AGREEMENT FOR MAINTENANCE OF STORM WATER DETENTION SYSTEM

This agreement, made and entered into this 22 day of April, 2019, by and between the City of Rochester Hills, a Municipal Corporation, 1000 Rochester Hills Drive, Rochester Hills, Michigan 48309, hereinafter referred to as "City", and Rochester Community Schools, a Public School District, whose address is 501 W. University Drive, Rochester, Michigan, 48307, hereinafter referred to as "Proprietor".

WHEREAS, Proprietor owns and developed the Property described in attached Exhibit A; and

WHEREAS, the existing development of the Property altered the natural flow of surface and storm water drainage; and

WHEREAS, Proprietor installed a storm water drainage and detention system, hereinafter referred to as the "System", comprised of storm water detention and devices, storm sewer pipes, catch basins, manholes for the Property when the Property was developed; and

WHEREAS, Proprietor has proposed, and the City has approved, the removal and replacement of the System as described and depicted in attached Exhibit B; and

WHEREAS, the parties will benefit from the removal and replacement of the System and enter into this agreement to provide for the same.

NOW, THEREFORE, in consideration of the foregoing and of these presents, CITY and PROPRIETOR agree as follows:

1. Use of the System:
   Components of the replacement System, including any and all water conveyance, detention and devises, underground detention system, manufactured treatment system, storm sewer pipes, catch basins, inlets and manholes, flow restrictors, overflow structures and outlet pipes, shall be used solely for the purpose of conveying and detaining storm and surface drainage on the Property until such time as: (i) The City determines and notifies Proprietor or Proprietor's successor's, grantees or assigns, in writing, that it is no longer necessary to convey or detain the storm and surface drainage; and (ii) An adequate alternative for conveying, detaining and treating storm and surface drainage has been provided which is acceptable to the City and which includes the granting of any easements to the City or third parties as may be required or necessary for the alternative drainage system.

2. Maintenance:
   A. Proprietor shall be responsible for the proper maintenance, repair and replacement of the System and all parts thereof as detailed in the Maintenance Plan attached as Exhibit C.
   B. Proper maintenance of the System shall include, but it is not limited to: (i) Removing accumulated sediment, trash and debris from the detention basin and inlet pipes; (ii) Managing deleterious vegetative growth; (iii) Maintaining storm sewer, structures, end-sections and safety features; (iv) Controlling the effects of erosion; (v) Inspection of the underground detention pipes; (vi) Any other maintenance that is reasonable and necessary to facilitate and continue the proper operation and use of the System.

3. Action by City:
   If, at any time, Proprietor or Proprietor's successors, grantees or assigns, neglect or fail to properly maintain the System or any part thereof, the City may notify the Proprietor or Proprietor's successors, grantees or assigns. The notice shall be writing and shall list and describe the maintenance deficiencies and demand that they be corrected within thirty (30) days.

The notice shall further specify the date and place for hearing to be held at least fourteen (14) days after the date of the notice before the City Council, or such other board or officials as the City Council may designate. AT the hearing, the City Council (or other designated board or official) may affirm or modify the list and description of maintenance deficiencies and, for good cause shown, may extend the time for the deficiencies to be corrected.

Thereafter, if the maintenance deficiencies are not corrected within the time allowed, the City may undertake the necessary corrective actions, and the City may maintain the System for up to one (1) year. Such maintenance of the System by the City shall not be construed to be a trespass or taking of the Property, nor shall the City's action vest in the public any right to enter or use the Property. Thereafter, if Proprietor or Proprietor's successors, grantees or assigns do not properly maintain the System, the City may, after providing similar written notice, schedule and hold another hearing to determine whether the City should maintain the System for another year, and subject to a similar notice, hearing and determination in subsequent years.

In the event the City determines an emergency condition caused by or relating to the System threatens the public health, safety or general welfare, the City shall have the right to immediately and without notice to enter the Property and undertake corrective action.

4. Charges:
The City shall charge to the current owner of the Property the cost of maintenance or other corrective action undertaken by the City under this agreement, plus a ten (10%) administrative fee. If not timely paid, the City may place the charges on the City's tax roll, which charges shall be a lien on the real property and shall be collectible and enforceable in the same manner general property taxes are collected and enforced.

5. Notice:
Any notices required under this agreement shall be sent by certified mail to the address for each party set forth below, or to such other addresses as such party may notify the other parties in writing:

To Proprietor: Rochester Community Schools
501 W. University Drive
Rochester, MI, 48307

To the City: City Clerk
1000 Rochester Hills Drive,
Rochester Hills, Michigan 48309

6. Successors and Assigns:
This agreement shall bind and inure to the benefit of the parties and their respective successors, grantees, and assigns. The benefits, burdens, rights, obligations and responsibilities hereunder shall run with the land and shall bind all current and future owners of the Property and any divisions thereof.

7. Recording of the Agreement:
This agreement shall be recorded at the Oakland County Register of Deeds.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement for Storm Water System Maintenance to be executed by their respective, duly-authorized officers and their seals to be affixed hereto all as of the day and year first above written.

Rochester Community Schools

By: Dana J. Taylor
Dana J. Taylor

Title: Deputy Superintendent for Business Affairs

STATE OF MICHIGAN)
)ss.
COUNTY OF OAKLAND)

The foregoing instrument was acknowledged before me this 22 day of April, 2019, by Dana J. Taylor, Deputy Superintendent for Business Affairs, of Rochester Community Schools, a Public School District, on behalf of the District.

Theresa Kimble
Notary Public
Macomb County, Acting in Oakland, MI
My Commission Expires: _____

THERESA KIMBLE
Notary Public - Michigan
Macomb County
My Commission Expires Sept. 28, 2025

City of Rochester Hills

By: _____
Bryan K. Barnett, Mayor

By: _____
Tina Barton, City Clerk

STATE OF MICHIGAN)
)ss.
COUNTY OF OAKLAND)

The foregoing instrument was acknowledged before me this _____ day of _____, 2019, by Bryan K. Barnett, Mayor of City of Rochester Hills and Tina Barton, City Clerk of City of Rochester Hills, a Michigan municipal corporation, on behalf of the Corporation.

_____
Notary Public
_____County, _____
My Commission Expires: _____

When recorded, return to:
Tina Barton, City Clerk
City of Rochester Hills
1000 Rochester Hills Drive
Rochester Hills, MI 48309

Drafted by:
James Serbinski
Spalding DeDecker
905 South Blvd East
Rochester Hills, MI 48307

John Staran
Approved 4/29/19

EXHIBIT "A"

LEGAL DESCRIPTIONS

ROCHESTER COMMUNITY SCHOOLS - TRANSPORTATION BUILDING
380 S. LIVERNOIS RD.
ROCHESTER HILLS, MI 48307

PARCEL: #15-16-226-001

LAND LOCATED IN AND BEING A PART OF THE EAST HALF OF THE NORTHEAST QUARTER OF SECTION 16, TOWN 3 NORTH, RANGE 11 EAST, CITY OF ROCHESTER HILLS, OAKLAND COUNTY, MICHIGAN; SAID LAND BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BEGINNING AT THE NORTHEAST CORNER OF SAID SECTION 16; THENCE S 01°04'20" W 1945.58 FEET ALONG THE EAST LINE OF SAID SECTION 16; THENCE S 89°11'20" W 1071.00 FEET; THENCE N 01°05'00" W (1945.47 FEET MEASURED) TO THE NORTH LINE OF SAID SECTION 16; THENCE (N 89°14'00" E 1144.18 FEET MEASURED) EASTERLY ALONG THE NORTH LINE OF SAID SECTION 16 TO THE POINT OF BEGINNING. EXCEPTING THE NORTH 60 FEET AND THE EAST 60 FEET TAKEN FOR ROAD RIGHT OF WAY. ALSO EXCEPTING THE FOLLOWING 8.5 WIDE FOOT STRIP OF LAND THAT BEGINS AT A POINT DISTANT S 01°40'40" W 60.03 FEET AND S 89°50'20" W 60.03 FEET FROM THE NORTHEAST CORNER OF SAID SECTION 16; THENCE S 01°40'40" W 707.00 FEET; THENCE N 88°19'20" W 8.50 FEET; THENCE N 01°40'40" E 706.73 FEET; THENCE N 89°50'20" E 8.50 FEET TO THE POINT OF BEGINNING. CONTAINING 46.71 ACRES AND SUBJECT TO RESTRICTIONS AND EASEMENTS OF RECORD.

Jenny M.
Approved 6/5/19

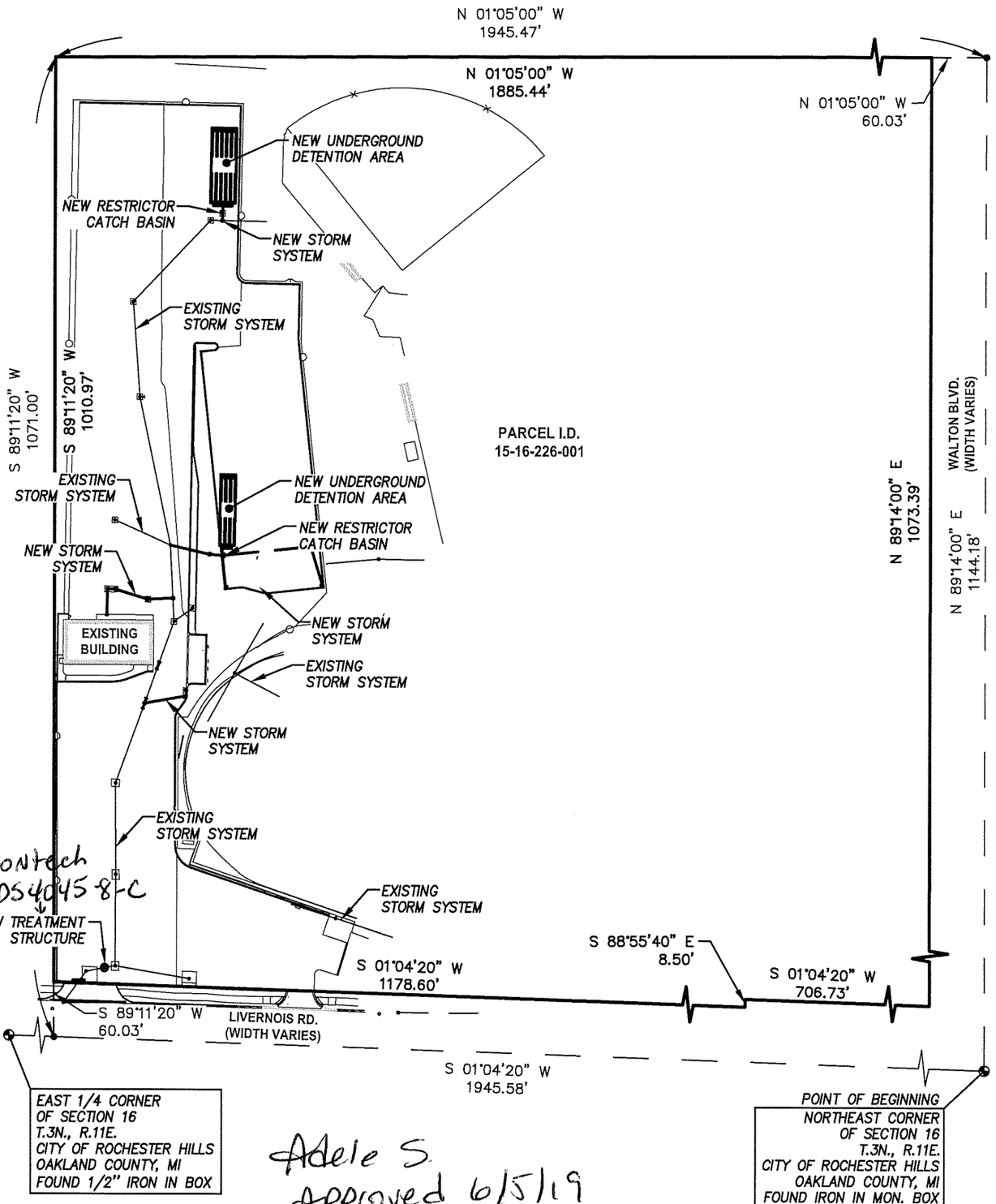
SPALDING DEDECKER
Engineers | Surveyors
905 South Blvd. East
Rochester Hills, MI 48307
Phone: (248) 844-5400
Fax: (248) 844-5404
www.sda-eng.com

DRAWN: J.SERBINSKI	DATE: 4-1-19
CHECKED: T.SOVEL	DATE: 4-1-19
MANAGER: T.SOVEL	SCALE:
JOB No. NP18-034	SHEET: 1 OF 1
SECTION 16 TOWN 3 NORTH RANGE 11 EAST	
CITY OF ROCHESTER HILLS OAKLAND COUNTY, MI	

EXHIBIT "B"

NOTE:
SDA HAS NOT PERFORMED A BOUNDARY SURVEY OF THIS PARCEL AND THE PARCEL DESCRIPTION DOES NOT NECESSARILY REFLECT FIELD–MEASURED VALUES. THE EXHIBIT "A" DESCRIPTION IS WRITTEN BASED UPON THE RECORD DESCRIPTION OF THIS OVERALL PARCEL.

GRAPHIC SCALE
0 75 150 300
(IN FEET)
1 inch = 150 ft.



Contech
CDS4045-8-C

Adele S.
Approved 6/5/19

SPALDING DEDECKER
Engineers | Surveyors
905 South Blvd. East
Rochester Hills, MI 48307
Phone: (248) 844-5400
Fax: (248) 844-5404
www.sda-eng.com

DRAWN: J.SERBINSKI	DATE: 4-1-19
CHECKED: T.SOVEL	DATE: 4-1-19
MANAGER: T.SOVEL	SCALE: 1" = 150'
JOB No. NP18-034	SHEET: 1 OF 1
SECTION 16 TOWN 3 NORTH RANGE 11 EAST	
CITY OF ROCHESTER HILLS OAKLAND COUNTY, MI	

EXHIBIT "C"

A. PHYSICAL LIMITS OF THE STORM WATER MANAGEMENT SYSTEM

THE STORM WATER MANAGEMENT SYSTEM (SWMS) SUBJECT TO THIS LONG-TERM MAINTENANCE PLAN (LTMP) IS DEPICTED ON EXHIBIT B AND INCLUDES WITHOUT LIMITATION THE STORM SEWERS, MANHOLES, CATCH BASINS, CLOSED CONDUITS, UNDERGROUND DETENTION SYSTEMS, FLOW RESTRICTOR STRUCTURES AND PRETREATMENT STRUCTURE THAT CONVEY FLOW FROM THE UNDERGROUND DETENTION SYSTEMS TO A PRETREATMENT STRUCTURE BEFORE GOING TO AN EXISTING STORM MANHOLE THAT OUTLETS TO A CITY STORM SEWER.

FOR PURPOSES OF THIS SWMS, THIS STORM WATER MANAGEMENT SYSTEM AND ALL OF ITS COMPONENTS AS SHOWN ON EXHIBIT B IS REFERRED TO AS THE "SYSTEM".

B. TIME FRAME FOR LONG-TERM MAINTENANCE RESPONSIBILITY

THE PROPRIETOR IS RESPONSIBLE FOR MAINTAINING THE SYSTEM, INCLUDING COMPLYING WITH APPLICABLE REQUIREMENTS OF THE CITY OF ROCHESTER HILLS, UNTIL OAKLAND COUNTY RELEASES THE CONSTRUCTION PERMIT. LONG-TERM MAINTENANCE RESPONSIBILITY FOR THE SYSTEM COMMENCES WHEN DEFINED BY THE MAINTENANCE PERMIT ISSUED BY THE COUNTY. LONG-TERM MAINTENANCE CONTINUES IN PERPETUITY.

THE OPERATION OF THE STORM WATER MANAGEMENT SYSTEM, INCLUDING UNDERGROUND DETENTION SYSTEMS AND PIPES SHALL BE MONITORED TO VERIFY THAT THE SYSTEM IS PERFORMING AS INTENDED AND WILL BE REPAIRED OR MODIFIED AS REQUIRED TO INSURE THAT THE SYSTEM OPERATES AS INTENDED AND AS REQUIRED.

MAINTENANCE OF STORM WATER COLLECTION SYSTEM CONSISTS OF THE FOLLOWING ITEMS, WHICH ARE TO BE DONE AT LEAST TWICE PER YEAR AS FOLLOWS:

1. CLEAN THE COVER OF ALL CATCH BASINS.

2. CHECK THE DEPTH OF ACCUMULATED SEDIMENT IN EACH STORM STRUCTURE AND REMOVE THE SEDIMENT IF IT IS 12 OR MORE INCHES DEEP.

3. IF WHILE CHECKING THE SEDIMENT IN THE STORM STRUCTURES, IT BECOMES APPARENT THAT THE SEDIMENT HAS ENTERED THE CONNECTING PIPES, THE PIPES SHALL BE JETTED TO REMOVE THE SEDIMENT.

4. IF ANY SETTLING AROUND THE STORM STRUCTURES OR ALONG THE ROUTE OF THE PIPES IS EVIDENT, THE STRUCTURES AND THE PIPES SHALL BE CHECKED FOR OPEN JOINTS AND CRACKS WHICH, IF FOUND, SHALL BE REPAIRED.

MAINTENANCE OF THE DETENTION SYSTEMS AND FLOW RESTRICTOR STRUCTURES MUST BE PERFORMED AT LEAST TWICE PER YEAR AS FOLLOWS:

1. THE DETENTION SYSTEMS IS TO BE INSPECTED AND CLEANED OF ANY ACCUMULATED DEBRIS AND SEDIMENT WHEN SEDIMENT DEPTH REACHES 6".

2. THE DETENTION SYSTEMS MUST BE CLEANED IF ITS VOLUME IS REDUCED BY MORE THEN 10% DUE TO THE ACCUMULATION OF SILT AND SEDIMENT.

3. THE FLOW RESTRICTOR STRUCTURES SHALL BE MAINTAINED IN ACCORDANCE WITH MAINTENANCE SCHEDULE FOR THE COLLECTION SYSTEM AS MENTIONED ABOVE.

C. MANNER OF ENSURING MAINTENANCE RESPONSIBILITY

THE PROPRIETOR HAS ASSUMED RESPONSIBILITY FOR LONG-TERM MAINTENANCE OF THE SYSTEM. THE STIPULATION BY WHICH THE PROPRIETOR HAS ASSUMED MAINTENANCE RESPONSIBILITY IS INDICATED IN THE "AGREEMENT FOR STORM SEWER MAINTENANCE". THE CITY OF ROCHESTER HILLS RETAINS THE RIGHT TO ENTER THE PROPERTY AND PERFORM THE NECESSARY MAINTENANCE OF THE SYSTEM IF THE PROPRIETOR FAILS TO PERFORM THE REQUIRED MAINTENANCE ACTIVITIES.

TO ENSURE THAT THE SYSTEM IS MAINTAINED IN PERPETUITY, THE "AGREEMENT FOR STORM SEWER MAINTENANCE" BETWEEN THE CITY OF ROCHESTER HILLS AND THE PROPRIETOR TOGETHER WITH ITS EXHIBIT A (LEGAL DESCRIPTION OF PROPERTY), EXHIBIT B (THE MAP OF THE PHYSICAL LIMITS OF THE STORM WATER MANAGEMENT SYSTEM , AND EXHIBIT C (THIS PLAN FOR LONG TERM MAINTENANCE) WILL BE RECORDED WITH THE OAKLAND COUNTY REGISTER OF DEEDS. UPON RECORDING, A COPY OF THE RECORDED DOCUMENTS WILL BE PROVIDED TO THE CITY OF ROCHESTER HILLS.

D. LONG-TERM MAINTENANCE PLAN AND SCHEDULE

TABLE 1 IDENTIFIES THE MAINTENANCE ACTIVITIES TO BE PERFORMED, ORGANIZED BY CATEGORY (MONITORING/INSPECTIONS, PREVENTATIVE MAINTENANCE, AND REMEDIAL SECTIONS). TABLE 1 ALSO IDENTIFIES SITE-SPECIFIC WORK NEEDED TO ENSURE THAT THE STORM WATER MANAGEMENT SYSTEM FUNCTIONS PROPERLY AS DESIGNED.

E. STORMWATER PRE-TREATMENT DEVICES

1. CONTECH CDS4045-8-C UNIT

REFER TO THE ATTACHED MAINTENANCE MANUALS FROM THE MANUFACTURER FOR ALL INSPECTION AND MAINTENANCE REQUIREMENTS FOR THE PRE-TREATMENT STRUCTURE.

BK ARS 4/5/19

SPALDING DEDECKER
Engineers | Surveyors
905 South Blvd. East
Rochester Hills, MI 48307
Phone: (248) 844-5400
Fax: (248) 844-5404
www.sda-eng.com

DRAWN: J.SERBINSKI	DATE: 4-1-19
CHECKED: T.SOVEL	DATE: 4-1-19
MANAGER: T.SOVEL	SCALE:
JOB No. NP18-034	SHEET: 1 OF 2
SECTION 16 TOWN 3 NORTH RANGE 11 EAST	
CITY OF ROCHESTER HILLS OAKLAND COUNTY, MI	

N:\NP\NLD Projects\NP18034 - Rochester Schools - Bus Lot\DWG\NP18034EA3.dwg

N:\NP\NLD Projects\NP18034 – Rochester Schools – Bus Lot\DWG\NP18034EAS.dwg

EXHIBIT "C"

TABLE 1

STORM WATER MANAGEMENT SYSTEM LONG-TERM MAINTENANCE SCHEDULE SYSTEM COMPONENT

Maintenance Activities	Underground Detention System	Manufactured Treatment System	Catch Basins & Storm Sewers	Inlets to Pretreatment Systems and Detention/retention Systems	Flow Restrictors	Other	Frequency
Monitoring/Inspection							
Inspect for sediment accumulation**/clogging of stone filter	X	X	X	X	X		Annually
Inspect for floatables, dead vegetation and debris	X	X	X	X	X		Annually and after major events
Inspect all components during wet weather and compare to as-built plans	X	X	X	X	X		Annually
Ensure means of access for maintenance remain clear/open	X	X	X	X	X		Annually
Preventative Maintenance							
Remove accumulated sediment	X	X	X		X		As needed*
Remove floatables, dead vegetation and debris	X	X	X	X			As needed
Sweeping of paved surfaces (streets and parking lots)						X	2 times per year
Other - (Recommended By Manufacturer)		X				X	
Remedial Actions							
Repair/stabilize areas of erosion			X	X			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

* Manufactured treatment system and underground detention systems to be clened according to manufacturer's recommendations: at a minimum, whenever sediment accumulates to a depth of 6-12 inches or if sediment resuspention is observed.

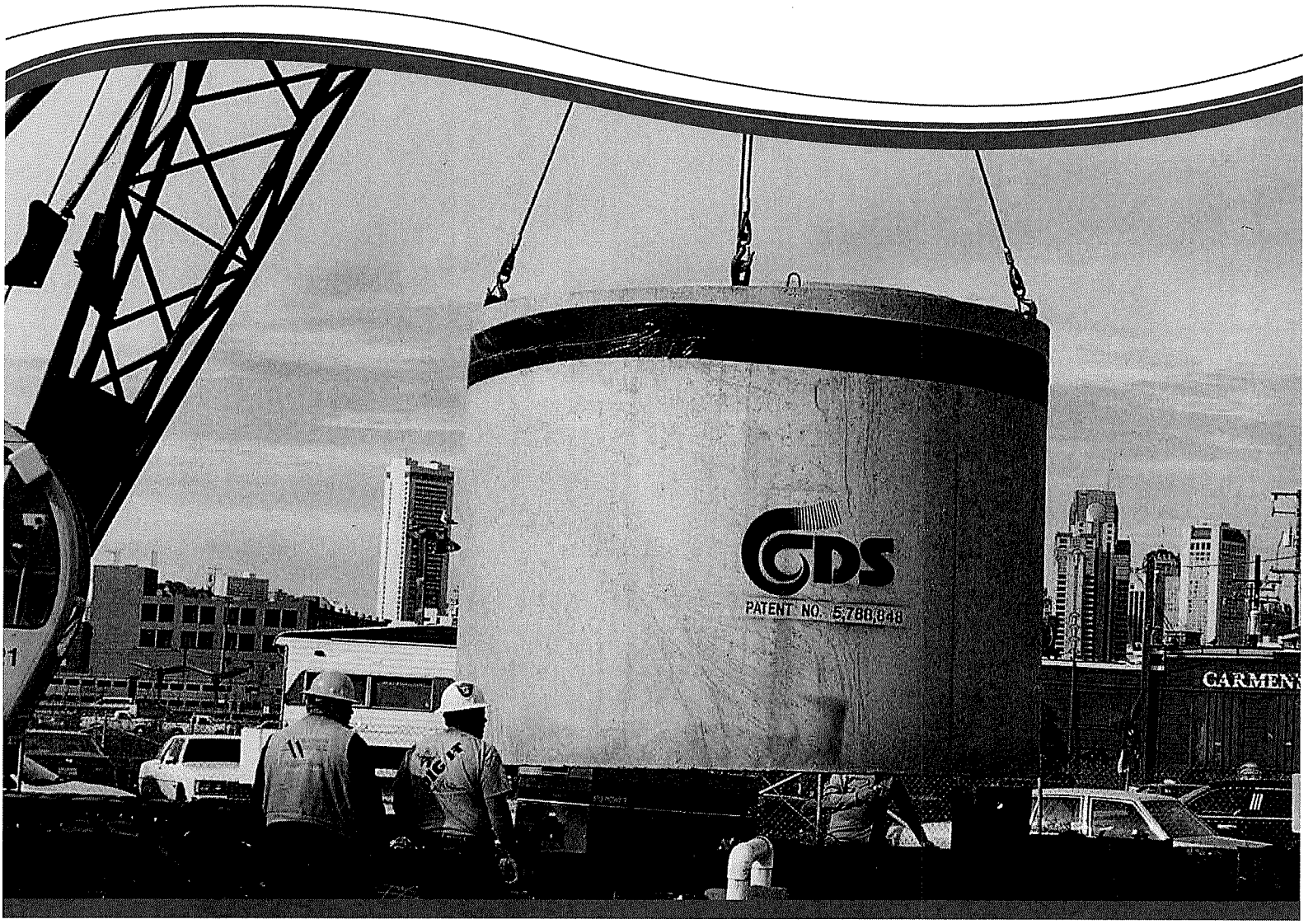
NOTE:
CHEMICALS SHALL NOT BE APPLIED TO BIORETENTION AREA , BUFFER STRIPS AND VEGETATED SWALES OR WATERCOURSES.

SPALDING DEDECKER
Engineers | Surveyors
905 South Blvd. East
Rochester Hills, MI 48307
Phone: (248) 844-5400
Fax: (248) 844-5404
www.sda-eng.com

DRAWN: J.SERBINSKI	DATE: 4-1-19
CHECKED: T.SOVEL	DATE: 4-1-19
MANAGER: T.SOVEL	SCALE:
JOB No. NP18-034	SHEET: 2 OF 2
SECTION 16 TOWN 3 NORTH RANGE 11 EAST	
CITY OF ROCHESTER HILLS OAKLAND COUNTY, MI	

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.

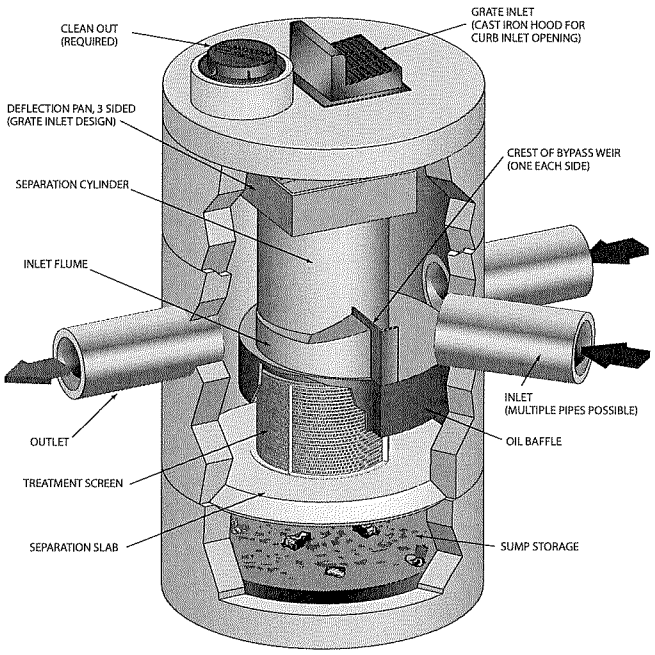
Operation Overview

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.

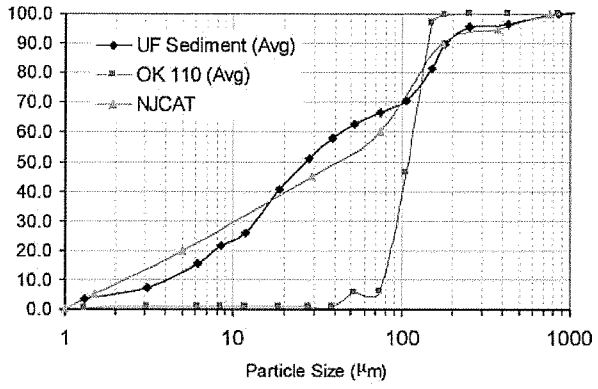


Figure 1. Particle size distributions

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.

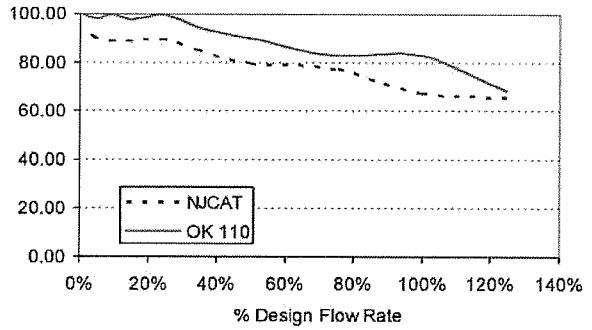


Figure 2. CDS stormwater treatment predictive performance for various particle gradations as a function of operating rate.

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).

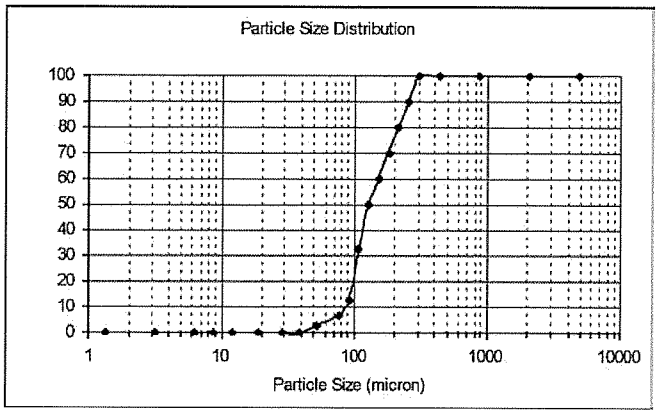


Figure 3. WASDOE PSD

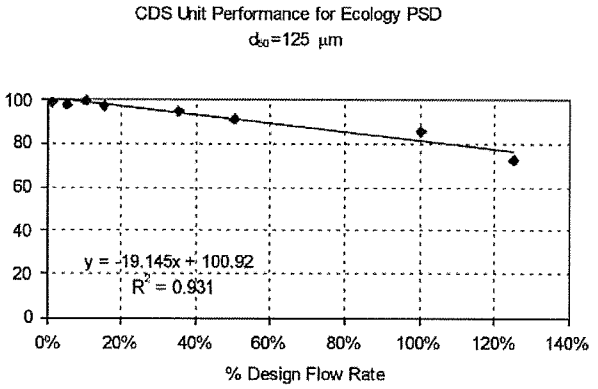


Figure 4. Modeled performance for WASDOE PSD.

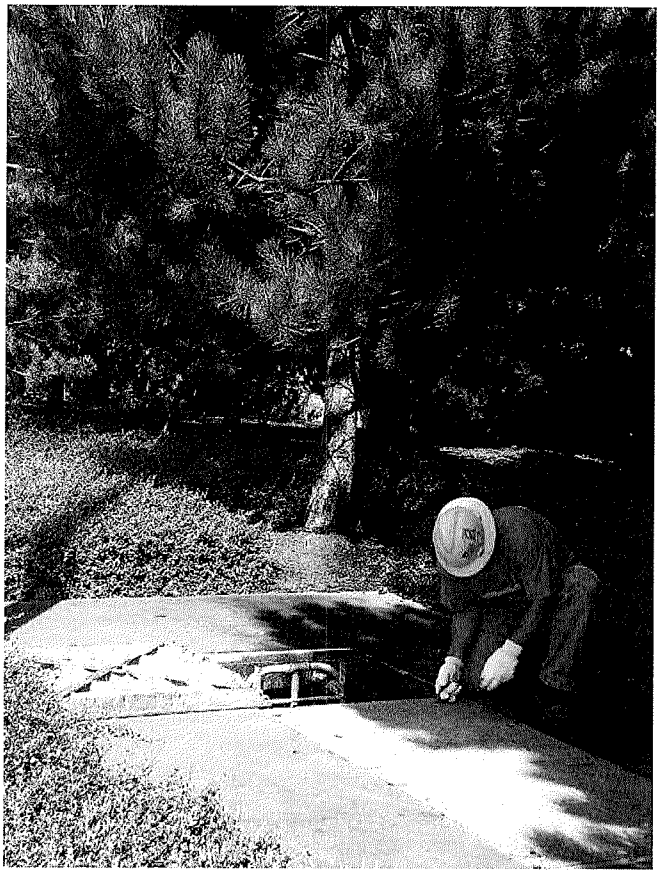
Maintenance

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.

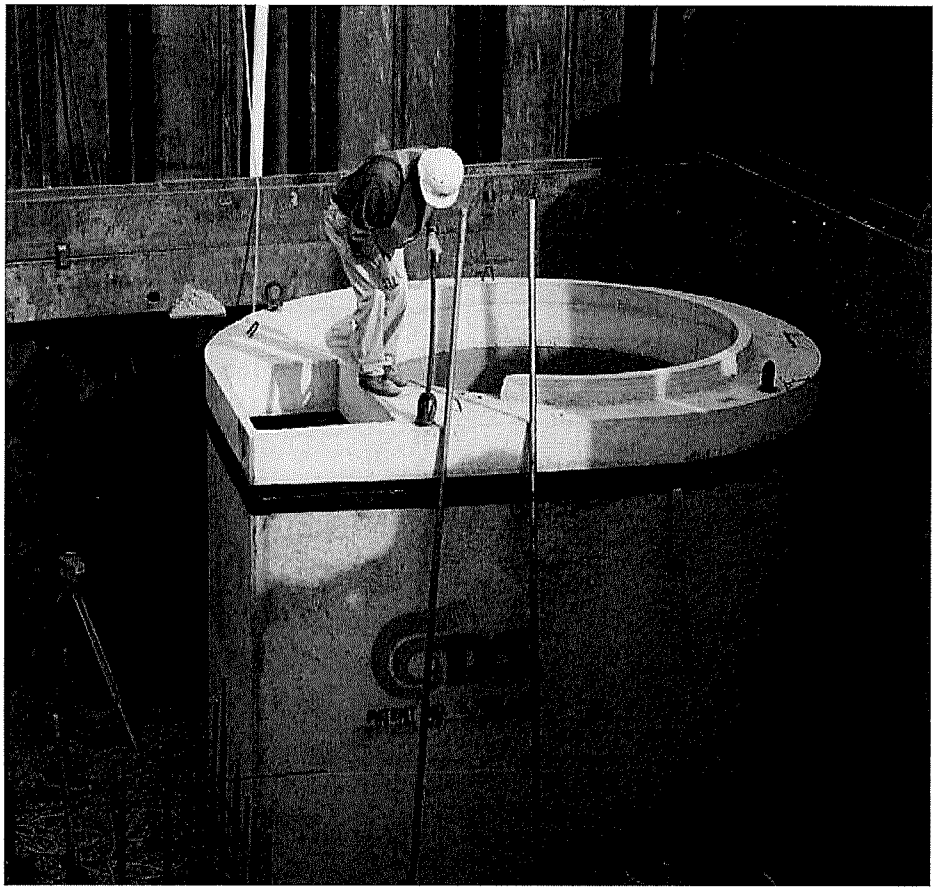
In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should 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	y^3	m^3
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
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
CDS3025	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
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

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.

CONTECH®
ENGINEERED SOLUTIONS
800-338-1122
www.ContechES.com

Contech Engineered Solutions provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, earth stabilization and stormwater treatment products. For information on other Contech division offerings, visit www.ContechES.com or call 800.338.1122

The product(s) described may be protected by one or more of the following US patents: 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; 7,296,692; 7,297,266; related foreign patents or other patents pending.