

ATTACHMENT 6-1

Site Plan and Drainage Plan

- **Location Map**
- **Site Map**
- **Land Use Plan**
- **WQMP EXHIBIT**
- **EXISTING HYDROLOGY MAP**
- **BASIS FOR SEASONAL HIGH GROUNDWATER**



Project Site



robert m. beers pe

8175 Limonte Avenue, Suite E
Jurupa Valley, CA 92509
Ph. (951) 360-2070 Fax (951) 360-2080
Cell: (951) 317-2041
rmbears777@hotmail.com

WQMP

Millcreek Farming

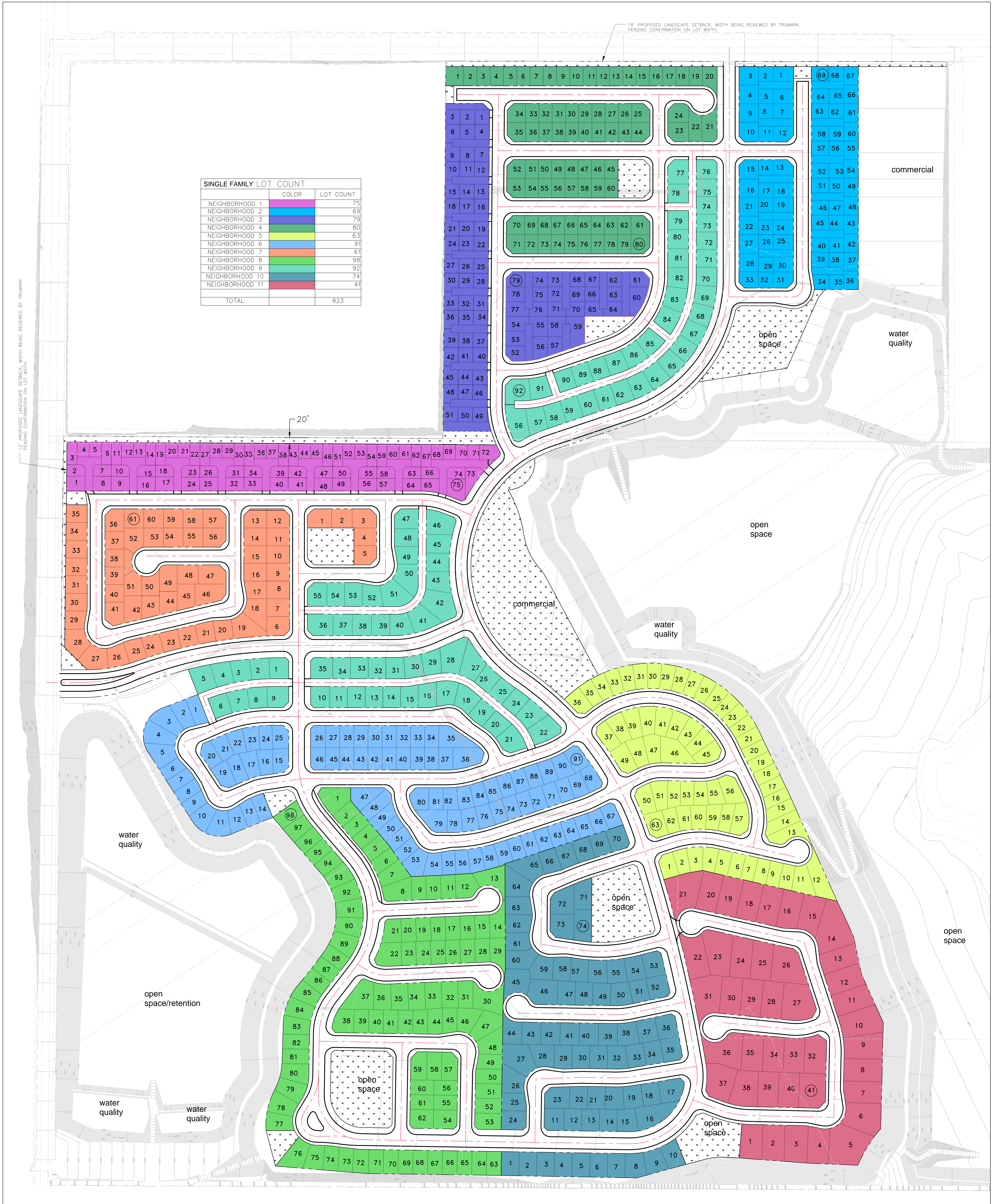
Exhibit "A" Location Map

PREPARED BY: R.M.B. DATE: 03-26-13 1 of 1

RANCHO MIRAMONTE

Updated Base for TTM 18846 "A" Map Lots and 74' Onsite Backbone Street
with last grade base overlay

SINGLE FAMILY LOT COUNT		
NEIGHBORHOOD	COLOR	LOT COUNT
NEIGHBORHOOD 1	Green	75
NEIGHBORHOOD 2	Blue	69
NEIGHBORHOOD 3	Purple	79
NEIGHBORHOOD 4	Orange	80
NEIGHBORHOOD 5	Yellow	63
NEIGHBORHOOD 6	Light Blue	91
NEIGHBORHOOD 7	Light Green	61
NEIGHBORHOOD 8	Light Blue	98
NEIGHBORHOOD 9	Light Green	92
NEIGHBORHOOD 10	Light Blue	74
NEIGHBORHOOD 11	Light Green	41
TOTAL		823



BASIS FOR SEASONAL HIGH GROUNDWATER ELEVATION

Plates from the 2007 GMU soils report out of 2009 EIR for Edgewater SPA provide maps for the borings and include water surface elevations. The seasonal high groundwater elevation will be re-evaluated in final design.

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 GMU Page 9

mapping done by Mendenhall around 1900 (Fife, 1976) documented relatively shallow groundwater levels throughout the basin, as well as artesian conditions in a large area northwest of the site. An increase in population and agricultural activity triggered a decline in groundwater elevations until the 1970s. During the first half of the 20th century, significant areas of subsidence were documented across the Basin. In the 1970s efforts were started to restore the groundwater regime (Fife, 1976, and Wildermuth Environmental, 1999). Groundwater management by the Chino Basin Watermaster as well as imported water have led to more stabilized groundwater elevations within the Chino Basin.

Groundwater within the Chino Basin consists of several stacked aquifers within the basin alluvial deposits, which are up to several hundred feet thick. The shallowest of these varies across the basin in elevation and thickness. Historical regional data on the Chino Basin Watermaster website indicates groundwater elevations of approximately 525 feet msl underlying the site in the 1930s, and elevations of approximately 500 feet msl in the late 1990s. Current regional groundwater elevations have not yet been posted by the Watermaster, but are anticipated to be higher than reported in the 1990s.

Local Groundwater Conditions. Groundwater data collected during our previous investigation indicated groundwater depths of approximately 13 to 23 feet below the site (elevations of approximately 523 to 547 feet msl). Our current investigation encountered perched zones of seepage in scattered locations across the site. These locations are likely local zones of minor seepage. Groundwater was encountered between approximately 6 and 40 feet below the existing

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ground surface across the site (elevations of approximately 519 to 539 feet msl) during our current investigation. Groundwater elevations observed during our current investigation were compiled with data from our previous investigation to complete the site subsurface groundwater model. The following table lists the groundwater data collected:

Exploration Number	Date of Reading/Test	Depth to Groundwater (feet bgs)	Elevation of Groundwater (feet msl)
CPT-1	2-13-04	16	546
CPT-3	2-13-04	13	547
CPT-5	2-13-04	23	523
DH-3	2-7-07	26.2	535.8
DH-5	2-7-07	6.8	529.2
DH-6	2-7-07	38.6	519.4
DH-7	2-7-07	20.0	525.0
DH-8	2-7-07	30.2	519.8

In general, the groundwater surface beneath the site appears to slope gently to the south and east. The shallowest groundwater elevations occur along the southern boundary of the site (approximately 520 feet msl) and the eastern boundary, adjacent to Mill Creek (approximately 520 to 525 feet msl). The groundwater surface ramps upward toward the northern portion of the site, with elevations up to approximately 545 feet msl.

In comparison to historical data, the current groundwater table appears to be up to approximately 20 feet higher in the northern portion of the site. As a result, current groundwater elevations were utilized in both liquefaction and slope stability analyses as the historic high elevations.

ATTACHMENT 6-2
Electronic Data Submittal

ATTACHMENT 6-3

Post Construction

- **O&M Plans and Maintenance Agreements**

Attachment A-1

Maintenance Mechanisms

A-1.1 The Agency shall not accept storm water structural BMPs as meeting the WQMP requirements standard, unless an O&M Plan is prepared (see WQMP Section 4.1) and a mechanism is in place that will ensure ongoing long-term maintenance of all structural and non-structural BMPs. This mechanism can be provided by the Agency or by the project proponent. As part of project review, if a project proponent is required to include interim or permanent structural and non-structural BMPs in project plans, and if the Agency does not provide a mechanism for BMP maintenance, the Agency shall require that the applicant provide verification of maintenance requirements through such means as may be appropriate, at the discretion of the Agency, including, but not limited to covenants, legal agreements, maintenance agreements, conditional use permits and/or funding arrangements.

A-1.2 Maintenance Mechanisms

1. **Public entity maintenance:** The Agency may approve a public or acceptable quasi-public entity (e.g., the County Flood Control District, or annex to an existing assessment district, an existing utility district, a state or federal resource agency, or a conservation conservancy) to assume responsibility for operation, maintenance, repair and replacement of the BMP. Unless otherwise acceptable to individual Agencies, public entity maintenance agreements shall ensure estimated costs are front-funded or reliably guaranteed, (e.g., through a trust fund, assessment district fees, bond, letter of credit or similar means). In addition, the Permittees may seek protection from liability by appropriate releases and indemnities.

The Agency shall have the authority to approve storm water BMPs proposed for transfer to any other public entity within its jurisdiction before installation. The Permittee shall be involved in the negotiation of maintenance requirements with any other public entities accepting maintenance responsibilities within their respective jurisdictions; and in negotiations with the resource agencies responsible for issuing permits for the construction and/or maintenance of the facilities. The Agency must be identified as a third party beneficiary empowered to enforce any such maintenance agreement within their respective jurisdictions.

2. **Project proponent agreement to maintain storm water BMPs:** The Agency may enter into a contract with the project proponent obliging the project proponent to maintain, repair and replace the storm water BMP as necessary into perpetuity. Security or a funding mechanism with a "no sunset" clause may be required.
3. **Assessment districts:** The Agency may approve an Assessment District or other funding mechanism created by the project proponent to provide funds for storm water BMP maintenance, repair and replacement on an ongoing basis. Any agreement with such a District shall be subject to the Public Entity Maintenance Provisions above.

4. **Lease provisions:** In those cases where the Agency holds title to the land in question, and the land is being leased to another party for private or public use, the Agency may assure storm water BMP maintenance, repair and replacement through conditions in the lease.
5. **Conditional use permits:** For discretionary projects only, the Agency may assure maintenance of storm water BMPs through the inclusion of maintenance conditions in the conditional use permit. Security may be required.
6. **Alternative mechanisms:** The Agency may accept alternative maintenance mechanisms if such mechanisms are as protective as those listed above.

Attachment A-2



INSTRUCTIONS FOR COMPLETING THE WATER QUALITY MANAGEMENT PLAN (WQMP) TRANSFER, ACCESS, AND MAINTENANCE AGREEMENT

In order for your project to receive approval, you will need to prepare a WQMP and Storm Water Best Management Practices Transfer, Access and Maintenance Agreement (Maintenance Agreement). ***Please contact the Department of Public Works, Environmental Management Division after the final WQMP is approved, and at least ten (10) business days prior to your project's construction being completed, to receive the current Maintenance Agreement template. You can contact the Environmental Management Division by phone, by calling (909) 387 – 8109, or by email, at evarga@dpw.sbcounty.gov.*** The Maintenance Agreement shall be completed and approved according to the procedure outlined below, and must include the following information and attachments:

1. Provide all written information requested in the Maintenance Agreement template, including project and property owner's signature(s).
2. Attach a legal description of the project location, as well as a legal description of the locations of where all proposed storm water Best Management Practices will be constructed / installed, including a listing of the applicable Assessor's Parcel Numbers (APN). This page will be labeled as "EXHIBIT A, LEGAL DESCRIPTION".
3. Attach an 8.5" x 11" or 8.5" x 14" sized project plan sheet (labeled as "EXHIBIT B, BMP SITE PLAN"), illustrating the proposed storm water Best Management Practices and maintenance / access points. Cross sections and other pertinent details of such measures shall also be included. (Plan should be legible)
4. Attach a completed Notary page, with notary's wet seal affixed, **and having the following statement inserted on the Notary page:**

"FOR: Maintenance Agreement, dated _____, for the project known as _____ (APN _____), as described in the WQMP dated _____."

5. Attach a copy of the cover sheet for the most current WQMP that was approved. The cover sheet must display the information that is requested in the most current WQMP Guidance and Template document. Please visit the Environmental Management Division's website for the current WQMP Guidance and Template document (http://www.sbcounty.gov/dpw/land/environmental_mgmt.asp).

6. The completed Maintenance Agreement (along with attachments) shall be submitted for review to:

Department of Public Works
Environmental Management Division
825 E. Third Street, Room 201
San Bernardino, CA 92415-0835

7. Staff at the Environmental Management Division will review the Maintenance Agreement, and request any necessary changes.
8. When the Maintenance Agreement has been approved, the project and property owner(s) must sign the Maintenance Agreement and have his / her signature notarized.
9. The Maintenance Agreement will then be returned to the Environmental Management Division, where appropriate staff will obtain the notarized signature of the Director of Public Works (this may take up to ten (10) business days, depending on the Director's schedule and availability of the notary). Please provide a telephone number where you can be reached when the Maintenance Agreement is ready to be picked up for you to record.

Please Note: The Director of Public Works will not sign the Maintenance Agreement until the proposed Best Management Practices, as documented in the project WQMP, are constructed / installed, and all outstanding charges and invoices are paid.

10. The fully executed Maintenance Agreement must now be recorded at the San Bernardino County Recorder's Office at:

222 W. Hospitality Lane (behind the Souplantation restaurant)
San Bernardino, CA 92415-0018

11. A photocopy of the final recorded Maintenance Agreement must be returned to the Environmental Management Division. You must also show the recorded Maintenance Agreement to the Land Development Division of the Department of Public Works, in order to receive their final approval on your project.

If during project construction, there are any field changes to the storm water Best Management Practices and maintenance / access points proposed in the WQMP, then the WQMP must be revised and re-submitted for approval by the County, and a new Maintenance Agreement must also be completed and re-submitted for approval by the County, according to the procedure outlined above.

If you have any further questions about this process, please call the Environmental Management Division, County Storm Water Program, at (909) 387-8109.

RECORDING REQUESTED BY:

County of San Bernardino
Department of Public Works

AND WHEN RECORDED MAIL TO:

County of San Bernardino
Department of Public Works
825 E. Third Street, Room 201
San Bernardino, CA 92415-0835

SPACE ABOVE THIS LINE FOR RECORDER'S USE

AGREEMENT

**THIS PAGE ADDED TO PROVIDE ADEQUATE SPACE FOR RECORDING
INFORMATION (Additional Recording Fees Apply)**

**Water Quality Management Plan and Storm Water Best Management Practices
Transfer, Access and Maintenance Agreement**

OWNER NAME : _____

PROPERTY ADDRESS: _____

APN: _____

THIS AGREEMENT is made and entered into in

_____, California, this _____ day of

_____, by and between

_____, hereinafter

referred to as Owner, and the COUNTY OF SAN BERNARDINO, a municipal corporation, located in the County of San Bernardino, State of California, hereinafter referred to as County;

WHEREAS, the Owner owns real property ("Property") in the County of San Bernardino, State of California, more specifically described in Exhibit "A" and depicted in Exhibit "B", each of which exhibits is attached hereto and incorporated herein by this reference;

WHEREAS, at the time of initial approval of development project known as

_____ within the Property described herein, the County required the project to employ Best Management Practices, hereinafter referred to as "BMPs," to minimize pollutants in urban runoff;

WHEREAS, the Owner has chosen to install and/or implement BMPs as described in the Water Quality Management Plan, on file with the County, hereinafter referred to as "WQMP", to minimize pollutants in urban runoff and to minimize other adverse impacts of urban runoff;

WHEREAS, said WQMP has been certified by the Owner and reviewed and approved by the County;

WHEREAS, the Owner is aware that periodic and continuous maintenance, including, but not necessarily limited to, filter material replacement and sediment removal, is required to assure peak performance of all BMPs in the WQMP and that, furthermore, such maintenance activity will require compliance with all Local, State, or Federal laws and regulations, including those pertaining to confined space and waste disposal methods, in effect at the time such maintenance occurs;

NOW THEREFORE, it is mutually stipulated and agreed as follows:

1. All maintenance or replacement of BMPs proposed as part of the WQMP are the sole responsibility of the Owner in accordance with the terms of this Agreement.
2. Owner hereby provides the County of San Bernardino's designee complete access, of any duration, to the BMPs and their immediate vicinity at any time, upon reasonable notice, or in the event of emergency, as determined by the County Director of Public Works, no advance notice, for the purpose of inspection, sampling, testing of the Device, and in case of emergency, to undertake all necessary repairs or other preventative measures at owner's expense as provided in paragraph 3 below. The County shall make every effort at all times to minimize or avoid interference with Owner's use of the Property. Denial of access to any premises or facility that contains WQMP features is a violation of the County Storm Water Ordinance, County Code 3587. If there is reasonable cause to believe that an illicit discharge or breach of the WQMP operation and maintenance commitments is occurring on the premises then the authorized enforcement agency may seek issuance of a search warrant from any court of competent jurisdiction in addition to other enforcement actions.
3. Owner shall use its best efforts diligently to maintain all BMPs in a manner assuring peak performance at all times. All reasonable precautions shall be exercised by Owner and Owner's representative or contractor in the removal and extraction of any material(s) from the BMPs and the ultimate disposal of the material(s) in a manner consistent with all relevant laws and regulations in effect at the time. As may be requested from time to time by the County, the Owner shall provide the County with documentation identifying the material(s) removed, the quantity, and disposal destination.
4. In the event Owner, or its successors or assigns, fails to accomplish the necessary maintenance contemplated by this Agreement, within five (5) days of being given written notice by the County, the County is hereby authorized to cause any maintenance necessary to be done and charge the entire cost and expense against the property and/or to the Owner or Owner's successors or assigns, including administrative costs, attorneys fees and interest thereon at the maximum rate authorized by the County Code from the date of the notice of expense until paid in full.
5. The County may require the owner to post security in form and for a time period satisfactory to the County to guarantee the performance of the obligations stated herein. Should the Owner fail to perform the obligations under the Agreement, the County may, in the case of a cash bond, act for the Owner using the proceeds from it, or in the case of a surety bond, require the sureties to perform the obligations of the Agreement. As an additional remedy, the Director of Public Works may withdraw any previous storm water-related approval with respect to the property on which BMPs have been installed and/or implemented until such time as Owner repays to County its reasonable costs incurred in accordance with paragraph 3 above.

6. This agreement shall be recorded in the Office of the Recorder of San Bernardino County, California, at the expense of the Owner and shall constitute notice to all successors and assigns of the title to said Property of the obligation herein set forth, and also a lien in such amount as will fully reimburse the County, including interest as herein above set forth, subject to foreclosure in event of default in payment.
7. In event of legal action occasioned by any default or action of the Owner, or its successors or assigns, then the Owner and its successors or assigns agree(s) to hold the County harmless and pay all costs incurred by the County in enforcing the terms of this Agreement, including reasonable attorney's fees and costs, and that the same shall become a part of the lien against said Property.
8. It is the intent of the parties hereto that burdens and benefits herein undertaken shall constitute covenants that run with said Property and constitute a lien there against.
9. The obligations herein undertaken shall be binding upon the heirs, successors, executors, administrators and assigns of the parties hereto. The term "Owner" shall include not only the present Owner, but also its heirs, successors, executors, administrators, and assigns. Owner shall notify any successor to title of all or part of the Property about the existence of this Agreement. Owner shall provide such notice prior to such successor obtaining an interest in all or part of the Property. Owner shall provide a copy of such notice to the County at the same time such notice is provided to the successor.
10. Time is of the essence in the performance of this Agreement.
11. Any notice to a party required or called for in this Agreement shall be served in person, or by deposit in the U.S. Mail, first class postage prepaid, to the address set forth below. Notice(s) shall be deemed effective upon receipt, or seventy-two (72) hours after deposit in the U.S. Mail, whichever is earlier. A party may change a notice address only by providing written notice thereof to the other party.
12. The Owner its successors and assigns, hereby agrees to save and hold harmless the County, any of its departments, agencies, officers or employees, all of whom while working within their respective authority, from all cost, injury and damage incurred by any of the above, and from any other injury or damage to any person or property whatsoever, any of which is caused by an activity, condition or event arising out of the performance, preparation for performance or nonperformance of any provision of this agreement by the Owner, its agents, or any of its independent contractors.

[REMAINDER OF THIS PAGE INTENTIONALLY LEFT BLANK]

IF TO COUNTY :

IF TO OWNER:

Director of Public Works _____

825 E. Third Street, Room 201 _____

San Bernardino, CA 92415-0835 _____

IN WITNESS THEREOF, the parties hereto have affixed their signatures as of the date first written above.

OWNER:

Signature: _____

Name: _____

Title

OWNER:

Signature: _____

Name: _____

Title

NOTARIES ON FOLLOWING PAGE

A notary acknowledgement is required for recordation (attach appropriate acknowledgement).

ACCEPTED BY:

GERRY NEWCOMBE, Director of Public Works

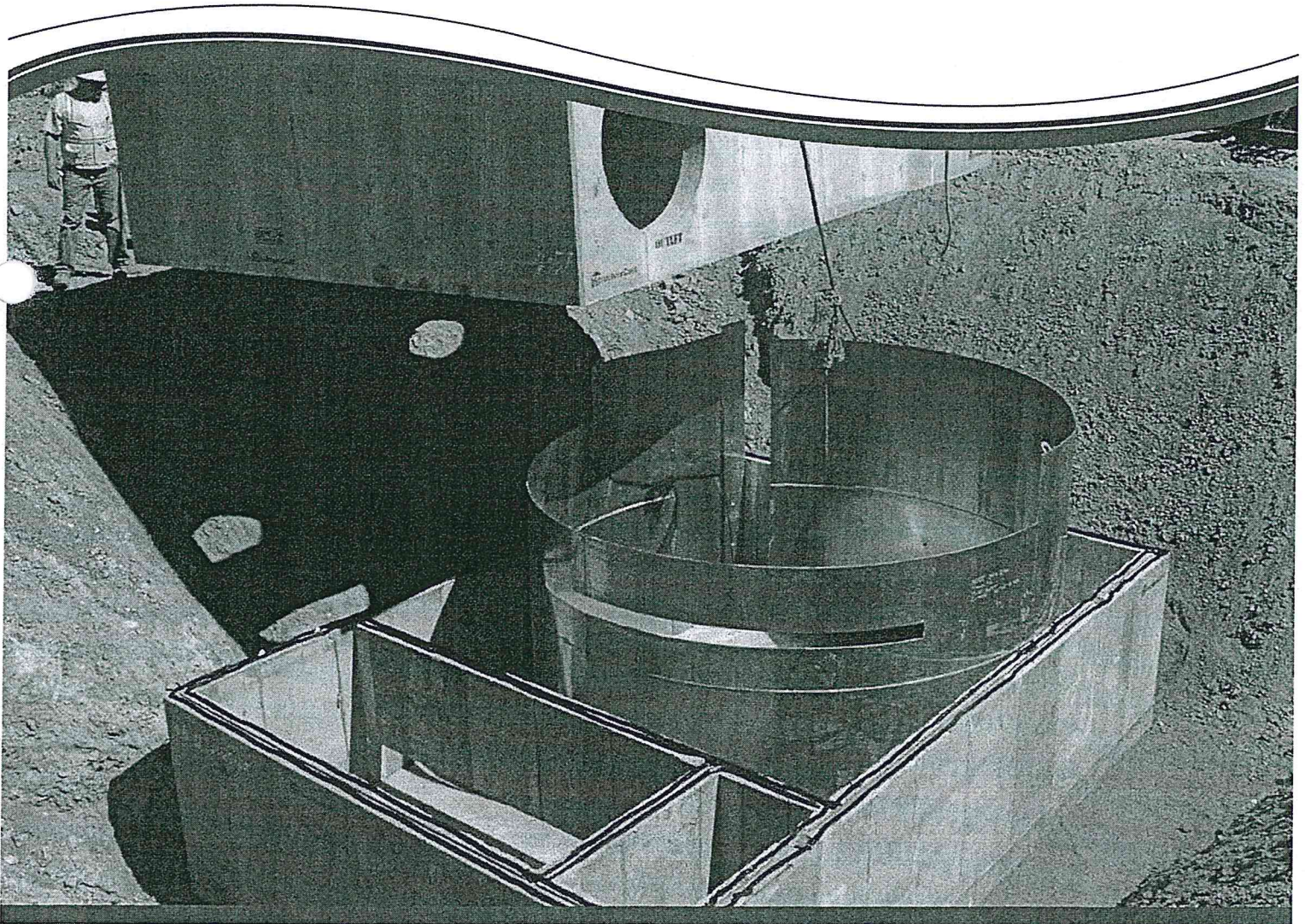
Date: _____

Attachment: Standard Notary Acknowledgement

EXHIBIT A
(Legal Description)

EXHIBIT B
(Map/illustration)

Vortechs[®] Guide Operation, Design, Performance and Maintenance



Vortechs®

The Vortechs system is a high-performance hydrodynamic separator that effectively removes finer sediment (e.g. 50-microns (μm), oil, and floating and sinking debris). The swirl concentration operation and flow controls work together to minimize turbulence and provide stable storage of captured pollutants. Precast models can treat peak design flows up to 30-cfs (850-l/s); cast-in-place models handle even greater flows. A typical system is sized to provide a specific removal efficiency of a predefined particle size distribution (PSD).

Operation Overview

Stormwater enters the swirl chamber inducing a gentle swirling flow pattern and enhancing gravitational separation. Sinking pollutants stay in the swirl chamber while floatables are stopped at the baffle wall. Vortechs systems are usually sized to efficiently treat the frequently occurring runoff events and are primarily controlled by the low flow control orifice. This orifice effectively reduces inflow velocity and turbulence by inducing a slight backwater that is appropriate to the site.

During larger storms, the water level rises above the low flow control orifice and begins to flow through the high flow control. Any layer of floating pollutants is elevated above the invert of the Floatables Baffle Wall, preventing release. Swirling action increases in relation to the storm intensity, while sediment pile remains stable. When the storm drain is flowing at peak capacity, the water surface in the system approaches the top of the high flow control. The Vortechs system will be sized large enough so that previously captured pollutants are retained in the system, even during these infrequent events.

As a storm subsides, treated runoff decants out of the Vortechs system at a controlled rate, restoring the water level to a dry-weather level equal to the invert of the inlet pipe. The low water level facilitates easier inspection and cleaning, and significantly reduces maintenance costs by reducing pump-out volume.

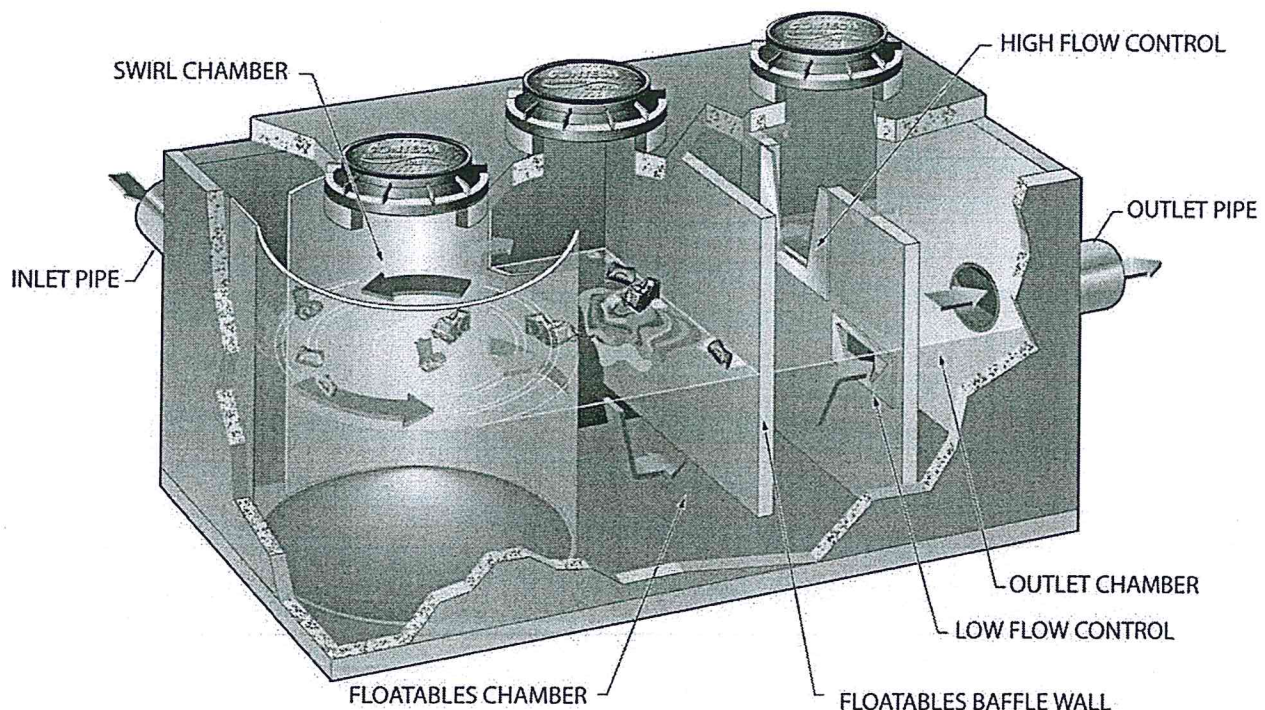
Design Basics

Each Vortechs system is custom designed based on site size, site runoff coefficient, regional precipitation intensity distribution, and anticipated pollutant characteristics. There are two primary methods of sizing a Vortechs system. The first is to determine which model size provides the desired removal efficiency at a given flow for a defined particle size or PSD. The second and more in depth method is the summation of Rational Rainfall Method™ which uses a summation process described below in detail and is used when a specific removal efficiency of the net annual sediment load is required.

Typically Vortechs systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for either 50- μm particles, or a particle gradation found in typical urban runoff (see performance section of this manual for more information).

The 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 Vortechs 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.

Once a system size is established, the internal elements of the system are designed based on information provided by the site engineer. Flow control sizes and shapes, sump depth, oil spill storage capacity, sediment storage volume and inlet and outlet orientation are determined for each system. In addition, bypass weir calculations are made for off-line systems.

Flow Control Calculations

Low Flow Control

The low flow control, or orifice, is typically sized to submerge the inlet pipe when the Vortechs system is operating at 20% of its treatment capacity. The orifice is typically a Cipolletti shaped aperture defined by its flat crest and sides which incline outwardly at a slope of 1 horizontal to 4 vertical.

$$Q_{\text{orifice}} = C_d \cdot A \cdot \sqrt{2gh}$$

Where:

Q_{orifice} = flow through orifice, cfs (L/s)

C_d = orifice coefficient of discharge = 0.56 (based on lab tests)

A = orifice flow area, ft² (m²) (calculated by orifice geometry)

h = design head, ft (m) (equal to the inlet pipe diameter)

g = acceleration due to gravity (32.2-ft/s² (9.81-m/s²))

The minimum orifice crest length is 3-in (76-mm) and the minimum orifice height is 4-in (102-mm). If flow must be restricted beyond what can be provided by this size aperture, a Fluidic-Amp™ HydroBrake flow control will be used. The HydroBrake allows the minimum flow constriction to remain at 3-in (76-mm) or greater while further reducing flow due to its unique throttling action.

High Flow Control

The high flow control, or weir, is sized to pass the peak system capacity minus the peak orifice flow when the water surface elevation is at the top of the weir. This flow control is also a Cipolletti type weir.

The weir flow control is sized by solving for the crest length and head in the following equation:

$$Q_{\text{weir}} = C_d \cdot L \cdot (h)^{3/2}$$

Where:

Q_{weir} = flow through weir, cfs (L/s)

C_d = Cipolletti weir coefficient = 3.37 (based on lab testing)

h = available head, ft (m) (height of weir)

L = design weir crest length, ft (m)

Bypass Calculations

In most all cases, pollutant removal goals can be met without treating peak flow rates and it is most feasible to use a smaller Vortechs system configured with an external bypass. In such cases, a bypass design is recommended by CONTECH Stormwater Solutions for each off-line system. To calculate the bypass capacity, first subtract the system's treatment capacity from the peak conveyance capacity of the collection system (minimum of 10-year recurrence interval). The result is the flow rate that must be bypassed to avoid surcharging the Vortechs system. Then use the following arrangement of the Francis formula to calculate the depth of flow over the bypass weir.

$$H = (Q_{\text{bypass}} / (C_d \cdot L))^{2/3}$$

Where:

H = depth of flow over bypass weir crest, ft (m)

Q_{bypass} = required bypass flow, cfs (L/s)

C_d = discharge coefficient = 3.3 for rectangular weir

L = length of bypass weir crest, ft

The bypass weir crest elevation is then calculated to be the elevation at the top of the Cipolletti weir minus the depth of flow.

Hydraulic Capacity

In the event that the peak design flow from the site is exceeded, it is important that the Vortechs system is not a constriction to runoff leaving the site. Therefore, each system is designed with enough hydraulic capacity to pass the 100-year flow rate. It is important to note that at operating rates above 100-gpm/ft² (68-Lps/m²) of the swirl chamber area (peak treatment capacity), captured pollutants may be lost.

When the system is operating at peak hydraulic capacity, water will be flowing through the gap over the top of the flow control wall as well as the orifice and the weir.

Performance

Full Scale Laboratory Test Results

Laboratory testing was conducted on a full scale Vortechs model 2000. The 150- μm curve demonstrates the results of tests using particles that passed through a 60-mesh sieve and were retained on a 100-mesh sieve. The 50- μm curve is based on tests of particles passing through a 200-mesh sieve and retained on a 400-mesh sieve (38- μm). A gradation with an average particle size (d50) of 80- μm , containing particles ranging from 38-500- μm in diameter was used to represent typical stormwater solids. (Table 1)

Particle Size Distribution (μm)	Percentage of Sample Make-Up
<63	42%
63 - 75	4%
75 - 100	9%
100 - 150	7%
150 - 250	11%
>250	27%

Table 1: Particle gradation of typical urban runoff used for efficiency curve

As shown, the Vortechs system maintains positive total suspended solids (TSS), defined by the tested gradations, removal efficiencies over the full range of operating rates. This allows the system to effectively treat all runoff from large, infrequent design storms, as well as runoff from more frequent low-intensity storms.

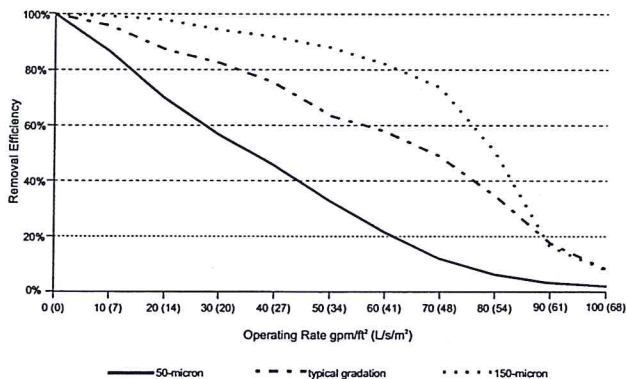


Figure 1: Vortechs model 2000 Removal Efficiencies

Typical Vortechs systems are designed to treat peak flows from 1.6-cfs (45-L/s) up to 30-cfs (850-L/s) online without the need for bypass. However, external bypasses can be configured to convey peak flows around the system if treatment capacity is exceeded. The system can also be configured to direct low flows from the last chamber of the system to polishing treatment when more stringent water quality standards are imposed. In all configurations, high removal efficiencies are achieved during the lower intensity storms, which constitute the majority of annual rainfall volume.

Full report available at www.contechstormwater.com.

Laboratory Testing

Full reports available at www.contechstormwater.com

Technical Bulletin 1: Removal Efficiencies for Selected Particle Gradations

Technical Bulletin 2: Particle Distribution of Sediments and the Effect on Heavy Metal Removal

Technical Bulletin 3: Sizing for Net Annual Sediment Removal

Technical Bulletin 3a: Determining Bypass Weir Elevation for Off-Line Systems

Technical Bulletin 4: Modeling Long Term Load Reduction: The Rational Rainfall Method

Technical Bulletin 5: Oil Removal Efficiency

Field Monitoring

Following are brief summaries of the field tests completed to date.

Full reports available at www.contechstormwater.com

DeLorme Mapping Company

Yarmouth, ME

CONTECH Stormwater Solutions

Prior to this premier field test of the Vortechs system, CONTECH developed an extensive body of laboratory data to document total suspended solids (TSS) removal efficiency. CONTECH performed this field study in order to compare the performance predicted using laboratory data to the performance of a correctly sized system in the field.

The study site was the headquarters of DeLorme Mapping in Yarmouth, Maine. The building, driveway, parking lot and ancillary facilities were constructed in 1996. A Vortechs model 11000 was installed to treat runoff from the 300-space, 4-acre (1.62-ha) parking lot.

Testing Period	May 1999 to Dec 1999
# of Storms Sampled	20
Mean Influent Concentration	328-mg/L
Mean Effluent Concentration	60-mg/L
Removal Efficiency	82%

The main purpose of the DeLorme study was to verify that the sizing methodology developed from our full-scale laboratory testing was valid and an accurate means of predicting field performance. The results of the study confirmed our sizing methodology.

Village Marine Drainage

Lake George, NY

New York State Department of Environmental Conservation, Division of Water

The New York State DEC used funds obtained in a Section 319 grant to initiate a study of the effectiveness of the Vortechs system to remove sediment and other pollutants transported

by stormwater to Lake George, Lake George Village, New York. "Since the 1970s, when there was a rapid increase in the rate and concentration of development along the southwestern shores of Lake George, we have been concerned about the impact of stormwater discharges into the lake," said Tracy West, co-author of the study.

Testing Period	Feb 2000 to Dec 2000
# of Storms Sampled	13
Mean Influent Concentration	801-mg/L
Mean Effluent Concentration	105-mg/L
Removal Efficiency	88%

The study concluded that the Village and Town of Lake George should consider installing additional Vortechs systems in areas where sedimentation and erosion have been identified as non-point source pollution problems.

**Harding Township Rest Area
Harding Township, NJ
RTP Environmental Associates**

This third party evaluation was performed under a U.S. Environmental Protection Agency grant, administered by the New Jersey Department of Environmental Protection. A. Roger Greenway, principal of RTP Environmental Associates, Inc., conducted the study in conjunction with Thonet Associates, which assisted with data analysis and helped develop best management practices (BMP) recommendations.

The Vortechs model 4000 was sized to handle a 100-year storm from the 3 acre (1.21 ha) paved parking area at the Harding Rest Stop, located off the northbound lane of I-287 in Harding Township, New Jersey.

Testing Period	May 1999 to Nov 2000
# of Storms Sampled	5
Mean Influent Concentration (TSS)	493-mg/L
Mean Effluent Concentration (TSS)	35-mg/L
Removal Efficiency (TSS)	93%
Mean Influent Concentration (TPH)	16-mg/L
Mean Effluent Concentration (TPH)	5-mg/L
Removal Efficiency (TPH)	67%

The study concluded that truck rest stops and similar parking areas would benefit from installing stormwater treatment systems to mitigate the water quality impacts associated with stormwater runoff from these sites.

**Timothy Edwards Middle School
South Windsor, CT**

UCONN Department of Civil & Environmental Engineering

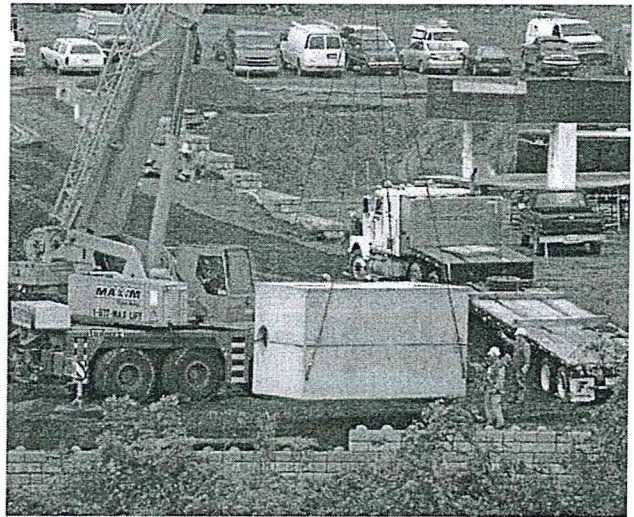
This study of the Vortechs system was published as a thesis by Susan Mary Board, as part of the requirements for a Master of Science degree from the University of Connecticut. Her objective was to determine how well the Vortechs system retained pollutants from parking lot runoff, including total suspended solids (TSS), nutrients, metals, and petroleum hydrocarbons.

A Vortechs model 5000 was installed in 1998 to treat runoff from the 82-space parking lot of Timothy Edwards Middle School. The entire watershed was approximately 2 acres (0.81 ha), and was 80% impervious.

Testing Period	Jul 2000 to Apr 2001
# of Storms Sampled	weekly composite samples taken
Mean Influent Concentration	324-mg/L
Mean Effluent Concentration	73-mg/L
Removal Efficiency	77%

Additionally, the Vortechs system was particularly effective in removing zinc (85%), lead (46%), copper (56%), phosphorus (67%) and nitrate (54%).

The study concluded that the Vortechs system significantly reduced effluent concentrations of many pollutants in stormwater runoff.



Maintenance

The Vortechs 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, e.g., unstable soils or heavy winter sanding will cause the swirl chamber to fill more quickly but regular sweeping will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant deposition and transport may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. Inspections should be performed twice per year (i.e. spring and fall) however more frequent inspections may be necessary in equipment washdown areas and in climates where winter sanding operations may lead to rapid accumulations. It is useful and often required as part of a permit to keep a record of each inspection. A simple inspection and maintenance log form for doing so is provided on the following page, and is also available on contechstormwater.com.

The Vortechs system should be cleaned when inspection reveals that the sediment depth has accumulated to within 12 to 18 inches (300 to 450 mm) of the dry-weather water surface elevation. This determination can be made by taking two measurements with a stadia rod or similar measuring device; one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. **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. Finer, silty particles at the top of the pile typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile.

Cleaning

Cleaning of the Vortechs system should be done during dry weather conditions when no flow is entering the system. Clean-out of the Vortechs system with a vacuum truck is generally the most effective and convenient method of excavating pollutants from the system. If such a truck is not available, a "clamshell" grab may be used, but it is difficult to remove all accumulated pollutants using a "clamshell".

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, an oil or gasoline spill should be cleaned out immediately. 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 adsorbent pads to solidify the oil since these pads are usually much easier to remove from the unit individually and less expensive to dispose of than the oil/water emulsion that may be created by vacuuming the oily layer. Floating trash can be netted out if you wish to separate it from the other pollutants.

Cleaning of a Vortechs system is typically done by inserting a vacuum hose into the swirl chamber and evacuating this chamber of water and pollutants. As water is evacuated, the water level outside of the swirl chamber will drop to a level roughly equal to the crest of the lower aperture of the swirl chamber. The water outside the swirl chamber should remain

near this level throughout pumping as the bottom and sides of the swirl chamber are sealed to the tank floor and walls. This "water lock" feature prevents water from migrating into the swirl chamber, exposing the bottom of the baffle wall and creating excess pump-out volume. Floating pollutants will decant into the swirl chamber as the water level is drawn down. This allows most floating material to be withdrawn from the same access point above the swirl chamber. Floating material that does not decant into the swirl chamber during draw down should be skimmed from the baffle chamber. If maintenance is not performed as recommended, sediment may accumulate outside the swirl chamber. If this is the case, it may be necessary to pump out other chambers. It is advisable to check for sediment accumulation in all chambers during inspection and maintenance.

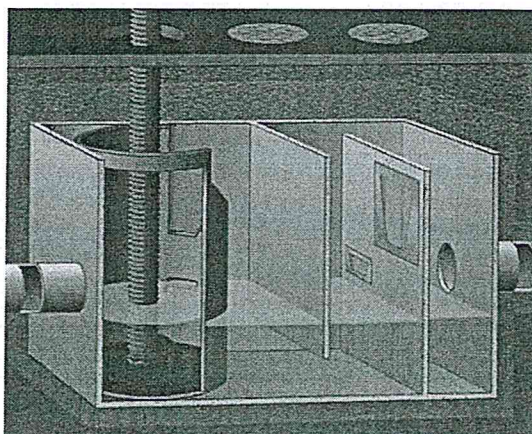
These maintenance recommendations apply to all Vortechs systems with the following exceptions:

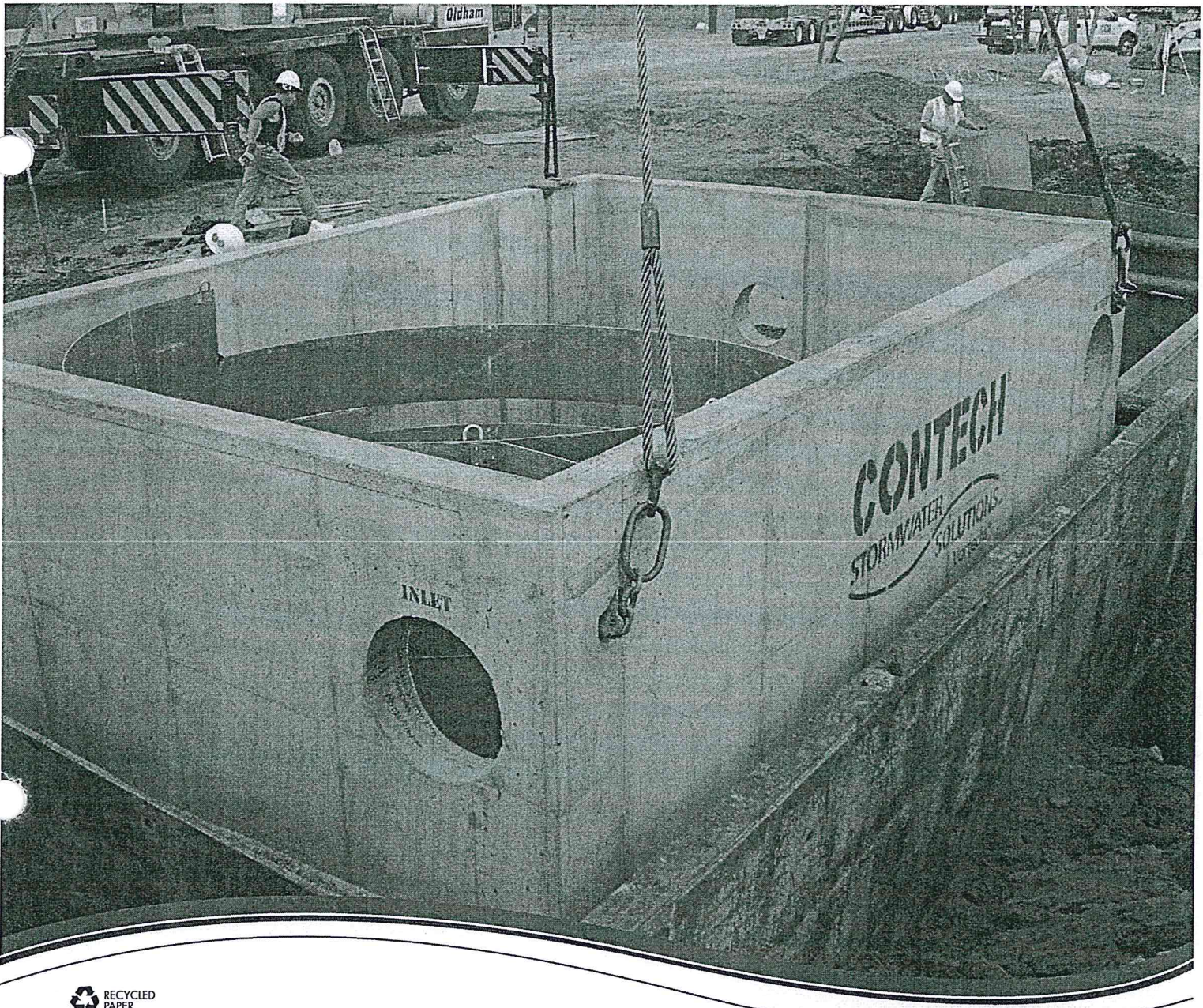
1. It is strongly recommended that when cleaning systems larger than the Model 16000 the baffle chamber be drawn down to depth of three feet prior to beginning clean-out of the swirl chamber. Drawing down this chamber prior to the swirl chamber reduces adverse structural forces pushing upstream on the swirl chamber once that chamber is empty.
2. Entry into a Vortechs system is generally not required as cleaning can be done from the ground surface. However, if manned entry into a system is required the entire system should be evacuated of water prior to entry regardless of the system size.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure proper safety precautions. If anyone physically enters the unit, Confined Space Entry procedures need to be followed.

Disposal of all material removed from the Vortechs system should be done in accordance with local regulations. In many locations, disposal of evacuated sediments may be handled in the same manner as disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.

For assistance with maintaining your Vortechs system, contact us regarding the CONTECH Maintenance Compliance Certification Program.





800.925.5240
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Support

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

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