintenance and use irrigation only to sustain the health of vegetation.

Application & Limitations

Green roofs may be considered 100% pervious in water quality calculations, thus reducing the size of water quality facilities. Green roofs can be applied to a range of building types, from ‘flat’ rooftops (minimum of 1/4” slope per foot) to sloped rooftops with up to 4:12 pitch (3H:1V slope) or higher with adequate slope control. Depending on configuration and structure of the roof, the vegetated area may be partial or 100% coverage. The structural roof support must hold the additional weight of the green roof. Greater flexibility and options are available for new buildings, but retrofits are possible. For retrofit projects, an architect, structural engineer, or roof consultant can determine the condition of the existing building structure and what might be needed to support a green roof. Generally, the building structure must hold an additional 15 to 30 pounds per square foot for saturated weight.
Design Factors

Sizing
Green roofs replace impervious area at a 1:1 ratio. They may not receive water from other impervious areas such as an adjacent conventional roof.

Slope
Maximum roof pitch is 4:12 (3H:1V slope) unless the applicant provides documentation of runoff retention and erosion control on steeper slopes.

Waterproofing
On the roof surface, use a good waterproofing material such as modified asphalt, synthetic rubber, or reinforced thermal plastics. Waterproofing materials also may act as a root barrier. Waterproof membranes should be thoroughly tested to identify and remedy potential defects and leaks prior to installation of any green roof components.

Protection boards or materials (recommended)
These materials protect the waterproof membrane from damage and are usually made of soft fibrous materials. They may be required to maintain the waterproofing warranty, depending on the membrane used. Consult with roofing manufacturer for requirements.

Ballast (optional)
Gravel ballast may be placed along the roof perimeter and at air vents or other vertical elements to separate roofing elements and vegetation. The need for ballast depends on the type of roof and rooftop flashing details. Ballast or rooftop pavers may be used to provide access, especially to vertical elements that require maintenance.

Header/separation board (optional)
If needed, a header or separation board may be placed between gravel ballast and soil or drains.

Root barrier
A root barrier may be required, depending on the waterproofing material, warranty requirements, and the types of vegetation proposed. Root barriers impregnated with pesticides, metals, or other chemicals that could leach into stormwater should not be applied unless documentation that leaching does not occur is provided. If a root barrier is used it must extend under any gravel ballast and the growing medium, and up the side of any vertical elements.
Design Factors (continued)

Drainage
A method of drainage should allow excess water to flow into drains when soils are saturated. A manufactured drain mat, filter fabric, aggregate or gravel layers, or the growing medium itself may be used if water drains when soils are saturated. Every green roof should have an approved discharge location and drain or drains. Check with the local jurisdiction.

Growing medium
The growing medium depth is 3 to 4 inches or more, depending on the project. This material should be lightweight and provide a good base for plant growth. Mixes range from 5% organic/95% inorganic to 30% organic/70% inorganic, depending on specific vegetation needs.

Growing media should be stable over time and not break down into fine particles that might increase compaction and clog drainage layers. Components include pumice, perlite, paper pulp, digested organic fiber, and water retention components such as expanded slate, diatomaceous earth, or polymers. For growing media specification, include all constituent elements and their % composition, and a saturated weight per cubic foot (pcf) that has been tested by a third party lab.

Vegetation and coverage
Green roof vegetation traits:
- Adapted to seasonal drought, excess heat, cold and high winds and other harsh conditions
- Fire resistant
- Requires little or no irrigation once established
- Predominately self-sustaining, low maintenance, with minimal fertilizer
- Perennial or self-sowing annually that are dense and mat-forming
- Diverse palette to increase survivability and good coverage

Examples of appropriate species include: Sedum, ice plant, blue fescue, sempervivum and creeping thyme. Other herbs, forbs, grasses, and low groundcovers can provide additional benefits and aesthetics, but may need more watering and maintenance to survive and may be prone to additional fire risk if allowed to dry out. For a list of acceptable plants refer to the LIDA Handbook, Appendix A.

Establishment Period
Achieve 90% plant coverage within the 2 year establishment period. At least 70% of the green roof should be evergreen species. No more than 10% of the green roof may be non-vegetated components such as gravel ballast or pavers for maintenance access. Mechanical units may protrude through the green roof, but are not considered elements of the green roof and may be removed from square foot totals.

Irrigation during the 2-year establishment period should not exceed ½ inch of water per week (7 days) for the irrigation season (May through October). Post-establishment irrigation should not exceed ¼ inch of water every 10 days during the irrigation season.

Exposed areas during establishment periods should be mulched with an approved, biodegradable mesh blanket, straw, gravel, and pebbles or pumice to protect exposed soil from erosion.
Long Term Maintenance

The property owner is responsible for ongoing maintenance per a recorded maintenance agreement (see see page 77 for example maintenance agreement).

Green roofs should be low maintenance but will require some scheduled maintenance to avoid or resolve problems. The level of maintenance will vary depending on soil depth, vegetation type, and location.

- During the winter rainy season, check drains monthly and remove any accumulated debris.
- Remove dead plants and replant as needed in spring and fall to maintain the required 80% plant coverage.
- During the first growing season remove weeds and undesirable plant growth monthly, and in late spring and early fall in subsequent years.
- Pesticides and herbicides of any kind are prohibited, unless approved by the District to contain a detrimental outbreak of weeds or other pests.

For detailed Operation and Maintenance Plans that describe proper maintenance activities please refer to page 45.

Due to the low level of organic material, fertilizers may be required for plant growth. These should be non-chemical, organic and slow release as approved by the District.

Minimal irrigation may be necessary to maintain vegetation health and ecological function of green roofs. Harvested rainwater is highly recommended for landscape irrigation. Green roofs larger than 1,000 square feet should have an automatic irrigation system for more efficient coverage and to eliminate the need for hand watering. Those larger than 5,000 square feet also should have an irrigation flow meter to monitor water usage.

References
- Clean Water Services Design and Construction Standards
Infiltration Planter/Rain Garden

Description
Infiltration Planters (also known as rain gardens) are landscaped reservoirs that collect, filter, and infiltrate stormwater runoff, allowing pollutants to settle and filter out as the water percolates through planter soil and infiltrates into the ground. Infiltration planters typically require less piping than flow-through planters and a smaller facility size than traditional swales where native soils allow for infiltration. Depending on the site, infiltration planters can vary in shape and construction, with or without walls to contain the facility, or formed as a shallow, basin-like depression.

Application & Limitations
Infiltration planters should be integrated into the overall site design and may help fulfill the landscaping area requirement. Infiltration planters can be used to manage stormwater flowing from all types of impervious surfaces, from private property and within the public right-of-way. Check with the local jurisdiction if proposing to use infiltration planters in the public right-of-way. The size, depth, and use of infiltration planters are determined by the infiltration rates of the site’s existing soils.

Beaumont Village Lofts, NE Portland
Geometry/Slopes
The shape may be circular, square, rectangular, etc. to suit the site design requirements. Regardless of the shape, a minimum planter width of 30 inches is needed to achieve sufficient time for treatment and avoid short-circuiting. Planters in a relatively flat landscaped open area should not slope more than 0.5% in any direction.

Piping for Infiltration Planters
Follow Plumbing Code requirements for piping that directs stormwater from impervious surfaces to planters. Stormwater may flow directly from the public street right-of-way or adjacent parking lot areas via curb openings. For infiltration planters with walls, install an overflow drain to allow not more than 6 inches of water to pond. Infiltration planters with side slopes, such as rain gardens, need an overflow drain to ensure no more than 6 inches of water will pond. On private property, follow Plumbing Code requirements for this overflow drain and piping, and direct excess stormwater to an approved disposal point as identified on permit drawings. Check with local jurisdiction or use Clean Water Services Design and Construction Standards for additional information on piping material for use in the public right-of-way.

Setbacks
Check with the local building department to confirm site-specific requirements.
• Generally, a minimum setback of 10 feet from building structures is recommended.
• Planters should not be located immediately upslope of building structures.

Before site work begins, clearly mark infiltration planter areas to avoid soil disturbance during construction. No vehicular traffic should be allowed within 10 feet of infiltration planter areas,
Design Factors (continued)

except as necessary to construct the facility. Consider construction of infiltration planter areas before construction of other impervious surfaces to avoid unnecessary traffic loads.

Soil Amendment/Mulch
Amended soils with appropriate compost and sand provide numerous benefits: infiltration; detention; retention; better plant establishment and growth; reduced summer irrigation needs; reduced fertilizer need; increased physical/chemical/microbial pollution reduction; and, reduced erosion potential. Primary treatment will occur in the top 18 inches of the infiltration planter. Amended soil in the treatment area is composed of organic compost, gravelly sand and topsoil. Compost is weed-free, decomposed, non-woody plant material; animal waste is not allowed. Check with the local jurisdiction or Clean Water Services for Seal of Testing Approval Program (STA) Compost provider.

To avoid erosion, use approved erosion control BMPs for non-structural infiltration planters.

Vegetation
Planted vegetation helps to attenuate stormwater flows and breakdown pollutants by interactions with bacteria, fungi, and other organisms in the planter soil. Vegetation also traps sediments, reduces erosion, and limits the spread of weeds. Appropriate, carefully selected plantings enhance the aesthetic and habitat value. For a list of acceptable plants refer to the LIDA Handbook, Appendix A.

The entire water quality treatment area should be planted appropriately for the soil conditions. Walled infiltration run-on planters will be inundated periodically. Therefore the entire planter should be planted with herbaceous rushes, sedges, perennials, ferns and shrubs that are well-suited to wet-to-moist soil conditions.

If the infiltration planter has side slopes (basin without vertical walls), soil conditions will vary from wet to relatively dry; several planting zones should be considered. The flat bottom area will be moist-to-wet, and the side slopes will vary from moist at the bottom to relatively dry near the top where inundation rarely occurs. The moisture gradient will depend upon the designed maximum water depth, total depth of the planter, and steepness of the side slopes. This moisture gradient is a transition zone and should be planted with species that tolerate occasional standing water, and plants that prefer drier conditions toward the top of the slope. Areas above the side slopes, immediately adjacent to the basin, and above the designed high water line will not be inundated and should be planted with self-sustaining, low maintenance grasses, perennials, and shrubs suitable for the local climate.

Native plants are encouraged, but non-invasive ornamentals that add aesthetic and functional value are acceptable. All vegetation should be planted densely and evenly to ensure proper hydrological function of the infiltration planter.

Quantities per 100 square feet:

• 115 herbaceous plants, 1’ on center spacing, ½-gal container size; or

• 100 herbaceous plants, 1’ on center, and 4 shrubs, 1-gal container size 2’ on center.

Trees are optional; if used, minimum 2 gallon by 2 feet tall.

Trees are allowed in infiltration planters and should be selected by their adaptability to wet-to-moist conditions and full size at maturity. An area twice the width of tree rootball and the depth of the rootball plus 12” (or total depth of 30”, whichever is greater) should be backfilled with amended soil for optimal growth, with no sub-surface rock layer. For infiltration planters with side slopes, trees should be placed along the side slopes of the facility rather than at the bottom.
Infiltration Planter/Rain Garden

Required Maintenance Period

- Water-efficient irrigation should be applied for the first two years after construction of the facility, particularly during the dry summer months, while plantings become established. Irrigation after these two years is at the discretion of the owner.
- If public, the permittee is responsible for the maintenance of the infiltration planter for a minimum of two years following construction and acceptance of the facility.

Long Term Maintenance

If private, the property owner will be responsible for ongoing maintenance per a recorded maintenance agreement (see page 77 for example maintenance agreement).

For detailed Operation and Maintenance Plans that describe proper maintenance activities please refer to page 46.

All publicly maintained facilities not located in the public right-of-way must have a public easement to ensure access for maintenance.

References

Clean Water Services Design and Construction Standards
Flow-Through Planter

Description

Flow-through planters are structural landscaped reservoirs that collect stormwater and filter out pollutants as the water percolates through the vegetation, growing medium, and gravel. These are appropriate where soils do not drain well or there are site constraints. A liner may be required when located adjacent to buildings, over contaminated soils, and on unstable slopes. Excess stormwater collects in a perforated pipe at the bottom of the flow-through planter and drains to an approved discharge point.

Tree box filters are flow-through planters with a concrete “box” that contains filtering growing media and a tree or large shrub. Tree box filters are used singly or in multiples, often adjacent to streets where runoff is directed to them to treat stormwater runoff before it enters a catch basin.

Application & Limitations

Flow-through planters may help fulfill a site’s landscape area requirement and can be used to manage stormwater runoff from all types of impervious surfaces on private property and within the public right-of-way. Check with the local jurisdiction if proposing to use a flow-through planter in the public right-of-way. Flow-through planters can be placed next to buildings and are ideal for sites with poorly draining soils, steep slopes or other constraints. Design variations of shape, wall treatment, and planting scheme will fit the character of any site.

Headwaters at Tryon Creek, Portland
**Flow-Through Planter**

**Design Factors**

**Sizing**
To calculate the planter size, multiply the impervious surface (rooftops, driveways, parking lots, etc.) area by 6%. The square footage is the peak water surface prior to overflow. For example, a 1,200 sf rooftop and 300 sf driveway (1,500 sf total impervious area) requires a 90 sf stormwater planter (1,500 x 0.06). This could be accomplished with one 9-foot by 10-foot flow-through planter.

**Geometry/Slopes**
- Stormwater planters may be any shape, and can be designed as square, rectangular, circular, oblong, or irregular.
- Regardless of the shape, a minimum planter width of 30 inches is needed to achieve sufficient time for treatment and to avoid short-circuiting.
- The minimum treatment depth of 18 inches is achieved in the growing medium.
- Planters are designed to evenly distribute and filter flows. Surface longitudinal slopes should be less than 0.5%.

**Piping for Flow Through Planters**
Follow Plumbing Code requirements for piping that directs stormwater from impervious surfaces to flow-through planters. Stormwater may flow directly from the public street right-of-way or adjacent parking lot areas via curb openings. The overflow drain allows not more than 6 inches of water to pond in the planter prior to overflow. A perforated pipe system under the planter drains water that has filtered through the topsoil to prevent long-term ponding. On private property, the overflow drain and piping must meet Plumbing Code requirements and direct excess and filtered stormwater to an approved disposal point. Check with the local jurisdiction or use Clean Water Services Design and Construction Standards for additional information on piping material for use in the public right-of-way.

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*Portland Rebuilding Center*
Design Factors (continued)

Setbacks
Check with the local building department to confirm site-specific requirements.
• For planters without an impermeable liner, generally the minimum setback from building structures is 10 feet.
• Typically, no building setback is required for planters lined with waterproofed concrete or 60 mil PVC liner to prevent infiltration.

Soil Amendment/Mulch
Amended soils with appropriate compost and sand provide numerous benefits: infiltration; detention; retention; better plant establishment and growth; reduced summer irrigation needs; reduced fertilizer need; increased physical/chemical/microbial pollution reduction; and, reduced erosion potential. Primary treatment will occur in the top 18 inch flow-through planter. Amended soil in the treatment area is composed of organic compost, gravelly sand and topsoil. Compost is weed-free, decomposed, non-woody plant material; animal waste is not allowed. Check with the local jurisdiction or Clean Water Services for Seal of Testing Approval Program (STA) Compost provider.

To avoid erosion, use approved erosion control BMPs for flow-through planters.

Vegetation
Planted vegetation helps to attenuate stormwater flows and break down pollutants by interactions with bacteria, fungi, and other organisms in the planter soil. Vegetation also traps sediments, reduces erosion, and limits the spread of weeds. Appropriate, carefully selected plantings enhance the aesthetic and habitat value. For a list of acceptable plants refer to the LIDA Handbook, Appendix A.

The entire water quality treatment area should be planted appropriately for the soil conditions. Walled infiltration run-on planters will be inundated periodically. Therefore the entire planter should be planted with herbaceous rushes, sedges, perennials, ferns and shrubs that are well-suited to wet-to-moist soil conditions.

Because the entire facility will be inundated periodically, plant the water quality treatment area with herbaceous species such as rushes, sedges, perennials, ferns and shrubs appropriate for wet-to-moist soil conditions. Most moisture-tolerant plants can withstand seasonal droughts during the dry summer months and do not need irrigation after they become established.

Native plants are encouraged, but non-invasive ornamentals that add aesthetic and functional value are acceptable. All vegetation should be planted densely and evenly to ensure proper hydrological function of the flow-through planter.

Quantities per 100 square feet:
• 115 herbaceous plants, 1’ on center spacing, ½-gal container size; or
• 100 herbaceous plants, 1’ on center, and 4 shrubs, 1-gal container size 2’ on center.
Flow-Through Planter

Required Maintenance Period

• Water-efficient irrigation should be applied for the first two years after construction of the facility, particularly during the dry summer months, while plantings become established. Irrigation after these two years is at the discretion of the owner.
• If public, the permittee is responsible for the maintenance of the flow-through planter for a minimum of two years following construction and acceptance of the facility.

Long Term Maintenance

If private, the property owner will be responsible for ongoing maintenance per a recorded maintenance agreement (see page 77 for example maintenance agreement).

For detailed Operation and Maintenance Plans that describe proper maintenance activities please refer to page 49.

All publicly maintained facilities not located in the public right-of-way must have a public easement to ensure access for maintenance.

References

Clean Water Services Design and Construction Standards
LIDA Swale

Description
A LIDA swale is a narrow, gently sloping landscaped depression that collects and conveys stormwater runoff. The densely planted LIDA swale filters stormwater as it flows the length of the swale and allows infiltration of water into the ground. The LIDA swale discharges to a storm sewer or other approved discharge point.

Compared to vegetated swales, LIDA swales may be shorter and narrower, but require deeper levels of amended soil and a subsurface drain rock layer to compensate for the smaller size and to function effectively.

Application & Limitations
A LIDA swale may help fulfill a site’s landscaping area requirement. LIDA swales are approved to treat stormwater flowing from all types of impervious surfaces including private property and the public right-of-way, rooftops, parking lots, and streets. Check with the local jurisdiction if proposing to use a LIDA swale in the public right-of-way.

Boeckman Road, Wilsonville
Design Factors

Sizing
The size of the LIDA swale will depend upon the infiltration rate of existing soils. A sizing factor of 0.06 assumes the site infiltration rate is less than 2 in/hr.

For example, the size of a LIDA swale managing 1,500 square feet of total impervious area would be 90 square feet (1,500 x 0.06).

Size may be decreased if:
- Demonstrated infiltration rate is greater than 2 in/hr using ASTM D3395-09 method; or
- Amended soil depth is increased

Geometry/Slopes
A LIDA swale’s slope end to end is at least 0.5% and no more than 6%. For sites with steeper slopes, check dams may be incorporated into the design. Side slopes from the bottom to the top of the swale must be 3:1 or less. The minimum bottom width is 2 feet, and the minimum depth is 1 foot.

Piping for LIDA Swales
If needed, stormwater may be directed from impervious surfaces to LIDA swales by piping per plumbing code requirements, or may flow directly into the LIDA swale via curb openings. A LIDA swale has no underdrain. An overflow drain allows no more 6 inches of water depth to collect in the LIDA swale. On private property, the overflow drain and piping must meet plumbing code requirements and direct excess stormwater to an approved disposal point. Check with the local jurisdiction or use Clean Water Services Design and Construction Standards for additional information on piping material for use in the public right-of-way.

Setbacks
- Check with the local building department to confirm site-specific requirements.

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Peoples Food Cooperative, SE Portland
Design Factors (continued)

Soil Amendment/Mulch
Amended soils with appropriate compost and sand provide numerous benefits: infiltration; detention; retention; better plant establishment and growth; reduced summer irrigation needs; reduced fertilizer need; increased physical/chemical/microbial pollution reduction; and, reduced erosion potential. Primary treatment will occur in the top 18 inches of the LIDA swale. Amended soil in the treatment area is composed of organic compost, gravelly sand and topsoil. Compost is weed-free, decomposed, non-woody plant material; animal waste is not allowed. Check with the local jurisdiction or Clean Water Services for Seal of Testing Approval Program (STA) Compost provider.

To avoid erosion, use approved erosion control BMPs for LIDA swale.

Vegetation
The entire facility area including side slopes and treatment areas are planted with vegetation appropriate for the soil conditions. Planting conditions vary from wet to relatively dry within the LIDA swale. The flat bottom will be inundated frequently and should be planted with species such as rushes, sedges, perennials, ferns, and shrubs well-suited to wet-to-moist soil conditions. The side slope moisture gradient varies from wet at the bottom to relatively dry near the top where inundation rarely occurs. The moisture gradient will vary depending upon the designed water depth, the swale depth, and side slope steepness. The transition zone from the bottom of the LIDA swale to the designed high water line or top of freeboard should be planted with sedges, rushes, perennials, ferns, and shrubs that can tolerate occasional standing water and wet-to-moist planting conditions. The areas above the designed high water line and immediately adjacent to the LIDA swale will not be regularly inundated and should be planted with self-sustaining, low maintenance grasses, perennials, and shrubs suitable for the local climate and site. Native plants are encouraged, but appropriate, non-invasive ornamentals are acceptable for aesthetic and functional value. All vegetation should be densely and evenly planted to ensure proper hydrological function of the LIDA swale. For a list of acceptable plants refer to the LIDA Handbook, Appendix A.

Quantities:
Bottom of LIDA swale (wet-to-moist zone, per 100 sf)
• 115 herbaceous plants, 1’ on center spacing, ½-gal container size; or
• 100 herbaceous plants, 1’ on center, and 4 shrubs, 1-gal container size, 2’ on center

Side slopes and top of LIDA swale (wet-to-moist transition zone and dry zone)
• 1 tree per 300 sq. ft, minimum 2-gal container size by 2 ft-tall
• 10 shrubs (1-gal) and 70 groundcovers (½-gal) per 100 sf

Trees are allowed in LIDA swales, and may be required. Trees should be selected by adaptability to wet-to-moist conditions and size at maturity. An area twice the width of the tree rootball and the depth of the rootball plus 12” (or total depth of 30”, whichever is greater) should be backfilled with amended soil for optimal growth, with no sub-surface rock layer. Place trees along the side slopes rather than the bottom of the LIDA swale.
Required Maintenance Period

- Water-efficient irrigation should be applied for the first two years after construction of the facility, particularly during the dry summer months, while plantings become established. Irrigation after these two years is at the discretion of the owner.
- If public, the permittee is responsible for the maintenance of the LIDA swale for a minimum of two years following construction and acceptance of the facility.

Long Term Maintenance

If private, the property owner will be responsible for ongoing maintenance per a recorded maintenance agreement (see page 77 for example maintenance agreement).

For detailed Operation and Maintenance Plans that describe proper maintenance activities please refer to page 52.

All publicly maintained facilities not located in the public right-of-way must have a public easement to ensure access for maintenance.

References

Clean Water Services Design and Construction Standards
Vegetated Filter Strip

Description
Vegetated filter strips are gently sloped areas designed to receive sheet flows from adjacent impervious surfaces. Filter strips are vegetated with grasses and groundcovers that filter and reduce the velocity of stormwater. Peak stormwater flows are attenuated as stormwater travels across the filter strip and infiltrates or is stored temporarily in the soils below.

For residential driveways, center filter strips typically are 3 feet wide between two 3-foot wide paved sections. The strip treats and infiltrates stormwater only from the impervious area of the drive aisles which slope toward the center filter strip. The driveway center filter strip must be maintained to the design requirements for vegetated filter strips.

Application & Limitations
Vegetated filter strips should be integrated into the overall site design and may help fulfill a site’s landscaping area requirement. Vegetated filter strips can be used to manage stormwater runoff from a variety of impervious surfaces such as walkways and driveways on private property and within the public right-of-way. Check with the local jurisdiction if proposing to use a vegetated filter strip in the public right-of-way.
Piping for Vegetated Filter Strips
Non-infiltrated flows/overflows from the vegetated filter strip are collected and conveyed to an approved system or outlet structure.

Setbacks
Check with local building department to confirm site-specific requirements.

Soil Amendment/Mulch
Amended soils with appropriate compost and sand provide numerous benefits: infiltration; detention; retention; better plant establishment and growth; reduced summer irrigation needs; reduced fertilizer need; increased physical/chemical/microbial pollution reduction; and, reduced erosion potential. Primary treatment will occur in the top 18 inches of the vegetated filter strip. Amended soil in the treatment area is composed of organic compost, gravelly sand and topsoil. Compost is weed-free, decomposed, non-woody plant material; animal waste is not allowed. Check with the local jurisdiction or Clean Water Services for Seal of Testing Approval Program (STA) Compost provider.

To avoid erosion, use approved erosion control BMPs for vegetated filter strip.

Design Factors

Sizing
Vegetated filter strips are appropriate for all soil types and have 18” depth of growing medium. The size of the filter strip will depend upon the infiltration rate of existing soils. A sizing factor of 0.06 assumes that the site has an infiltration rate less than 2 in/hr.

For example, a facility managing 1,500 square feet of total impervious area would require a 90 sq ft filter strip (1,500 x 0.06).

Size may be decreased if:
• Demonstrated infiltration rate is greater than 2 in/hr using ASTM D3395-09 method; or
• Amended soil depth is increased

Geometry/Slopes
The minimum width of a vegetated filter strip is 5 feet measured in the direction of stormwater flow. The slope is between 0.5 and 6%, and the slope of the impervious area draining to the strip is less than 6%

Check dams may be required to maintain shallow slopes if the existing site slopes exceed 5%. Typically, check dams are 3 to 5 inches high and are placed every 10 feet where slopes exceed 5%. If a level spreader such as a grade board or sand/gravel trench is required to disperse runoff evenly across the filter strip, the top must be horizontal and at an appropriate height to direct sheet flow to the soil without scour. Grade boards may be any material that withstands weather and solar degradation but should not be old railroad ties, used utility poles, or other pollutant source.
Vegetated Filter Strip

Design Factors (continued)

Vegetation
Herbs, shrubs and grasses can provide the vegetation needed to remove sediment and pollutants. The vegetated filter strip is planted or seeded with a mix of grasses, wildflowers, and groundcovers well-suited to moist-to-dry soil conditions. All vegetation should be self-sustaining and drought tolerant.

Native plants are encouraged, but non-invasive ornamentals that add aesthetic and functional value are acceptable. For a list of acceptable plants refer to the LIDA Handbook, Appendix A.

Trees are not required for vegetated filter strips, but are encouraged where applicable. Tree species should be selected by their adaptability to moist-to-dry conditions and full size at maturity. The filter strip conveys evenly-distributed sheet flows of water through vegetation for treatment. Because unplanted areas may decrease stormwater treatment, the entire filter strip must have 100% vegetation coverage to ensure proper hydrologic function.

If check dams are required, plants suited to wet-to-moist planting conditions may be supplemented on the upslope side of the check dam where occasional inundation and pooling of water may occur.

Required Maintenance Period

• Water-efficient irrigation should be applied for the first two years after construction of the facility, particularly during the dry summer months, while plantings become established. Irrigation after these two years is at the discretion of the owner.

• If public, the permittee is responsible for the maintenance of the vegetated filter strip for a minimum of two years following construction and acceptance of the facility.

Long Term Maintenance

If private, the property owner will be responsible for ongoing maintenance per a recorded maintenance agreement (see page 77 for example maintenance agreement).

For Detailed Operation and Maintenance Plans Refer to page 55 for maintenance.

All publicly maintained facilities not located in the public right-of-way must have a public easement to ensure access for maintenance.

References
Clean Water Services Design and Construction Standards
Vegetated Swale

Description
A vegetated swale is a gently sloping landscaped depression that collects and conveys stormwater runoff, and is narrow and at least 100 feet in length. The densely planted swale filters stormwater as it flows the length of the swale and allows infiltration of water into the ground. The vegetated swale may discharge to a storm sewer or other approved discharge point where soils do not drain well.

Vegetated swales have a required minimum length, width and stormwater residence time. See Clean Water Services Design and Construction Standards Details 700 and 710.

Application & Limitations
Vegetated swales may help fulfill a site’s landscaping area requirement. Vegetated swales are approved to treat stormwater from all types of impervious surfaces including private property and the public right-of-way, rooftops, parking lots, and streets.

Westhaven Subdivision, Washington County, Oregon
Piping for Vegetated Swales
Flows coming into the vegetated swale facility are pretreated by a water quality manhole in accordance with the Design and Construction Standards. Other pretreatment may include an approved proprietary treatment device, filter strip, trapped catch basin, or other method approved by the District or City. An approved outlet structure must be provided for all flows. If location would make access for maintenance difficult, the swale may be a flow-through facility with unsumped structures.

Arbor Oaks Subdivision, Washington County, Oregon
Design Factors (continued)

Setbacks
Check with the local building department to confirm site-specific requirements.

Soil Amendment/Mulch
The treatment area has ¾” to 2-inch river run rock placed 2.5 to 3 inches deep on high density jute or coconut matting over 12 inches of native topsoil. The river rock, topsoil and high density jute or coconut matting extends to the top of the treatment area, topsoil and low density jute matting extends to the edge of the water quality tract or easement area.

Vegetation
The entire facility including freeboard and treatment areas is vegetated according to the Standards with vegetation appropriate for the soil conditions. Planting conditions vary from wet to relatively dry within the swale. The flat bottom will be inundated frequently and should be planted with species such as rushes, sedges, perennials, and ferns, as well as shrubs that are well-suited to wet-to-moist soil conditions. The side slope moisture gradient varies from wet at the bottom to relatively dry near the top where inundation rarely occurs. The moisture gradient will vary depending upon the designed water depth, swale depth, and side slope steepness. The transition zone from the bottom of the swale to the designed high water line or top of freeboard should be planted with sedges, rushes, perennials, and ferns, as well as shrubs that can tolerate occasional standing water, and wet-to-moist planting conditions. The areas above the designed high water line and immediately adjacent to the vegetated swale will not be regularly inundated and should be planted with self-sustaining, low maintenance grasses, perennials, and shrubs suitable for the local climate and site.

Native plants are encouraged, but non-invasive ornamentals that add aesthetic and functional value are acceptable. All vegetation should be densely and evenly planted to ensure proper hydrological function of the swale. For a list of acceptable plants refer to the LIDA Handbook, Appendix A.

Plant Spacing
A) Vegetated swales in tracts or easements less than 30 feet wide are planted as follows to achieve the specified per acre densities:
   i. Treatment area  = 6 plugs per square foot (min. 1-inch diameter by 6-inch tall)
   ii. Total number of shrubs per acre = area in square feet x 0.05
   iii. Groundcover = plant and seed to achieve 100% coverage

B) Vegetated swales in tracts or easements 30 feet wide or more are planted as follows to achieve the specified per acre densities:
   i. Treatment area  = 6 plugs per square foot (min. 1-inch diameter by 6-inch tail)
   ii. Total number of trees per acre = area in square feet x 0.01
   iii. Total number of shrubs per acre = area in square feet x 0.05
   iv. Groundcover = plant and seed to achieve 100% coverage
Required Maintenance Period

- Water-efficient irrigation should be applied for the first two years after construction of the facility, particularly during the dry summer months, while plantings become established. Irrigation after these two years is at the discretion of the owner.
- If public, the permittee is responsible for the maintenance of the vegetated swale for a minimum of two years following construction and acceptance of the facility.

Long Term Maintenance

If private, the property owner will be responsible for ongoing maintenance per a recorded maintenance agreement (see page 77 for example maintenance agreement).

For detailed Operation and Maintenance Plans that describe proper maintenance activities please refer to page 57.

All publicly maintained facilities not located in the public right-of-way must have a public easement to ensure access for maintenance.

References
Clean Water Services Design and Construction Standards
Extended Dry Basin

Description
An extended dry basin is a shallow landscaped depression with a flat bottom that collects and holds stormwater runoff, allowing pollutants to settle and filter out as the water infiltrates into the ground or is discharged to an approved location. An extended dry basin has two or more cells (the first cell is the forebay). An inflow pipe conveys stormwater into the basin where it is temporarily stored. Extended dry basins may infiltrate stormwater where soils have high infiltration rates, or may overflow to an approved discharge point.

Application & Limitations
Extended dry basins may help fulfill a site’s landscaping area requirement. This type of swale is approved to treat stormwater from all types of impervious surfaces, including private property and the public right-of-way, rooftops, parking lots, and streets.

Home Depot, Glenn Widing Drive, North Portland
Design Factors

Sizing
Sizing of the detention basin is determined by the volume of runoff and the detention period required for treatment. At a minimum, the detention basin must accommodate the water quality design storm and be sized for a 48 hour drawdown time.

The minimum water quality detention volume is equal to (1) x the water quality volume (WQV). The outlet orifice size is determined by the following equation:

\[ D = 24 \times \left( \frac{Q}{C(2gH)^{0.5}} \right) / \pi \]

Where:
- \( D \) (in) = diameter of orifice
- \( Q \) (cfs) = WQV(cf) / (48*60*60)
- \( C = 0.62 \)
- \( H(\text{ft}) = \frac{2}{3} \times \text{temporary detention height to centerline of orifice.} \)

Geometry/Slopes
An extended dry basin has two or more cells. The first cell, the forebay, is at least 10% of the entire surface area and constitutes 20% of the treatment volume. The minimum width of the bottom of the extended dry basin is 4 feet, and the permanent pool depth is 0.4 feet and covers the entire bottom of the basin. The maximum depth of the water quality pool, not including the permanent pool, is 4 feet unless otherwise limited by the jurisdiction.

The maximum side slopes of the basin treatment area are 3H: 1V (33.33%); the minimum freeboard is 1 foot above the 25-year design water surface elevation.

Piping for Extended Dry Basins
Incoming flows are pretreated using a water quality manhole in accordance with the District Standards. Other pretreatment may include proprietary devices, filter strip, trapped catch basin, or methods approved by the District or City. An approved outlet structure is provided for all flows.

Setbacks
Check with the local building department to confirm site-specific requirements.

 Soil Amendment/Mulch
If required, place ¾” to 2-inch river run rock 2.5 to 3 inches deep where sustained flow is anticipated. River rock (if required), topsoil, and high density jute or coconut matting extend to the top of the treatment area. Topsoil and low density jute matting extend to the edge of the water quality tract or easement area.
Vegetation
The entire facility area (side slopes and treatment areas) is planted with vegetation appropriate for the varying planting conditions within the extended dry basin. Planting conditions vary from saturated soil to relatively dry, and several planting zones should be considered. The flat bottom of the extended dry basin to the top of the 0.4 foot permanent pool is a saturated zone and will be constantly inundated with water. The saturated zone should be planted with rushes, sedges, and other wetland species (oxygenators) that are well-suited to water-saturated, oxygen-deprived (anaerobic) planting conditions.

The side slopes above the permanent pool depth will vary from wet at the bottom to relatively dry near the top where inundation rarely occurs. This moisture gradient will vary depending upon the designed maximum water depth, basin depth, and side slope steepness. This wet-to-moist transition zone from the top of the permanent pool to the designed high water line or top of freeboard should be planted with sedges, rushes, perennials, ferns and shrubs that can tolerate occasional standing water and wet-to-moist planting conditions. The areas above the designed high water line and immediately adjacent to the extended dry basin will not be regularly inundated. The dry zone should be planted with self-sustaining, low maintenance grasses, perennials, and shrubs suitable for the local climate and site.

The use of native plants is encouraged, but appropriate, adapted non-invasive ornamentals are acceptable for added aesthetic and functional value. All vegetation should be densely and evenly planted to ensure proper hydrological function of the extended dry basin. For a list of acceptable plants refer to the LIDA Handbook, Appendix A.

Plant Spacing
A) Extended Dry Basins in tracts or easements less than 30 feet wide are planted as follows to achieve the specified per acre densities:
   i. Treatment area = 6 plugs per square foot (min. 1-inch diameter by 6-inch tall)
   ii. Total number of shrubs per acre = area in square feet x 0.05
   iii. Groundcover = plant and seed to achieve 100% coverage

B) Extended Dry Basins in tracts or easements 30 feet wide or more are planted as followings to achieve the specified per acre densities:
   i. Treatment area = 6 plugs per square foot (min. 1-inch diameter by 6-inch tall)
   ii. Total number of trees per acre = area in square feet x 0.01
   iii. Total number of shrubs per acre = area in square feet x 0.05
   iv. Groundcover = plant and seed to achieve 100% coverage
Required Maintenance Period

- Water-efficient irrigation should be applied for the first two years after construction of the facility, particularly during the dry summer months, while plantings become established. Irrigation after these two years is at the discretion of the owner.
- If public, the permittee is responsible for the maintenance of the extended dry basin for a minimum of two years following construction and acceptance of the facility.

Long Term Maintenance

If private, the property owner will be responsible for ongoing maintenance per a recorded maintenance agreement (see page 77 for example maintenance agreement).

For detailed Operation and Maintenance Plans that describe proper maintenance activities please refer to page 61.

All publicly maintained facilities must have a public easement.

References

Clean Water Services Design and Construction Standards
**Description**

A constructed water quality wetland is a shallow landscaped depression that collects and holds stormwater runoff and allows pollutants to settle and filter out during storm events. Constructed wetlands have a permanent pool of water and also an extended detention area above that fills during storm events and releases water slowly over a number of hours. The permanent pool is sized to reduce pollution by settling and biological processes. The extended detention area is sized to meet flow control requirements.

**Application & Limitations**

Constructed water quality wetlands may help fulfill a site’s landscaping area requirement. Constructed wetlands are approved to treat stormwater from all types of impervious surfaces, including private property and the public right-of-way, runoff from rooftops, parking lots, and streets.
Design Factors

**Sizing**
Sizing of the constructed water quality wetland is determined by the volume of runoff and the required detention time for treatment. At a minimum, the detention basin must accommodate the water quality design storm and be sized for a 48 hour drawdown time. The minimum water quality detention volume is equal to (1)x the water quality volume (WQV). The outlet orifice size is determined by the following equation:

\[ D = 24 \times \left[ \left( \frac{Q}{C(2gH)^{0.5}} \right) \times \frac{1}{\pi} \right]^{0.5} \]

Where:
- \( D \) (in) = diameter of orifice
- \( Q \) (cfs) = WQV(cf) / (48*60*60)
- \( C = 0.62 \)
- \( H \) (ft) = 2/3 x temporary detention height to centerline of orifice.

**Geometry/Slopes**
Constructed water quality wetlands have two or more cells. The first cell, known as the forebay, is at least 10% of the entire surface area and constitutes 20% of the treatment volume. If space is limited, one cell with a forebay at the inlet will settle sediments and distribute flow across the wet pond.

Unlike the flat bottom of an extended dry basin, in a constructed wetland the pool depth varies throughout the pond. Not including the permanent pool, the maximum depth of the water quality pool is 2.5-feet unless otherwise approved by the jurisdiction.

Side slopes for wetland planting areas should not exceed 5H: 1V (20%) and side slopes for non-wetland planting areas should not exceed 3H: 1V (33.33%). The minimum freeboard height is 1 foot from the 25-year design water surface elevation. A perimeter 10 to 20 feet wide provides inundation during storm events.

**Piping for Constructed Water Quality Wetlands**
Incoming flows to the water quality wetland facility are pretreated by a water quality manhole or other approved pretreatment method in accordance with District Standards. Other pretreatment methods may include proprietary devices, filter strip, trapped catch basin, or other methods as approved by the District or City. An approved outlet structure is provided for all flows.

**Setbacks**
Check with the local building department to confirm site-specific requirements.
Design Factors (continued)

Soil Amendment/Mulch
A minimum of 12” of topsoil should be applied to all treatment areas.

Vegetation
The entire facility area (permanent pool, side slopes and perimeter zone) are planted with vegetation appropriate for the varying planting conditions within the constructed wetland. Planting conditions within the wetland vary from saturated soil to relatively dry, and several planting zones should be considered. The zone between the bottom of the constructed wetland and the top of the permanent pool will be constantly inundated with water and have saturated soils. This wet zone should be planted with rushes, sedges, and other wetland species that are well-suited to water-saturated, oxygen-deprived (anaerobic) planting conditions. The variable depth of the bottom of the wetland will create a series of micro planting conditions. Within this wet zone, areas of open water may be too deep to support significant vegetation.

The side slopes above the permanent pool depth to the outer edges of the perimeter zone will have a moisture gradient that varies from wet near the bottom to relatively dry near the edge of the perimeter area where inundation rarely occurs. This moisture gradient will vary depending upon the maximum designed water depth, constructed wetland depth, and side slope steepness. This moist-to-wet transition zone from the top of the permanent pool to the designed high water line or top of freeboard should be planted with sedges, rushes, perennials, ferns and shrubs that can tolerate occasional standing water and wet-to-moist planting conditions. Areas above the designed high water line and immediately adjacent to the water quality wetland is a dry zone and will not be regularly inundated. The dry zone should be planted with self-sustaining, low maintenance grasses, perennials, and shrubs suitable for the local climate.

The planting design should minimize solar exposure of open water areas to reduce heat gain in the water. Lower water temperatures help to maintain healthy oxygen levels and minimize algae blooms. Trees or other appropriate vegetation should be planted at the perimeter of the pond to maximize shading.

The use of native plants is encouraged, but adapted, non-invasive ornamentals are acceptable for added aesthetic and functional value. For a list of acceptable plants refer to the LIDA Handbook, Appendix A.
Vegetation (continued)
All vegetation should be densely and evenly planted to ensure proper hydrological function of the water quality wetland.

Plant Spacing
Constructed Water Quality Wetlands in tracts or easements are to be planted as follows to achieve the specified per acre densities:
1. Treatment area = 6 plugs per square foot (min. 1-inch diameter by 6-inch tall)
2. Total number of trees per acre = area in square feet x 0.01
3. Total number of shrubs per acre = area in square feet x 0.05
4. Groundcover = plant and seed to achieve 100% areal coverage

Required Maintenance Period
• Water-efficient irrigation should be applied for the first two years after construction of the facility, particularly during the dry summer months, while plantings become established. Irrigation after these two years is at the discretion of the owner.
• If public, the permittee is responsible for the maintenance of the constructed water quality wetland for a minimum of two years following construction and acceptance of the facility.

Long Term Maintenance
If private, the property owner will be responsible for ongoing maintenance per a recorded maintenance agreement (see page 77 for example maintenance agreement).

For detailed Operation and Maintenance Plans that describe proper maintenance activities please refer to page 65.

All publicly maintained facilities must have a public easement.

References
Clean Water Services Design and Construction Standards
Water Quality Manhole (Hydrodynamic Separator)

Description
A water quality manhole (hydrodynamic separator) provides pretreatment to a series of Best Management Practices (BMPs). The water quality (WQ) manhole removes coarse solids and floatable pollutants that may rapidly clog other BMPs, reducing maintenance.

The WQ manhole may provide required pretreatment for a vegetated swale, an extended dry basin, and constructed water quality wetland. Two types of WQ manholes are approved:

1) Standard WQ manhole with snout or mechanical tee assembly, and
2) Proprietary hydrodynamic separators

Contech’s CDS® is an approved proprietary hydrodynamic separator. It is a flow-through structure with a settling or separation unit to remove sediment and other pollutants.

Application & Limitations
Water quality manholes manage stormwater flow from all types of impervious surfaces including private property and the public right-of-way, treating runoff from rooftops, parking lots, and streets. Generally, these facilities are allowed in ultra high density development with high pollutant load potentials, such as commercial parking lots. Consult the Design and Construction Standards for allowed uses.
Design Factors
Designers should use Standard Detail Number 240 or 250 in the Clean Water Services Design and Construction Standards to size a standard WQ manhole.

WQ manholes are sized by treatment objectives, including desired level of pollutant removal, flow to be treated and target particle size. Designers should contact the manufacturer’s representative for design and sizing guidance. The pollutant removal rates differ by product and should be evaluated before a system is selected for a site. Because performance is affected by hydraulic loading rate, excess flow should not be routed through the device.

Long Term Maintenance
Frequency of maintenance may be adjusted in response to monitoring information from regular inspections.

Accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in accordance with regulatory protocols.

For detailed Operation and Maintenance Plans that describe proper maintenance activities please refer to page 75; or contact the manufacturer for specific maintenance procedures.

References
Clean Water Services Design and Construction Standards

Required Warranty Period
- Infrastructure inspection occurs for one year to determine defects in the system.
- The owner shall correct any defects identified prior to conclusion of one year warranty period.
Filter Vault Structure and Catch Basin Unit

Description
Filter structures are a proprietary treatment option that may be appropriate for specific uses. This Best Management Practice (BMPs) can target a full range of pollutants in urban runoff, including Total Suspended Solids (TSS), soluble heavy metals, oil and grease, and total nutrients. During a storm, runoff passes through the filtration media and starts to fill the cartridge center tube. As the water rises, air below the hood is purged through a one-way check valve. When water reaches the top, the float releases and filtered water drains out.

After the storm, the water level in the structure starts to fall. A water column hangs under the cartridge hood until the water level reaches the scrubbing regulators. Then air rushes through the regulators, releasing water and creating air bubbles that agitate the surface of the filter media and cause accumulated sediment to drop to the vault floor. This patented surface-cleaning mechanism helps restore the filter’s permeability between storm events.

Application & Limitations
Filter structures can be used to manage stormwater flowing from all types of impervious surfaces, including private property and the public right-of-way, treating runoff from rooftops, parking lots, and streets. Generally, these facilities are allowed in ultra high density development with high pollutant load potentials, such as commercial parking lots. Consult the Design and Construction Standards for allowed uses.
Design Factors
Designers should contact the manufacturer’s representative for correct design and sizing. Only 18-inch height Filter Structure cartridges are allowed. Filter Structures should be designed to treat the water quality storm, which is a dry weather storm event totaling 0.36 inches of precipitation falling in 4 hours with an average storm return of 96 hours. The water quality volume (WQV) is the volume of water that is produced by the water quality storm. The WQV equals 0.36 inches over the impervious area that is required to be treated, as shown in the formula below.

\[
WQV \text{ (cu.ft)} = \frac{0.36 \text{ (in.)} \times \text{Area} \text{(sq.ft.)}}{12 \text{ (in./ft.)}}
\]

Inspection & Maintenance Guidelines
As with any effective filtration system, pollutants must be removed periodically to restore the Filter Structure to full efficiency and effectiveness. Maintenance requirements and frequency are determined by the pollutant load characteristics of each site. Maintenance activities may be required in the event of a chemical spill or due to excessive sediment loading from site erosion or extreme storms. It is a good practice to inspect the system after major storm events.

Required Warranty Period
- Infrastructure inspection occurs for one year to determine defects in the system.
- The owner shall correct any defects identified prior to conclusion of one year warranty period.

Long Term Maintenance
Accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in accordance with regulatory protocols.

For detailed Operation and Maintenance Plans that describe proper maintenance activities please refer to page 72 or contact the manufacturer for specific maintenance procedures.

References
Clean Water Services Design and Construction Standards
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Porous Pavement Operation and Maintenance Plan

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

<table>
<thead>
<tr>
<th>Identified Problem</th>
<th>Condition to Check for</th>
<th>Maintenance Activity</th>
<th>Maintenance Timing</th>
<th>✔ Task Complete Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface is Clogged</td>
<td>Water infiltrates unevenly across surface or ponds in low areas</td>
<td>Recommend vacuum sweep at least twice per year; if pavement surface has become significantly clogged use low pressure washer to restore permeability; do not use surfactants</td>
<td>SUMMER FALL</td>
<td></td>
</tr>
<tr>
<td>Cracked or moving edge constraints; cracked or settled pavement</td>
<td>Cracked or moving edge constraints; cracked or settled pavement that affects overall performance of stormwater structural components</td>
<td>Repair all cracks, settlement or other defects that affect performance of structural components. Refer to manufacturers’ specifications</td>
<td>As Needed</td>
<td></td>
</tr>
<tr>
<td>Leaf, soil deposition on surface</td>
<td>Leaf litter that could affect stormwater infiltration through pavement. Look for soil washout from adjacent planted areas</td>
<td>Sweep leaf litter and sediment to prevent surface clogging and ponding. Planted areas adjacent to porous pavement should be well maintained to prevent soil washout onto the pavement.</td>
<td>FALL WINTER</td>
<td></td>
</tr>
<tr>
<td>Excessive weeds</td>
<td>Weeds cover 10% of the surface area</td>
<td>Remove weeds by hand, or use an herbicide approved for use around sensitive areas; refer to Clean Water Services Integrated Pest Management Plan for appropriate control methods, including proper use of chemical treatment</td>
<td>SPRING SUMMER FALL</td>
<td></td>
</tr>
<tr>
<td>Settling of pavers or lack of aggregate around pavers</td>
<td>Filter medium between pavers reduced. Aggregate loss in pavers from settling and power washing</td>
<td>Reset pavers and replace pore space with aggregate from original design</td>
<td>As Needed</td>
<td></td>
</tr>
<tr>
<td>Visual evidence of trash, debris or dumping</td>
<td>Any debris or trash that could clog the surface</td>
<td>Remove trash or debris and vacuum sweep area if necessary</td>
<td>As Needed</td>
<td></td>
</tr>
</tbody>
</table>
### Green Roof Operation and Maintenance Plan

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

<table>
<thead>
<tr>
<th>Identified Problem</th>
<th>Condition to Check for</th>
<th>Maintenance Activity</th>
<th>Maintenance Timing</th>
<th>✓ Task Complete Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standing Water</td>
<td>Standing water, super saturated soil observed. Check for clogged drain or compacted soil</td>
<td>Clear drains; remove organics and other debris from drain; loosen compacted soil and amend soil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leaks in Green Roof</td>
<td>Leaks in roof observed. Check for tears or perforation of membrane</td>
<td>Contact manufacturer or installer for repair or replacement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dead or stressed vegetation; exposed soil</td>
<td>80% survival of approved vegetation and no bare areas large enough to affect function of facility.</td>
<td>Remove dead or stressed vegetation and replant per original planting plan; irrigate as needed. Remove excessive weeds and all invasive plants</td>
<td>FALL SPRING</td>
<td></td>
</tr>
<tr>
<td>Excessive Vegetation</td>
<td>Vegetation has become overgrown</td>
<td>Prune grass and plantings; remove dippings</td>
<td>SUMMER FALL</td>
<td></td>
</tr>
<tr>
<td>Excessive Weeds</td>
<td>Weeds on more than 20% of the surface area</td>
<td>Remove weeds by hand; avoid using pesticides</td>
<td>SPRING SUMMER FALL WINTER</td>
<td></td>
</tr>
<tr>
<td>Erosion</td>
<td>Erosion or channelization that impacts or affects the function of the facility or creates a safety concern</td>
<td>Repair eroded areas and stabilized using proper erosion control measures. Establish appropriate vegetation as needed</td>
<td></td>
<td>As Needed</td>
</tr>
</tbody>
</table>

**If replanting in the Summer, irrigation will be necessary.**
<table>
<thead>
<tr>
<th>Identified Problem</th>
<th>Condition to Check for</th>
<th>Maintenance Activity</th>
<th>Maintenance Timing</th>
<th>✔ Task Complete Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invasive Vegetation as outlined in Appendix A</td>
<td>Invasive vegetation found in facility. Examples include: Himalayan Blackberry; Reed Canary Grass; Teasel; English Ivy; Nightshade; Clematis; Cattail; Thistle; Scotch Broom</td>
<td>Remove excessive weeds and all invasive plants. Attempt to control even if complete eradication is not feasible. Refer to Clean Water Services Integrated Pest Management Plan for appropriate control methods, including proper use of chemical treatment.</td>
<td>SPRING SUMMER FALL</td>
<td></td>
</tr>
<tr>
<td>Obstructed Inlet/Outlet</td>
<td>Material such as vegetation, trash, sediment is blocking more than 10% of the inlet pipe or basin opening</td>
<td>Remove blockages from facility</td>
<td></td>
<td>WINTER SPRING</td>
</tr>
<tr>
<td>Excessive Vegetation</td>
<td>Vegetation grows so tall it competes with or shades approved emergent wetland grass/shrubs; interferes with access or becomes a fire danger</td>
<td>Cut tall grass 4” to 6” and remove clippings. Prune emergent wetland grass/shrubs that have become overgrown.</td>
<td></td>
<td>SPRING</td>
</tr>
<tr>
<td>Tree/Shrub Growth</td>
<td>Tree/shrub growth shades out wetland/emergent grass in treatment area. Interferes with access for maintenance/inspection</td>
<td>Prune trees and shrubs that block sun from reaching treatment area. Remove trees that block access points. Do not remove trees that are not interfering with access or maintenance without first contacting Clean Water Services or local City.</td>
<td></td>
<td>WINTER</td>
</tr>
</tbody>
</table>
### Infiltration Planter / Rain Garden Operation and Maintenance Plan (continued)

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

<table>
<thead>
<tr>
<th>Identified Problem</th>
<th>Condition to Check for</th>
<th>Maintenance Activity</th>
<th>Maintenance Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazard Trees</td>
<td>Observe dead, dying or diseased trees</td>
<td>Remove hazard trees. A certified arborist may need to determine health of tree or removal requirements</td>
<td>As Needed</td>
</tr>
<tr>
<td>Poor Vegetation Coverage</td>
<td>80% survival of approved vegetation and no bare areas large enough to affect function of facility.</td>
<td>Determine cause of poor growth and correct the condition. Replant per the approved planting plan and applicable standards at the time of construction. Remove excessive weeds and all invasive plants.</td>
<td>SPRING FALL Ideal time to plant is spring and fall seasons</td>
</tr>
<tr>
<td>Trash and Debris</td>
<td>Visual evidence of trash, debris or dumping</td>
<td>Remove trash and debris from facility. Dispose of properly</td>
<td>SPRING SUMMER FALL WINTER</td>
</tr>
<tr>
<td>Contaminants and Pollution</td>
<td>Evidence of oil, gasoline, contaminants or other pollutants. Look for sheens, odor or signs of contamination.</td>
<td>If contaminants or pollutants are present, coordinate removal/cleanup with local jurisdiction</td>
<td>SPRING SUMMER FALL WINTER</td>
</tr>
<tr>
<td>Erosion</td>
<td>Erosion or channelization that impacts or effects the function of the facility or creates a safety concern</td>
<td>Repair eroded areas and stabilize using proper erosion control measures. Establish appropriate vegetation as needed.</td>
<td>FALL WINTER SPRING</td>
</tr>
<tr>
<td>Flow Not Distributed Evenly</td>
<td>Flows unevenly distributed through planter width due to uneven or clogged flow spreader</td>
<td>Level the spreader and clean so that flows spread evenly over entire planter width</td>
<td>WINTER SPRING</td>
</tr>
</tbody>
</table>
## Infiltration Planter / Rain Garden Operation and Maintenance Plan (continued)

<table>
<thead>
<tr>
<th>Identified Problem</th>
<th>Maintenance Activity</th>
<th>Condition to Check for</th>
<th>Maintenance Timing</th>
<th>Task Complete Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vector Control</td>
<td>Evidence of rodents or water piping through facility via rodent holes, or insects such as wasps and hornets interfere with maintenance/inspection activities</td>
<td>Sediment depth in treatment area exceeds 3 inches</td>
<td>As Needed</td>
<td>Repair facility if damaged; Remove harmful insects, use professional if needed. Refer to Clean Water Services Integrated Pest Management Plan for management options</td>
</tr>
<tr>
<td>Sediment Accumulation in Treatment Area</td>
<td></td>
<td></td>
<td></td>
<td>Ideally in the dry season</td>
</tr>
<tr>
<td>Standing Water</td>
<td></td>
<td></td>
<td></td>
<td>Inspect after major storm (1-inch in 24 hours)</td>
</tr>
<tr>
<td>Grate Damaged, Missing or Not in Place</td>
<td></td>
<td></td>
<td></td>
<td>Grate must be in place and meets design standards. Replace or repair any open structure</td>
</tr>
</tbody>
</table>

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.
## Flow-Through Planter Operation and Maintenance Plan

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

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<th>Identified Problem</th>
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<th>Maintenance Timing</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Sediment Accumulation in Treatment Area</td>
<td>Sediment depth exceeds 3 inches</td>
<td>Remove sediment from treatment area. Ensure planter is level from side to side and drains freely toward outlet; no standing water within 24 hours after any major storm (1-inch in 24 hours)</td>
<td>Ideally in dry season</td>
<td></td>
</tr>
<tr>
<td>Erosion</td>
<td>Erosion or channelization that impacts or effects the function of the facility or creates a safety concern</td>
<td>Repair eroded areas and stabilized using proper erosion control measures. Establish appropriate vegetation as needed</td>
<td>Inspect after major storm (1-inch in 24 hours)</td>
<td></td>
</tr>
<tr>
<td>Standing Water</td>
<td>Standing water in the planter between storms that does not drain freely. Water should drain after 24 hours of dry weather.</td>
<td>Remove sediment or trash blockages. Grade out areas of mounding and improve end to end grade so there is no standing water.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flow Not Distributed Evenly</td>
<td>Flow unevenly distributed through planter width due to uneven or clogged flow spreader</td>
<td>Level the spreader and clean so that flows spread evenly over entire planter width</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obstructed Inlet/Outlet</td>
<td>Material such as vegetation, sediment, trash is blocking more than 10% of the inlet/outlet pipe</td>
<td>Remove blockages from facility</td>
<td>Inspect after major storm (1-inch in 24 hours)</td>
<td></td>
</tr>
</tbody>
</table>
### Flow-Through Planter Operation and Maintenance Plan (continued)

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

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</thead>
<tbody>
<tr>
<td>Poor Vegetation Coverage</td>
<td>80% survival of approved vegetation and no bare areas large enough to affect function of facility.</td>
<td>Determine cause of poor growth and correct the condition; replant with plugs or containerized plants per approved plans and applicable standards at time of construction. Remove excessive weeds and all invasive plants.</td>
<td>SPRING</td>
<td>Ideal time to plant is spring and fall seasons</td>
</tr>
<tr>
<td>Invasive Vegetation as outlined in Appendix A</td>
<td>Invasive vegetation found in facility. Examples include: Himalayan Blackberry; Reed Canary Grass; Teasel, English Ivy, Nightshade, Clematis, Cattail, Thistle</td>
<td>Remove excessive weeds and all invasive plants. Attempt to control even if complete eradication is not feasible. Refer to Clean Water Services Integrated Pest Management Plan for appropriate control methods, including proper use of chemical treatment.</td>
<td>SPRING, SUMMER, FALL</td>
<td></td>
</tr>
<tr>
<td>Excessive Vegetation</td>
<td>Vegetation grows so tall it competes with or shades approved emergent wetland grass/shrubs; interferes with access or becomes a fire danger</td>
<td>Prune over-hanging limbs, if possible; remove brushy vegetation as needed. Prune emergent wetland grass/shrubs that have become overgrown.</td>
<td>SPRING</td>
<td></td>
</tr>
<tr>
<td>Vector Control</td>
<td>Evidence of rodents or water flowing through facility via rodent holes. Harmful insects such as wasps or hornets present</td>
<td>Repair damage to facility. Remove harmful insects, call professional if needed. Refer to Clean Water Services Integrated Pest Management Plan for management options.</td>
<td>As Needed</td>
<td></td>
</tr>
</tbody>
</table>
Flow-Through Planter Operation and Maintenance Plan (continued)

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

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<th>Maintenance Timing</th>
<th>✔ Task Complete Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trash and Debris</td>
<td>Visual evidence of trash, debris or dumping.</td>
<td>Remove and dispose of trash and debris from facility.</td>
<td>SPRING SUMMER FALL WINTER</td>
<td></td>
</tr>
<tr>
<td>Contamination and Pollution</td>
<td>Evidence of oil, gasoline, contaminants, or other pollutants. Look for sheens, odor or signs of contamination.</td>
<td>If contaminants or pollutants present, coordinate removal/cleanup with local jurisdiction.</td>
<td>SPRING SUMMER FALL WINTER</td>
<td></td>
</tr>
<tr>
<td>Outlet Structure Damaged</td>
<td>Grate or overflow structure is missing or only partially in place and may have missing or broken grate members.</td>
<td>Repair or replace outlet structure.</td>
<td>As Needed</td>
<td></td>
</tr>
</tbody>
</table>
### LIDA Swale Operation and Maintenance Plan

**Annual Inspections and Maintenance Activities:**
- **Sediment Accumulation in Treatment Area:** Inspect for accumulated sediment.
- **Standing Water:** Inspect for standing water in treatment area.
- **Flow Not Distributed Evenly:** Inspect for uneven flow distribution.
- **Poor Vegetation Coverage:** Inspect for inadequate vegetation coverage.
- **Excessive Vegetation:** Inspect for excessive vegetation.

#### Condition to Check for

<table>
<thead>
<tr>
<th>Identified Problem</th>
<th>Sediment Accumulation in Treatment Area</th>
<th>Standing Water</th>
<th>Flow Not Distributed Evenly</th>
<th>Poor Vegetation Coverage</th>
<th>Excessive Vegetation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance Timing</td>
<td><strong>SUMMER:</strong> Ideally in Dry Season</td>
<td><strong>SPRING:</strong> Inspect after any major storm (1 inch in 24 hours)</td>
<td><strong>AS NEEDED</strong></td>
<td><strong>SPRING:</strong> Ideal time to plant is Spring and Fall seasons</td>
<td><strong>SPRING:</strong> Ideal time to prune emergent wetland grass is Spring</td>
</tr>
<tr>
<td>Maintenance Activity</td>
<td>Remove sediment deposits in treatment area, Swale should be level from side to side and drain freely</td>
<td>Remove sediment or trash blockages, improve grade from end to end of swale, no standing water 24 hours after any major storm (1 inch in 24 hours)</td>
<td>Level the spreader and clean so that flows spread evenly over entire swale width</td>
<td>Determine cause of poor growth and correct conditions; replant with plugs or containerized plants per approved plans and applicable standards at time of construction. Remove excessive weeds and all invasive plants.</td>
<td>Prune overhanging limbs if possible. Prune emergent wetland grass; remove access or becomes a fire danger.</td>
</tr>
</tbody>
</table>
**LIDA Swale Operation and Maintenance Plan (continued)**

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

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<thead>
<tr>
<th>Identified Problem</th>
<th>Condition to Check for</th>
<th>Maintenance Activity</th>
<th>Maintenance Timing</th>
<th>✔ Task Complete Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invasive Vegetation as outlined in Appendix A</td>
<td>Invasive vegetation found in facility, Reed Canary Grass; Teasel, English Ivy; Nightshade; Clematis; Cattail, Thistle; Scotch Broom</td>
<td>Remove excessive weeds and all invasive plants. Attempt to control even if complete eradication is not feasible. Refer to Clean Water Services Integrated Pest Management Plan for appropriate control methods, including proper use of chemical treatment</td>
<td>SPRING SUMMER FALL</td>
<td></td>
</tr>
<tr>
<td>Hazard Trees</td>
<td>Observed dead, dying or diseased trees</td>
<td>Remove hazard trees. A certified arborist may need to determine health of tree or removal requirements</td>
<td>As Needed</td>
<td></td>
</tr>
<tr>
<td>Obstructed Inlet/Outlet</td>
<td>Material such as vegetation, sediment or debris is blocking more than 10% of the inlet/outlet pipe</td>
<td>Remove blockages from facility</td>
<td>WINTER SPRING</td>
<td>Inspect after any major storm (1-inch in 24 hours)</td>
</tr>
<tr>
<td>Damage to Outlet Structure</td>
<td>Outlet structure damage may include a grate that is missing or not in place. Grate may have broken members or have a damaged frame</td>
<td>Grate must be in place and meet design standards. Replace or repair grate and ensure grate is firmly attached</td>
<td>As Needed</td>
<td></td>
</tr>
<tr>
<td>Erosion</td>
<td>Erosion or channelization that impacts or effects the function of the facility or creates a safety concern</td>
<td>Repair eroded areas and stabilized using proper erosion control measures. Establish appropriate vegetation as needed</td>
<td>FALL WINTER SPRING</td>
<td></td>
</tr>
</tbody>
</table>
## LIDA Swale Operation and Maintenance Plan (continued)

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

<table>
<thead>
<tr>
<th>Identified Problem</th>
<th>Condition to Check for</th>
<th>Maintenance Activity</th>
<th>Maintenance Timing</th>
<th>✓ Task Complete Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trash and Debris</td>
<td></td>
<td>Remove trash and debris from facility. Dispose of properly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contamination and Pollution</td>
<td>Evidence of oil, gasoline, contaminants, or other pollutants. Look for sheens, odor or other signs of contamination</td>
<td>Locate source of contamination and correct. Remove oil using oil-absorbent pads or vactor truck. If low levels of oil persist plant wetland plants that can uptake small concentrations of oil such as Juncus effuses. (soft rush) If high levels of contaminants or pollutants are present, coordinate removal/cleanup with local jurisdiction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vector Control</td>
<td>General evidence of rodents or water piping through facility via rodent holes. Insects such as wasps and hornets interfere with maintenance/inspection activities</td>
<td>Repair facility if damaged. Remove harmful insects, use professional if needed. Refer to Clean Water Services Integrated Pest Management Plan for management options</td>
<td>As Needed</td>
<td></td>
</tr>
<tr>
<td>Damage to Outlet Structure</td>
<td>Damage to Frame or Top Slab. Frame not sitting flush on top slab (more than ¼ inch between frame and top slab); frame not securely attached</td>
<td>Ensure frame is firmly attached and sits flush on the riser rings or top slab</td>
<td>As Needed</td>
<td></td>
</tr>
<tr>
<td>Damage to Outlet Structure</td>
<td>Fractures or Cracks in Walls or Bottom. Maintenance person determines the structure is unsound. Soil entering structure through cracks</td>
<td>Structure replaced or repaired to design standards</td>
<td>As Needed</td>
<td></td>
</tr>
</tbody>
</table>
## Vegetated Filter Strip Operation and Maintenance Plan

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

<table>
<thead>
<tr>
<th>Identified Problem</th>
<th>Condition to Check for</th>
<th>Maintenance Activity</th>
<th>Maintenance Timing</th>
<th>✓ Task Complete Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow not distributed evenly</td>
<td>Flows unevenly distributed through filter strip due to uneven or clogged flow spreader</td>
<td>Level and clean the spreader so that flows spread evenly over entire filter strip width</td>
<td>Winter</td>
<td>Spring</td>
</tr>
<tr>
<td>Invasive Vegetation as outlined in Appendix A</td>
<td>Invasive vegetation is found in facility. Examples include: Himalayan Blackberry; Reed Canary Grass; Teasel; English Ivy; Nightshade; Clematis; Cattail Thistle; Scotch Broom</td>
<td>Remove excessive weeds and all invasive plants. Attempt to control even if complete eradication is not feasible. Refer to Clean Water Services Integrated Pest Management Plan for appropriate control methods, including proper use of chemical treatment.</td>
<td>Spring; Summer; Fall</td>
<td></td>
</tr>
<tr>
<td>Poor Vegetation Coverage</td>
<td>80% survival of approved vegetation and no bare areas large enough to affect function of facility.</td>
<td>Determine cause of poor growth and correct the condition; replant with plugs or containerized plants per approved plans and applicable standards at time of construction. Remove excessive weeds and all invasive plants</td>
<td>Fall; Spring</td>
<td></td>
</tr>
<tr>
<td>Excessive Vegetation</td>
<td>Vegetation grows so tall it competes with or shades approved emergent wetland grass/shrubs; interferes with access or becomes a fire danger</td>
<td>Cut grass tall grass 4” to 6” and remove clippings. Prune emergent wetland grass/shrubs that have become overgrown.</td>
<td>Spring</td>
<td></td>
</tr>
<tr>
<td>Tree/Shrub Growth</td>
<td>Tree/shrub growth shades out wetland/emergent grass in treatment area. Interferes with access for maintenance/inspection</td>
<td>Prune trees and shrubs that block sun from reaching treatment area. Remove trees that block access points. Do not remove trees that are not interfering with access or maintenance without first contacting Clean Water Services or local City.</td>
<td>Winter</td>
<td></td>
</tr>
</tbody>
</table>

Ideal time to plant is Spring and Fall seasons. Ideal time to prune emergent wetland grass is Spring. Cut grass in dry months. Ideal timing for pruning trees is winter.
### Vegetated Filter Strip Operation and Maintenance Plan (continued)

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

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<tr>
<th>Identified Problem</th>
<th>Condition to Check for</th>
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<th>Maintenance Timing</th>
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<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erosion</td>
<td>Erosion or channelization that impacts or effects the function of the facility or creates a safety concern</td>
<td>Repair eroded areas and stabilize using proper erosion control measures. Establish appropriate vegetation as needed</td>
<td>FALL WINTER SPRING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sediment Accumulation in Treatment Area</td>
<td>Sediment depth in treatment area exceeds 3 inches</td>
<td>Remove sediment from treatment area. Ensure facility is level from side to side and drains freely toward outlet; no standing water once inflow has ceased</td>
<td>SUMMER FALL</td>
<td></td>
<td>Ideally in the dry season</td>
</tr>
<tr>
<td>Trash and Debris</td>
<td>Visual evidence of trash, debris or dumping</td>
<td>Remove trash and debris from facility. Dispose of properly</td>
<td>SPRING SUMMER FALL WINTER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contaminants and Pollution</td>
<td>Evidence of oil, gasoline, contaminants or other pollutants. Look for sheens, odor or signs of contamination</td>
<td>If contaminants or pollutants present; coordinate removal/cleanup with local jurisdiction</td>
<td>SPRING SUMMER FALL WINTER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vector Control</td>
<td>Evidence of rodents or water piping through facility via rodent holes. Harmful insects present such as wasps and hornets that interfere with maintenance/inspection activities</td>
<td>Repair facility if damaged. Remove harmful insects, use professional service if needed. Refer to Clean Water Services Integrated Pest Management Plan for management options</td>
<td>As Needed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Vegetated Swale Operation and Maintenance Plan

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

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<tbody>
<tr>
<td>Obstructed Inlet/Outlet</td>
<td>Material such as vegetation, sediment is blocking more than 10% of Inlet/outlet pipe or basin opening</td>
<td>Remove blockages from facility</td>
<td>Winter Spring</td>
<td></td>
</tr>
<tr>
<td>Flow not distributed evenly</td>
<td>Flows unevenly distributed through swale due to uneven or clogged flow spreader</td>
<td>Level and clean the spreader so that flows spread evenly over entire swale width</td>
<td>Winter Spring</td>
<td></td>
</tr>
<tr>
<td>Sediment Accumulation in Treatment Area</td>
<td>Sediment depth in treatment area exceeds 3 inches</td>
<td>Remove sediment from treatment area. Ensure facility is level from side to side and drains freely toward outlet; no standing water once inflow has ceased</td>
<td>Summer Fall</td>
<td></td>
</tr>
<tr>
<td>Tree/Shrub Growth</td>
<td>Tree/shrub growth shades out wetland/emergent grass in treatment area. Interferes with access for maintenance/inspection</td>
<td>Prune trees and shrubs that block sun from reaching treatment area. Remove trees that block access points. Do not remove trees that are not interfering with access or maintenance without first contacting Clean Water Services or local City</td>
<td>Winter</td>
<td></td>
</tr>
<tr>
<td>Hazard Trees</td>
<td>Observed dead, dying or diseased trees</td>
<td>Remove hazard trees. A certified arborist may be needed to determine health of tree or removal requirements</td>
<td>As Needed</td>
<td></td>
</tr>
</tbody>
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### Vegetated Swale Operation and Maintenance Plan (continued)

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

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<tbody>
<tr>
<td>Erosion</td>
<td>Erosion or channelization that impacts or affects the function of the facility or creates a safety concern</td>
<td>Repair eroded areas and stabilized using proper erosion control measures. Establish appropriate vegetation as needed.</td>
<td>FALL WINTER SPRING</td>
<td>✓</td>
</tr>
<tr>
<td>Poor Vegetation Coverage</td>
<td>80% survival of approved vegetation and no bare areas large enough to affect function of facility</td>
<td>Determine cause of poor growth and correct the condition. Replant per the approved planting plan and applicable standards at time of construction. Remove excessive weeds and all invasive plants.</td>
<td>FALL SPRING</td>
<td>✓</td>
</tr>
<tr>
<td>Invasive Vegetation as outlined in Appendix A</td>
<td>Invasive vegetation is found in facility. Examples include: Himalayan Blackberry; Reed Canary Grass; Teasel; English Ivy; Nightshade; Clematis; Cattail; Thistle; Scotch Broom</td>
<td>Remove excessive weeds and all invasive plants. Attempt to control even if complete eradication is not feasible. Refer to Clean Water Services Integrated Pest Management Plan for appropriate control methods, including proper use of chemical treatment</td>
<td>SPRING SUMMER FALL</td>
<td>✓</td>
</tr>
<tr>
<td>Excessive Vegetation</td>
<td>Vegetation grows so tall it competes with or shades approved emergent wetland grass/shrubs; interferes with access or becomes fire danger</td>
<td>Cut tall grass to 4” to 6” and remove clippings. Prune emergent wetland grass/shrubs that have become overgrown.</td>
<td>SPRING</td>
<td>✓</td>
</tr>
<tr>
<td>Trash and Debris</td>
<td>Visual evidence of trash, debris or dumping</td>
<td>Trash and debris removed from facility. Dispose of properly</td>
<td>SPRING SUMMER FALL WINTER</td>
<td>✓</td>
</tr>
</tbody>
</table>
### Vegetated Swale Operation and Maintenance Plan (continued)

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

<table>
<thead>
<tr>
<th>Identified Problem</th>
<th>Condition to Check for</th>
<th>Maintenance Activity</th>
<th>Maintenance Timing</th>
<th>✔ Task Complete Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standing Water</td>
<td>Standing water in the swale between storms that does not drain freely</td>
<td>Remove sediment or trash blockages; improve grade from end to end of swale; no standing water 24 hours after any major storm (1-inch in 24 hours)</td>
<td>WINTER SPRING</td>
<td>Inspect after any major storm (1-inch in 24 hours)</td>
</tr>
<tr>
<td>Vector Control</td>
<td>Evidence of rodents or water piping through facility via rodent holes. Harmful insects such as wasps and hornets interfere with maintenance/inspection activities</td>
<td>Repair facility if damaged. Remove harmful insects, use professional if needed. Refer to Clean Water Services Integrated Pest Management Plan for management options</td>
<td>As Needed</td>
<td></td>
</tr>
<tr>
<td>Contamination and Pollution</td>
<td>Evidence of oil, gasoline, contaminants, or other pollutants. Look for sheens, odor or signs of contamination</td>
<td>If contaminants or pollutants present, coordinate removal/ cleanup with local jurisdiction</td>
<td>SPRING SUMMER FALL WINTER</td>
<td></td>
</tr>
<tr>
<td>Grate Damaged, missing or not in place</td>
<td>Grate is missing or only partially in place, may have missing or broken grate members</td>
<td>Grate must be in place and meet design standards. Replace or repair any open structure, replace grate if missing.</td>
<td>As Needed</td>
<td></td>
</tr>
<tr>
<td>Damage to Outlet Structure</td>
<td>Frame not sitting flush on top slab (more than ¼ inch between frame and top slab); frame not securely attached</td>
<td>Ensure frame is firmly attached and sits flush on riser rings or on top of slab. Structure replaced or repaired to design standards</td>
<td>As Needed</td>
<td></td>
</tr>
<tr>
<td>Identified Problem</td>
<td>Condition to Check for</td>
<td>Maintenance Activity</td>
<td>Maintenance Timing</td>
<td></td>
</tr>
<tr>
<td>--------------------</td>
<td>------------------------</td>
<td>----------------------</td>
<td>--------------------</td>
<td></td>
</tr>
<tr>
<td>Vegetated Swale Operation and Maintenance Plan (continued)</td>
<td>Annual inspections are required. It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damage to Outlet Structure</td>
<td>Fractures or Cracks in Walls or Bottom. Maintenance person determines the structure is sound. Soil entering structure through cracks.</td>
<td>Structure replaced or repaired to design standards</td>
<td>As Needed</td>
<td></td>
</tr>
<tr>
<td>Damage to Outlet Structure</td>
<td>Settlement or Misalignment. Failure of basin has created a safety, function, or design problem.</td>
<td>Structure replaced or repaired to design standards</td>
<td>As Needed</td>
<td></td>
</tr>
</tbody>
</table>
### Extended Dry Basin Operation and Maintenance Plan

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services, or city representative for more information.

<table>
<thead>
<tr>
<th>Identified Problem</th>
<th>Task &amp; Debris</th>
<th>Condition to Check for</th>
<th>Maintenance Activity</th>
<th>Maintenance Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contamination and Pollution</td>
<td>Visual evidence of trash, debris or dumping</td>
<td>Evidence of oil, gasoline, contaminants, or other pollutants. Look for sheens, odor or signs of contamination</td>
<td>Remove trash and debris from facility. Dispose of properly. Located source of contamination and correct. Remove oil using oil-absorbent pads or vacuum truck. If low levels of oil persist, plant wetland plants that can uptake small contaminations of oil. If high levels of contaminants, remove all oil. Coordinate removal with local jurisdiction.</td>
<td>Summer, Fall</td>
</tr>
<tr>
<td>Invasive vegetation found in facility. Examples: Himalayan Balsam, Rea Canary Grass, Knapweed, Scotch Thistle.</td>
<td>Invasive vegetation as outlined in Appendix A.</td>
<td>Remove excessive weeds and all invasive plants. Attempt to control even if complete eradication is not feasible, refer to Clean Water Services Integrated Pest Management Plan for appropriate control methods, including proper use of chemical treatments.</td>
<td>Summer, Fall</td>
<td></td>
</tr>
<tr>
<td>Obstructed Inlet/Outlet pipe</td>
<td>Material such as vegetation, trash, sediment is blocking more than 10% of inlet/outlet pipe of basin opening.</td>
<td>Remove blockages from facility.</td>
<td>Winter, Spring</td>
<td></td>
</tr>
<tr>
<td>Poor Vegetation Cover</td>
<td>80% survival of approved vegetation and no bare areas large enough to affect function of facility.</td>
<td>Determine cause of poor growth and correct the condition. Replace with approved planting plan and applicable standards at time of construction. Remove excessive weeds and all invasive plants.</td>
<td>Winter, Fall</td>
<td></td>
</tr>
</tbody>
</table>

Ideal time to plant is spring and fall seasons.
**Extended Dry Basin Operation and Maintenance Plan (continued)**

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

<table>
<thead>
<tr>
<th>Identified Problem</th>
<th>Condition to Check for</th>
<th>Maintenance Activity</th>
<th>Maintenance Timing</th>
<th>Task Complete Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vector Control</td>
<td>Evidence of rodents or water piping through facility via rodent holes. Harmful insects present such as wasps and hornets that interfere with maintenance/inspection activities</td>
<td>Repair facility if damaged. Remove harmful insects, use professional if needed. Refer to Clean Water Services Integrated Pest Management Plan for management options</td>
<td>As Needed</td>
<td></td>
</tr>
<tr>
<td>Tree/Shrub Growth</td>
<td>Tree/shrub growth shades out wetland/emergent grass in treatment area. Interferes with access for maintenance/inspection</td>
<td>Prune trees and shrubs that block sun from reaching treatment area. Remove trees that block access points. Do not remove trees that are not interfering with access or maintenance without first contacting Clean Water Services or local City</td>
<td>Ideal time for pruning is winter</td>
<td></td>
</tr>
<tr>
<td>Hazard Trees</td>
<td>Observed dead, dying or diseased trees</td>
<td>Remove hazard trees. A certified Arborist may need to determine health of tree or removal requirements</td>
<td>As Needed</td>
<td></td>
</tr>
<tr>
<td>Excessive Vegetation</td>
<td>Vegetation grows so tall that it competes with approved emergent wetland grass/shrubs, interferes with access or becomes a fire danger</td>
<td>Cut tall grass 4” to 6” and remove clippings. Prune emergent wetland grass/shrubs that have become overgrown.</td>
<td>Ideal time to prune emergent wetland grass is spring. Cut grass in dry months</td>
<td></td>
</tr>
<tr>
<td>Erosion</td>
<td>Erosion or channelization that impacts or effects the function of the facility or creates a safety concern</td>
<td>Repair eroded areas and stabilize using proper erosion control measures. Establish appropriate vegetation as needed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Extended Dry Basin Operation and Maintenance Plan (continued)

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

<table>
<thead>
<tr>
<th>Identified Problem</th>
<th>Condition to Check for</th>
<th>Maintenance Activity</th>
<th>Maintenance Timing</th>
<th>✔ Task Complete Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Settlement of Pond Dike/ Berm</td>
<td>Look for any part of dike/berm that has settled 4 inches or more lower than the design elevation</td>
<td>Repair dike/berm to approved design specifications. A licensed civil engineer should be consulted to determine the source of the settlement</td>
<td>As Needed</td>
<td></td>
</tr>
<tr>
<td>Blockage of Emergency Overflow/ Spillway</td>
<td>Blockage of overflow/ spillway by trees, vegetation or other material. Blockages may cause the berm to fail due to uncontrolled overtopping</td>
<td>Remove blockage. Small root system (base less than 4 inches) may be left in place; otherwise, roots are removed. A licensed civil engineer should be consulted for proper berm/spillway restoration.</td>
<td>WINTER SPRING Inspect after major storm (1-Inch in 24 hours)</td>
<td></td>
</tr>
<tr>
<td>Erosion of Emergency Overflow/Spillway</td>
<td>Native soil is exposed at the spillway, or there is only one layer of rock in an area of 5 square feet or larger</td>
<td>Restore rock and pad depth to appropriate depth. Refer to design specifications</td>
<td>WINTER SPRING Inspect after major storm (1-Inch in 24 hours)</td>
<td></td>
</tr>
<tr>
<td>Blockage of Overflow Structure/ Orifice Plate</td>
<td>Excessive standing water or water is not detained for required time.</td>
<td>Inspect and if needed clear orifice plate for proper drainage or re-install to ensure required detention.</td>
<td>WINTER SPRING Inspect after major storm (1-Inch in 24 hours)</td>
<td></td>
</tr>
<tr>
<td>Sediment Accumulation in Pond Bottom</td>
<td>Sediment accumulation in pond bottom exceeds 6 inches or affects facility inlet/ outlet or plant growth in treatment area</td>
<td>Remove sediment from pond bottom. Re-establish designed pond shape and depth. Establish appropriate vegetation in treatment area</td>
<td>SUMMER FALL Ideally in the dry season</td>
<td></td>
</tr>
</tbody>
</table>
## Extended Dry Basin Operation and Maintenance Plan (continued)

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

<table>
<thead>
<tr>
<th>Identified Problem</th>
<th>Condition to Check for</th>
<th>Maintenance Activity</th>
<th>Maintenance Timing</th>
<th>✔ Task Complete Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grate Damaged, missing or not in place</td>
<td>Grate is missing or only partially in place, may have missing or broken grate members.</td>
<td>Grate must be in place and meet design standards. Replace or repair any open structure, replace grate if missing</td>
<td>As Needed</td>
<td></td>
</tr>
<tr>
<td>Damage to Outlet Structure</td>
<td>Damage to Frame or Top Slab. Frame not sitting flush on top slab (more than ¼ inch between frame and top slab); frame not securely attached</td>
<td>Ensure frame is firmly attached and sits flush on the riser rings or top slab</td>
<td>As Needed</td>
<td></td>
</tr>
<tr>
<td>Damage to Outlet Structure</td>
<td>Fractures or Cracks in Walls or Bottom. Maintenance person determines the structure is unsound. Soil entering structure through cracks.</td>
<td>Structure replaced or repaired to design standards.</td>
<td>As Needed</td>
<td></td>
</tr>
<tr>
<td>Damage to Outlet Structure</td>
<td>Settlement or Misalignment of Basin. Failure of basin has created a safety, function, or design problem</td>
<td>Structure replaced or repaired to design standards</td>
<td>As Needed</td>
<td></td>
</tr>
</tbody>
</table>
## Constructed Water Quality Wetland Operation and Maintenance Plan

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

<table>
<thead>
<tr>
<th>Identified Problem</th>
<th>Condition to Check for</th>
<th>Maintenance Activity</th>
<th>Maintenance Timing</th>
<th>✓ Task Complete Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trash and Debris</td>
<td>Visual evidence of trash, debris or dumping</td>
<td>Remove trash and debris from facility. Dispose of properly</td>
<td>SPRING SUMMER FALL WINTER</td>
<td></td>
</tr>
<tr>
<td>Contaminants and Pollution</td>
<td>Evidence of oil, gasoline, or other contaminants. Look for signs such as sheens or odors</td>
<td>Locate source of contamination and correct. Remove oil using oil-absorbent pads or vactor truck. If low levels of oil persist plant wetland plants that can uptake small concentrations of oil such as Juncus effuses, (soft rush). If high levels of contaminants or pollutants are present, coordinate removal/cleanup with local jurisdiction.</td>
<td>SPRING SUMMER FALL WINTER</td>
<td></td>
</tr>
<tr>
<td>Erosion</td>
<td>Erosion or channelization that impacts or affects the function of the facility or creates a safety concern</td>
<td>Repair eroded areas and stabilize using proper erosion control measures. Establish appropriate vegetation as needed.</td>
<td>SPRING WINTER</td>
<td></td>
</tr>
<tr>
<td>Obstructed Inlet/Outlet or basin opening</td>
<td>Material such as vegetation, sediment, trash is blocking more than 10% of inlet/outlet pipe or basin opening</td>
<td>Remove blockages from facility. Inspect after major storm (1-inch in 24 hours)</td>
<td>SPRING WINTER</td>
<td></td>
</tr>
<tr>
<td>Invasive Vegetation as outlined in Appendix A</td>
<td>Invasive vegetation found in facility. Examples include: Himalayan Blackberry; Reed Canary Grass; Teasel; English Ivy; Nightshade; Clematis; Cattail; Thistle; Scotch Broom</td>
<td>Remove excessive weeds and all invasive plants. Attempt to control even if complete eradication is not feasible. Refer to Clean Water Services Integrated Pest Management Plan for appropriate control methods, including proper use of chemical treatment.</td>
<td>SPRING SUMMER FALL</td>
<td></td>
</tr>
</tbody>
</table>

---

**Note:**
- SPRING: March to May
- SUMMER: June to August
- FALL: September to November
- WINTER: December to February
**Constructed Water Quality Wetland Operation and Maintenance Plan (continued)**

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

<table>
<thead>
<tr>
<th>Identified Problem</th>
<th>Condition to Check for</th>
<th>Maintenance Activity</th>
<th>Maintenance Timing</th>
<th>✔ Task Complete Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree/Shrub Growth</td>
<td>Tree/shrub growth shades out wetland/emergent grass in treatment area. Interferes with access for maintenance/inspection</td>
<td>Prune trees and shrubs that block sun from reaching treatment area. Remove trees that block access points. Do not remove trees that are not interfering with access or maintenance without first contacting Clean Water Services or local City.</td>
<td>Winter</td>
<td>Ideal timing for pruning is winter</td>
</tr>
<tr>
<td>Poor Vegetation Cover</td>
<td>80% survival of approved vegetation and no bare areas large enough to affect function of facility.</td>
<td>Determine cause of poor growth and correct the condition. Sediment accumulation or competition with invasive vegetation could be cause. Replant with plugs or containerized plants per the approved planting plan and applicable standards at time of construction. Remove excessive weeds and all invasive plants.</td>
<td>Spring, Fall</td>
<td>Ideal time to plant is spring and fall seasons</td>
</tr>
<tr>
<td>Hazard Trees</td>
<td>Observed dead, dying or diseased trees</td>
<td>Remove hazard trees. A Certified Arborist may need to determine health of tree or removal requirements.</td>
<td>As Needed</td>
<td></td>
</tr>
<tr>
<td>Vector Control</td>
<td>Evidence of rodents, or water piping through facility via rodent holes. Harmful insects present such as wasps and hornets that interfere with maintenance/inspection activities</td>
<td>Repair facility if damaged. Remove harmful insects, use professional service if needed. Refer to Clean Water Services Integrated Pest Management Plan for management options.</td>
<td>As Needed</td>
<td></td>
</tr>
<tr>
<td>Sediment Accumulation in Wetland Bottom</td>
<td>Sediment depth in wetland bottom exceeds 6 inches or affects inlet/outlet functions or plant growth in treatment area</td>
<td>Remove sediment from wetland bottom. Re-establish designed wetland shape and depth; re-seed if necessary to control erosion, or replant to achieve treatment.</td>
<td>Summer, Fall</td>
<td>Ideally in the dry season</td>
</tr>
</tbody>
</table>
**Constructed Water Quality Wetland Operation and Maintenance Plan (continued)**

**Annual inspections are required.** It is recommended that the facility is inspected on a monthly basis to ensure proper function. The plan below describes inspection and maintenance activities, and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

<table>
<thead>
<tr>
<th>Identified Problem</th>
<th>Condition to Check for</th>
<th>Maintenance Activity</th>
<th>Maintenance Timing</th>
<th>✓ Task Complete Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Settlement of Pond Dike/Berm</td>
<td>Look for any part of dike/berm that has settled 4 inches or more lower than the design elevation</td>
<td>Repair dike/berm to approved design specifications. A licensed civil engineer should be consulted to determine the source of settlement.</td>
<td>As Needed</td>
<td></td>
</tr>
<tr>
<td>Excessive Vegetation</td>
<td>Vegetation grows so tall that it competes with approved emergent wetland grass/shrubs, interferes with access or becomes a fire danger</td>
<td>Cut tall grass to 4” to 6” and remove clippings. Prune emergent wetland grass/shrubs that have become overgrown</td>
<td></td>
<td>Ideal time to prune emergent wetland grass is spring. Cut grass in dry months</td>
</tr>
<tr>
<td>Grate Damaged, missing or not in place</td>
<td>Grate is missing or only partially in place, may have missing or broken grate members</td>
<td>Grate must be in place and meet design standards. Replace or repair any open structure, replace grate if missing.</td>
<td>As Needed</td>
<td></td>
</tr>
<tr>
<td>Damage to Outlet Structure</td>
<td>Frame not sitting flush on top slab (more than 3/8 inch between frame and top slab); frame not securely attached</td>
<td>Frame is firmly attached and sits flush on the riser rings or top slab. Structure replaced or repaired to design standards.</td>
<td>As Needed</td>
<td></td>
</tr>
<tr>
<td>Damage to Outlet Structure</td>
<td>Fractures or Cracks in walls or bottom. Maintenance person determines the structure is unsound. Soil entering structure through cracks</td>
<td>Structure replaced or repaired to design standards</td>
<td>As Needed</td>
<td></td>
</tr>
<tr>
<td>Damage to Outlet Structure</td>
<td>Settlement or Misalignment of Outlet Basin. Failure of basin has created a safety, function, or design problem</td>
<td>Structure replaced or repaired to design standards</td>
<td>As Needed</td>
<td></td>
</tr>
</tbody>
</table>
## Catch Basin Operation and Maintenance Plan

**Annual inspections are required.** The plan below describes maintenance and inspection activities and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

<table>
<thead>
<tr>
<th>Identified Problem</th>
<th>Condition to Check for</th>
<th>Maintenance Activity</th>
<th>Inspection Frequency</th>
<th>✓ Task Complete Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vermin and Odors</td>
<td>Dead animals or vegetation is observed in catchbasin.</td>
<td>Remove dead animals or vegetation that is generating odors or dangerous gases (e.g., methane). Dispose of properly</td>
<td>Annually or as needed</td>
<td></td>
</tr>
<tr>
<td>Contamination and Pollution</td>
<td>Evidence of oil, gasoline, contaminants, or other pollutants</td>
<td>Determine source(s) of contaminant and coordinate removal/cleanup with local water quality response agency</td>
<td>Monthly from November through May</td>
<td></td>
</tr>
<tr>
<td>Basin Settlement or Misalignment</td>
<td>Failure of basin has created a safety, function, or design problem</td>
<td>Replace or repair basin to design standards</td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Vegetation, trash or other debris blocking basin opening</td>
<td>Vegetation or other debris is blocking more than 20% of the basin opening</td>
<td>Remove material that is blocking basin opening and dispose of properly</td>
<td>Annually or as needed</td>
<td></td>
</tr>
<tr>
<td>Inlet/Outlet pipe blockage or damaged</td>
<td>Sediment, trash or vegetation blocking inlet or outlet pipe. Vegetable in inlet/outlet pipe joints causing separation</td>
<td>If material is blocking more than 1/3 of its capacity clear blockage. Remove vegetation in the pipe joints if large enough to cause damage</td>
<td>Annually or as needed</td>
<td></td>
</tr>
<tr>
<td>Grate damaged, missing or not in place</td>
<td>Grate is missing or only partially in place; may have missing or broken grate members</td>
<td>Ensure grate is in place and meets design standards. Any open structure needs maintenance; replace grate if missing</td>
<td>Annually or as needed</td>
<td></td>
</tr>
<tr>
<td>Catch Basin Cover (manhole cover) not in place</td>
<td>Catch basin cover is missing or only partially in place</td>
<td>Repair or replace cover. Any open catch basin requires maintenance immediately</td>
<td>Annually or as needed</td>
<td></td>
</tr>
<tr>
<td>Catch Basin Cover difficult to Remove</td>
<td>One maintenance person cannot remove lid using normal lifting pressure; difficult to access for maintenance</td>
<td>Determine if cover is rusted/seized or damaged. Repair lid to allow access</td>
<td>Annually or as needed</td>
<td></td>
</tr>
</tbody>
</table>
### Catch Basin Operation and Maintenance Plan (continued)

**Annual inspections are required.** The plan below describes maintenance and inspection activities and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

<table>
<thead>
<tr>
<th>Identified Problem</th>
<th>Condition to Check for</th>
<th>Maintenance Activity</th>
<th>Inspection Frequency</th>
<th>Task Complete Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure damage to frame or top slab</td>
<td>Frame not sitting flush on top slab (more than ¼ inch between frame and top slab); frame not securely attached. Cracks or holes present.</td>
<td>Repair frame so that it is firmly attached and sits flush on top of slab. If holes are large enough to allow material to enter basin repair is needed</td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Ladder Rungs Unsafe</td>
<td>Ladder is unsafe (missing rungs, not securely attached, misalignment, rust, cracks, sharp edges, etc.)</td>
<td>Ladder meets design standards and allows safe access for maintenance person</td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Fracture or cracks in Basin Walls and Bottom</td>
<td>Grout fill separated or cracked wider than ½ inch and longer than 1 foot at the joint of any inlet/outlet pipe; evidence of soil entering through cracks</td>
<td>Basin replaced or repaired to design standards. Maintenance person should determine if the structure is unsound</td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Trash &amp; Debris/Sediment in sump</td>
<td>Trash, debris or sediment in the basin exceeds 50% of the sump depth from the bottom of basin to invert of the lowest pipe into or out of the basin</td>
<td>Remove material from sump. Attempt to determine where source of material is coming from to reduce future input into sump</td>
<td>Monthly. Inspect after any major storm (1 inch in 24 hours). Annually Required</td>
<td></td>
</tr>
</tbody>
</table>
Closed Detention System (Tank/Vault) Operation and Maintenance Plan

**Annual inspections are required.** The plan below describes maintenance and inspection activities and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

<table>
<thead>
<tr>
<th>Identified Problem</th>
<th>Condition to Check for</th>
<th>Maintenance Activity</th>
<th>Inspection Frequency</th>
<th>✔ Task Complete Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trash and Debris</td>
<td>Visual evidence of trash, debris or dumping</td>
<td>Remove trash and debris from facility. Dispose of properly</td>
<td>Monthly and after any major storm (1-inch in 24 hours); Annually Required</td>
<td></td>
</tr>
<tr>
<td>Debris and Sediment in Storage Area</td>
<td>Depth of accumulated sediment exceeds 10% of the storage area diameter for ½ length of storage vault, or exceeds by 15% of diameter at any point (Example: 72-inch storage tank to be cleaned if sediment is 7 inches deep for more than ½ length of tank)</td>
<td>Remove sediment and debris from storage area. Dispose of properly</td>
<td>Annually Required or as needed</td>
<td></td>
</tr>
<tr>
<td>Plugged or Damaged Air Vents in Storage Area</td>
<td>Vent is damaged or ½ of vent cross section is blocked</td>
<td>Clear vents openings. Repair if damaged and ensure they are functioning properly</td>
<td>Monthly from November through April; Annually Required</td>
<td></td>
</tr>
<tr>
<td>Open Joints Between Tank/ Pipe Section within Storage Area</td>
<td>Openings or voids between tank/pipe section that allows material into facility</td>
<td>All joint between tank/pipe sections are sealed. Requires engineering analysis to determine structural stability</td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Tank/ Pipe Bent Out of Shape within Storage Area</td>
<td>Any part of tank/pipe is bent more than 10% of its design shape</td>
<td>Replace or repair tank/pipe to design standards. May require engineering analysis to determine structural stability</td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Vault Structure Damaged. Cracks in Wall, Bottom, Damage to Frame and/or Top Slab.</td>
<td>Cracks wider than ½ -inch and any evidence of soil entering the structure. Inspection determines the vault is not structurally sound</td>
<td>Vault replaced or repaired to design specifications. May require engineering analysis to determine structural stability</td>
<td>Annually Required</td>
<td></td>
</tr>
</tbody>
</table>
### Closed Detention System (Tank/Vault) Operation and Maintenance Plan (continued)

**Annual inspections are required.** The plan below describes maintenance and inspection activities and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

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<tr>
<th>Identified Problem</th>
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<th>Inspection Frequency</th>
<th>✅ Task Complete Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cracks at joints of inlet/outlet pipes or walls</td>
<td>Cracks wider than ½ -inch at the joint of inlet/outlet pipe or any evidence of soil entering the vault through the walls.</td>
<td>Repair cracks if possible. If cracks wider than ½ -inch at inlet/outlet pipe joints, seal joints or replace pipe as needed.</td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Locking Mechanism Not Working at Manhole</td>
<td>Mechanism cannot be opened by one maintenance person with proper tools; bolts into frame have less than ½ inch of thread (may not apply to self-locking lids).</td>
<td>Repair mechanism to allow access</td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Manhole Cover Not in Place</td>
<td>Cover is missing or only partially in place; any open manhole needs maintenance.</td>
<td>Replace or reinstall manhole cover to ensure it is closed</td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Ladder Rungs in Manhole Unsafe</td>
<td>Maintenance person determines ladder is unsafe (missing rungs, misalignment, rust, cracks);</td>
<td>Ladder must be repaired or secured immediately. Ladder meets design standards and allows safe access for maintenance</td>
<td>Annually Required</td>
<td></td>
</tr>
</tbody>
</table>
# Filter Vault Structure and Catch Basin Unit Operation and Maintenance Plan

**Annual inspections are required.** The plan below describes maintenance and inspection activities and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

<table>
<thead>
<tr>
<th>Identified Problem</th>
<th>Condition to Check for</th>
<th>Maintenance Activity</th>
<th>Inspection Frequency</th>
<th>✓ Task Complete Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment accumulation on top of filter cartridges within filter vault/catch basin</td>
<td>Sediment accumulation on top of cartridges exceeds ¼ inch</td>
<td>If sediment on top of cartridges exceeds ¼ inch cartridges may be plugged and require replacement.</td>
<td>Monthly from November through April</td>
<td></td>
</tr>
<tr>
<td>Sediment accumulation on filter vault floor</td>
<td>Sediment accumulation on vault floor exceeds 4 inches.</td>
<td>Remove sediment from vault and replace cartridges. Dispose of sediment in accordance with regulatory protocols.</td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Filter Cartridges Submerged</td>
<td>Greater than 4 inches of static water remains at cartridge bottom 24 hours after storm. Look for evidence of submergence due to backwater or excessive hydrocarbon loading</td>
<td>Replace filter cartridges. If cartridges are plugged with oil, additional treatment or source control clean up may be needed; NOTE: If filters have not been changed in 3 years, replace immediately</td>
<td>Annually and after any major storm (1-inch in 24 hours)</td>
<td></td>
</tr>
<tr>
<td>Filter vault/catch basin is in bypass</td>
<td>Filter structure remains in bypass condition (water over the internal outlet baffle wall or submerged cartridges) during an average rain fall event</td>
<td>Replace filter cartridges if filter vault/catch basin is in bypass</td>
<td>Monthly from November through April</td>
<td></td>
</tr>
<tr>
<td>Prominent Scum line within filter vault/catch basin</td>
<td>Obvious scum line on structure wall above top cap of cartridge that is more than ¼ inch</td>
<td>Remove sediment and replace filter cartridges</td>
<td>Monthly from November through April</td>
<td></td>
</tr>
<tr>
<td>Filter vault access cover damaged or not working</td>
<td>One maintenance person cannot remove lid using 80 pounds of lift; cover is corroded or deformed</td>
<td>Repair or replace cover. Ensure cover is working to specifications</td>
<td>Annually Required</td>
<td></td>
</tr>
</tbody>
</table>
Filter Vault Structure and Catch Basin Unit Operation and Maintenance Plan (continued)

**Annual inspections are required.** The plan below describes maintenance and inspection activities and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

<table>
<thead>
<tr>
<th>Identified Problem</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Damaged pipes within filter vault/catchbasin</td>
<td>Any part of the inlet/outlet pipes are crushed or damaged due to settlement or corrosion</td>
<td>Repair or replace if pipes are damaged.</td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Damage to Baffles, Flow Spreader or Energy Dissipator</td>
<td>Component corroded, cracked, warped, or showing signs of failure. Baffle wall seals are failing</td>
<td>Repair or replace damaged component to design specifications; baffle wall seal repaired using grout or mastic</td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Damage to Vault Structure</td>
<td>Vault structure has cracks in wall, bottom; damage to frame or top slab. Cracks wider than 1/2 inch or evidence of soil entering through the cracks; maintenance or inspection determines the vault is not structurally sound</td>
<td>Repair or replace vault; vault must meet design specifications and is structurally sound</td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Damage to Vault Structure</td>
<td>Cracks wider than 1/4 inch at the joint of any inlet/outlet pipe or evidence of soil entering through the cracks</td>
<td>Repair cracks wider than 1/4 inch at the joint of inlet/outlet pipe using grout or mastic</td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Ladder rungs unsafe</td>
<td>Maintenance person determines ladder is unsafe (missing rungs, misalignment, rust, cracks); ladder must be repaired or secured immediately</td>
<td>Repair ladder so it meets design standards and allows for safe access for maintenance</td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Damage to outlet structure</td>
<td>Grate is damaged, missing or only partially in place may have missing or broken grate members</td>
<td>Ensure grate is in place and meets design standards. Any open structure needs maintenance; replace grate if missing</td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Identified Problem</td>
<td>Condition to Check for</td>
<td>Inspection Frequency</td>
<td>Maintenance Activity</td>
<td>Task Complete Comments</td>
</tr>
<tr>
<td>--------------------</td>
<td>------------------------</td>
<td>----------------------</td>
<td>----------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Trash and Debris blocking grate</td>
<td>Trash and debris blocking more than 20% grate surface area reducing capacity</td>
<td>Monthly and after any major storm (1-inch in 24 hours)</td>
<td>Remove trash and debris from grate. Dispose of properly.</td>
<td>Annually Required</td>
</tr>
<tr>
<td>Filter Catch Basin Access cover damaged or not working</td>
<td>One maintenance person cannot remove grate using normal lifting pressure; difficult to access for maintenance</td>
<td>Annually Required</td>
<td>Ensure that grate can be removed by one maintenance person.</td>
<td></td>
</tr>
<tr>
<td>Filter Catch Basin Access cover damaged or not working</td>
<td>Filter Catch Basin Access cover damaged or not working</td>
<td>Annually Required</td>
<td>Ensure that grate can be removed by one maintenance person.</td>
<td></td>
</tr>
</tbody>
</table>
### Water Quality Manhole Operation and Maintenance Plan

**Annual inspections are required.** The plan below describes maintenance and inspection activities and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

<table>
<thead>
<tr>
<th>Identified Problem</th>
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<th>Maintenance Activity</th>
<th>Inspection Frequency</th>
<th>✔ Task Complete Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trash, Debris and Sediment</td>
<td>Material exceeds 50% of sump depth or one foot below the Tee or Snout</td>
<td>Remove material so Tee or Snout is not blocked</td>
<td>Monthly from November through April</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Tee, tee plug or Snout missing</td>
<td>Tee/tee plug or snout missing</td>
<td>Replace missing components</td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Structural Damage to Tee or Snout.</td>
<td>Tee or Snout is not securely attached to manhole wall.</td>
<td>Repair Tee or Snout so that it is securely attached to wall and outlet pipe.</td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Manhole structure not in correct position</td>
<td>Manhole structure is not upright (allow up to 10% from plumb)</td>
<td>Ensure manhole structure is in correct position. Must meet design standards</td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Structural Damage</td>
<td>Connections to outlet pipe are not watertight</td>
<td>Repaired or replace damaged connections to outlet pipe to ensure they are watertight; structure must work as designed</td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Structural Damage</td>
<td>Damage from holes in the structure (other than designed)</td>
<td>Repair holes (except as designed)</td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Locking mechanism not working on manhole cover</td>
<td>Manhole cover cannot be opened by one maintenance person with proper tools; bolts into frame have less than ½ inch of thread (may not apply to self-locking lids)</td>
<td>Repair or replace mechanism so manhole cover opens with proper tools</td>
<td>Annually Required</td>
<td></td>
</tr>
</tbody>
</table>
**Water Quality Manhole Operation and Maintenance Plan (continued)**

**Annual inspections are required.** The plan below describes maintenance and inspection activities and may be used as an inspection log. Contact the design engineer, Clean Water Services or City representative for more information.

<table>
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<tr>
<th>Identified Problem</th>
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<th>Inspection Frequency</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Manhole Cover Not in Place</td>
<td>Cover is missing or only partially in place</td>
<td>Repair or replace cover. Any open manhole needs maintenance immediately</td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Manhole Cover Difficult to Remove</td>
<td>One maintenance person cannot remove lid using normal lifting pressure; cover makes access for maintenance difficult</td>
<td>Cover can be removed by one maintenance person</td>
<td>Annually Required</td>
<td></td>
</tr>
<tr>
<td>Ladder Rungs Unsafe</td>
<td>Maintenance person determines ladder is unsafe (missing rungs, misalignment, rust, cracks); ladder must be repaired or secured immediately</td>
<td>Repair or replace ladder to meet design standards and allow for safe access for maintenance</td>
<td>Annually Required</td>
<td></td>
</tr>
</tbody>
</table>
PRIVATE STORMWATER FACILITIES AGREEMENT

This Agreement is made and entered into this _______ day of ________________ 20___, by and between Clean Water Services (District) and ________________________(Owner) whose address is _________________________________.

RECITALS

A. Owner has developed or will develop the Facilities listed below. (List the type of private stormwater facilities on site and the quantity of each type).
   Facility type (list each) ________________________________ Quantity ________________________________

B. The Facilities enable development of property while mitigating the impacts of additional surface water and pollutants associated with stormwater runoff prior to discharge from the property to the public stormwater system. The consideration for this Agreement is connection to the public stormwater system.

C. The property benefited by the Facilities and subject to the obligation of this Agreement is described below or in Exhibit A (Property) attached hereto and incorporated by reference.

D. The Facilities are designed by a registered professional engineer to accommodate the anticipated volume of runoff and to detain and treat runoff in accordance with District’s Design and Construction Standards.

E. Failure to inspect and maintain the Facilities can result in an unacceptable impact to the public stormwater system.
NOW, THEREFORE, it is agreed by and between the parties as follows:

1. **OWNER INSPECTIONS** District shall provide Owner an Operations and Maintenance Plan (O&M Plan) for each Facility. Owner agrees to operate, inspect and maintain each Facility in accordance with the current O&M Plan and any subsequent modifications to the Plan. Owner shall maintain a log of inspection activities. The log shall be available to District upon request or during District inspections.

2. **DEFICIENCIES** All aspects in which the Facilities fail to satisfy the O&M Plan shall be noted as “Deficiencies”.

3. **OWNER CORRECTIONS** All Deficiencies shall be corrected at Owner’s expense within thirty (30) days after completion of the inspection. If more than 30 days is reasonably needed to correct a Deficiency, Owner shall have a reasonable period to correct the Deficiency so long as the correction is commenced within the 30-day period and is diligently prosecuted to completion.

4. **DISTRICT INSPECTIONS** Owner grants District the right to inspect the Facilities. District will endeavor to give ten (10) days prior written notice to Owner, except that no notice shall be required in case of an emergency. District shall determine whether Deficiencies need to be corrected. Owner (at the address provided in this Agreement, or such other address as Owner may designate in writing to District) will be notified in writing through the US Mail of the Deficiencies and shall make corrections within 30 days of the date of the notice.

5. **DISTRICT CORRECTIONS** If correction of all Owner or District identified Deficiencies is not completed within thirty (30) days after Owner’s inspection or District notice, District shall have the right to have any Deficiencies corrected. District (i) shall have access to the Facilities for the purpose of correcting such Deficiencies and (ii) shall bill Owner for all costs reasonably incurred by District for work performed to correct the Deficiencies (District Correction Costs) following Owner’s failure to correct any Deficiencies in the Facilities. Owner shall pay District the District Correction Costs within thirty (30) days of the date of the invoice. Owner understands and agrees that upon non-payment, District Correction Costs shall be secured by a lien on the Property for the District Correction Cost amount plus interest and penalties.

6. **EMERGENCY MEASURES** If at any time District reasonably determines that the Facilities create any imminent threat to public health, safety or welfare, District may immediately and without prior notice to Owner take measures reasonably designed to remedy the threat. District shall provide notice of the threat and the measures taken to Owner as soon as reasonably practicable, and charge Owner for the cost of these corrective measures.

7. **FORCE AND EFFECT** This Agreement has the same force and effect as any deed covenant running with the land and shall benefit and bind all owners of the Property present and future, and their heirs, successors and assigns.

8. **AMENDMENTS** The terms of this Agreement may be amended only by mutual agreement of the parties. Any amendments shall be in writing, shall refer specifically to this Agreement, and shall be valid only when executed by the owners of the Property, District and recorded in the Official Records of the county where the Property is located.

9. **PREVAILING PARTY** In any action brought by either party to enforce the terms of this Agreement, the prevailing party shall be entitled to recover all costs, including reasonable attorney’s fees as may be determined by the court having jurisdiction, including any appeal.

10. **SEVERABILITY** The invalidity of any section, clause, sentence, or provision of this Agreement shall not affect the validity of any other part of this Agreement, which can be given effect without such invalid part or parts.
IN WITNESS WHEREOF, Owner and District have signed this Agreement.

NOTARIZE DOCUMENT BELOW

INDIVIDUAL OWNERS SIGN BELOW

Owner (Individual)

Owner (Individual)

CORPORATE, LLC, PARTNERSHIP, TRUST OR OTHER LEGAL ENTITY SIGN BELOW

(Entity name)

By: ____________________________

(Sign here for entity)

Title: ____________________________

CLEAN WATER SERVICES

APPROVED AS TO FORM

By: ____________________________

General Manager or Designee

District Counsel

[Use this notary block if OWNER is an individual.]

STATE OF _________________   )
County of  _________________   )

This instrument was acknowledged before me this _______day of __________________________, 20____,
by ______________________________________ .

_____________________________________________
Notary Public

[Use this notary block if OWNER is an entity.]

STATE OF _________________   )
County of  _________________   )

This instrument was acknowledged before me on ___________________________(date)
by____________________________________(name of person) as
____________________________(title) of _________________________________(name of entity).

_____________________________________________
Notary Public