AMENDMENT TO AGREEMENT FOR MAINTENANCE OF STORM WATER DETENTION SYSTEM

On the 28th day of July, 2000, Michael W. Fox Real Estate, L.L.C., a Michigan limited liability company of 755 South Rochester Road, Rochester Hills, Michigan 48307 (MWFRE) entered into with the City of Rochester Hills, MI, whose address is 1000 Rochester Hills Drive, Rochester Hills, Michigan 48309 (CITY) an Agreement for Maintenance of Storm Water Detention System as recorded by the Oakland County Register of Deeds on March 1, 2001 at Liber 22403, Page 750 (the Agreement), specifically pertaining to certain property located in the City of Rochester Hills, Oakland County, Michigan, more particularly described as **Exhibit A** attached hereto.

Subsequent to the Agreement, JF Real Estate, L.L.C., a Michigan limited liability company (successor in title to MWFRE) of 755 South Rochester Road, Rochester Hills, Michigan 48307 has decided to undertake renovations to demolish its existing Toyota dealership building and commence construction of an expansion to its existing Volkswagen dealership building, such that it is now necessary to amend the Agreement to provide for the location of an amended storm water detention system to accommodate said renovations.

Based on these facts and circumstances, the parties agree to and by this document do hereby amend the existing Agreement so that the previous Exhibit B attached to and included as part of the original Agreement is hereby superseded and replaced with the revised **Exhibit B** attached hereto and the original Exhibit B shall be of no further force or effect. In addition, an **Exhibit C**, consisting of the Maintenance Plan is attached hereto and made part of the Agreement.

[*See attached and incorporated Exhibit A, B & C*]

Tax Identification Number: 15-14-351-060

[*SIGNATURES ON FOLLOWING 2 PAGES*]

IN WITNESS HEREOF, the undersigned have hereunto affixed their signatures on this 15 day of August, 2017.

JF REAL ESTATE, L.L.C.
a Michigan limited liability company

By: John Fox
(Print Name:

Its: President

STATE OF MICHIGAN
COUNTY OF OAKLAND

The foregoing instrument was acknowledged before me on this 15TH day of AUGUST, 2017, by JOHN FOX, the PRESIDENT of JF Real Estate, L.L.C., a Michigan limited liability company, on behalf of the company.

Robert W Cloutier
Notary Public, ROBERT W. CLOUTIER
Acting in OAKLAND County, MI
My commission expires: MAY 1, 2020

ROBERT W CLOUTIER
Notary Public - Michigan
Macomb County
My Commission Expires May 1, 2020
Acting in the County of OAKLAND

CITY OF ROCHESTER HILLS
a Michigan municipal corporation

By: ______________________________
(Print Name: Bryan K. Barnett

Its: Mayor

STATE OF MICHIGAN
COUNTY OF OAKLAND

The foregoing instrument was acknowledged before me on this ____________ day of______________________________, 2017, by Bryan K Barnett, the Mayor, of the City of Rochester Hills, a Michigan municipal corporation, on behalf of the corporation.

____
Notary Public,
Acting in County, MI
My commission expires:

DRAFTED BY: B. Buchholz
Nowak & Fraus Engineers, Job #I678
46777 Woodward Avenue
Pontiac, Michigan 48342

WHEN RECORDED RETURN TO:
Clerk's Department
City of Rochester Hills
1000 Rochester Hills Drive
Rochester Hills, MI 48309

John Staran
Approved 8/18/17

Exhibit A
PROPERTY LEGAL DESCRIPTIONS

LEGAL DESCRIPTION:
PARCEL I.D. 15-14-351-060

(PER AVAILABLE RECORDS):

TOWN 3 NORTH, RANGE 11 EAST, IN THE SOUTHWEST 1/4 OF SECTION 14, CITY OF ROCHESTER HILLS, OAKLAND COUNTY, MICHIGAN, DESCRIBED AS: COMMENCING FROM THE SOUTHWEST CORNER OF SECTION 14; THENCE NORTH 00 DEGREES 14 MINUTES 16 SECONDS EAST 1043.48 FEET ALONG THE WEST LINE OF SAID SECTION 14; THENCE SOUTH 89 DEGREES 43 MINUTES 10 SECONDS EAST 82.50 FEET TO THE POINT OF BEGINNING; THENCE SOUTH 89 DEGREES 42 MINUTES 52 SECONDS EAST 517.50 FEET; THENCE NORTH 00 DEGREES 14 MINUTES 16 SECONDS EAST 378.27 FEET; THENCE NORTH 89 DEGREES 42 MINUTES 52 SECONDS WEST 600.00 FEET; THENCE SOUTH 00 DEGREES 14 MINUTES 16 SECONDS WEST 293.20 FEET; THENCE SOUTH 89 DEGREES 42 MINUTES 52 SECONDS EAST 40.00 FEET; THENCE SOUTH 00 DEGREES 14 MINUTES 16 SECONDS WEST 50.00 FEET; THENCE SOUTH 89 DEGREES 42 MINUTES 52 SECONDS EAST 42.50 FEET; THENCE SOUTH 00 DEGREES 14 MINUTES 16 SECONDS WEST 35.07 FEET TO THE POINT OF BEGINNING, EXCLUDING THAT PART LYING WESTERLY OF A LINE 60 FEET EASTERLY OF THE WEST LINE OF SAID SECTION 14 (MEASURED AT RIGHT ANGLES) TAKEN FOR ROCHESTER ROAD.

Mike Taunt
Approved 8/17/17

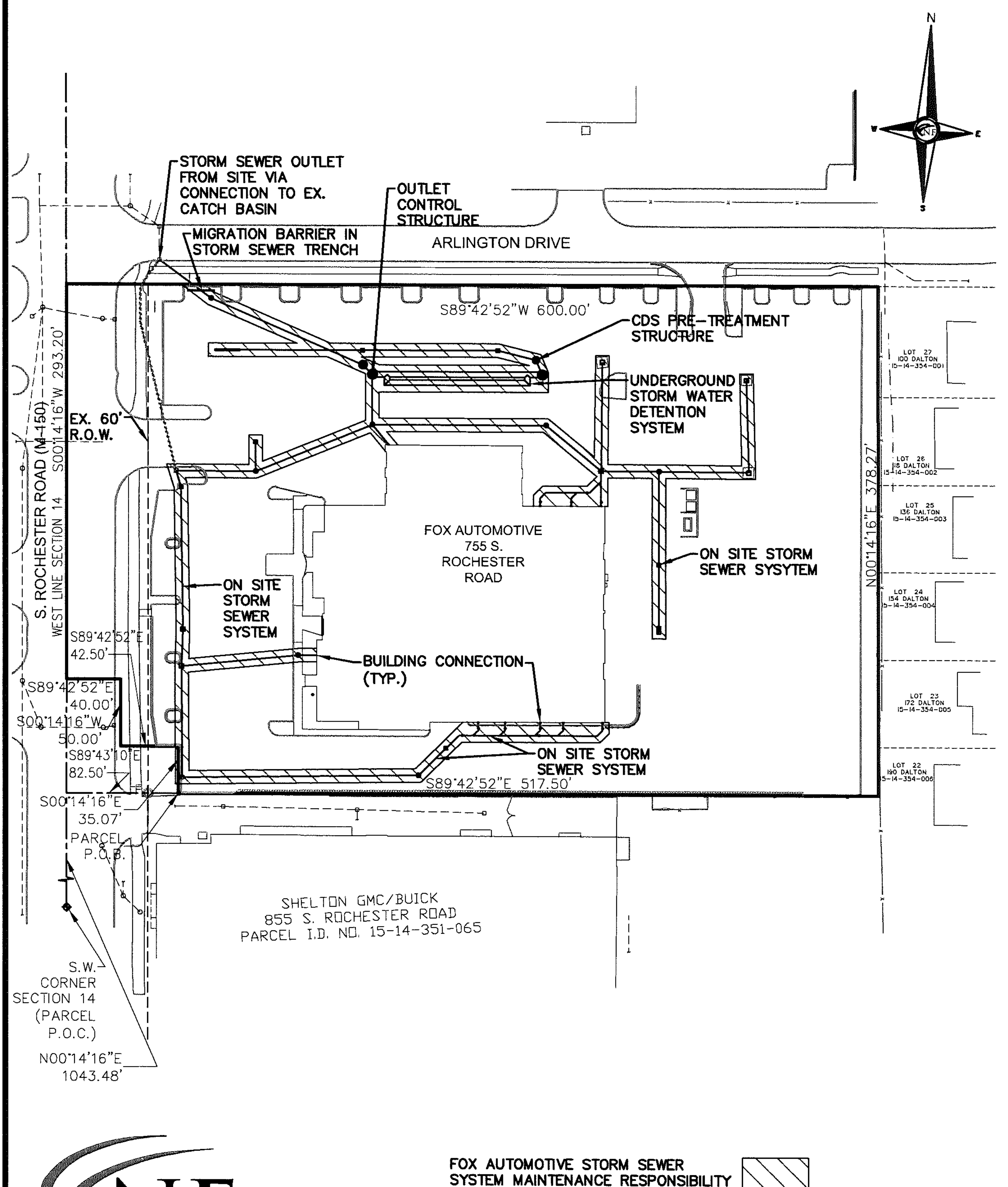
NF ENGINEERS
NOWAK & FRAUS ENGINEERS
46777 WOODWARD AVE.
PONTIAC, MI 48342-5032
TEL. (248) 332-7931
FAX. (248) 332-8257

PREPARED FOR:
FOX AUTOMOTIVE.

SCALE	DATE	DRAWN	JOB NO.	SHEET
N.T.S.	08-03-2017	CD	I678	1 of 1

Exhibit B

STORM WATER SYSTEM SKETCH



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PREPARED FOR: FOX AUTOMOTIVE.

SCALE	DATE	DRAWN	JOB NO.	SHEET
1" = 100'	08-03-2017	CD	I678	1 of 1

EXHIBIT 'C'

OPERATIONS AND MAINTENANCE MANUAL

FOX AUTOMOTIVE

STORMWATER MAINTENANCE PLAN

ROCHESTER HILLS, MICHIGAN

PROPERTY OWNER:

JF REAL ESTATE, LLC
755 S. ROCHESTER ROAD
ROCHESTER HILLS, MI 48307

Phone: (248) 651-8089

Contact: Mr. John Fox

Adele Swann
Appd. 8/17/17

Prepared by:
Nowak and Fraus Engineers, PLLC
46777 Woodward Ave.
Pontiac, Michigan 48342
Phone: (248) 332-7931
Contact: Paul Tulikangas, P.E.

August 3, 2017

OPERATION AND MAINTENANCE MANUAL

INTRODUCTION:

This manual identifies the ownership, operation and maintenance responsibilities for all storm water management systems including the underground detention system, underground storm sewer system, outlet control structures, and mechanical pre-treatment device as incorporated into and detailed on the approved Construction Plans as Prepared by Nowak and Fraus Engineers, PLLC. In order to comply with the local best management practices (BMP) requirements, this manual should serve as a minimum performance standard. This manual should be retained intact and read in its entirety by all parties responsible for the operations and maintenance of the on-site BMP's.

OWNER:

John Fox
JF Real Estate, LLC
755 S. Rochester Road
Rochester Hills, Michigan, 48307
Phone: (248) 651-8089

PROPERTY INFORMATION:

This Operations and Maintenance Manual covers the storm water systems located at the following subject property:

(PER AVAILABLE RECORDS):

TOWN 3 NORTH, RANGE 11 EAST, IN THE SOUTHWEST 1/4 OF SECTION 14, CITY OF ROCHESTER HILLS, OAKLAND COUNTY, MICHIGAN, DESCRIBED AS: COMMENCING FROM THE SOUTHWEST CORNER OF SECTION 14; THENCE NORTH 00 DEGREES 14 MINUTES 16 SECONDS EAST 1043.48 FEET ALONG THE WEST LINE OF SAID SECTION 14; THENCE SOUTH 89 DEGREES 43 MINUTES 10 SECONDS EAST 82.50 FEET TO THE POINT OF BEGINNING; THENCE SOUTH 89 DEGREES 42 MINUTES 52 SECONDS EAST 517.50 FEET; THENCE NORTH 00 DEGREES 14 MINUTES 16 SECONDS EAST 378.27 FEET; THENCE NORTH 89 DEGREES 42 MINUTES 52 SECONDS WEST 600.00 FEET; THENCE SOUTH 00 DEGREES 14 MINUTES 16 SECONDS WEST 293.20 FEET; THENCE SOUTH 89 DEGREES 42 MINUTES 52 SECONDS EAST 40.00 FEET; THENCE SOUTH 00 DEGREES 14 MINUTES 16 SECONDS WEST 50.00 FEET; THENCE SOUTH 89 DEGREES 42 MINUTES 52 SECONDS EAST 42.50 FEET; THENCE SOUTH 00 DEGREES 14 MINUTES 16 SECONDS WEST 35.07 FEET TO THE POINT OF BEGINNING, EXCLUDING THAT PART LYING WESTERLY OF A LINE 60 FEET EASTERLY OF THE WEST LINE OF SAID SECTION 14 (MEASURED AT RIGHT ANGLES) TAKEN FOR ROCHESTER ROAD.

PARCEL ID NO.: 15-14-351-060

STORMWATER MAINTENANCE EXHIBIT:

Exhibit 'B' of the Storm Water Maintenance Agreement is the Storm Water System which provides a clear presentation of all components of the storm water system. This system is subject to the long-term operation and maintenance responsibilities detailed in this manual. The system includes:

- Storm Sewer Pipes
- Storm Sewer Collection System & Structures (swales, manholes, inlets, catch basins, etc.)
- Underground Detention System Piping
- Outlet Control Structures
- Pre-Treatment Device (Contech CDS Model 2015-4-C)

INSPECTIONS:

The frequency of system inspections outlined in the manual and attached exhibits should be considered the minimum, if no events warrant additional inspections. The frequency of inspections should be fine-tuned over time as system specific conditions are better known and the rate at which certain maintenance operations need to be performed is better understood. Maintenance Inspection Checklists are provided for each of the BMP's in this system. Inspections should be performed by personnel responsible for maintenance and may need to be certified for confined space entry, depending on the component being inspected. Operation of the definition system, outlet control structures and pre-treatment devices may need to be inspected by a practicing civil engineer familiar with their operation.

Records of all routine inspections and any work performed on the system for maintenance, repair, or replacement should be maintained by the owner and kept for a minimum of ten (10) years. A copy of all records should be provided to the City of Rochester Hills Engineering Division. The records should include this manual, all inspection sheets, approved construction plans and as-built documents, a maintenance log of work performed to the system(s) and contact information for the system inspector, civil engineer, landscape architect, geotechnical engineer and contractor involved with the system.

STORM WATER SYSTEMS MAINTENANCE:

Regular inspection and maintenance of BMP's are necessary if these facilities are to consistently perform up to expectations. Stormwater systems are expected to perform quality and quantity control functions as long as the land use they serve exists. Failure to maintain these systems can create the following adverse impacts:

- Increased pollutants to surrounding surface water features
- Potential property damage resulting from excessive flooding.
- Potential loss of life or property resulting from catastrophic failure of the facility
- Aesthetic or nuisance conditions, such as mosquitos or reduced property values due to a degraded facility appearance.

Most of the impacts can be avoided through proper and timely inspection and maintenance. A major concern associated with these impacts is the general public's expectations related to the quality of life provided, in part, by construction of these systems. Inadequate maintenance means the general public may have a false sense of security. The most common cause of stormwater system failure is the lack of adequate and proper operation, inspection, maintenance, and management.

Good design and construction can reduce subsequent maintenance needs and costs, but they cannot eliminate the need for maintenance altogether. Maintenance requires a long term commitment of time, money, personnel, and equipment. Monitoring the overall performance of the stormwater management system is a major aspect of any maintenance program.

The maintenance responsibilities for these systems lie with the current property owner and transfer with the property in perpetuity. If maintenance of the system is not performed, the City of Rochester Hills reserves the right to enter property and perform all necessary work at the property owners' cost. Refer to the *Agreement for Storm Water Systems Maintenance* for additional details.

General Maintenance Items:

Parking Lot Sweeping:

Routine sweeping of all paved surfaces provides a more attractive appearance and removes accumulations of sediment and trash that tend to migrate into stormwater management systems during rainfall events. Parking lot sweeping should be performed quarterly or as necessary to limit sediment and trash build-up.

Grass Mowing and Maintenance:

Mowing requirements at a facility should be designed to the specific site conditions, grass types and seasonal variations in climate. Grassed areas require periodic fertilizing, de-thatching and soil conditioning in order to maintain healthy growth. Provisions will need to be made to reseed and reestablish grass cover in areas damaged by sediment accumulation, stormwater flow, erosion or other causes. Dead turf will need to be replaced after being discovered. Inspection of the grass areas and other landscaping features should be made annually.

Trash and Debris Removal:

Removal of trash and debris from all areas of the property should be performed monthly. Removal of these items will prevent damage to vegetated areas and eliminate their potential to inhibit the operation of any of the stormwater management systems. Sediment, debris, and trash that are removed and collected should be disposed of according to local, State and Federal regulations at suitable disposal and/or recycling centers.

Stormwater System Maintenance Items:

The following narratives give an overview of the maintenance requirements of the different components of the stormwater system. The inspection checklists attached to this report offer a more complete listing of what should be inspected, when inspection should occur and the likely frequency of maintenance activities.

Storm Sewer, Structures, and Sedimentation Control Structures:

Catch basins, inlets, manholes, outlet control structures, and storm sewer pipes should be inspected to check for sediment accumulation and clogging, floatable debris, dead vegetation, etc. The structures and sewers should also be observed during a wet weather event to ensure their proper operation. Accumulated sediment and debris should be removed on an annual basis or as needed by observed conditions. Structural repairs or maintenance should occur as needed based on observed conditions such as cracks, spalling, joint failure, leakage, misalignment, or settlement of structures. A civil engineer should be retained if problems are thought to exist.

Stormwater Pre-Treatment Devices:

Refer to the attached maintenance manuals from the manufacturer for all inspection and maintenance requirements for the pre-treatment structures.

The following pages include inspection checklists for the various devices and components listed above as well as the manufacturer's manuals for the stormwater pre-treatment structures.

Exhibit C

STORM WATER SYSTEM MAINTENANCE PLAN & SCHEDULE

STORM WATER MANAGEMENT SYSTEM LONG-TERM MAINTENANCE SCHEDULE

MAINTENANCE ACTIVITIES	SYSTEM COMPONENTS	Storm Collection System (Sewers, Swales, Catch Basins, Manholes)	Manufactured Treatment System	Underground Detention System	Outlet Control Structures & Outlet Pipe	Pavement Areas	FREQUENCY
Monitoring/Inspection							
Inspect for Sediment Accumulation/Clogging*		X	X	X	X		Annually
Inspect For Floatables, Dead Vegetation & Debris		X	X	X	X		Annually & After Major Events
Inspect For Erosion And Integrity of System		X	X	X	X		Annually & After Major Events
Inspect All Components During Wet weather & Compare to As-Built Plans		X	X	X	X		Annually
Ensure Maintenance Access Remain Open/Clear		X	X	X	X		Annually
Preventative Maintenance							
Remove Accumulated sediments*		X	X	X	X		As Needed (See Note Below)
Remove Floatables, Dead Vegetation & Debris		X	X	X	X		As Needed
Sweeping of Paved Surfaces						X	As Needed
Remedial Actions							
Repair/Stabilize Areas of Erosion		X					As Needed
Replace Dead Plantings & Reseed Bare Areas							As needed
Structural Repairs		X	X	X	X	X	As Needed
Make Adjustments/Repairs to Ensure Proper Functioning		X	X	X	X	X	As Needed

NOTE: *Manufactured treatment system and underground detention system to be cleaned according to the manufacturer's recommendations; at a minimum, whenever sediments accumulate to a depth of 6-12 inches, or if sediment resuspension is observed.

PROJECT:	PROPERTY OWNER:	ENGINEER:
Fox Automotive **755 S. Rochester Road** **Rochester Hills, MI 48307** **Oakland County, Michigan**	**JF Real Estate, LLC** **755 S. Rochester Road** **Rochester Hills, MI 48307** **Contact: John Fox** **Phone: (248) 651-8089**	**Nowak & Fraus Engineers** **46777 Woodward Ave.** **Pontiac, MI 48342-5032** **Phone: (248) 332-7931** **Fax: (248) 332-8257**

STATE OF MICHIGAN
PAUL TULIKANGAS
ENGINEER NO. 057929
LICENSED PROFESSIONAL ENGINEER

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PREPARED FOR:	SCALE	DATE	DRAWN	JOB NO.	SHEET
FOX AUTOMOTIVE.	N.T.S.	08-03-2017	CD	I678	6 of 6

CONTECH®
ENGINEERED SOLUTIONS

CDS Guide
Operation, Design, Performance and Maintenance

CDS®

Using patented continuous deflective separation technology, the CDS system screens, separates and traps debris, sediment, and oil and grease from stormwater runoff. The indirect screening capability of the system allows for 100% removal of floatables and neutrally buoyant material without blinding. Flow and screening controls physically separate captured solids, and minimize the re-suspension and release of previously trapped pollutants. Inline units can treat up to 6 cfs, and internally bypass flows in excess of 50 cfs (1416 L/s). Available precast or cast-in-place, offline units can treat flows from 1 to 300 cfs (28.3 to 8495 L/s). The pollutant removal capacity of the CDS system has been proven in lab and field testing.

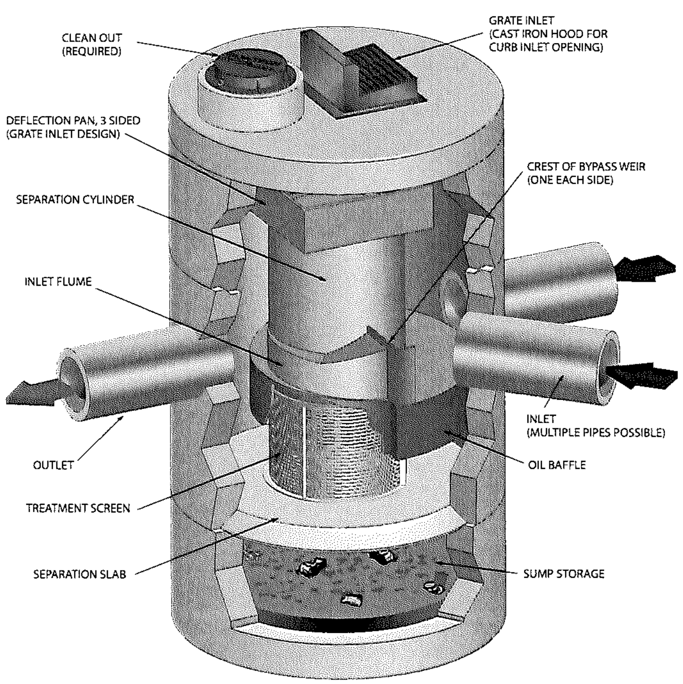
Operation Overview

Stormwater enters the diversion chamber where the diversion weir guides the flow into the unit's separation chamber and pollutants are removed from the flow. All flows up to the system's treatment design capacity enter the separation chamber and are treated.

Swirl concentration and screen deflection force floatables and solids to the center of the separation chamber where 100% of floatables and neutrally buoyant debris larger than the screen apertures are trapped.

Stormwater then moves through the separation screen, under the oil baffle and exits the system. The separation screen remains clog free due to continuous deflection.

During the flow events exceeding the treatment design capacity, the diversion weir bypasses excessive flows around the separation chamber, so captured pollutants are retained in the separation cylinder.



Design Basics

There are three primary methods of sizing a CDS system. The Water Quality Flow Rate Method determines which model size provides the desired removal efficiency at a given flow rate for a defined particle size. The Rational Rainfall Method™ or the and Probabilistic Method is used when a specific removal efficiency of the net annual sediment load is required.

Typically in the Unites States, CDS systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for a gradation with an average particle size (d50) of 125 microns (μm). For some regulatory environments, CDS systems can also be designed to achieve an 80% annual solids load reduction based on an average particle size (d50) of 75 microns (μm) or 50 microns (μm).

Water Quality Flow Rate Method

In some cases, regulations require that a specific treatment rate, often referred to as the water quality design flow (WQQ), be treated. This WQQ represents the peak flow rate from either an event with a specific recurrence interval, e.g. the six-month storm, or a water quality depth, e.g. 1/2-inch (13 mm) of rainfall.

The CDS is designed to treat all flows up to the WQQ. At influent rates higher than the WQQ, the diversion weir will direct most flow exceeding the WQQ around the separation chamber. This allows removal efficiency to remain relatively constant in the separation chamber and eliminates the risk of washout during bypass flows regardless of influent flow rates.

Treatment flow rates are defined as the rate at which the CDS will remove a specific gradation of sediment at a specific removal efficiency. Therefore the treatment flow rate is variable, based on the gradation and removal efficiency specified by the design engineer.

Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydraulically unique. It is important to take these factors into consideration when estimating the long-term performance of any stormwater treatment system. The Rational Rainfall Method combines site-specific information with laboratory generated performance data, and local historical precipitation records to estimate removal efficiencies as accurately as possible.

Short duration rain gauge records from across the United States and Canada were analyzed to determine the percent of the total annual rainfall that fell at a range of intensities. US stations' depths were totaled every 15 minutes, or hourly, and recorded in 0.01-inch increments. Depths were recorded hourly with 1-mm resolution at Canadian stations. One trend was consistent at all sites; the vast majority of precipitation fell at low intensities and high intensity storms contributed relatively little to the total annual depth.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Rainfall Method. Since most sites are relatively small and highly impervious, the Rational Rainfall Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS system are determined. Performance efficiency curve determined from full scale laboratory tests on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Probabilistic Rational Method

The Probabilistic Rational Method is a sizing program Contech developed to estimate a net annual sediment load reduction for a particular CDS model based on site size, site runoff coefficient, regional rainfall intensity distribution, and anticipated pollutant characteristics.

The Probabilistic Method is an extension of the Rational Method used to estimate peak discharge rates generated by storm events of varying statistical return frequencies (e.g. 2-year storm event). Under the Rational Method, an adjustment factor is used to adjust the runoff coefficient estimated for the 10-year event, correlating a known hydrologic parameter with the target storm event. The rainfall intensities vary depending on the return frequency of the storm event under consideration. In general, these two frequency dependent parameters (rainfall intensity and runoff coefficient) increase as the return frequency increases while the drainage area remains constant.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Method. Since most sites are relatively small and highly impervious, the Rational Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS are determined. Performance efficiency curve on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Treatment Flow Rate

The inlet throat area is sized to ensure that the WQQ passes through the separation chamber at a water surface elevation equal to the crest of the diversion weir. The diversion weir bypasses excessive flows around the separation chamber, thus preventing re-suspension or re-entrainment of previously captured particles.

Hydraulic Capacity

The hydraulic capacity of a CDS system is determined by the length and height of the diversion weir and by the maximum allowable head in the system. Typical configurations allow hydraulic capacities of up to ten times the treatment flow rate. The crest of the diversion weir may be lowered and the inlet throat may be widened to increase the capacity of the system at a given water surface elevation. The unit is designed to meet project specific hydraulic requirements.

Performance

Full-Scale Laboratory Test Results

A full-scale CDS system (Model CDS2020-5B) was tested at the facility of University of Florida, Gainesville, FL. This CDS unit was evaluated under controlled laboratory conditions of influent flow rate and addition of sediment.

Two different gradations of silica sand material (UF Sediment & OK-110) were used in the CDS performance evaluation. The particle size distributions (PSDs) of the test materials were analyzed using standard method "Gradation ASTM D-422 "Standard Test Method for Particle-Size Analysis of Soils" by a certified laboratory.

UF Sediment is a mixture of three different products produced by the U.S. Silica Company: "Sil-Co-Sil 106", "#1 DRY" and "20/40 Oil Frac". Particle size distribution analysis shows that the UF Sediment has a very fine gradation (d50 = 20 to 30 μm) covering a wide size range (Coefficient of Uniformity, C averaged at 10.6). In comparison with the hypothetical TSS gradation specified in the NJDEP (New Jersey Department of Environmental Protection) and NJCAT (New Jersey Corporation for Advanced Technology) protocol for lab testing, the UF Sediment covers a similar range of particle size but with a finer d50 (d50 for NJDEP is approximately 50 μm) (NJDEP, 2003).

The OK-110 silica sand is a commercial product of U.S. Silica Sand. The particle size distribution analysis of this material, also included in Figure 1, shows that 99.9% of the OK-110 sand is finer than 250 microns, with a mean particle size (d50) of 106 microns. The PSDs for the test material are shown in Figure 1.

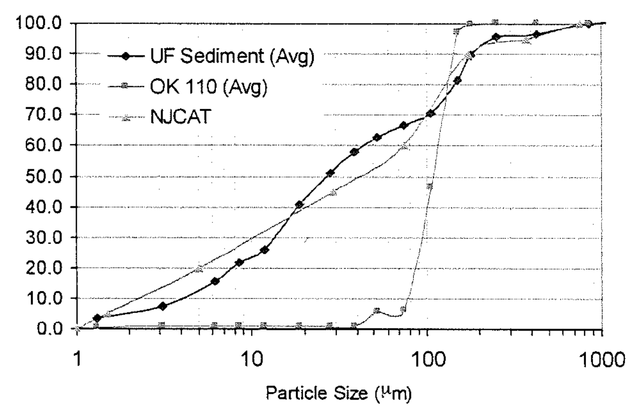


Figure 1. Particle size distributions

Tests were conducted to quantify the performance of a specific CDS unit (1.1 cfs (31.3-L/s) design capacity) at various flow rates, ranging from 1% up to 125% of the treatment design capacity of the unit, using the 2400 micron screen. All tests were conducted with controlled influent concentrations of approximately 200 mg/L. Effluent samples were taken at equal time intervals across the entire duration of each test run. These samples were then processed with a Dekaport Cone sample splitter to obtain representative sub-samples for Suspended Sediment Concentration (SSC) testing using ASTM D3977-97 "Standard Test Methods for Determining Sediment Concentration in Water Samples", and particle size distribution analysis.

Results and Modeling

Based on the data from the University of Florida, a performance model was developed for the CDS system. A regression analysis was used to develop a fitting curve representative of the scattered data points at various design flow rates. This model, which demonstrated good agreement with the laboratory data, can then be used to predict CDS system performance with respect to SSC removal for any particle size gradation, assuming the particles are inorganic sandy-silt. Figure 2 shows CDS predictive performance for two typical particle size gradations (NJCAT gradation and OK-110 sand) as a function of operating rate.

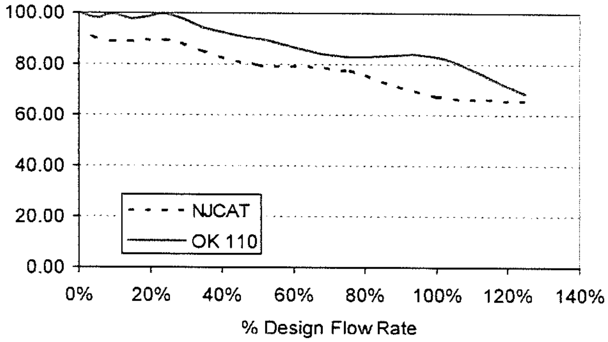


Figure 2. CDS stormwater treatment predictive performance for various particle gradations as a function of operating rate.

Many regulatory jurisdictions set a performance standard for hydrodynamic devices by stating that the devices shall be capable of achieving an 80% removal efficiency for particles having a mean particle size (d50) of 125 microns (e.g. Washington State Department of Ecology — WASDOE - 2008). The model can be used to calculate the expected performance of such a PSD (shown in Figure 3). The model indicates (Figure 4) that the CDS system with 2400 micron screen achieves approximately 80% removal at the design (100%) flow rate, for this particle size distribution (d50 = 125 μm).

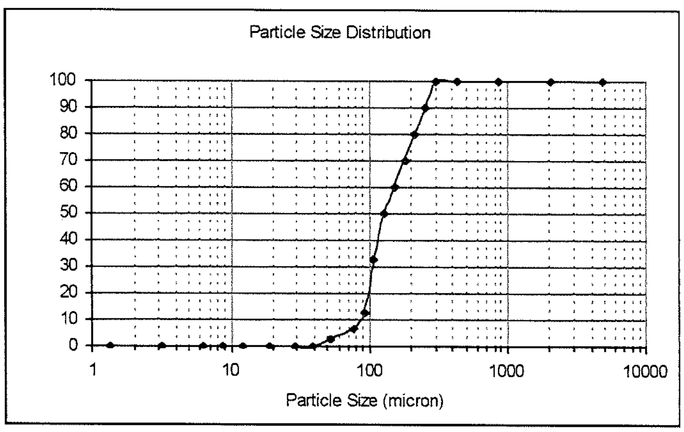


Figure 3. WASDOE PSD

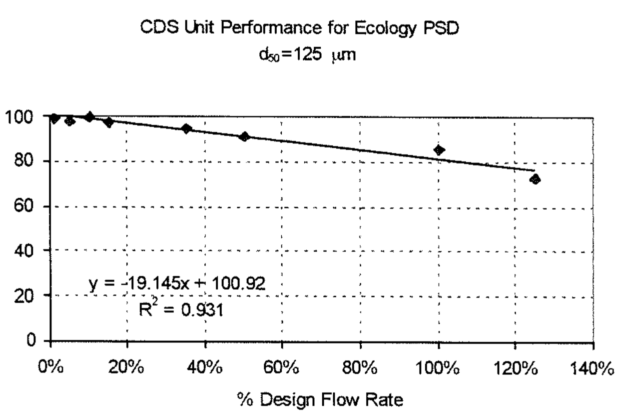


Figure 4. Modeled performance for WASDOE PSD.

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified

during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

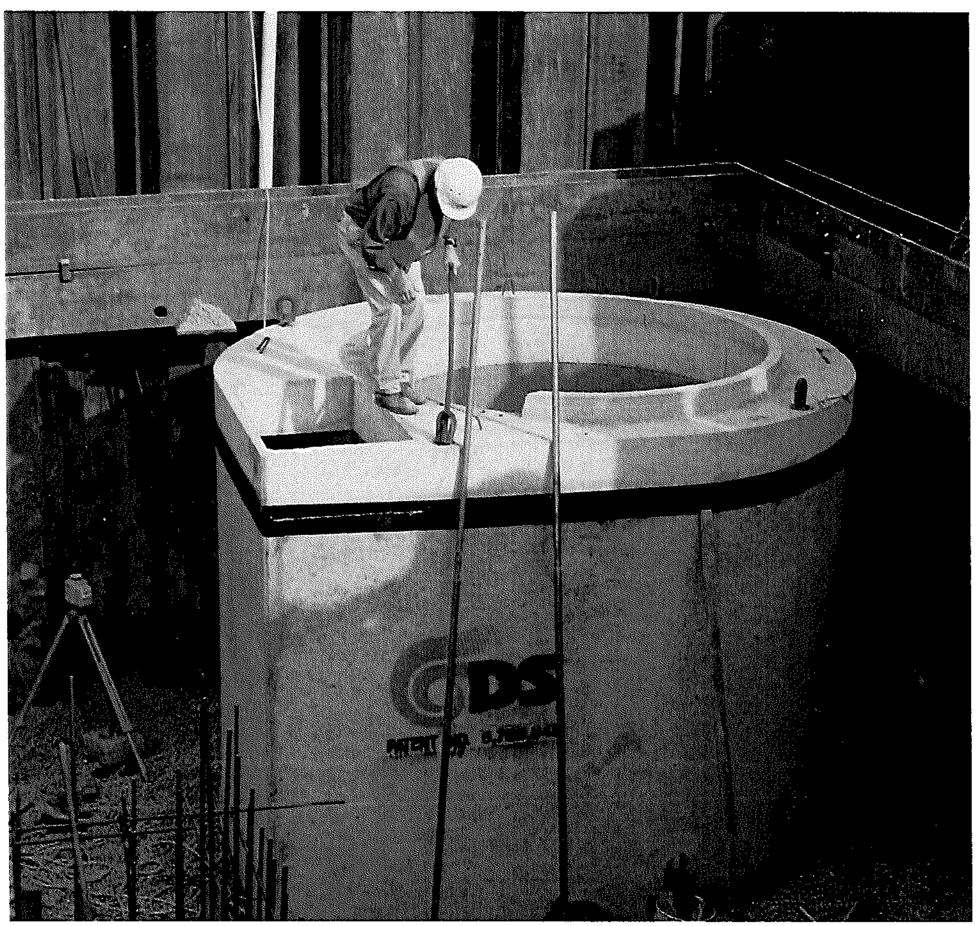
In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be cleaned to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	yd3	m3
CDS2015-4	4	1.2	3.0	0.9	0.5	0.4
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Note: To avoid underestimating the volume of sediment in the chamber, carefully lower the measuring device to the top of the sediment pile. Finer silty particles at the top of the pile may be more difficult to feel with a measuring stick. These finer particles typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile.



CDS Inspection & Maintenance Log

CDS Model: ______________________ Location: ______________________

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

SUPPORT

- Drawings and specifications are available at www.ContechES.com.
- Site-specific design support is available from our engineers.

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