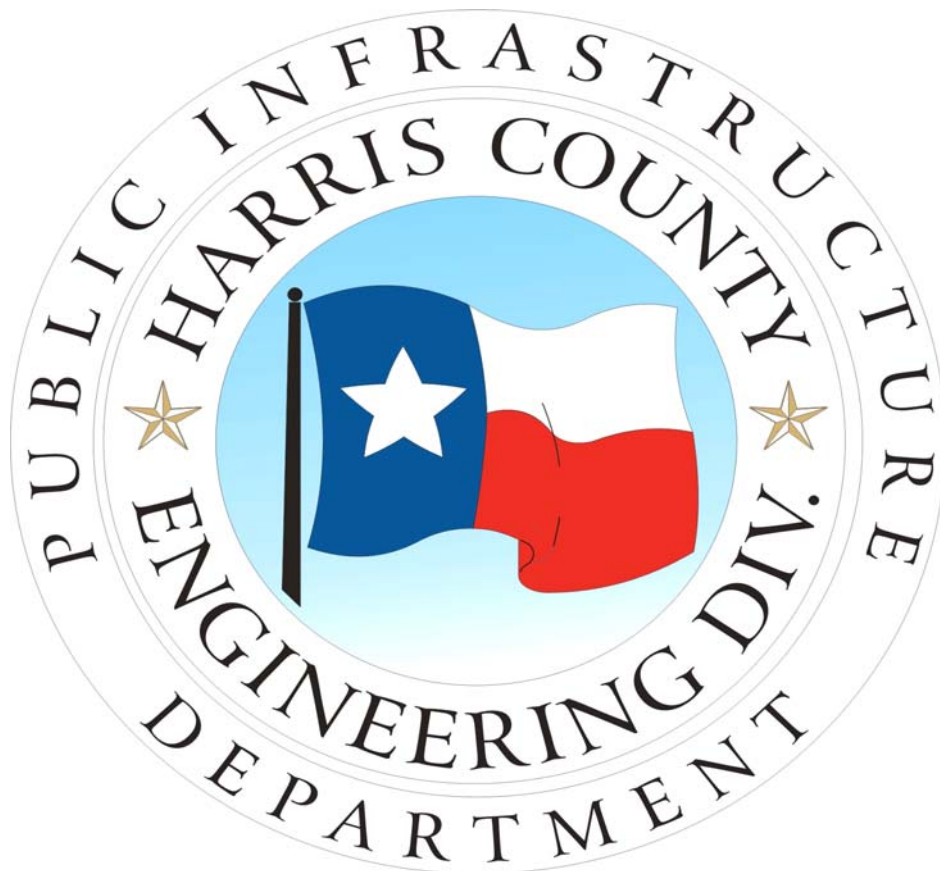


**HARRIS COUNTY
PUBLIC INFRASTRUCTURE DEPARTMENT
ENGINEERING DIVISION – PERMIT OFFICE**

STORM WATER QUALITY GUIDANCE DOCUMENT FOR
NEW DEVELOPMENT/REDEVELOPMENT PROJECTS
(Single Family Residential Development, Commercial Development, Road
Projects, Flood Control Projects)



**JOHN R. BLOUNT, P.E.
SCOTT BEAN, M.P.A.**

Revised April 04, 2004

INTRODUCTION

Storm water pollution from point sources and non-point sources is a challenging water quality problem. Unlike pollution from industry or sewage treatment facilities, which is caused by a discrete number of sources, stormwater pollution is caused by the daily activities of people everywhere. Rainwater runs off streets, lawns and construction and industrial sites and picks up fertilizers, dirt, pesticides, oil and grease, and many other pollutants on the way to our rivers, lakes, and coastal waters. Stormwater runoff is our most common cause of water pollution.

Because stormwater pollution is caused by so many different activities, traditional regulatory controls will only go so far. Education, source controls, and structural control requirements are key components to any successful storm water program. A successful program must also recognize that storm water quality, as a subject matter, is in its infancy and constantly changing. Best Management Practices (BMPs) and technologies that might be recommended or required today for addressing storm water pollution might be frowned upon tomorrow. Flexibility is a necessary component of a storm water quality program.

This policy document strives to be flexible in allowing different combinations of structural and non-structural BMPs to address runoff from areas of new development/redevelopment, while ensuring that an acceptable minimum is provided to address post-construction runoff concerns.

HISTORY OF HARRIS COUNTY REGULATIONS

The County obtained a permit from the EPA in conjunction with other governmental agencies in 1998. A condition of that permit is that the County under-take steps to reduce stormwater pollution by adopting regulations. On August 21, 2001 Harris County adopted the Regulations of Harris County, Texas for Storm Water Quality

Management. These regulations govern areas over five acres in size, including single-family residential development, commercial development, roadway projects, utility projects, and flood control projects. This document is issued to help engineers, developers, and government officials understand what options are available to them when undertaking each type of project.

POST-CONSTRUCTION

BEST MANAGEMENT PRACTICES (BMP'S)

All projects that constitute new development or significant redevelopment in accordance with County Regulations require Post-Construction Best Management Practices (BMP's). Post construction BMP's are in place to limit the quantity of harmful pollutants being discharged by the completed development during and following rain events. Post-construction BMP's take different forms, structural and nonstructural. Examples of nonstructural would be public education, source controls, and low impact development. Structural controls would be storm water quality basins, detention ponds, vegetative practices, and floatable collection devices.

GENERALLY RECOGNIZED STRUCTURAL AND NON- STRUCTURAL BMP'S FOR NEW DEVELOPMENT/REDEVELOPMENT PROJECTS

The following represents generally recognized structural and nonstructural BMP's that are applicable to new development/redevelopment projects in Harris County. A brief description is listed below. For a detailed discussion it is recommended that EPA's website, and the Houston/Harris County *Storm Water Quality Management Guidance Manual* be reviewed.

NON-STRUCTURAL CONTROLS:

Unlike structural controls, or “end-of-pipe” BMPs, non-structural controls are intended to keep pollutants out of storm water, thus alleviating the need to try and remove them by structural means. Non-structural controls are by far the most cost-effective means to reducing storm water pollution. A good storm water program should have its primary emphasis on non-structural elements. The following are examples of non-structural BMPs that should be utilized for new development/redevelopment projects.

- PUBLIC EDUCATION

It is recognized that preventing the pollutants from entering the stream is preferable to treating the storm water after the pollutants are co-mingled. One BMP that does this is public education. Educating homeowners and the public in general of the link between property specific activities (fertilizer/pesticide use, pet waste, etc.) and water quality in local surface waters is imperative if the amount of pollutants in storm water is to be limited.

- SOURCE CONTROLS

Seemingly innocuous practices such as overloading or failing to close trash dumpsters, washing restaurant mats and equipment in parking lots, and leaving products/inventory in open yards or storage facilities can generate harmful pollutants during rain events that will be transported into the storm sewer system. The only truly foolproof manner for preventing storm water pollution is to keep pollutants out of the storm water in the first place; therefore, source controls, such as good-housekeeping practices and no-exposure policies, are an essential component of a comprehensive storm water program.

- INLET MARKERS

A form of public education, permanent markers or stenciling at storm sewer inlets and manholes inform the public that storm sewers discharge directly to surface waters

without treatment. This BMP helps discourage homeowners and residents from dumping used motor oil and other household chemicals/wastes down storm sewer inlets.

- **LOW IMPACT DEVELOPMENT**

Low impact development is a broad term that covers a multitude of development practices that can reduce storm water pollution normally associated with development. These practices can include the reduction of impervious surfaces, elimination of curbs and gutters, substantial buffers around open storm water conveyances, urban forestry, and increasing the amount of open space by reducing lot sizes. Low impact development practices are known to have numerous environmental benefits, including pollutant reduction and removal. Trees and grasses can absorb water, pollutant gases, airborne particulates, sediment, nitrogen, phosphorous, and pesticides. Furthermore, by planting native species, the need for fertilizers and pesticides is substantially reduced.

There are numerous economic benefits to low impact development, including proven increases in property values. In addition, by preserving trees and forests, clearing and grading as well as erosion and sediment costs are saved during construction. Keeping areas natural as possible also minimizes maintenance costs.

- **URBAN FORESTRY**

Urban forestry is the planting and study of trees in and around towns and cities. Since trees absorb water and filter particulate matter, patches of forest and trees that line streets can help provide some of the storm water management required in an urban setting. Urban forests also help break up a landscape of impervious cover, provide small but essential green spaces, and line walkways and trails.

- COMMERCIAL PROPERTY SITE DESIGN FOR POLLUTION MINIMIZATION

Inadvertent or passive exposure of machinery, products, and refuse to rainfall at commercial sites can be a source of storm water pollution. Covering delivery and fueling areas and sloping pavement in those areas away from the storm sewer inlets can prevent contaminated runoff. Various site design recommendations are included in the *Storm Water Quality Management Guidance Manual*.

STRUCTURAL CONTROLS

Structural BMPs attempt to extract various pollutants out of storm water by various means. Due to local soil conditions, topography, and rainfall amounts, Harris County is limited in the type of structural BMPs that can be utilized. Infiltration practices and sand filters, for example, cannot be utilized for the most part due to impermeable soils and flat topography and are, therefore, not recommended or addressed in this document.

The primary pollutant removal mechanisms in the Harris County *Storm Water Quality Guidance Manual* are based on sedimentation (e.g. pollutants binding to suspended sediments and dropping out during a quiescent period in a basin), biological uptake of pollutants by vegetation, and separation of pollutants from storm water by mechanical means.

Structural controls, unlike non-structural practices, can be costly and they require considerable operation and maintenance. Along with proper design and construction, maintenance of structural controls is critical. Failure to maintain controls properly can result in drastically reduced, or non-existent, pollutant removal. In fact, “non-maintained” structural controls can actually have negative consequences, such as producing a breeding ground for mosquitoes and other nuisances.

It should be noted that, as of the initial date of this policy document, no structural controls have been tested in the Houston/Harris County area. While studies from other parts of the country detail various levels of pollutant removal for each type of structural control, their effectiveness in this area has not been verified.

- DRY/WET DETENTION PONDS

Dry and wet extended detention ponds are basins whose outlets have been designed to detain the storm water runoff from a water quality design storm for some minimum time (e.g., 48 hours) to allow particles and associated pollutants to settle. In wet ponds, biological uptake of pollutants by fringe vegetation is also possible. They provide flood control by including additional flood detention storage, and can provide both flood and water quality protection (dual-use). Another method that provides both detention storage and stream bank protection (aquatic habitat protection) is to detain the 10% and 1% exceedence probability, 24-hour storm events (10 and 100 year storm events).

- CONSTRUCTED STORM WATER QUALITY WETLANDS

Existing wetlands have a unique ability to remove pollutants from storm water. By constructing engineered wetlands to address runoff from new development projects, some of the negative impacts can be mitigated. Constructed wetlands systems are believed to be quite effective but, at the same time, very maintenance intensive. Harvesting plants periodically, dredging silted areas, and providing a source of makeup water are all considerations; therefore, constructed wetlands should only be attempted if the proper operation and maintenance commitments and funding are in place.

- VEGETATIVE PRACTICES (GRASSY SWALES/FILTER STRIPS)

Vegetative filter strips and grassy swales are recommended BMPs where land is available. By routing storm water through a vegetative BMP, pollutants either settle out in the low velocity flow, or are absorbed by and adsorbed to vegetation.

- FLOATABLE COLLECTION DEVICES

The accumulation of trash that is washed into our waterways causes a number of problems. Not only is it an aesthetic problem, but it also damages the aquatic habitat and is harmful to fish and other animal life. Small individual pieces of litter and trash find their way into local creeks and streams, which enter the major rivers and estuaries and eventually lead to our bays and ultimately the Gulf of Mexico. While the best method for addressing factitious floatables is through public education (“don’t litter” campaigns, signage, inlet markers, etc), it is believed that structural containment devices will be able to eliminate a certain percentage of floating trash and debris from storm water.

- HYDRODYNAMIC SEPARATORS/WATER QUALITY INLETS

Certain proprietary systems are available to address post-construction runoff. These systems mainly address oil and grease, as well as floating trash and debris. Their ability to remove suspended solids and associated pollutants is believed to be minimal. For highly impervious commercial sites where land is at a premium, these mechanical systems offer an alternative to land intensive basins and vegetative practices.

**ACCEPTABLE BMP'S FOR NEW
DEVELOPMENT/REDEVELOPMENT PROJECTS (SINGLE
FAMILY DEVELOPMENT, COMMERCIAL DEVELOPMENT,
ROAD PROJECTS, FLOOD CONTROL PROJECTS)**

This policy document is intended to provide information on what BMP's will be acceptable at plan review and permit time. These are not the only options available, and innovative storm water quality management plans and BMPs are encouraged. It is recognized that each property and project may have unique circumstances that will determine which BMPs are available, or even feasible for use. This policy document strives to be flexible in allowing different combinations of structural and non-structural BMPs, while ensuring that an acceptable minimum is provided to address post-construction runoff concerns. It is recognized that various local factors (detention/flood control criteria, topography, right-of-way constraints, etc) will impact the design of structural controls, and that it may not always be feasible to strictly comply with the design criteria contained in the *Houston/Harris County Storm Water Quality Management Guidance Manual, the Minimum Design Criteria for Implementation of Certain Best Management Practices for Storm Water Runoff Treatment Options, or the Harris County Storm Water Quality Guidance Document for New Development/Redevelopment Projects.*

NOTE 1: Those items italicized would be considered the minimum for each type project.

NOTE 2: When it is noted that requirements for detention exist, those requirements are set forth in the Harris County Flood Control District Criteria Manual and the Regulations of Harris County for the Approval and Acceptance of Infrastructure.

NOTE 3: Where used in this document, the term “Storm Water Quality Guidance Manual” refers to both the Houston/Harris County Storm Water Quality Management Guidance Manual, and the Minimum Design Criteria for Implementation of Certain Best Management Practices for Storm Water Runoff Treatment Options.

TYPE PROJECT	ACCEPTABLE BMP'S
Single Family Residential Development with Requirements for On-Site Detention	<ol style="list-style-type: none"> 1) Wet or dry dual-use (quantity/quality) basin(s) designed in general conformance with the Storm Water Quality Guidance Manual 2) Constructed wetland system designed in general conformance with the Storm Water Quality Guidance Manual 3) Subdivision designed in accordance with Low Impact Development principles, as detailed in the Storm Water Quality Guidance Manual 4) <i>Detention pond equipped to capture floatables to the 10-year storm and designed to detain</i>

	<p><i>the 10 and 100-year storm for stream bank/aquatic habitat protection (Construction criteria follows HCFCD Guidance Manual or the Harris County Regulations for Approval and Acceptance of Infrastructure, as applicable.)</i></p> <p>5) <i>Inlet markers to deter dumping of motor oil and household hazardous waste into the storm sewer system.</i></p> <p>6) <i>Public education (mailers, door hangers, signage, etc) through the municipal utility district or homeowners association, on the impact of fertilizers, pesticides, and animal waste on our creeks and bayous with guidance on ways to help.</i></p>
<p>Single Family Residential Development without On-Site Detention Requirements</p>	<p>1) Dry or wet storm water quality basin(s) designed in general conformance with the Storm Water Quality Guidance Manual</p> <p>2) Constructed wetland system designed in general conformance with the Storm Water Quality Guidance Manual</p> <p>3) Subdivision designed in accordance with Low Impact Development principles</p> <p>4) <i>Floatables capture and collection method either in a basin, or in an area adjacent to the storm sewer system prior to outfall into HCFCD ditch.</i></p> <p>5) <i>Inlet markers to deter dumping of motor oil and household hazardous waste into the storm sewer system.</i></p> <p>6) <i>Public education (mailers, door hangers, signage, etc) through the municipal utility</i></p>

	<p><i>district or homeowners association, on the impact of fertilizers, pesticides, and animal waste on our creeks and bayous with guidance on ways to help.</i></p>
<p>Commercial Development with On-Site Detention Requirements</p>	<ol style="list-style-type: none"> 1) Wet or dry dual-use (quantity/quality) basin(s) designed in general conformance with the Storm Water Quality Guidance Manual 2) Constructed wetland system designed in general conformance with the Storm Water Quality Guidance Manual 3) <i>Detention pond equipped to capture floatables to the 10-year storm and designed to detain the 10 and 100-year storm for stream bank/aquatic habitat protection (Construction criteria follows HCFCO Guidance Manual or the Harris County Regulations for Approval and Acceptance of Infrastructure, as applicable.)</i> 4) <i>Commercial Property Good-Housekeeping /No-Exposure Commitment as part of project's Storm Water Quality Management Plan <u>or</u> design the project in accordance with Storm Water Pollution Minimization Practices contained in the Storm Water Quality Guidance Manual</i> 5) <i>Proper Landscape Practices Commitment as part of the project's Storm Water Quality Management Plan.</i>
<p>Commercial Development Without On-Site Detention Requirements</p>	<ol style="list-style-type: none"> 1) <i>Wet or dry storm water quality basin(s), grassy swale(s), or filter strip(s) designed in general conformance with the Storm Water Quality Guidance Manual <u>or</u> a properly sized structural control such as a hydrodynamic</i>

	<p><i>separator or water quality inlet inserts.</i></p> <p>2) <i>Constructed wetland system designed in general conformance with the Storm Water Quality Guidance Manual.</i></p> <p>3) <i>Commercial Development Good-Housekeeping /No-Exposure Certificate as part of the project's Storm Water Quality Management Plan <u>or</u> design the project in accordance with Storm Water Pollution Minimization Practices contained in the Storm Water Quality Guidance Manual</i></p> <p>4) <i>Proper Landscape Practices Commitment as part of the project's Storm Water Quality Management Plan.</i></p>
<p>New Roadway / Roadway Extension Projects</p>	<p>If detention is required:</p> <p>1) Wet or dry dual-use (quantity/quality) basin(s) designed in accordance with the Storm Water Quality Guidance Manual</p> <p>2) <i>Detention pond equipped to capture floatables to the 10-year storm and designed to detain the 10 and 100-year storm for stream bank/aquatic habitat protection (Construction criteria follows HCFCD Guidance Manual or the Harris County Regulations for Approval and Acceptance of Infrastructure, as applicable.)</i></p> <p>3) <i>Inlet markers to deter dumping of motor oil and household hazardous waste into the storm sewer system.</i></p> <p>4) Urban Forestry Techniques</p> <p>5) Low Impact Practices (decrease impervious surfaces, elimination of curbs and gutters, green space)</p>

	<p>If detention is not required, any of the following may be acceptable</p> <ul style="list-style-type: none"> 1) <i>Floatables capture and collection method either in a basin, or in an area adjacent to the storm sewer system prior to outfall into HCFC D</i> 2) <i>Urban Forestry Techniques</i> 3) <i>Inlet markers (on inlets draining to basin) to deter dumping of motor oil and household hazardous waste into the storm sewer system.</i> 4) <i>Signage to deter littering</i>
<p>Flood Control Basin Projects or Channel Maintenance /Improvement Projects</p>	<p>If basin is proposed,</p> <ul style="list-style-type: none"> 1) Wet or dry dual-use (quantity/quality) basin(s) designed in general conformance with the Storm Water Quality Guidance Manual 2) <i>Detention basin equipped to capture floatables to the 10-year storm and designed to detain the 10 and 100 year storm for stream bank/aquatic habitat protection (Construction criteria follows HCFC D Guidance Manual</i> <p>If detention is not required, any of the following may be acceptable</p> <ul style="list-style-type: none"> 1) <i>Floatables capture and collection method either in a basin, or in an area adjacent to the storm sewer system prior to outfall into HCFC D ditch</i> 2) <i>Urban Forestry Techniques</i> 3) <i>Inlet markers (on inlets draining to basin) to deter dumping of motor oil and household</i>

	<p><i>hazardous waste into the storm sewer system.</i></p> <p>4) <i>Signage to deter littering</i></p> <p>5) <i>Over bank erosion control features with a vegetative maintenance plan</i></p>
<p>General Flood Control Project with no Detention Basins, Underground Utility Projects, Other</p>	<p>1) <i>Inlet markers or inlet stenciling to deter dumping of motor oil and household hazardous waste into the storm sewer system that drains into flood control facility and/or signage to deter littering</i></p> <p>2) <i>Urban Forestry Techniques</i></p>

ATTACHMENTS/EXHIBITS

- A. Public Education Examples (Mailers/Door Hangers)
- B. Inlet Markers/Manhole Cover Details
- C. Urban Forestry Details
- D. Signage Example
- E. Floatables Collection Device Design Example (In-Line Storm Sewer)
- *Pending*
- F. Floatables Collection Device Design Example (Detention Basin) -
Pending
- G. 10 Year Storm Event Weir Design Example - *Pending*
- H. Commercial Good Housekeeping/No-Exposure Commitment
- I. Commercial Proper Landscape Practices Commitment

ATTACHMENT A: PUBLIC EDUCATION EXAMPLES (MAILERS/DOOR HANGERS)

YOU CAN HELP KEEP TEXAS' WATERWAYS CLEAN

Storm Water Pollution Prevention

The Texas Commission on Environmental Quality is asking for your help to keep Texas' natural waterways clean and healthy by preventing storm water pollution. The storm sewer system in your neighborhood drains to _____ (specify bayou or creek) and, eventually to Galveston Bay, as indicated on the storm sewer inlets and manhole lids. The inlets also inform residents that, "No Dumping" is allowed, because harmful pollutants dumped into the sewer can damage the quality of these waters. The following are a few simple things you can do to help protect the biological health and beauty of our bayous and Galveston Bay.

1. Properly dispose of hazardous waste such as paint, used motor oil, bleach and cleaning fluids. These substances poison waterways, killing fish and the plants they live on.
2. Use fertilizers and pesticides sparingly and according to manufacturer's instructions. Pesticides poison waterways and fertilizers add excessive nutrients which promote the growth of algae, resulting in odor and poor quality water for fish.
3. Remove and properly dispose of pet waste. Pet waste left in yards will eventually be washed into storm sewers adding excessive nutrients to waterways. These nutrients, like fertilizers, promote rapid growth of algae which can kill fish and cause odor.

Your community relies on clear, unobstructed storm sewers to quickly remove storm water from the streets and protect from flooding. Help prevent blockages by:

1. Making sure the lid on your trash can is secure to reduce litter which often winds up clogging storm sewers.
2. Sweeping up and properly disposing of grass clippings and yard waste that could get washed into storm drains.
3. Removing debris which is blocking an inlet. The storm sewers are your flood protection!

If recycling is available in your area, you can help reduce the need for expensive and unsightly landfills by taking advantage of this free service. Recycle bins are usually available free from the recycle hauler upon request.

THANKS FOR DOING YOUR PART!



The Landtech Group, Inc.

ATTACHMENT A: PUBLIC EDUCATION EXAMPLES
(MAILERS/DOOR HANGERS)

**Stormwater Pollution
Found in Your Area!**

This is not a citation.

This is to inform you that our staff found the following pollutants in the storm sewer system in your area. This storm sewer system leads directly to

- Motor oil
- Oil filters
- Antifreeze/
transmission fluid
- Paint
- Solvent/degreaser
- Cooking grease
- Detergent
- Home improvement waste (concrete,
mortar)
- Pet waste
- Yard waste (leaves, grass, mulch)
- Excessive dirt and
gravel
- Trash
- Construction debris
- Pesticides and
fertilizers
- Other



**For more information or to report
an illegal discharge of
pollutants, please call:**



IT DRAINS
www.epa.gov/npdes/stormwater

EPA 833-F-03-002
April 2003

ATTACHMENT A: PUBLIC EDUCATION EXAMPLES (MAILERS/DOOR HANGERS)

Stormwater runoff is precipitation from rain or snowmelt that flows over the ground. As it flows, it can pick up debris, chemicals, dirt, and other pollutants and deposit them into a storm sewer system or waterbody.

Anything that enters a storm sewer system is discharged *untreated* into the waterbodies we use for swimming, fishing, and providing drinking water.

Remember: Only Rain Down the Drain

To keep the stormwater leaving your home or workplace clean, follow these simple guidelines:

- Use pesticides and fertilizers sparingly.
- Repair auto leaks.
- Dispose of household hazardous waste, used auto fluids (antifreeze, oil, etc.), and batteries at designated collection or recycling locations.
- Clean up after your pet.
- Use a commercial car wash or wash your car on a lawn or other unpaved surface.
- Sweep up yard debris rather than hosing down areas. Compost or recycle yard waste when possible.
- Clean paint brushes in a sink, not outdoors. Properly dispose of excess paints through a household hazardous waste collection program.
- Sweep up and properly dispose of construction debris like concrete and mortar.



ATTACHMENT A: PUBLIC EDUCATION EXAMPLES (MAILERS/DOOR HANGERS)

**PLEASE DON'T FEED
THE STORM DRAIN**

WHEN PET WASTE, MOTOR OIL, FERTILIZERS AND OTHER CHEMICALS WASH DOWN A STORM DRAIN, THEY FLOW INTO RIVERS AND LAKES, CONTAMINATING DRINKING WATER SOURCES. IT'S CALLED "NONPOINT SOURCE POLLUTION."

YARD
Don't overfertilize. Sweep (do not wash) fertilizer and soil off driveways and walkways.

CAR
Maintain your car to prevent oil leaks and recycle used motor oil.

PET
Pick up pet waste from yards, trails and sidewalks.

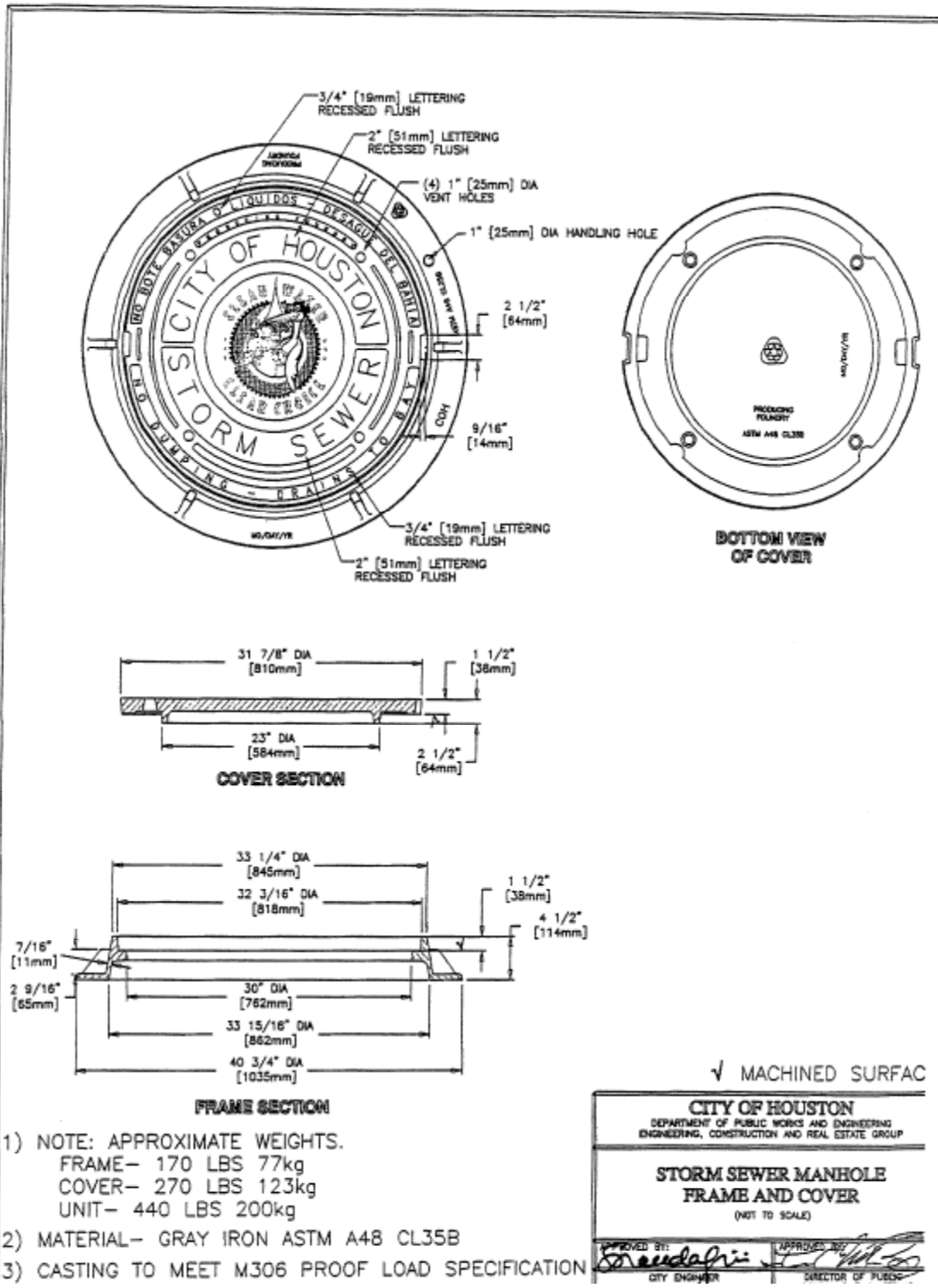
HOME
Use nontoxic or natural household cleaning products. Recycle or properly dispose of household chemicals.

**PLEASE DON'T FEED
THE STORM DRAIN**

1-800-CLEAN UP

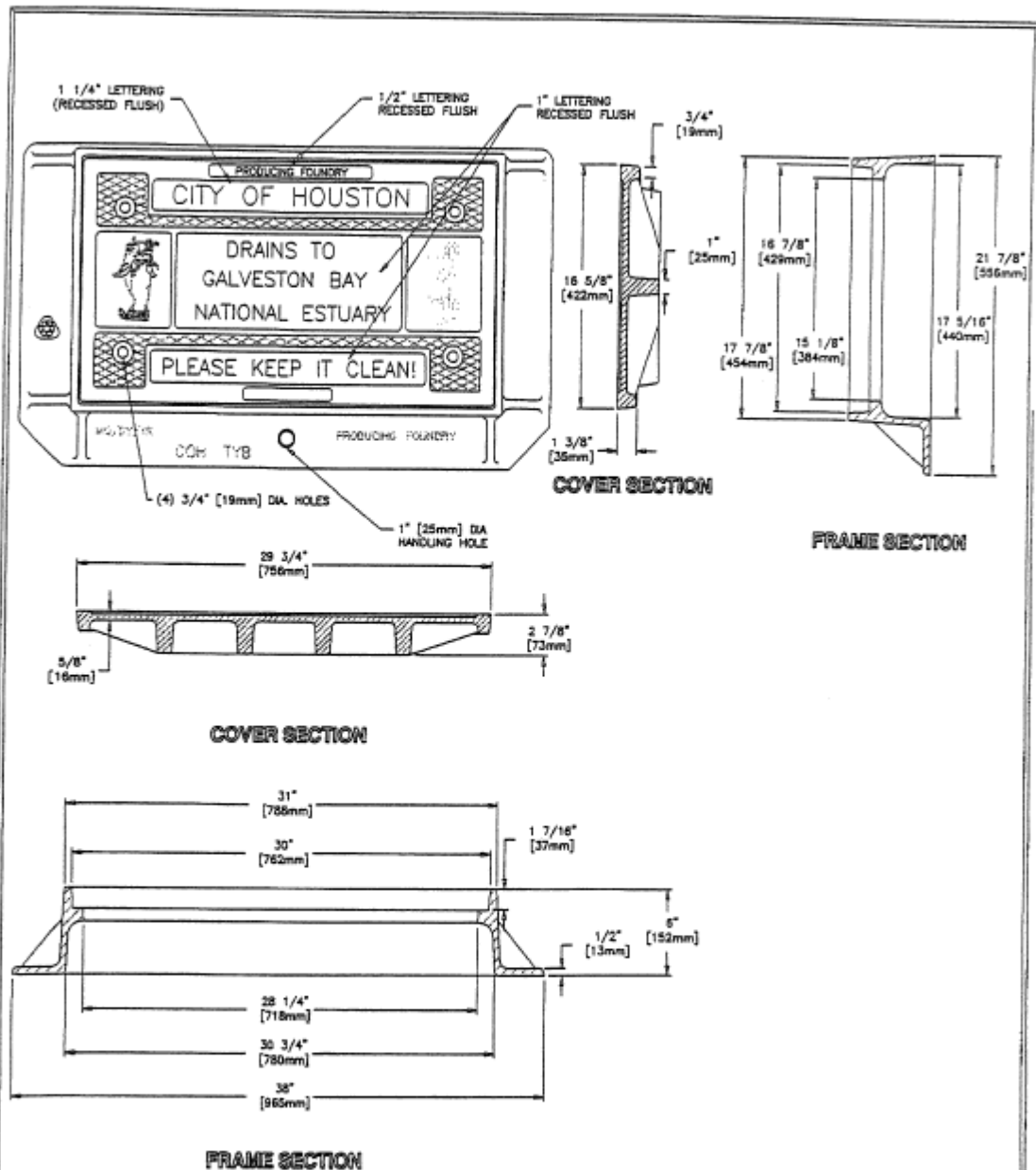
Texas Natural Resource Conservation Commission and the U.S. Environmental Protection Agency

ATTACHMENT B: INLET MARKERS/MANHOLE COVER DETAILS



- 1) NOTE: APPROXIMATE WEIGHTS.
 FRAME- 170 LBS 77kg
 COVER- 270 LBS 123kg
 UNIT- 440 LBS 200kg
- 2) MATERIAL- GRAY IRON ASTM A48 CL35B
- 3) CASTING TO MEET M306 PROOF LOAD SPECIFICATION

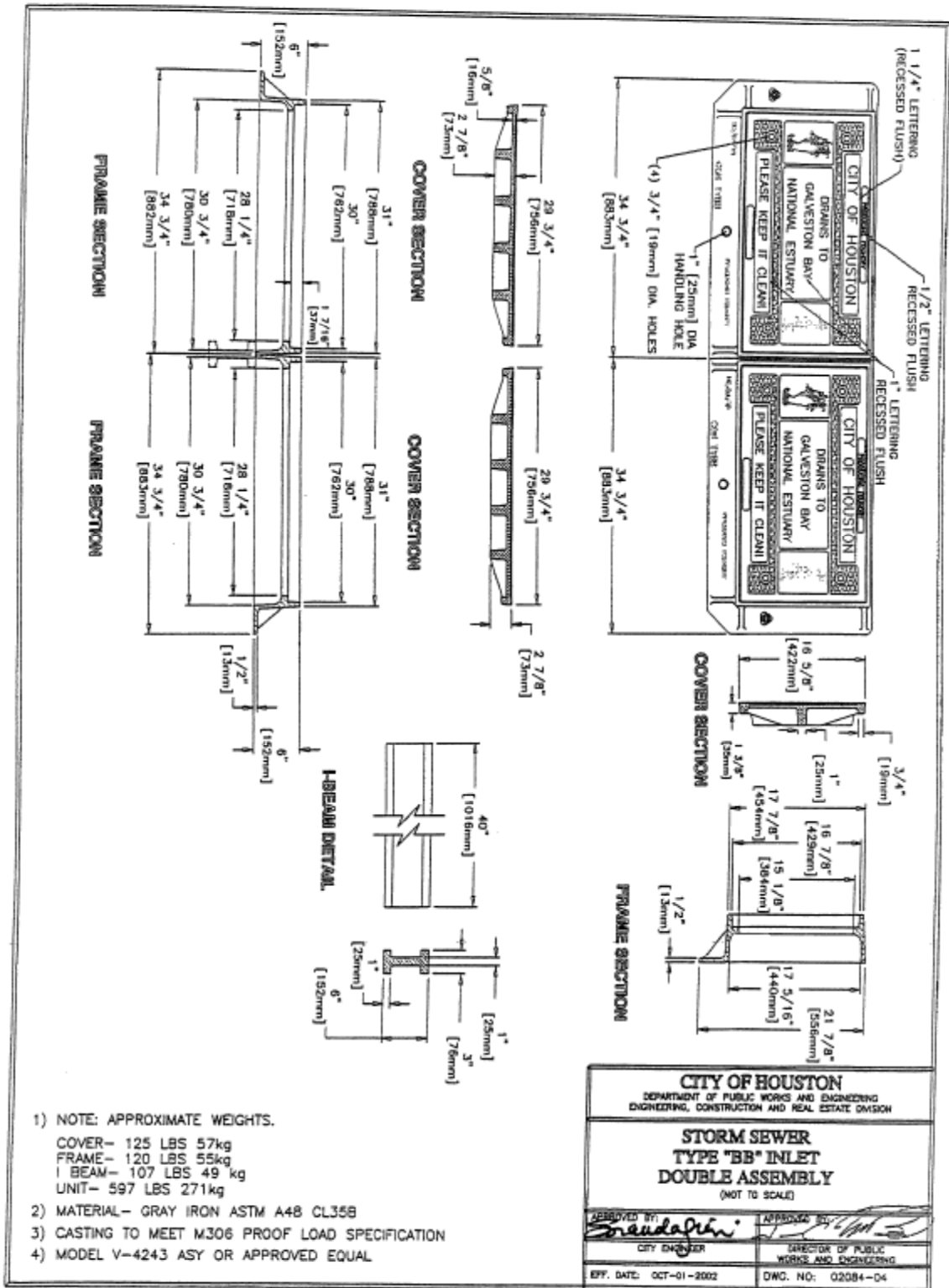
ATTACHMENT B: INLET MARKERS/MANHOLE COVER DETAILS



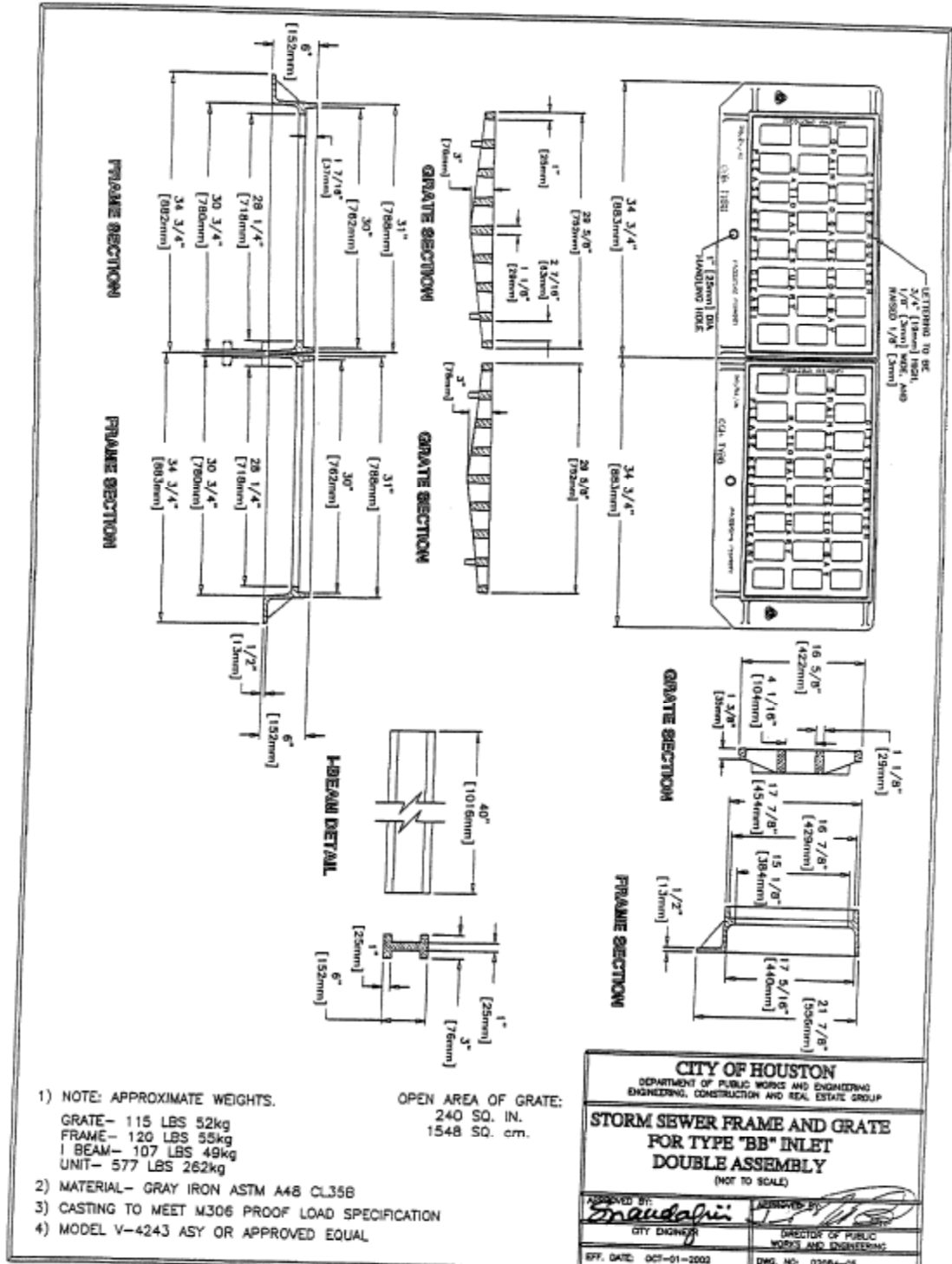
- 1) NOTE: APPROXIMATE WEIGHTS.
COVER- 125 LBS 57kg
FRAME- 130 LBS 59kg
UNIT- 255 LBS 116kg
- 2) MATERIAL- GRAY IRON ASTM A48 CL35B
- 3) CASTING TO MEET M306 PROOF LOAD SPECIFICATION
- 4) MODEL V-4241 ASY OR APPROVED EQUAL

CITY OF HOUSTON DEPARTMENT OF PUBLIC WORKS AND ENGINEERING ENGINEERING, CONSTRUCTION AND REAL ESTATE DIVISION	
STORM SEWER TYPE "B" INLET ASSEMBLY (NET TO SCALE)	
DESIGNED BY: <i>Eradatu</i>	APPROVED BY:
CITY ENGINEER	DIRECTOR OF PUBLIC WORKS AND ENGINEERING
EFF. DATE: OCT-01-2002	DWG. NO.: 02084-03

ATTACHMENT B: INLET MARKERS/MANHOLE COVER DETAILS



ATTACHMENT B: INLET MARKERS/MANHOLE COVER DETAILS



ATTACHMENT C: URBAN FORESTRY DETAILS

ACCEPTABLE URBAN FORESTRY CRITERIA

When Urban Forestry is chosen as a storm water quality BMP, The Storm Water Quality Management Plan must be certified by a licensed Urban Forester, Landscape Architect, Certified Arborist, or similarly qualified professional.

TREE SIZE AND CONDITION

Trees shall be a minimum of 4 feet tall and 1.5-inch caliper (diameter) at the base and a maximum of 14 feet tall and 3 inches in caliper at the base, when planted. American Standard for Nursery Stock criteria may be used as well.

It is essential that trees be self-supporting with straight trunks and leaders or tops intact. Trees that have been headed back are not acceptable. Trees should be normally shaped for their species and well branched with full foliage when leafed out. The roots must be healthy and sufficiently large to allow recovery after planting. The trunk must be free of abrasions and recent cuts and the tree free of insects and disease.

PLANTING TIMING

The recommended tree planting time in the Harris County area is usually early fall until late spring. Generally, mid October to early March is the best time to plant trees. Planting in late fall or winter will allow roots to become established before moisture demanding summer sets in. All trees must be maintained (primarily watered) for a minimum of two years.

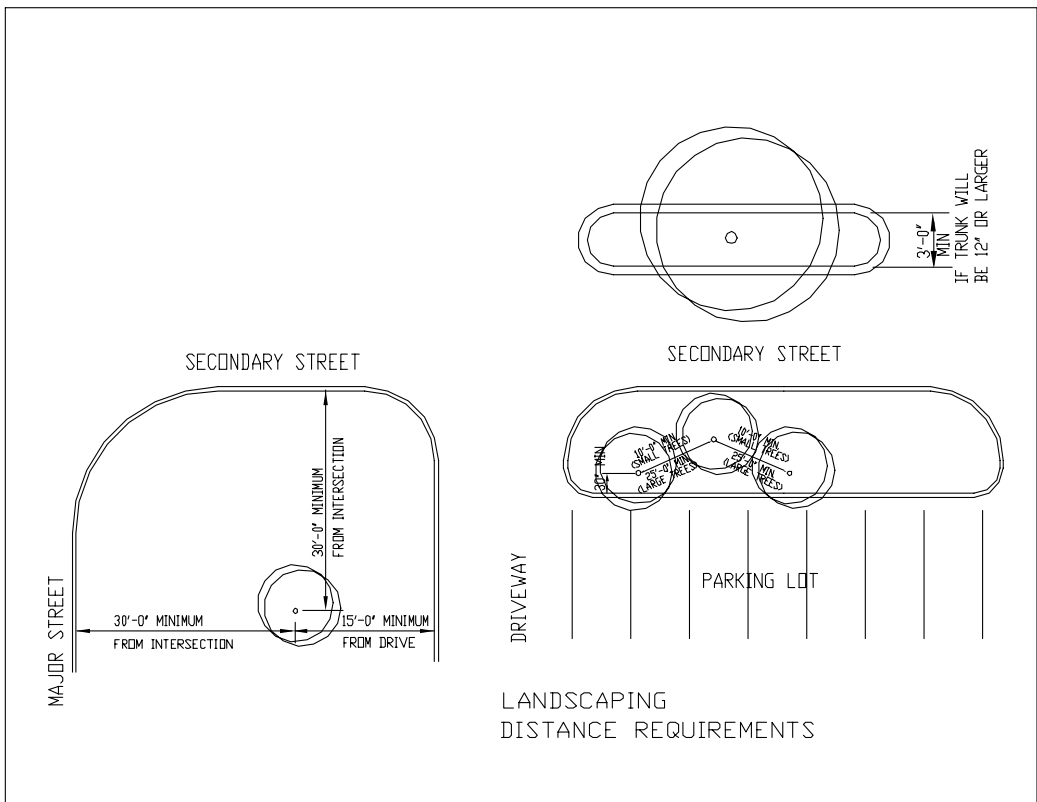
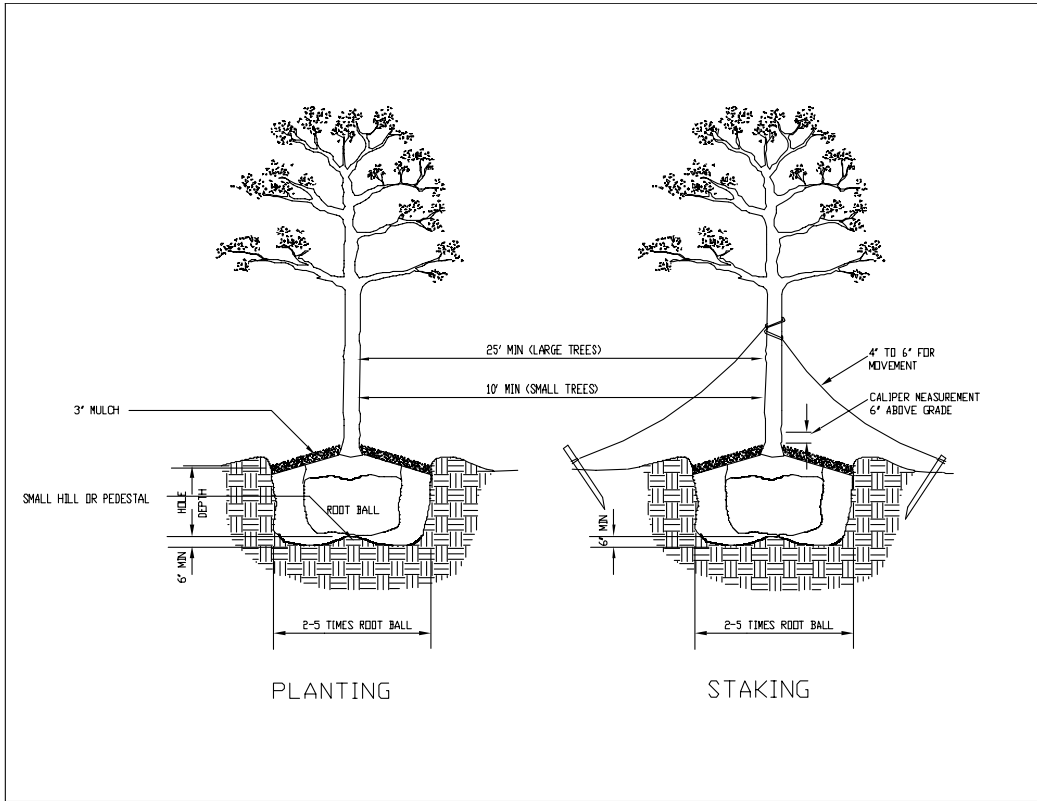
SPACING REQUIREMENTS

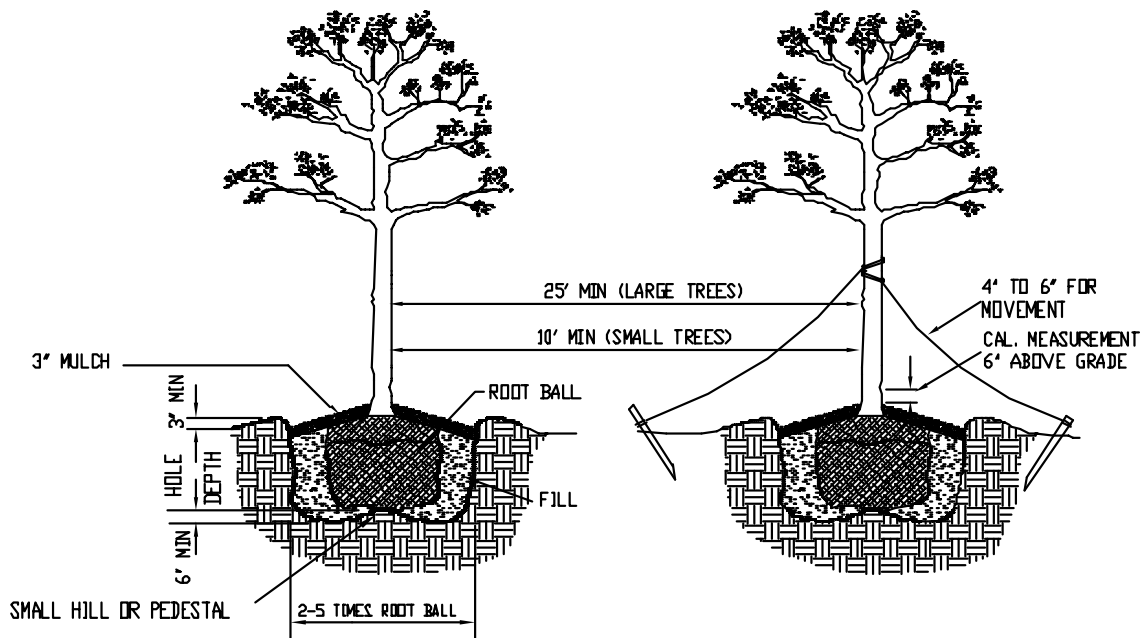
There shall be a minimum of 6 caliper inches per 100 lineal feet of new single lane pavement for road projects and a minimum of 1 caliper inch per 170 square feet of impervious surface for all other development projects. Alternative spacing requirements may be approved on a case-by-case basis.

Long-term survivability is the primary objective in urban forestry plantings therefore all planting of one linear mile or greater shall consist of at least four (4) different species from the recommended tree list.

The following requirements are particularly applicable to street tree plantings in Harris County Rights-of-way (Harris County Flood Control District Properties) to comply with the Storm Water Quality Document for New Development/Redevelopment Projects.

- No tree that will have a mature tree trunk diameter greater than 12 inches at the base should be planted in a tree lawn or right-of-way greenspace less than 3 feet wide.
- Trees should not be planted within 30 feet of an intersection or where they block views for safety.
- Trees should not be planted within 10 feet of utility poles or within 15 feet of driveways and alleys.
- Medium to large trees, those that mature to a height greater than 30 feet, should be planted 25 to 60 feet apart.
- Small trees, those that mature to less than 30 feet in height, should be planted a minimum of 10 feet apart.
- In business districts and general parking areas, trees must be planted a minimum of 30 inches from the curb to prevent damage from or to bumpers and doors.
- Only trees with a mature height of less than 25 feet should be planted under utility lines.





NOTES:

PLANTING

STAKING

1. DO NOT REMOVE TREE FROM CONTAINER UNTIL READY TO PLACE INTO PLANTING HOLE. FINE ROOTS DRY OUT RAPIDLY WHEN EXPOSED TO AIR.
2. PLANTING HOLE SHOULD BE DUG AT LEAST TWO (2) TO FIVE (5) TIMES THE DIAMETER AND THE SAME DEPTH AS THE ROOT BALL.
3. THE SIDES OF THE HOLE SHOULD BE SLIGHTLY SLOPED INWARD AND SHOULD BE ROUGHENED TO INCREASE ROOT PENETRABILITY INTO SURROUNDING SOIL. TREES SHOULD SIT ON A PEDESTAL OR SMALL HUMP OF UNDISTURBED SOIL TO MINIMIZE SETTLING AND FACILITATE DRAINAGE.
4. ALL CONTAINERS, BURLAP, WIRE AND ANY ROPE OR STRING SHOULD BE REMOVED PRIOR TO PLANTING. WITH THE TREE IN PLACE, THE ROOTS CAN BE SPREAD OUT NATURALLY. CHECK FOR CIRCLING ROOTS AND REJECT THOSE TREES WITH THEM.
5. THE PLANTING HOLE SHOULD BE BACKFILLED WITH THE SAME SOIL THAT WAS REMOVED UNLESS IT IS CLAY FROM BASEMENT EXCAVATION OR OTHER UNDESIRABLE FILL MATERIAL. IN THAT CASE BLEND TOGETHER ONE (1) PART WASHED SAND TO FOUR (4) PARTS LOAM, OR BRING IN AS MUCH GOOD TOPSOIL AS POSSIBLE. TAMP GENTLY AND ADD WATER TO FILL LARGE AIR SPACES. DO NOT USE EXCESSIVE TAMPING AROUND TREE BASE; COMPACTED SOIL MAY INHIBIT THE SPREAD OF ROOTS. THE BACK SOIL SHOULD BE LIGHTLY PACKED WHEN THE HOLE IS HALF FULL. WATER CAN BE SLOWLY ADDED AT THIS TIME TO SATURATE AND SETTLE THE SOIL. FINISH FILLING THE HOLE TO THE ORIGINAL GRADE AND WATER AGAIN.
6. MULCH WITH MAXIMUM OF FOUR (4) INCHES OF COARSE ORGANIC MULCH COVERING A CIRCLE THAT EXTENDS A MINIMUM OF THREE (3) FEET FROM THE TRUNK. TREE GRATES ARE NOT GENERALLY RECOMMENDED BUT MAY BE NECESSARY UNDER SPECIAL CONDITIONS.
7. THE TREE SHOULD BE STAKED ONLY IF IT IS NOT CAPABLE OF SUPPORTING ITSELF. STAKES ARE THEN ANCHORED IN NATIVE SOIL AND ARE TO BE REMOVED AFTER ONE (1) YEAR. USE SOFT TIES TO PREVENT BARK DAMAGE, KEEP THE STAKE OUT OF THE TREE LIMBS, AND ALLOW THE STAKED TREE FOUR (4) TO SIX (6) INCHES OF MOVEMENT.
8. ADEQUATE WATER IS ESSENTIAL AT PLANTING TIME. PLACE WATER HOSE AT THE BASE OF TREE AND ALLOW WATER TO TRICKLE UNTIL SOIL IS SATURATED.
9. AFTER WATERING AND ADDING MULCH TO COMPENSATE FOR ANY SETTLING. IF NECESSARY STAKE TREE TO KEEP UPRIGHT. THE ONLY PRUNING NECESSARY AT PLANTING IS TO REMOVE INJURED OR DEAD BRANCHES. STRUCTURAL PRUNING SHOULD BE DELAYED UNTIL THE SECOND YEAR OF GROWTH.

ACCEPTABLE SPECIES URBAN FORESTRY

SCIENTIFIC NAME	COMMON NAME	HEIGHT	SPREAD	GROWTH RATE	COMMENTS
MEDIUM TO LARGE TREES					
<i>Liquidambar styraciflua</i>	Red maple	Large	30	Medium	Fall color
<i>Carya illinoensis</i>	Pecan	Large	50	Slow	Fruit
<i>Fraxinus americana</i>	White ash	Large	40	Fast	Fall color
<i>Juglans nigra</i>	Black walnut	Large	40	Slow	Fall color
<i>Liquidambar styraciflua</i>	Sweetgum	Large	40	Fast	Fall color
<i>Magnolia grandiflora</i>	Southern magnolia	Large	45	Slow	Evergreen
<i>Nyssa sylvatica</i>	Black gum	Large	30	Medium	Fall color
<i>Pinus taeda</i>	Loblolly pine	Large	30	Fast	Evergreen
<i>Platanus mexicana</i>	Mexican sycamore	Large	50	Fast	Unique leaf
<i>Quercus acutissima</i>	Sawtooth oak	Large	40	Fast	Drought tolerant
<i>Quercus falcata</i>	Southern red oak	Large	40	Slow	Fall color
<i>Quercus laurifolia</i>	Laurel oak	Large	40	Slow	Semi-evergreen
<i>Quercus lyrata</i>	Overcup oak	Large	40	Slow	Large acorn
<i>Quercus macrocarpa</i>	Bur oak	Large	50	Slow	Large acorn
<i>Quercus michauxii</i>	Swamp chestnut oak	Large	40	Slow	Fall color
<i>Quercus muehlenbergii</i>	Chinkapin oak	Large	40	Slow	Fall color
<i>Quercus nigra</i>	Water oak	Large	40	Medium	Deciduous
<i>Quercus nutallii</i>	Nuttall oak	Large	40	Medium	Fall color
<i>Quercus phellos</i>	Willow oak	Large	40	Medium	Deciduous
<i>Quercus polymorpha</i>	Monterrey oak	Large	40	Fast	Drought tolerant
<i>Quercus rizophyllia</i>	Loquat leaf oak	Large	40	Fast	Drought tolerant
<i>Quercus shumardii</i>	Shumard oak	Large	40	Slow	Fall color
<i>Quercus stellata</i>	Post oak	Large	40	Slow	Deciduous
<i>Quercus virginiana</i>	Live oak	Large	50	Slow	Semi-evergreen
<i>Taxodium distichum</i>	Bald cypress	Large	30	Fast	Deciduous
<i>Taxodium mucronatum</i>	Montezuma cypress	Large	40	Fast	Semi-evergreen
<i>Ulmus alata</i>	Winged elm	Large	30	Medium	Drought tolerant
<i>Ulmus crassifolia</i>	Cedar elm	Large	30	Medium	Drought tolerant
SMALL TREES					
<i>Bumelia lanuginosa</i> *	Wholly bucket	Small	30	Slow	Unique leaf
<i>Ehretia anacua</i> *	Anacua	Small	20	Slow	Unique leaf
<i>Fraxinus texensis</i> *	Texas ash	Small	25	Fast	Deciduous
<i>Ilex opaca</i> *	American holly	Small	15	Slow	Evergreen
<i>Ilex x attenuata var East palatka</i> *	East palatka holly	Small	15	Slow	Evergreen
<i>Ilex x attenuata var Savannah</i> *	Savannah holly	Small	15	Slow	Evergreen
<i>Magnolia virginiana</i> *	Sweetbay magnolia	Small	20	Slow	Evergreen
<i>Pistacia chinensis</i> *	Chinese pistache	Small	25	Slow	Fall color
<i>Prunus serotina</i> *	Black cherry	Small	20	Medium	Unique leaf
<i>Quercus cambii</i> *	Camby oak	Small	20	Medium	Drought tolerant
<i>Lagerstroemia</i>	Crape Myrtle	Small	20	Medium	Drought tolerant
<i>Vitex agnus-castus</i>	Vitex/Chaste Tree	Small	20	Slow	Drought tolerant

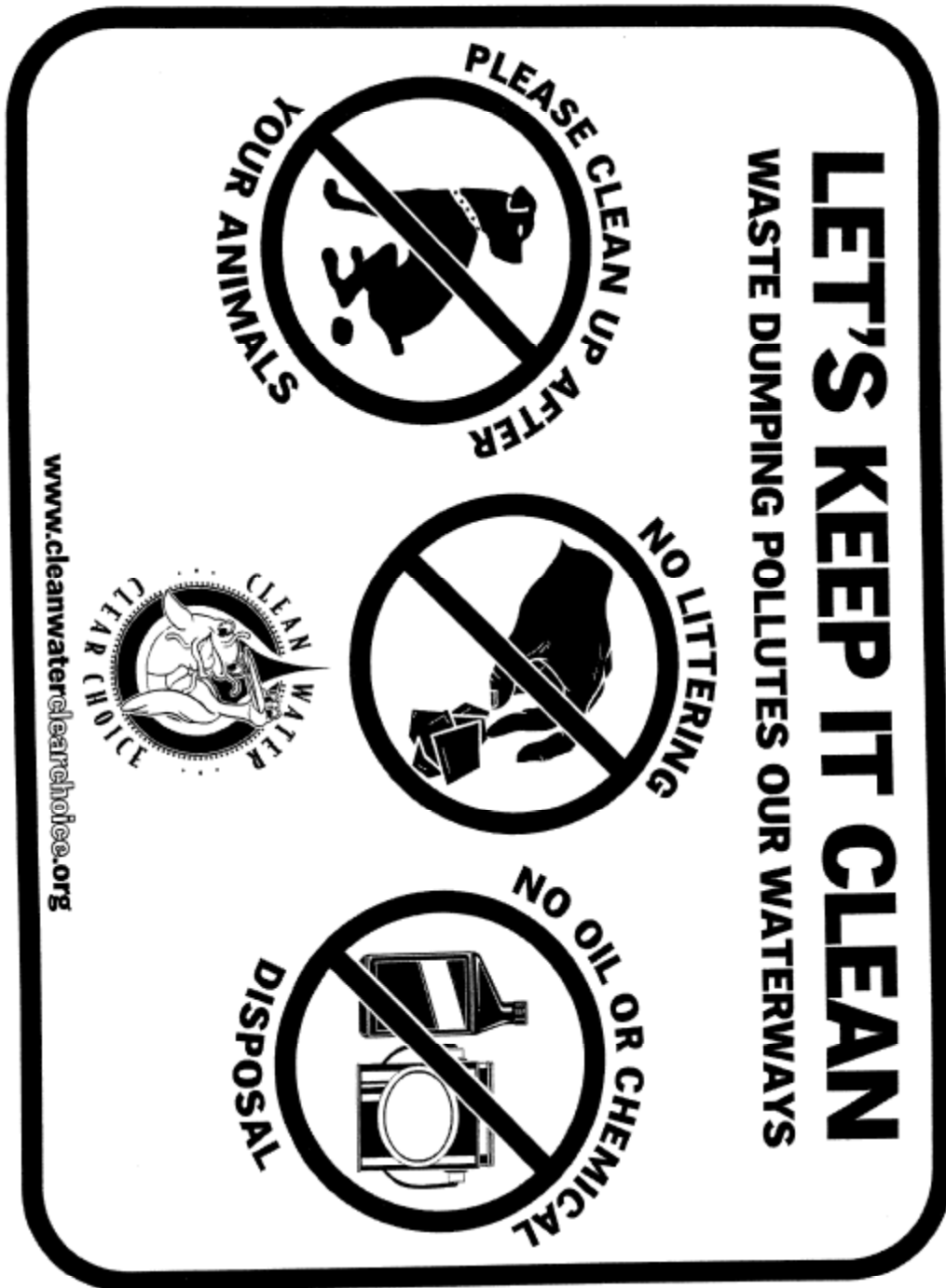


EXHIBIT E: FLOATABLES COLLECTION DEVICE DESIGN
EXAMPLE (IN-LINE STORM SEWER)

Pending

EXHIBIT F: FLOATABLES COLLECTION DEVICE DESIGN
EXAMPLE (DETENTION BASIN)

Pending

EXHIBIT G: 10-YEAR STORM EVENT WIER EXAMPLE

Pending



Commercial Development: No Exposure/Good Housekeeping Commitment

In accordance with the Regulations of Harris County, Texas for Storm Water Quality Management, this commitment is submitted as part of a comprehensive Storm Water Quality Management Plan (SWQMP) for post-construction storm water quality controls at:

(legal description and name of the project)

All current and future owners and any lessees of any portion of the property are bound by this commitment as a component of the project's SWQMP. To the Maximum Extent Practicable, the following practices will be implemented and/or observed at the development site:

- *No machinery, equipment, products, materials, or inventory will be stored or cleaned where residuals, grime, cleaning agents, or other substances generated from the cleaning process or exposure to rainfall could be introduced into the property's storm drain system.*
- *All trash, debris, and wastes will be properly disposed of and, if stored outdoors, will be in closed, non-leaking containers or lidded dumpsters that prevent the contents from being exposed to rainfall.*
- *Any spilled or leaked products, materials, lubricants, or fuels will be cleaned up and disposed of properly and will under no circumstances be hosed into or allowed to enter the property's storm drain system.*
- *In general, the property will be kept clean. Any noticeable accumulations of trash, debris, grit, or other potential water pollutants will be cleaned up and properly disposed of upon discovery.*

The undersigned states a commitment on behalf of the current and future owner(s) of subject property to maintain compliance with the above conditions and should the use of this property change and it becomes infeasible to maintain compliance with this commitment, he/she understands that it is the property owner's responsibility to contact the Harris County Engineer's Office to seek a revision of the SWQMP. The undersigned further understands that should the owner fail to maintain compliance with these obligations, the owner is subject to enforcement action by Harris County and possible suspension of the development's Storm Water Quality Permit. Additional storm water quality requirements may also be required if continual non-compliance is noted. The undersigned acknowledges that it is the owner's responsibility to inform all employees and/or lessees of any portion of the development or property of these obligations and to ensure compliance. This property and development is subject to random inspection by Harris County to check compliance with this commitment, and other requirements contained in the Storm Water Quality Management Plan.

Signed _____ Date _____

Printed Name _____

Title and Company Name (if applicable) _____



Commercial Development: Proper Landscape Practices Commitment

In accordance with the Regulations of Harris County, Texas for Storm Water Quality Management, this commitment is submitted as part of a comprehensive Storm Water Quality Management Plan (SWQMP) for post-construction storm water quality controls at:

(legal description and name of the project)

All current and future owners and any lessees of any portion of the property are bound by this commitment as a component of the project's SWQMP. To the Maximum Extent Practicable, the following practices will be implemented and/or observed at the development site:

- *All landscape activities, specifically the application of fertilizers, soil amendments, herbicides, and pesticides (if necessary), will be in accordance with state and federal regulations. If the property owner or an employee performs the maintenance, the manufacturer's instructions will be followed. If a commercial applicator company is used, the attached form will be completed and signed by the applicator, and kept with the project's SWQMP record book, after each application.*
- *Any spilled or leaked fertilizers/herbicides/pesticides will be cleaned up expeditiously and disposed of properly. Under no circumstances will excess or spilled fertilizers, soil amendments, or pesticides/herbicides be hosed into or allowed to enter the property's storm drain system.*
- *If necessary to keep fertilizers, herbicides, pesticides, and the like on the property, under no circumstances will they be stored where they could be exposed to rainfall.*
- *All lawn clippings, leaves, etc. that result from landscape maintenance activities will be dealt with properly and will not be blown or hosed into the property's storm drain system, or left on paved areas where they can be transported by rainfall into the storm drain system.*

The undersigned states a commitment on behalf of the current and future owner(s) of subject property to maintain compliance with the above conditions and should the use of this property change and it becomes infeasible to maintain compliance with this commitment, he/she understands that it is the property owner's responsibility to contact the Harris County Engineer's Office to seek a revision of the SWQMP. The undersigned further understands that should the owner fail to maintain compliance with these obligations, the owner is subject to enforcement action by Harris County and possible suspension of the development's Storm Water Quality Permit. Additional storm water quality requirements may also be required if continual non-compliance is noted. The undersigned acknowledges that it is the owner's responsibility to inform all employees and/or lessees of any portion of the development or property of these obligations and to ensure compliance. This property and development is subject to random inspection by Harris County to check compliance with this commitment, and other requirements contained in the Storm Water Quality Management Plan.

Signed _____ Date _____

Printed Name _____

Title and Company Name (if applicable) _____
