Bryan W. Shaw, Ph.D., P.E., *Chairman*
Toby Baker, *Commissioner*
Jon Niermann, *Commissioner*
Richard A. Hyde, P.E., *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

January 24, 2017

Mr. Robert Daigle
Continental Homes of Texas, L.P.
210 West Hutchison Street
San Marcos, Texas 78666

RECEIVED
JAN 31 2017
COUNTY ENGINEER

Re: Edwards Aquifer, Comal County

NAME OF PROJECT: Manor Creek Subdivision Units 4 - 6; Located on the north side of State Highway 46, approximately 2 miles west of the intersection of Loop 337 and State Highway 46; New Braunfels, Texas

TYPE OF PLAN: Request for Modification of an Approved Water Pollution Abatement Plan (WPAP); 30 Texas Administrative Code (TAC) Chapter 213 Edwards Aquifer

Regulated Entity No. RN108449968; Additional ID No. 13000297

Dear Mr. Daigle:

The Texas Commission on Environmental Quality (TCEQ) has completed its review of the WPAP modification for the above-referenced project submitted to the San Antonio Regional Office by HMT Engineering & Surveying on behalf of Continental Homes of Texas, L.P. on November 22, 2016. As presented to the TCEQ, the Temporary and Permanent Best Management Practices (BMPs) were selected and construction plans were prepared by a Texas Licensed Professional Engineer to be in general compliance with the requirements of 30 TAC Chapter 213. These planning materials were sealed, signed and dated by a Texas Licensed Professional Engineer. Therefore, based on the engineer's concurrence of compliance, the planning materials for construction of the proposed project and pollution abatement measures are hereby approved subject to applicable state rules and the conditions in this letter. The applicant or a person affected may file with the chief clerk a motion for reconsideration of the executive director's final action on this Edwards Aquifer Protection Plan. A motion for reconsideration must be filed no later than 23 days after the date of this approval letter. *This approval expires two (2) years from the date of this letter unless, prior to the expiration date, more than 10 percent of the construction has commenced on the project or an extension of time has been requested.*

BACKGROUND

The project was originally approved by letter dated January 8, 2016. It included the construction of 197 residential units with associated driveways, streets, and sidewalks on a 95.97 acre site. The impervious cover was 36.0 acres (37.51 percent).

PROJECT DESCRIPTION

The proposed residential project will have an area of approximately 94.78 acres. It will include the construction of 197 residential lots. The impervious cover foot print for the residential lots within unit 4 will increase from 3,300 square feet per lot to 4,600 square feet. Sand filter basins A4-1 and A4-5 will be sized to accommodate the increased TSS load. The projects impervious cover will be 38.18 acres (40.28 percent). Project wastewater will be disposed of by conveyance to the existing Gruene Road Wastewater Treatment Plant owned by New Braunfels Utilities.

PERMANENT POLLUTION ABATEMENT MEASURES

To prevent the pollution of stormwater runoff originating on-site or upgradient of the site and potentially flowing across and off the site after construction, five partial sedimentation/filtration basins, three grassy swales and 14 engineered vegetative filter strips, designed using the TCEQ technical guidance document, Complying with the Edwards Aquifer Rules: Technical Guidance on Best Management Practices (2005), will be constructed to treat stormwater runoff. The required total suspended solids (TSS) treatment for this project is 34,274 pounds of TSS generated from the 38.18 acres of impervious cover. The approved measures meet the required 80 percent removal of the increased load in TSS caused by the project.

Two sedimentation/filtration basins are proposed for Unit 4. Basin 4-1 will have a geomembrane liner and be designed with a 4 inch perforated PVC underdrain system that will be covered with a minimum 6 inch gravel layer. Geotextile fabric will be placed over the gravel layer and topped with a minimum of 18 inches of sand (ASTM C-33 compliant). The basin will be designed with a water quality volume of 20,432 cubic feet (12,542 cubic feet required), and a sand filter area of 1,050 square feet (1,045 square feet required).

Basin 4-5 will have a geomembrane liner and be designed with a 4 inch perforated PVC underdrain system that will be covered with a minimum 6 inch gravel layer. Geotextile fabric will be placed over the gravel layer and topped with a minimum of 18 inches of sand (ASTM C-33 compliant). The basin will be designed with a water quality volume of 34,286 cubic feet (25,317 cubic feet required), and a sand filter area of 2,152 square feet (2,110 square feet required).

Two partial sedimentation/filtration basins are proposed for Unit 5. Basin 5-1 will have a geomembrane liner and be designed with a 4 inch perforated PVC underdrain system that will be covered with a minimum 6 inch gravel layer. Geotextile fabric will be placed over the gravel layer and topped with a minimum of 18 inches of sand (ASTM C-33 compliant). The basin will be designed with a water quality volume of 124,011 cubic feet (123,961 cubic feet required), and a sand filter area of 10,535 square feet (10,330 square feet required).

Basin 5-6 will have a geomembrane liner and be designed with a 4 inch perforated PVC underdrain system that will be covered with a minimum 6 inch gravel layer. Geotextile fabric will be placed over the gravel layer and topped with a minimum of 18 inches of sand (ASTM C-33 compliant). The basin will be designed with a water quality volume of 36,033 cubic feet (34,214 cubic feet required), and a sand filter area of 2,943 square feet (2,851 square feet required).

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One partial sedimentation/filtration basin is proposed for Unit 6. Basin 6-1 will have a geomembrane liner and be designed with a 4 inch perforated PVC underdrain system that will be covered with a minimum 6 inch gravel layer. Geotextile fabric will be placed over the gravel layer and topped with a minimum of 18 inches of sand (ASTM C-33 compliant). The basin will be designed with a water quality volume of 38,839 cubic feet (38,807 cubic feet required), and a sand filter area of 3,234 square feet (3,234 square feet required).

Two grassy swales are located within Unit 4 and on within unit 5. The Longitudinal slope of grassy swale 4-2 is 1.00 percent with a bottom width of 2 feet, and side slopes no greater than a 3:1 ratio. The longitudinal slope of grassy swale 4-7 is 0.50 percent with a bottom width of 5 feet, and side slopes no greater than a 3:1 ratio. The longitudinal slope of grassy swale 5-2 is 2.5 percent with a bottom width of 5.5 feet, and side slopes no greater than a 3:1 ratio. The grassy swales will maintain a vegetative cover of at least 80 percent.

The engineered vegetative filter strips will be at least 15 feet wide (in the direction of flow), and will extend along the entire length of the contributing areas with no gullies, rills, or obstructions that will concentrate flow. The VFS will have a uniform slope of less than 20 percent, and will maintain a vegetated cover of at least 80 percent.

A summary of BMPs is listed in the table below. Note that uncaptured areas have been accounted for with overtreatment provided by the five sedimentation/filtration basins.

Unit 4 BMPs					
Sub-Basin	BMP	Total Area (Acres)	Impervious Area (Acres)	Required TSS Removal (lbs/yr)	Provided TSS Removal (lbs/yr)
4-1	Sand Filter	4.67	2.98	2,676	2,681
4-2	Grassy Swale	0.49	0.36	322	289
4-3	VFS	2.38	1.48	1,327	1,327
4-4	VFS	1.65	0.95	853	853
4-5	Sand Filter	6.63	3.89	3,491	3,796
4-6	VFS	0.61	0.11	95	95
4-7	Grassy Swale	0.68	0.57	510	455
4-15	Uncaptured	1.37	0.24	217	-
Total		18.48	10.58	9,491	9,496

Unit 5 BMPs					
Sub-Basin	BMP	Total Area (Acres)	Impervious Area (Acres)	Required TSS Removal (lbs/yr)	Provided TSS Removal (lbs/yr)
5-1	Sand Filter	12.56	5.77	5,183	5,441
5-2	Grassy Swale	1.02	0.68	610	377
5-3	VFS	0.28	0.07	64	64
5-4	VFS	5.24	0.71	641	641
5-4A	Uncaptured	0.28	0.17	152	-
5-5	VFS	0.83	0.29	257	257
5-6	Sand Filter	14.39	6.66	5,982	6,294
5-7	VFS	3.96	1.43	1,283	1,283
5-8	VFS	2.88	0.57	513	513
5-9	VFS	2.60	0.57	513	513
5-12	Uncaptured	0.30	0.20	183	-
Total		44.34	17.12	15,381	15,383

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Unit 6 BMPs					
Sub-Basin	BMP	Total Area (Acres)	Impervious Area (Acres)	Required TSS Removal (lbs/yr)	Provided TSS Removal (lbs/yr)
6-1	Sand Filter	15.59	6.695	6,009	6,323
6-2	VFS	1.56	0.572	513	513
6-3	VFS	1.68	0.572	513	513
6-4	VFS	1.91	0.857	770	770
6-5	VFS	2.24	0.857	770	770
6-6	VFS	1.55	0.572	513	513
6-8	Uncaptured	0.22	0.15	131	--
6-12	Uncaptured	0.30	0.20	183	--
Total		25.05	10.47	9,402	9,402

GEOLOGY

According to the geologic assessment included with the application, the site is located within the cyclic and marine members and leached and collapsed members of the Person Formation. Twenty-eight geologic features were assessed by the project geologist. Five of the 28 geologic features were rated as sensitive (S-15, S-38, S-70, S-71, and S-85). A 50 foot natural buffer surrounds each sensitive feature and is shown on the site plan for Unit 4, Unit 5, and Unit 6. In addition, a clear span bridge will protect feature S-38 which is located in a watercourse. The San Antonio Regional Office did not conduct a site assessment.

SPECIAL CONDITIONS

I. This modification is subject to all Special and Standard Conditions listed in the WPAP approval letter dated January 8, 2016.

II. Each permanent pollution abatement measure shall be operational prior to first occupancy of any structure within its drainage area.

III. All sediment and/or media removed from the water quality basins during maintenance activities shall be properly disposed of according to 30 TAC 330 or 30 TAC 335, as applicable.

STANDARD CONDITIONS

1. Pursuant to Chapter 7 Subchapter C of the Texas Water Code, any violations of the requirements in 30 TAC Chapter 213 may result in administrative penalties.
2. The holder of the approved Edwards Aquifer protection plan must comply with all provisions of 30 TAC Chapter 213 and all best management practices and measures contained in the approved plan. Additional and separate approvals, permits, registrations and/or authorizations from other TCEQ Programs (i.e., Stormwater, Water Rights, UIC) can be required depending on the specifics of the plan.
3. In addition to the rules of the Commission, the applicant may also be required to comply with state and local ordinances and regulations providing for the protection of water quality.

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Prior to Commencement of Construction:

4. Within 60 days of receiving written approval of an Edwards Aquifer Protection Plan, the applicant must submit to the San Antonio Regional Office, proof of recordation of notice in the county deed records, with the volume and page number(s) of the county deed records of the county in which the property is located. A description of the property boundaries shall be included in the deed recordation in the county deed records. A suggested form (Deed Recordation Affidavit, TCEQ-0625) that you may use to deed record the approved WPAP is enclosed.
5. All contractors conducting regulated activities at the referenced project location shall be provided a copy of this notice of approval. At least one complete copy of the approved WPAP and this notice of approval shall be maintained at the project location until all regulated activities are completed.
6. Modification to the activities described in the referenced WPAP application following the date of approval may require the submittal of a plan to modify this approval, including the payment of appropriate fees and all information necessary for its review and approval prior to initiating construction of the modifications.
7. The applicant must provide written notification of intent to commence construction, replacement, or rehabilitation of the referenced project. Notification must be submitted to the San Antonio Regional Office no later than 48 hours prior to commencement of the regulated activity. Written notification must include the date on which the regulated activity will commence, the name of the approved plan and program ID number for the regulated activity, and the name of the prime contractor with the name and telephone number of the contact person. The executive director will use the notification to determine if the approved plan is eligible for an extension.
8. Temporary erosion and sedimentation (E&S) controls, i.e., silt fences, rock berms, stabilized construction entrances, or other controls described in the approved WPAP, must be installed prior to construction and maintained during construction. Temporary E&S controls may be removed when vegetation is established and the construction area is stabilized. If a water quality pond is proposed, it shall be used as a sedimentation basin during construction. The TCEQ may monitor stormwater discharges from the site to evaluate the adequacy of temporary E&S control measures. Additional controls may be necessary if excessive solids are being discharged from the site.
9. All borings with depths greater than or equal to 20 feet must be plugged with non-shrink grout from the bottom of the hole to within three (3) feet of the surface. The remainder of the hole must be backfilled with cuttings from the boring. All borings less than 20 feet must be backfilled with cuttings from the boring. All borings must be backfilled or plugged within four (4) days of completion of the drilling operation. Voids may be filled with gravel.

During Construction:

10. During the course of regulated activities related to this project, the applicant or agent shall comply with all applicable provisions of 30 TAC Chapter 213, Edwards Aquifer. The applicant shall remain responsible for the provisions and conditions of this approval until such responsibility is legally transferred to another person or entity.
11. This approval does not authorize the installation of temporary aboveground storage tanks on this project. If the contractor desires to install a temporary aboveground storage tank for use during construction, an application to modify this approval must be submitted and approved prior to installation. The application must include information related to tank location and spill containment. Refer to Standard Condition No. 6, above.

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12. If any sensitive feature (caves, solution cavities, sink holes, etc.) is discovered during construction, all regulated activities near the feature must be suspended immediately. The applicant or his agent must immediately notify the San Antonio Regional Office of the discovery of the feature. Regulated activities near the feature may not proceed until the executive director has reviewed and approved the methods proposed to protect the feature and the aquifer from potentially adverse impacts to water quality. The plan must be sealed, signed, and dated by a Texas Licensed Professional Engineer.
13. No wells exist on site. All water wells, including injection, dewatering, and monitoring wells must be in compliance with the requirements of the Texas Department of Licensing and Regulation under Title 16 TAC Chapter 76 (relating to Water Well Drillers and Pump Installers) and all other locally applicable rules, as appropriate.
14. If sediment escapes the construction site, the sediment must be removed at a frequency sufficient to minimize offsite impacts to water quality (e.g., fugitive sediment in street being washed into surface streams or sensitive features by the next rain). Sediment must be removed from sediment traps or sedimentation ponds not later than when design capacity has been reduced by 50 percent. Litter, construction debris, and construction chemicals shall be prevented from becoming stormwater discharge pollutants.
15. Intentional discharges of sediment laden water are not allowed. If dewatering becomes necessary, the discharge will be filtered through appropriately selected best management practices. These may include vegetated filter strips, sediment traps, rock berms, silt fence rings, etc.
16. The following records shall be maintained and made available to the executive director upon request: the dates when major grading activities occur, the dates when construction activities temporarily or permanently cease on a portion of the site, and the dates when stabilization measures are initiated.
17. Stabilization measures shall be initiated as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, and construction activities will not resume within 21 days. When the initiation of stabilization measures by the 14th day is precluded by weather conditions, stabilization measures shall be initiated as soon as practicable.

<u>After Completion of Construction:</u>

18. A Texas Licensed Professional Engineer must certify in writing that the permanent BMPs or measures were constructed as designed. The certification letter must be submitted to the San Antonio Regional Office within 30 days of site completion.
19. The applicant shall be responsible for maintaining the permanent BMPs after construction until such time as the maintenance obligation is either assumed in writing by another entity having ownership or control of the property (such as without limitation, an owner's association, a new property owner or lessee, a district, or municipality) or the ownership of the property is transferred to the entity. The regulated entity shall then be responsible for maintenance until another entity assumes such obligations in writing or ownership is transferred. A copy of the transfer of responsibility must be filed with the executive director through San Antonio Regional Office within 30 days of the transfer. A copy of the transfer form (TCEQ-10263) is enclosed.
20. Upon legal transfer of this property, the new owner(s) is required to comply with all terms of the approved Edwards Aquifer protection plan. If the new owner intends to commence any new regulated activity on the site, a new Edwards Aquifer protection plan that specifically addresses the new activity must be submitted to the executive director. Approval of the plan for the new regulated activity by the executive director is required prior to commencement of the new regulated activity.

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21. An Edwards Aquifer protection plan approval or extension will expire and no extension will be granted if more than 50 percent of the total construction has not been completed within ten years from the initial approval of a plan. A new Edwards Aquifer protection plan must be submitted to the San Antonio Regional Office with the appropriate fees for review and approval by the executive director prior to commencing any additional regulated activities.
22. At project locations where construction is initiated and abandoned, or not completed, the site shall be returned to a condition such that the aquifer is protected from potential contamination.

This action is taken under authority delegated by the Executive Director of the Texas Commission on Environmental Quality. If you have any questions or require additional information, please contact Mr. Alex Grant of the Edwards Aquifer Protection Program of the San Antonio Regional Office at 210-403-4035

Sincerely,

Lynn Bumguardner, Water Section Manager
San Antonio Region
Texas Commission on Environmental Quality

LB/AG/eg

Enclosures: Deed Recordation Affidavit, Form TCEQ-0625
Change in Responsibility for Maintenance of Permanent BMPs, Form TCEQ-10263

cc: Mr. Christopher Van Heerde, P.E, HMT Engineering & Surveying
Mr. Robert Camareno, City of New Braunfels
Mr. Tom Hornseth, P.E., Comal County
Mr. H. L. Saur, Comal Trinity Groundwater Conservation District
Mr. Roland Ruiz, Edwards Aquifer Authority
TCEQ Central Records, Building F, MC 212

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Bryan W. Shaw, Ph.D., *Chairman*
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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

November 22, 2016

RECEIVED
NOV 29 2016
COUNTY ENGINEER

Mr. Thomas H. Hornseth, P.E.
Comal County Engineer
195 David Jonas Drive
New Braunfels TX 78132-3710

Re: Edwards Aquifer, Comal County

PROJECT NAME: Manor Creek Units 4, 5, & 6 Acres, located on Allemania Drive, New Braunfels, Texas

PLAN TYPE: Application for Approval of a Water Pollution Abatement Plan (WPAP) 30 Texas Administration Code (TAC) Chapter 213; Edwards Aquifer Protection Program

Dear Mr. Hornseth:

The referenced application is being forwarded to you pursuant to the Edwards Aquifer Rules. The Texas Commission on Environmental Quality (TCEQ) is required by 30 TAC Chapter 213 to provide copies of all applications to affected incorporated cities and underground water conservation districts for their comments prior to TCEQ approval. More information regarding this project may be obtained from the TCEQ Central Registry website at http://www.tceq.state.tx.us/permitting/central_registry/.

Please forward your comments to this office by December 22, 2016.

The Texas Commission on Environmental Quality appreciates your assistance in this matter and your compliance efforts to ensure protection of the State's environment. If you or members of your staff have any questions regarding these matters, please feel free to contact the San Antonio Region Office at (210) 490-3096.

Sincerely

Todd Jones

Todd Jones, Water Section Work Leader
San Antonio Regional Office

TJ/eg

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NOV 29 2016
COUNTY ENGINEER

Manor Creek Subdivision Units 4-6

RECEIVED
TCEQ-R13 (EAPP)
NOV 22 2016
SAN ANTONIO

A distinguished project by:

Continental Homes of Texas, L.P. dba DR Horton

Water Pollution Abatement Plan Report

Chris Van Heerde, PE
11/1/16

New Braunfels, Texas
Submittal November 2016

Prepared by:

HMT
ENGINEERING & SURVEYING

410 N. Seguin Ave.
New Braunfels, TX 78130
HMTNB.COM
830.625.8555 • FAX: 830.625.8556
TBPE FIRM F-10961

Water Pollution Abatement Plan Checklist

- **Edwards Aquifer Application Cover Page (TCEQ-20705)**
- **General Information Form (TCEQ-0587)**

  Attachment A - Road Map
  Attachment B - USGS / Edwards Recharge Zone Map
  Attachment C - Project Description

- **Geologic Assessment Form (TCEQ-0585)**

  Attachment A - Geologic Assessment Table (TCEQ-0585-Table)
  Comments to the Geologic Assessment Table
  Attachment B - Soil Profile and Narrative of Soil Units
  Attachment C - Stratigraphic Column
  Attachment D - Narrative of Site Specific Geology
  Site Geologic Map(s)
  Table or list for the position of features' latitude/longitude (if mapped using GPS)

- **Water Pollution Abatement Plan Application Form (TCEQ-0584)**

  Attachment A - Factors Affecting Water Quality
  Attachment B - Volume and Character of Stormwater
  Attachment C - Suitability Letter from Authorized Agent (if OSSF is proposed)
  Attachment D - Exception to the Required Geologic Assessment (if requesting an exception)
  Site Plan

- **Temporary Stormwater Section (TCEQ-0602)**

  Attachment A - Spill Response Actions
  Attachment B - Potential Sources of Contamination
  Attachment C - Sequence of Major Activities
  Attachment D - Temporary Best Management Practices and Measures
  Attachment E - Request to Temporarily Seal a Feature, if sealing a feature
  Attachment F - Structural Practices
  Attachment G - Drainage Area Map
  Attachment H - Temporary Sediment Pond(s) Plans and Calculations
  Attachment I - Inspection and Maintenance for BMPs
  Attachment J - Schedule of Interim and Permanent Soil Stabilization Practices

- **Permanent Stormwater Section (TCEQ-0600)**

  Attachment A - 20% or Less Impervious Cover Waiver, if project is multi-family residential, a school, or a small business and 20% or less impervious cover is proposed for the site
  Attachment B - BMPs for Upgradient Stormwater

Attachment C - BMPs for On-site Stormwater
Attachment D - BMPs for Surface Streams
Attachment E - Request to Seal Features (if sealing a feature)
Attachment F - Construction Plans
Attachment G - Inspection, Maintenance, Repair and Retrofit Plan
Attachment H - Pilot-Scale Field Testing Plan, if BMPs not based on Complying with the Edwards Aquifer Rules: Technical Guidance for BMPs
Attachment I -Measures for Minimizing Surface Stream Contamination

- **Agent Authorization Form (TCEQ-0599), if application submitted by agent**
- **Application Fee Form (TCEQ-0574)**
- **Check Payable to the "Texas Commission on Environmental Quality"**
- **Core Data Form (TCEQ-10400)**

Texas Commission on Environmental Quality

Edwards Aquifer Application Cover Page

Our Review of Your Application

The Edwards Aquifer Program staff conducts an administrative and technical review of all applications. The turnaround time for administrative review can be up to 30 days as outlined in 30 TAC 213.4(e). Generally administrative completeness is determined during the intake meeting or within a few days of receipt. The turnaround time for technical review of an administratively complete Edwards Aquifer application is 90 days as outlined in 30 TAC 213.4(e). Please know that the review and approval time is directly impacted by the quality and completeness of the initial application that is received. In order to conduct a timely review, it is imperative that the information provided in an Edwards Aquifer application include final plans, be accurate, complete, and in compliance with 30 TAC 213.

Administrative Review

1. Edwards Aquifer applications must be deemed administratively complete before a technical review can begin. To be considered administratively complete, the application must contain completed forms and attachments, provide the requested information, and meet all the site plan requirements. The submitted application and plan sheets should be final plans. Please submit one full-size set of plan sheets with the original application, and half-size sets with the additional copies.

   To ensure that all applicable documents are included in the application, the program has developed tools to guide you and web pages to provide all forms, checklists, and guidance. Please visit the below website for assistance: http://www.tceq.texas.gov/field/eapp.

2. This Edwards Aquifer Application Cover Page form (certified by the applicant or agent) must be included in the application and brought to the administrative review meeting.

3. Administrative reviews are scheduled with program staff who will conduct the review. Applicants or their authorized agent should call the appropriate regional office, according to the county in which the project is located, to schedule a review. The average meeting time is one hour.

4. In the meeting, the application is examined for administrative completeness. Deficiencies will be noted by staff and emailed or faxed to the applicant and authorized agent at the end of the meeting, or shortly after. Administrative deficiencies will cause the application to be deemed incomplete and returned.

   An appointment should be made to resubmit the application. The application is re-examined to ensure all deficiencies are resolved. The application will only be deemed administratively complete when all administrative deficiencies are addressed.

5. If an application is received by mail, courier service, or otherwise submitted without a review meeting, the administrative review will be conducted within 30 days. The applicant and agent will be contacted with the results of the administrative review. If the application is found to be administratively incomplete, it can be retrieved from the regional office or returned by regular mail. If returned by mail, the regional office may require arrangements for return shipping.

6. If the geologic assessment was completed before October 1, 2004 and the site contains "possibly sensitive" features, the assessment must be updated in accordance with the *Instructions to Geologists* (TCEQ-0585 Instructions).

Technical Review

1. When an application is deemed administratively complete, the technical review period begins. The regional office will distribute copies of the application to the identified affected city, county, and groundwater conservation district whose jurisdiction includes the subject site. These entities and the public have 30 days to provide comments on the application to the regional office. All comments received are reviewed by TCEQ.

2. A site assessment is usually conducted as part of the technical review, to evaluate the geologic assessment and observe existing site conditions. The site must be accessible to our staff. The site boundaries should be clearly marked, features identified in the geologic assessment should be flagged, roadways marked and the alignment of the Sewage Collection System and manholes should be staked at the time the application is submitted. If the site is not marked the application may be returned.

3. We evaluate the application for technical completeness and contact the applicant and agent via Notice of Deficiency (NOD) to request additional information and identify technical deficiencies. There are two deficiency response periods available to the applicant. There are 14 days to resolve deficiencies noted in the first NOD. If a second NOD is issued, there is an additional 14 days to resolve deficiencies. If the response to the second notice is not received, is incomplete or inadequate, or provides new information that is incomplete or inadequate, the application must be withdrawn or if not withdrawn the application will be denied and the application fee will be forfeited.

4. The program has 90 calendar days to complete the technical review of the application. If the application is technically adequate, such that it complies with the Edwards Aquifer rules, and is protective of the Edwards Aquifer during and after construction, an approval letter will be issued. Construction or other regulated activity may not begin until an approval is issued.

Mid-Review Modifications

It is important to have final site plans prior to beginning the permitting process with TCEQ to avoid delays.

Occasionally, circumstances arise where you may have significant design and/or site plan changes after your Edwards Aquifer application has been deemed administratively complete by TCEQ. This is considered a "Mid-Review Modification". Mid-Review Modifications may require redistribution of an application that includes the proposed modifications for public comment.

If you are proposing a Mid-Review Modification, two options are available to you:

- You can withdraw your application, and your fees will be refunded or credited for a resubmittal.
- TCEQ can continue the technical review of the application as it was submitted, and a modification application can be submitted at a later time.

If the application is withdrawn, the resubmitted application will be subject to the administrative and technical review processes and will be treated as a new application. The application will be redistributed to the effected jurisdictions.

Please contact the regional office if you have questions. If your project is located in Williamson, Travis, or Hays County, contact TCEQ's Austin Regional Office at 512-339-2929. If your project is in Comal, Bexar, Medina, Uvalde, or Kinney County, contact TCEQ's San Antonio Regional Office at 210-490-3096

Please fill out all required fields below and submit with your application.

1. Regulated Entity Name: Manor Creek Subdivision Units 4-6						**2. Regulated Entity No.:**			
3. Customer Name: Continental Homes of Texas, L.P. dba DR Horton						**4. Customer No.:** 602550360			
5. Project Type: (Please circle/check one)	New		Modification			Extension		Exception	
6. Plan Type: (Please circle/check one)	WPAP	CZP	SCS	UST	AST	EXP	EXT	Technical Clarification	Optional Enhanced Measures
7. Land Use: (Please circle/check one)	Residential		Non-residential			**8. Site (acres):**		94.78	
9. Application Fee:	$6,500		**10. Permanent BMP(s):**			N/A			
11. SCS (Linear Ft.):	N/A		**12. AST/UST (No. Tanks):**			N/A			
13. County:	Comal		**14. Watershed:**			Bleiders Creek			

Application Distribution

Instructions: Use the table below to determine the number of applications required. One original and one copy of the application, plus additional copies (as needed) for each affected incorporated city, county, and groundwater conservation district are required. Linear projects or large projects, which cross into multiple jurisdictions, can require additional copies. Refer to the "Texas Groundwater Conservation Districts within the EAPP Boundaries" map found at:

http://www.tceq.texas.gov/assets/public/compliance/field_ops/eapp/EAPP%20GWCD%20map.pdf

For more detailed boundaries, please contact the conservation district directly.

Austin Region			
County:	**Hays**	**Travis**	**Williamson**
Original (1 req.)	___	___	___
Region (1 req.)	___	___	___
County(ies)	___	___	___
Groundwater Conservation District(s)	___Edwards Aquifer Authority ___Barton Springs/ Edwards Aquifer ___Hays Trinity ___Plum Creek	___Barton Springs/ Edwards Aquifer	NA
City(ies) Jurisdiction	___Austin ___Buda ___Dripping Springs ___Kyle ___Mountain City ___San Marcos ___Wimberley ___Woodcreek	___Austin ___Bee Cave ___Pflugerville ___Rollingwood ___Round Rock ___Sunset Valley ___West Lake Hills	___Austin ___Cedar Park ___Florence ___Georgetown ___Jerrell ___Leander ___Liberty Hill ___Pflugerville ___Round Rock

San Antonio Region					
County:	**Bexar**	**Comal**	**Kinney**	**Medina**	**Uvalde**
Original (1 req.)	___	X	___	___	___
Region (1 req.)	___	X	___	___	___
County(ies)	___	X	___	___	___
Groundwater Conservation District(s)	___ Edwards Aquifer Authority ___Trinity-Glen Rose	X Edwards Aquifer Authority	___Kinney	___EAA ___Medina	___EAA ___Uvalde
City(ies) Jurisdiction	___Castle Hills ___Fair Oaks Ranch ___Helotes ___Hill Country Village ___Hollywood Park ___San Antonio (SAWS) ___Shavano Park	___Bulverde ___Fair Oaks Ranch ___Garden Ridge X New Braunfels ___Schertz	NA	___San Antonio ETJ (SAWS)	NA

I certify that to the best of my knowledge, that the application is complete and accurate. This application is hereby submitted to TCEQ for administrative review and technical review.
Chris Van Heerde. C.F.M.. P.E.
Print Name of Customer/Authorized Agent
Chris Van Heerde PE 11/01/2016
Signature of Customer/Authorized Agent Date

FOR TCEQ INTERNAL USE ONLY				
Date(s)Reviewed:		Date Administratively Complete:		
Received From:		Correct Number of Copies:		
Received By:		Distribution Date:		
EAPP File Number:		Complex:		
Admin. Review(s) (No.):		No. AR Rounds:		
Delinquent Fees (Y/N):		Review Time Spent:		
Lat./Long. Verified:		SOS Customer Verification:		
Agent Authorization Complete/Notarized (Y/N):		Fee Check:	Payable to TCEQ (Y/N):	
Core Data Form Complete (Y/N):			Signed (Y/N):	
Core Data Form Incomplete Nos.:			Less than 90 days old (Y/N):	

General Information Form

Texas Commission on Environmental Quality

For Regulated Activities on the Edwards Aquifer Recharge and Transition Zones and Relating to 30 TAC §213.4(b) & §213.5(b)(2)(A), (B) Effective June 1, 1999

To ensure that the application is administratively complete, confirm that all fields in the form are complete, verify that all requested information is provided, consistently reference the same site and contact person in all forms in the application, and ensure forms are signed by the appropriate party.

Note: Including all the information requested in the form and attachments contributes to more streamlined technical reviews.

Signature

To the best of my knowledge, the responses to this form accurately reflect all information requested concerning the proposed regulated activities and methods to protect the Edwards Aquifer. This **General Information Form** is hereby submitted for TCEQ review. The application was prepared by:

Print Name of Customer/Agent: Chris Van Heerde, C.F.M., P.E.

Date: 11/1/2016

Signature of Customer/Agent:

Chris Van Heerde, PE

Project Information

1. Regulated Entity Name: Manor Creek Subdivision Units 4-6
2. County: Comal
3. Stream Basin: Bleiders Creek
4. Groundwater Conservation District (If applicable): Edwards Aquifer Authority
5. Edwards Aquifer Zone:

   ☒ Recharge Zone
   ☐ Transition Zone

6. Plan Type:

   ☒ WPAP
   ☐ SCS
   ☒ Modification
   ☐ AST
   ☐ UST
   ☐ Exception Request

7. Customer (Applicant):

Contact Person: Robert Daigle
Entity: Continental Homes of Texas, L.P.
Mailing Address: 210 West Hutchison Street
City, State: San Marcos, Texas Zip: 78666
Telephone: 512-805-3600 FAX: 844-693-1213
Email Address: radaigle@drhorton.com

8. Agent/Representative (If any):

Contact Person: Chris Van Heerde, C.F.M., P.E.
Entity: HMT Engineering & Surveying
Mailing Address: 410 N. Sequin Avenue
City, State: New Braunfels, Texas Zip: 78130
Telephone: 830-625-8555 FAX: 830-625-8556
Email Address: chrisvh@hmtnb.com

9. Project Location:

☒ The project site is located inside the city limits of New Braunfels.
☐ The project site is located outside the city limits but inside the ETJ (extra-territorial jurisdiction) of _____.
☐ The project site is not located within any city's limits or ETJ.

10. ☒ The location of the project site is described below. The description provides sufficient detail and clarity so that the TCEQ's Regional staff can easily locate the project and site boundaries for a field investigation.

Beginning at TCEQ San Antonio regional office, head south on Judson Road towards Villa Camino, turn left onto I-35 Frontage Road, take the ramp on the left onto I-35 North. Take exit 184 toward TX-337 Loop/Farm to Market Rd 482/Rueckle Rd, merge onto I-35 Frontage Road, and turn left onto TX-337 Loop N/S Rueckle Rd. Turn left onto TX-46E/State Spur 453/N Walnut Ave, and then turn right onto Hamburg Avenue to enter the Manor Creek Subdivision. Turn left onto Kleem St and then turn right onto Allemania Drive.

11. ☒ **Attachment A – Road Map**. A road map showing directions to and the location of the project site is attached. The project location and site boundaries are clearly shown on the map.

12. ☒ **Attachment B - USGS / Edwards Recharge Zone Map**. A copy of the official 7 ½ minute USGS Quadrangle Map (Scale: 1" = 2000') of the Edwards Recharge Zone is attached. The map(s) clearly show:

☒ Project site boundaries.
☒ USGS Quadrangle Name(s).
☒ Boundaries of the Recharge Zone (and Transition Zone, if applicable).
☒ Drainage path from the project site to the boundary of the Recharge Zone.

13. ☒ **The TCEQ must be able to inspect the project site or the application will be returned.** Sufficient survey staking is provided on the project to allow TCEQ regional staff to locate the boundaries and alignment of the regulated activities and the geologic or manmade features noted in the Geologic Assessment.

☒ Survey staking will be completed by this date: May 15,2015

14. ☒ **Attachment C – Project Description**. Attached at the end of this form is a detailed narrative description of the proposed project. The project description is consistent throughout the application and contains, at a minimum, the following details:

☒ Area of the site
☒ Offsite areas
☒ Impervious cover
☒ Permanent BMP(s)
☒ Proposed site use
☒ Site history
☒ Previous development
☒ Area(s) to be demolished

15. Existing project site conditions are noted below:

☐ Existing commercial site
☐ Existing industrial site
☐ Existing residential site
☐ Existing paved and/or unpaved roads
☐ Undeveloped (Cleared)
☒ Undeveloped (Undisturbed/Uncleared)
☐ Other: _____

Prohibited Activities

16. ☒ I am aware that the following activities are prohibited on the Recharge Zone and are not proposed for this project:

(1) Waste disposal wells regulated under 30 TAC Chapter 331 of this title (relating to Underground Injection Control);

(2) New feedlot/concentrated animal feeding operations, as defined in 30 TAC §213.3;

(3) Land disposal of Class I wastes, as defined in 30 TAC §335.1;

(4) The use of sewage holding tanks as parts of organized collection systems; and

(5) New municipal solid waste landfill facilities required to meet and comply with Type I standards which are defined in §330.41(b), (c), and (d) of this title (relating to Types of Municipal Solid Waste Facilities).

(6) New municipal and industrial wastewater discharges into or adjacent to water in the state that would create additional pollutant loading.

17. ☒ I am aware that the following activities are prohibited on the Transition Zone and are not proposed for this project:

(1) Waste disposal wells regulated under 30 TAC Chapter 331 (relating to Underground Injection Control);

(2) Land disposal of Class I wastes, as defined in 30 TAC §335.1; and

(3) New municipal solid waste landfill facilities required to meet and comply with Type I standards which are defined in §330.41 (b), (c), and (d) of this title.

Administrative Information

18. The fee for the plan(s) is based on:

☒ For a Water Pollution Abatement Plan or Modification, the total acreage of the site where regulated activities will occur.
☐ For an Organized Sewage Collection System Plan or Modification, the total linear footage of all collection system lines.
☐ For a UST Facility Plan or Modification or an AST Facility Plan or Modification, the total number of tanks or piping systems.
☐ A request for an exception to any substantive portion of the regulations related to the protection of water quality.
☐ A request for an extension to a previously approved plan.

19. ☒ Application fees are due and payable at the time the application is filed. If the correct fee is not submitted, the TCEQ is not required to consider the application until the correct fee is submitted. Both the fee and the Edwards Aquifer Fee Form have been sent to the Commission's:

☐ TCEQ cashier
☐ Austin Regional Office (for projects in Hays, Travis, and Williamson Counties)
☒ San Antonio Regional Office (for projects in Bexar, Comal, Kinney, Medina, and Uvalde Counties)

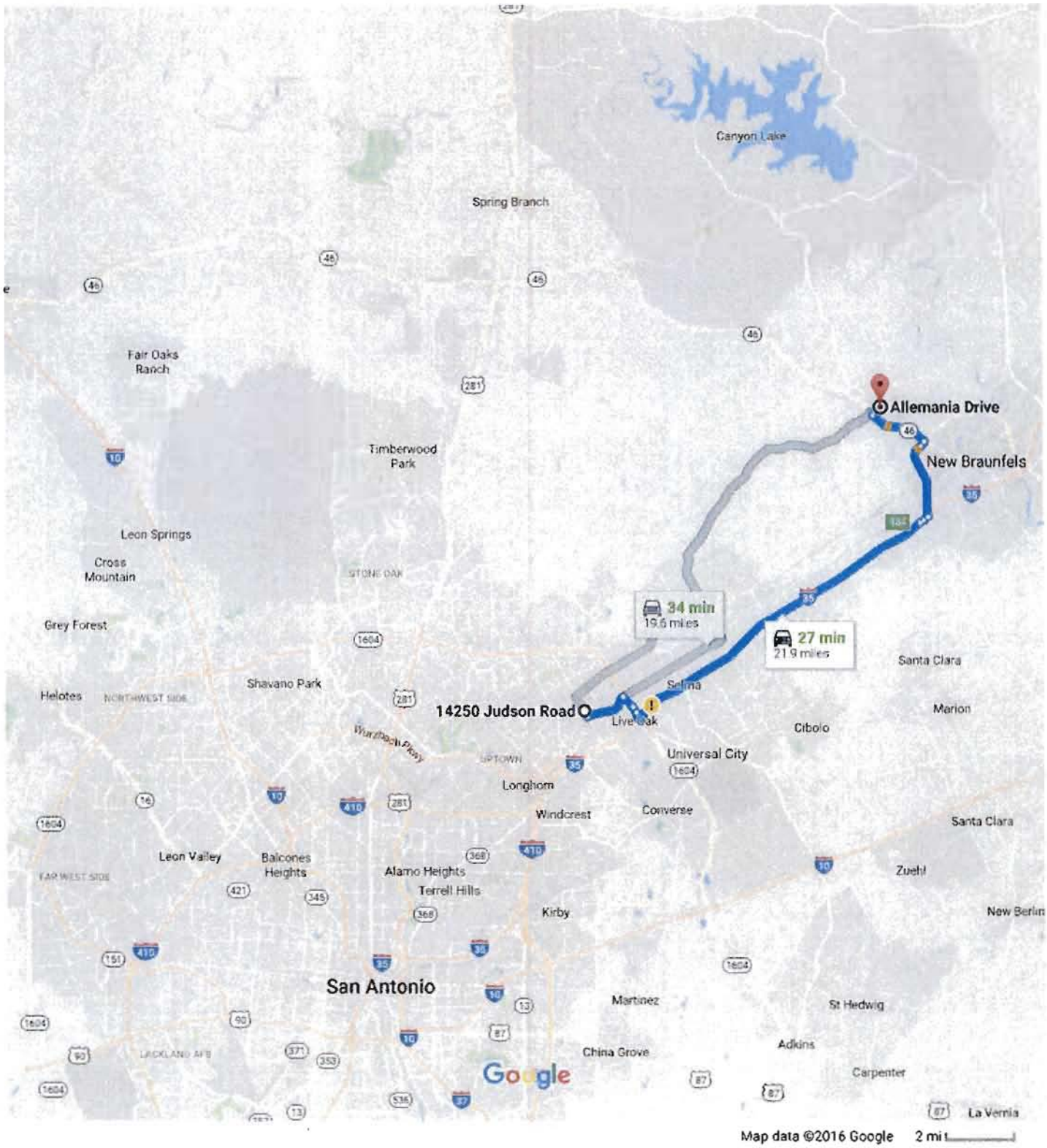
20. ☒ Submit one (1) original and one (1) copy of the application, plus additional copies as needed for each affected incorporated city, groundwater conservation district, and county in which the project will be located. The TCEQ will distribute the additional copies to these jurisdictions. The copies must be submitted to the appropriate regional office.

21. ☒ No person shall commence any regulated activity until the Edwards Aquifer Protection Plan(s) for the activity has been filed with and approved by the Executive Director.

Google Maps

14250 Judson Road, San Antonio, TX 78233 to Allemania Drive, New Braunfels, TX 78132

Drive 21.9 miles, 27 min



14250 Judson Road

San Antonio, TX 78233

Get on I-35 N in Selma from Lookout Rd

6 min (3.5 mi)

1. Head south on Judson Rd toward Villa Camino

476 ft

2. Turn left to stay on Judson Rd

0.1 mi

3. Turn left onto Lookout Rd

1.6 mi

4. Turn right onto N Loop 1604 E

0.5 mi

5. Use the left lane to take the Texas 1604 Loop S ramp

0.3 mi

6. Keep right at the fork, follow signs for I-35 N/Austin and merge onto I-35 N

0.8 mi

Follow I-35 N to Interstate 35 Frontage Rd in New Braunfels. Take exit 184 from I-35 N

11 min (12.4 mi)

7. Merge onto I-35 N

12.3 mi

8. Take exit 184 toward TX-337 Loop/Farm to Market Rd 482/Rueckle Rd

0.1 mi

Take TX-337 Loop N and TX-46 E to Klemm St

11 min (6.0 mi)

9. Merge onto Interstate 35 Frontage Rd

0.2 mi

10. Turn left onto TX-337 Loop N/S Rueckle Rd
    Continue to follow TX-337 Loop N

2.8 mi

11. Use the right lane to take the TX-46 W/TX-46 BUS ramp to Boerne/New Braunfels

0.2 mi

12. Turn left onto TX-46 E

2.2 mi

13. Turn right onto Hamburg Ave
    Restricted usage road

0.4 mi

14. Turn left onto Klemm St
    Restricted usage road

351 ft

Allemania Drive

New Braunfels, TX 78132

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Edwards Aquifer Recharge Zone a
Edwards Aquifer Authority
STATE OF TEXAS
TEXAS WATER DEVELOPME

HMT
ENGINEERING & SURVEYING
410 N. SEGUIN AVE.
NEW BRAUNFELS,
TEXAS 78130
PH: (830)625-8555
FAX: (830)625-8556
www.HMTNB.com
TBPE FIRM F-10961

10/23/15

ATTACHMENT B -
USGS/EDWARDS
RECHARGE ZONE MAP

CIVIL SITE CONSTRUCTION PLANS

MANOR CREEK UNITS 4, 5, & 6 WPAP

DR HORTON
210 W. HUTCHISON
SAN MARCOS, TEXAS 78666

DATE: JUNE 2015
DRAWN BY: KNK
DESIGNED BY: DJM
CHECKED BY: CVH
REVIEWED BY: SMH
PROJECT NO. 031.024.105

SHEET
B

GENERAL INFORMATION FORM
ATTACHMENT C
Project Description

The proposed Manor Creek Subdivision project (previously titled Tschurhart Ranch Subdivision) is located on Hamburg Avenue, New Braunfels, Texas. The subdivision is within the New Braunfels city limits. The total subdivision site covers a total of 267.03 Acres and divided into 6 Units. Manor Creek Units 1-3 have been completed and contain 164 lots on 171.169 Acres. Construction of homes within Unit 3 is currently on going; however, all street and drainage improvements are currently complete. When fully developed Units 1, 2B, and 3 will have 34.067 Acres of impervious cover, or 19.90% of the total area. The WPAP for Manor Creek Subdivision Units 1-3 was approved on December 11, 2015 and is included within this application. Manor Creek Subdivision Units 4-6 represent the remainder of the land owned by Continental Homes of Texas, L.P. in this development which totals 94.78 Acres and is currently undeveloped. Construction of the roads in Unit 5A will start shortly and Unit 4 is at the beginning stages of construction. To date clearing has occurred and rough-cut of the street to subgrade is in progress. Paving is likely to occur in the 2nd quarter of 2017. There is no existing impervious cover on the 94.78 Acres of Units 4, 5A, 5B, and 6 at this time. In proposed conditions, the impervious cover of Units 4-6 increases to be 38.18 Acres or 40.28% at the full development of the site. The pervious WPAP for Manor Creek Units 4-6 was approved on January 8, 2016 and is included within this application.

The proposed residential subdivision improvements include the construction of 8" gravity wastewater lines, a 4" force main, a lift station, and 197 lots. The impervious cover that has been and is planned to be constructed for Manor Creek Units 4-6 will exceed the maximum 20% impervious cover. Therefore, Units 4-6 will have permanent BMPs to treat the impervious cover from these units. Unit 5 has been split into two phases, Phase 5A consists of a total area of 22.08 Acres (drainage area 5.8 and all drainage areas to the west). Phase 5B consists of a total area of 23.59 Acres which is be the remainder of the drainage areas in Unit 5. There are platted lots within Unit 4 and 6 that will contribute open space to the remaining 20% Impervious Cover WPAP for Manor Creek Subdivision Units 1, 2B, and 3. These areas include Lot 200 in Unit 6 (15.04 Acres), Lot 201 in Unit 4 (68.86 Acres), and Lot 202 in Unit 4 (2.65 Acres). Exhibit C1 shows the areas included in this WPAP, the areas in the less than 20% Impervious Cover WPAP, and the Manor Creek Amenity Center (Unit 2A) which has a sand basin as the Permanent BMP and remains unchanged. Vegetative Filter Strips, Sand Filter Systems, and Grassy Swales are the proposed permanent BMPS to be constructed on the residential subdivision site as shown in the Manor Creek Subdivision, Units 4-6 Site Construction Plans on Sheet 11 of Unit 4, Sheet 10A for Phase 5A and 10B for Phase 5B of Unit 5, and Sheet 8 of Unit 6. Continental Homes of Texas, L.P. dba DR Horton is the permitted entity that will operate the proposed site.

Units 4-6 will be constructed in four separate phases. The phases will be constructed in the following order: 5A, 4, 5B, and 6.

The Manor Creek Subdivision Units 4-6 Water Pollution Abatement Plan is being modified because the proposed changes would affect the design of the previously designed and approved

permanent BMPs. DR Horton wants to increase the proposed building footprints for Manor Creek Subdivision Unit 4 from 3,300 square foot (SF) per lot to 4,600 SF per. The 4,600 SF was calculated assuming 4,035 SF for the home, 450 SF for driveway, and 450 SF for Private Sidewalks and other future improvements by homeowners. This increase in impervious cover increases the overall required TSS Removal from 7,544 lbs. to 9,491 lbs. The comparison of the previous impervious cover and the modified impervious cover due to the increased building footprints for Manor Creek Subdivision Unit 4 can be seen below in Table 1. The Permanent BMPs increase in size due to the increased impervious cover for Manor Creek Subdivision Unit 4 (see Table 2 below for comparison). The changes in sand filter basin A4-1 and A4-5 to provide sufficient TSS removal to treat the increased impervious cover (see Tables 3 and 4, below).

Table 1: Impervious Cover Breakdown Comparison		
	Approved WPAP (sq ft)	Modification Impervious Cover (sq ft)
Streets	141,913	153,177
Building Footprint	3,300 sq ft * 64 lots= 211,200	4600 sq ft * 64 lots = 294,400
Concrete 'U' Channel	3,787	3,787
Fire Access Road	9,222	9,222
Total	366,122	460,586

Table 2: Permanent BMP Comparison						
	Impervious Area (acres)	Imp %	L_R (lbs)	L_M (lbs)	L_M (lbs) Desired	Required TSS Removed
Approved Design	8.41	50	8,046	7,544	7,580	7,544
Modified Design	10.57	59.5	10,065	9,491	9,496	9,491
Total Increase	2.16	9.5	2,019	1,947	1,916	1,947

Table 3: Sand Filter Basin A4-1		
	Approved Design	Modified Design
WQ Volume Required	12,542 CF	13,585 CF
WQ Volume Provided	20,432 CF	20,432 CF
Sedimentation Area Required	1,045 SF	283 SF
Sedimentation Area Provided	1,050 SF	840 SF
Filter Area Required	1,045 SF	1,132 SF
Filter Area Provided	1,050 SF	1,225 SF
WQ Storage Depth	5.21 Feet	5.06 Feet
TSS Removed	2,202 LBS	2,681 LBS

Table 4: Sand Filter Basin A4-5		
	Approved Design	Modified Design
WQ Volume Required	25,314 CF	32,805 CF
WQ Volume Provided	34,288 CF	34,286 CF
Sedimentation Area Required	2,110 SF	683 SF
Sedimentation Area Provided	2,110 SF	1,494 SF
Filter Area Required	2,100 SF	2,734 SF
Filter Area Provided	2,152 SF	2,767 SF
WQ Storage Depth	5.0 Feet	5.12 Feet
TSS Removed	3,020 LBS	9,846 LBS

All other portions of the previously approved WPAP have not been modified.

Bryan W. Shaw, Ph.D., P.E., *Chairman*
Toby Baker, *Commissioner*
Jon Niermann, *Commissioner*
Richard A. Hyde, P.E., *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

December 11, 2015

Mr. Daniel Clawson II
Continental Homes of Texas, L.P.
210 West Hutchison Street
San Marcos, Texas 78666

Re: Edwards Aquifer, Comal County

NAME OF PROJECT: Manor Creek Subdivision; Located on the north side of State Highway 46, approximately 2 miles west of the intersection of Loop 337 and State Highway 46; New Braunfels, Texas

TYPE OF PLAN: Request for Modification of an Approved Water Pollution Abatement Plan (WPAP); 30 Texas Administrative Code (TAC) Chapter 213 Edwards Aquifer

Regulated Entity No. RN105801568; Investigation No. 1255265; Additional ID No. 13-15060902

Dear Mr. Clawson:

The Texas Commission on Environmental Quality (TCEQ) has completed its review of the WPAP Modification for the above-referenced project submitted to the San Antonio Regional Office by HMT Engineering & Surveying on behalf of Continental Homes of Texas, L.P. on June 9, 2015. Final review of the WPAP was completed after additional material was received on September 30, 2015, November 10, 2015, and December 1, 2015. As presented to the TCEQ, the Temporary and Permanent Best Management Practices (BMPs) were selected and construction plans were prepared by a Texas Licensed Professional Engineer to be in general compliance with the requirements of 30 TAC Chapter 213. These planning materials were sealed, signed and dated by a Texas Licensed Professional Engineer. Therefore, based on the engineer's concurrence of compliance, the planning materials for construction of the proposed project and pollution abatement measures are hereby approved subject to applicable state rules and the conditions in this letter. The applicant or a person affected may file with the chief clerk a motion for reconsideration of the executive director's final action on this Edwards Aquifer Protection Plan. A motion for reconsideration must be filed no later than 23 days after the date of this approval letter. *This approval expires two (2) years from the date of this letter unless, prior to the expiration date, more than 10 percent of the construction has commenced on the project or an extension of time has been requested.*

BACKGROUND

The Manor Creek Subdivision (formerly known as Tschirhart Ranch) was originally approved by letter dated April 4, 2006 for a single family residential development on 252.038 acres. The project proposed to develop 343 lots, roads, and utilities. The impervious cover was 50.29 acres (19.95 percent) and a less than 20 percent impervious cover exemption from installing permanent BMPs was approved.

The plan was subsequently modified by letter dated April 8, 2010. That project proposed to increase the overall site area by 15 acres, dedicate 0.123 acres of the site to TxDOT, and construct 340 single family residential lots, roads, and utilities on 266.92 acres. The impervious cover was increased from 50.29 acres to 53.141 acres (19.91 percent). Since the total impervious cover remained below 20 percent an exemption from installing permanent BMPs was approved.

A separate WPAP for a community center within the Manor Creek Subdivision was approved by letter dated May 4, 2010. The commercial project included the construction of a community pool, restroom facility, storage building, parking, and associated utilities on a 1.08 acre site. The impervious cover was 0.318 acres (29.4 percent). One sedimentation/filtration basin and engineered vegetative filter strips were constructed to provide permanent stormwater treatment.

PROJECT DESCRIPTION

The proposed residential project will have an area of approximately 171.169 acres. It will include the construction of 164 single-family residential lots, roads, and associated utilities within Units 1, 2, and 3. The impervious cover will be 34.067 acres (19.90 percent). Project wastewater will be disposed of by conveyance to the existing Gruene Road Wastewater Treatment Plant owned by New Braunfels Utilities. Residential development within Units 4, 5 and 6 will be separated from the site and submitted with a new WPAP application.

PERMANENT POLLUTION ABATEMENT MEASURES

This single-family residential project will not have more than 20 percent impervious cover.

GEOLOGY

According to the geologic assessment included with the application, the site is located on the Cyclic and Marine and Leached and Collapsed members of the Edwards Person Formation. The report identified 76 features (13 sensitive and 63 non-sensitive) within the site limits. The San Antonio Regional Office did not conduct a site assessment.

Sensitive Features

Natural buffers were proposed for 13 sensitive geologic features. According to FEMA maps, the features are shown near or within Zone A of the 100-year flood plain along Blieders Creek. All of the sensitive features except S-89 are shown surrounded with rock berms. Feature S-89 is shown in a "no disturbance" area delineated on the site plan for the WPAP. No regulated activities (such as construction or soil disturbing activities) will take place within the natural buffers.

Setback distances and buffer areas were generally based on the drainage areas for each of the sensitive features being protected.

The setbacks for the sensitive features are described in the following table.

Identification No.	Buffer Description
S-15	50 ft north, 50 ft. south, 50 ft. east, 50 ft. west
S-21	50 ft north, 50 ft. south, 50 ft. east, 50 ft. west
S-25	50 ft north, 50 ft. south, 50 ft. east, 50 ft. west
S-35	50 ft north, 50 ft. south, 50 ft. east, 50 ft. west
S-38	50 ft north, 50 ft. south, 50 ft. east, 50 ft. west
S-61	50 ft north, 50 ft. south, 50 ft. east, 50 ft. west
S-63	50 ft north, 50 ft. south, 50 ft. east, 50 ft. west
S-70	50 ft north, 50 ft. south, 50 ft. east, 50 ft. west
S-71	50 ft north, 50 ft. south, 50 ft. east, 50 ft. west
S-81	50 ft north, 50 ft. south, 50 ft. east, 50 ft. west
S-85	50 ft north, 50 ft. south, 50 ft. east, 50 ft. west
S-89	50 ft north, 50 ft. south, 50 ft. east, 50 ft. west
S-93	50 ft north, 50 ft. south, 50 ft. east, 50 ft. west

SPECIAL CONDITIONS

I. This modification is subject to all Special and Standard Conditions listed in the WPAP approval letter dated April 4, 2006, and April 8, 2010.

II. Since this project will not have more than 20 percent impervious cover, an exemption from additional permanent BMPs is approved. If the percent impervious cover ever increases above 20 percent or the land use changes, the exemption for the whole site as described in the property boundaries required by §213.4(g), may no longer apply and the property owner must notify the appropriate regional office of these changes.

III. The temporary rock berms installed around sensitive features must remain in place until final stabilization of the site has been achieved and appropriately documented. The rock berms shall be inspected and maintained in operable condition and in accordance with the approved maintenance schedule provided in the application.

STANDARD CONDITIONS

1. Pursuant to Chapter 7 Subchapter C of the Texas Water Code, any violations of the requirements in 30 TAC Chapter 213 may result in administrative penalties.
2. The holder of the approved Edwards Aquifer protection plan must comply with all provisions of 30 TAC Chapter 213 and all best management practices and measures contained in the approved plan. Additional and separate approvals, permits, registrations and/or authorizations from other TCEQ Programs (i.e., Stormwater, Water Rights, UIC) can be required depending on the specifics of the plan.

3. In addition to the rules of the Commission, the applicant may also be required to comply with state and local ordinances and regulations providing for the protection of water quality.

Prior to Commencement of Construction:

4. Within 60 days of receiving written approval of an Edwards Aquifer Protection Plan, the applicant must submit to the San Antonio Regional Office, proof of recordation of notice in the county deed records, with the volume and page number(s) of the county deed records of the county in which the property is located. A description of the property boundaries shall be included in the deed recordation in the county deed records. A suggested form (Deed Recordation Affidavit, TCEQ-0625) that you may use to deed record the approved WPAP is enclosed.
5. All contractors conducting regulated activities at the referenced project location shall be provided a copy of this notice of approval. At least one complete copy of the approved WPAP and this notice of approval shall be maintained at the project location until all regulated activities are completed.
6. Modification to the activities described in the referenced WPAP application following the date of approval may require the submittal of a plan to modify this approval, including the payment of appropriate fees and all information necessary for its review and approval prior to initiating construction of the modifications.
7. The applicant must provide written notification of intent to commence construction, replacement, or rehabilitation of the referenced project. Notification must be submitted to the San Antonio Regional Office no later than 48 hours prior to commencement of the regulated activity. Written notification must include the date on which the regulated activity will commence, the name of the approved plan and program ID number for the regulated activity, and the name of the prime contractor with the name and telephone number of the contact person. The executive director will use the notification to determine if the approved plan is eligible for an extension.
8. Temporary erosion and sedimentation (E&S) controls, i.e., silt fences, rock berms, stabilized construction entrances, or other controls described in the approved WPAP, must be installed prior to construction and maintained during construction. Temporary E&S controls may be removed when vegetation is established and the construction area is stabilized. If a water quality pond is proposed, it shall be used as a sedimentation basin during construction. The TCEQ may monitor stormwater discharges from the site to evaluate the adequacy of temporary E&S control measures. Additional controls may be necessary if excessive solids are being discharged from the site.
9. All borings with depths greater than or equal to 20 feet must be plugged with non-shrink grout from the bottom of the hole to within three (3) feet of the surface. The remainder of the hole must be backfilled with cuttings from the boring. All borings less than 20 feet must be backfilled with cuttings from the boring. All borings must be backfilled or plugged within four (4) days of completion of the drilling operation. Voids may be filled with gravel.

During Construction:

10. During the course of regulated activities related to this project, the applicant or agent shall comply with all applicable provisions of 30 TAC Chapter 213, Edwards Aquifer. The applicant shall remain responsible for the provisions and conditions of this approval until such responsibility is legally transferred to another person or entity.

11. This approval does not authorize the installation of temporary aboveground storage tanks on this project. If the contractor desires to install a temporary aboveground storage tank for use during construction, an application to modify this approval must be submitted and approved prior to installation. The application must include information related to tank location and spill containment. Refer to Standard Condition No. 6, above.
12. If any sensitive feature (caves, solution cavities, sink holes, etc.) is discovered during construction, all regulated activities near the feature must be suspended immediately. The applicant or his agent must immediately notify the San Antonio Regional Office of the discovery of the feature. Regulated activities near the feature may not proceed until the executive director has reviewed and approved the methods proposed to protect the feature and the aquifer from potentially adverse impacts to water quality. The plan must be sealed, signed, and dated by a Texas Licensed Professional Engineer.
13. No wells exist on site. All water wells, including injection, dewatering, and monitoring wells must be in compliance with the requirements of the Texas Department of Licensing and Regulation under Title 16 TAC Chapter 76 (relating to Water Well Drillers and Pump Installers) and all other locally applicable rules, as appropriate.
14. If sediment escapes the construction site, the sediment must be removed at a frequency sufficient to minimize offsite impacts to water quality (e.g., fugitive sediment in street being washed into surface streams or sensitive features by the next rain). Sediment must be removed from sediment traps or sedimentation ponds not later than when design capacity has been reduced by 50 percent. Litter, construction debris, and construction chemicals shall be prevented from becoming stormwater discharge pollutants.
15. Intentional discharges of sediment laden water are not allowed. If dewatering becomes necessary, the discharge will be filtered through appropriately selected best management practices. These may include vegetated filter strips, sediment traps, rock berms, silt fence rings, etc.
16. The following records shall be maintained and made available to the executive director upon request: the dates when major grading activities occur, the dates when construction activities temporarily or permanently cease on a portion of the site, and the dates when stabilization measures are initiated.
17. Stabilization measures shall be initiated as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, and construction activities will not resume within 21 days. When the initiation of stabilization measures by the 14th day is precluded by weather conditions, stabilization measures shall be initiated as soon as practicable.

<u>After Completion of Construction:</u>

18. A Texas Licensed Professional Engineer must certify in writing that the permanent BMPs or measures were constructed as designed. The certification letter must be submitted to the San Antonio Regional Office within 30 days of site completion.
19. The applicant shall be responsible for maintaining the permanent BMPs after construction until such time as the maintenance obligation is either assumed in writing by another entity having ownership or control of the property (such as without limitation, an owner's association, a new property owner or lessee, a district, or municipality) or the ownership of the property is transferred to the entity. The regulated entity shall then be responsible for maintenance until another entity assumes such obligations in writing or ownership is

transferred. A copy of the transfer of responsibility must be filed with the executive director through San Antonio Regional Office within 30 days of the transfer. A copy of the transfer form (TCEQ-10263) is enclosed.

20. Upon legal transfer of this property, the new owner(s) is required to comply with all terms of the approved Edwards Aquifer protection plan. If the new owner intends to commence any new regulated activity on the site, a new Edwards Aquifer protection plan that specifically addresses the new activity must be submitted to the executive director. Approval of the plan for the new regulated activity by the executive director is required prior to commencement of the new regulated activity.
21. An Edwards Aquifer protection plan approval or extension will expire and no extension will be granted if more than 50 percent of the total construction has not been completed within ten years from the initial approval of a plan. A new Edwards Aquifer protection plan must be submitted to the San Antonio Regional Office with the appropriate fees for review and approval by the executive director prior to commencing any additional regulated activities.
22. At project locations where construction is initiated and abandoned, or not completed, the site shall be returned to a condition such that the aquifer is protected from potential contamination.

This action is taken under authority delegated by the Executive Director of the Texas Commission on Environmental Quality. If you have any questions or require additional information, please contact Mr. Alex Grant of the Edwards Aquifer Protection Program of the San Antonio Regional Office at 210-403-4035

Sincerely,

Lynn Bumguardner, Water Section Manager
San Antonio Region Office
Texas Commission on Environmental Quality

LB/AG/eg

Enclosure: Deed Recordation Affidavit, Form TCEQ-0625
Change in Responsibility for Maintenance of Permanent BMPs, Form TCEQ-10263

cc: Mr. Chris Van Heerde, P.E., HMT Engineering & Surveying
Mr. Garry Ford, Jr., P.E., City of New Braunfels
Mr. Tom Hornseth, P.E., Comal County
Mr. Roland Ruiz, Edwards Aquifer Authority
TCEQ Central Records, Building F, MC 21

Bryan W. Shaw, Ph.D., P.E., *Chairman*
Toby Baker, *Commissioner*
Jon Niermann, *Commissioner*
Richard A. Hyde, P.E., *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

January 8, 2016

Mr. Daniel Clawson II
Continental Homes of Texas, L.P.
210 West Hutchison Street
San Marcos, Texas 78666

Re: Edwards Aquifer, Comal County

NAME OF PROJECT: Manor Creek Subdivision Units 4-6; Located at the intersection of Hamburg Avenue and Hwy 46; New Braunfels, Texas

TYPE OF PLAN: Request for Approval of a Water Pollution Abatement Plan (WPAP); 30 Texas Administrative Code (TAC) Chapter 213 Edwards Aquifer

Investigation No. 1259127; Regulated Entity No. RN108449968; Additional ID No. 13-15061001

Dear Mr. Clawson:

The Texas Commission on Environmental Quality (TCEQ) has completed its review of the WPAP application for the above-referenced project submitted to the San Antonio Regional Office by HMT Engineering and Surveying on behalf of Continental Homes of Texas, L.P. on June 10, 2016. Final review of the WPAP was completed after additional material was received on October 22, 2015, November 10, 2015 and December 23, 2015. As presented to the TCEQ, the Temporary and Permanent Best Management Practices (BMPs) were selected and construction plans were prepared by a Texas Licensed Professional Engineer to be in general compliance with the requirements of 30 TAC Chapter 213. These planning materials were sealed, signed and dated by a Texas Licensed Professional Engineer. Therefore, based on the engineer's concurrence of compliance, the planning materials for construction of the proposed project and pollution abatement measures are hereby approved subject to applicable state rules and the conditions in this letter. The applicant or a person affected may file with the chief clerk a motion for reconsideration of the executive director's final action on this Edwards Aquifer Protection Plan. A motion for reconsideration must be filed no later than 23 days after the date of this approval letter. *This approval expires two (2) years from the date of this letter unless, prior to the expiration date, more than 10 percent of the construction has commenced on the project or an extension of time has been requested.*

PROJECT DESCRIPTION

The proposed residential development will have an area of approximately 95.97 acres. The proposed development will consist of 197 residential units with associated driveways, streets and

sidewalks. Impervious cover for the site totals 36.00 acres (37.51 percent). Project wastewater will be disposed of by conveyance to the existing Gruene Wastewater Treatment Plant owned by the New Braunfels Utilities.

PERMANENT POLLUTION ABATEMENT MEASURES

To prevent the pollution of stormwater runoff originating on-site or upgradient of the site and potentially flowing across and off the site after construction, five partial sedimentation/filtration basins, three grassy swales and 14 engineered vegetative filter strips, designed using the TCEQ technical guidance document, Complying with the Edwards Aquifer Rules: Technical Guidance on Best Management Practices (2005), will be constructed to treat stormwater runoff. The required total suspended solids (TSS) treatment for this project is 32,327 pounds of TSS generated from the 36.00 acres of impervious cover. The approved measures meet the required 80 percent removal of the increased load in TSS caused by the project.

Two sedimentation/filtration basins are proposed for Unit 4. The total capture volume of basin 4-1 is 20,432 cubic feet (12,542 cubic feet required). The filtration system for the basin will consist of 1,050 square feet of sand (1,045 square feet required) meeting ASTM C-33, which is 18 inches thick and an underdrain piping system covered with a minimum two inch gravel layer. The total capture volume of basin 4-5 is 34,286 cubic feet (25,317 cubic feet required). The filtration system for the basin will consist of 2,152 square feet of sand (2,110 square feet required) meeting ASTM C-33, which is 18 inches thick and an underdrain piping system covered with a minimum two inch gravel layer.

Two sedimentation/filtration basins are proposed for Unit 5. The total capture volume of basin 5-1 is 41,474 cubic feet (33,114 cubic feet required). The filtration system for the basin will consist of 2,800 square feet of sand (2,759 square feet required) meeting ASTM C-33, which is 18 inches thick and an underdrain piping system covered with a minimum two inch gravel layer. The total capture volume of basin 5-6 is 36,033 cubic feet (34,214 cubic feet required). The filtration system for the basin will consist of 2,943 square feet of sand (2,851 square feet required) meeting ASTM C-33, which is 18 inches thick and an underdrain piping system covered with a minimum two inch gravel layer.

One sedimentation/filtration basin is proposed for Unit 6. The total capture volume of basin 6-1 is 38,839 cubic feet (38,807 cubic feet required). The filtration system for the basin will consist of 3,234 square feet of sand (3,234 square feet required) meeting ASTM C-33, which is 18 inches thick and an underdrain piping system covered with a minimum two inch gravel layer.

Two grassy swales are proposed for Unit 4. The longitudinal slope of grassy swale 4-2 is 1.00 percent with a bottom width of 2 feet, and side slopes with no greater than a 3:1 ratio. The longitudinal slope of grassy swale 4-7 is 0.50 percent with a bottom width of 5 feet, and side slopes with no greater than a 3:1 ratio. One grassy swale is proposed for Unit 5. The longitudinal slope of grassy swale 5-2 is 2.50 percent with a bottom width of 5.5 feet, and side slopes with no greater than a 3:1 ratio. All of the grassy swales will have at least 80 percent vegetative cover to provide adequate treatment of runoff.

Three 15-foot engineered vegetative filter strips (VFS) are proposed for Unit 4, six for Unit 5 and five for Unit 6. Each VFS shall have a uniform slope of less than 20 percent and vegetated cover of at least 80 percent which will extend along the entire length of the contributing area and will be free of gullies or rills that can concentrate overland flow. The contributing area shall be relatively flat to evenly distribute runoff, and the impervious cover in the direction of flow shall not exceed 72 feet.

Please refer to Table 1, Table 2 and Table 3 below for BMP details. Note that overtreatment is provided by the five sedimentation/filtration basins to compensate for grassy swale removal efficiency and untreated releases.

Table 1 Unit 4 BMPs

Sub-basin	BMP	Total Area (acres)	Impervious Area (acres)	Required TSS Removal (lbs/yr)	Provided TSS Removal (lbs/year)
4-1	Sand Filter	4.67	2.38	2,134	2,202
4-2	Grassy Swale	0.49	0.36	322	289
4-3	VFS	2.38	1.06	952	952
4-4	VFS	1.65	0.68	612	612
4-5	Sand Filter	6.63	3.06	2,744	3,020
4-6	VFS	0.61	0.08	68	68
4-7	Grassy Swale	0.68	0.55	495	437
4-15	Untreated release	1.37	0.24	217	--
Total		18.48	8.41	7,544	7,580

Table 2 Unit 5 BMPs

Sub-basin	BMP	Total Area (acres)	Impervious Area (acres)	Required TSS Removal (lbs/yr)	Provided TSS Removal (lbs/year)
5-1	Sand Filter	12.56	5.77	5,183	5,441
5-2	Grassy Swale	1.02	0.68	610	377
5-3	VFS	0.28	0.07	64	64
5-4	VFS	5.24	0.71	641	641
5-5	VFS	0.83	0.29	257	257
5-6	Sand Filter	14.39	6.66	5,982	6,294
5-7	VFS	3.96	1.43	1,283	1,283
5-8	VFS	2.88	0.57	513	513
5-9	VFS	2.60	0.57	513	513
5-12	Untreated release	0.30	0.20	183	--

5-4A	Untreated release	0.28	0.17	152	--
Total		44.34	17.12	15,381	15,383

Table 3 Unit 6 BMPs

Sub-basin	BMP	Total Area (acres)	Impervious Area (acres)	Required TSS Removal (lbs/yr)	Provided TSS Removal (lbs/year)
6-1	Sand Filter	15.59	6.695	6,009	6,323
6-2	VFS	1.56	0.572	513	513
6-3	VFS	1.68	0.572	513	513
6-4	VFS	1.91	0.857	770	770
6-5	VFS	2.24	0.857	770	770
6-6	VFS	1.55	0.572	513	513
6-8	Untreated release	0.22	0.15	131	--
6-12	Untreated release	0.30	0.20	183	--
Total		25.05	10.47	9,402	9,402

GEOLOGY

According to the geologic assessment included with the application, the site is located within the cyclic and marine members and leached and collapsed members of the Person Formation. Twenty-eight geologic features were assessed by the project geologist. Five of the 28 geologic features were rated sensitive and include the following: S-15, S-38, S-70, S-71 and S-85. A 50 foot natural buffer surrounds each sensitive feature and is shown on the site plan for Unit 4, Unit 5 and Unit 6. In addition, a clear span bridge will protect feature S-38 which is located in a watercourse. The San Antonio Regional Office site assessment conducted on July 23, 2015 revealed that the site was generally as described in the application.

SPECIAL CONDITIONS

I. The permanent pollution abatement measures shall be operational prior to first occupancy within their respective drainage areas.

II. All sediment and/or media removed from the water quality basins during maintenance activities shall be properly disposed of according to 30 TAC 330 or 30 TAC 335, as applicable.

STANDARD CONDITIONS

1. Pursuant to Chapter 7 Subchapter C of the Texas Water Code, any violations of the requirements in 30 TAC Chapter 213 may result in administrative penalties.
2. The holder of the approved Edwards Aquifer protection plan must comply with all provisions of 30 TAC Chapter 213 and all best management practices and measures contained in the approved plan. Additional and separate approvals, permits, registrations and/or authorizations from other TCEQ Programs (i.e., Stormwater, Water Rights, UIC) can be required depending on the specifics of the plan.
3. In addition to the rules of the Commission, the applicant may also be required to comply with state and local ordinances and regulations providing for the protection of water quality.

Prior to Commencement of Construction:

4. Within 60 days of receiving written approval of an Edwards Aquifer Protection Plan, the applicant must submit to the San Antonio Regional Office, proof of recordation of notice in the county deed records, with the volume and page number(s) of the county deed records of the county in which the property is located. A description of the property boundaries shall be included in the deed recordation in the county deed records. A suggested form (Deed Recordation Affidavit, TCEQ-0625) that you may use to deed record the approved WPAP is enclosed.
5. All contractors conducting regulated activities at the referenced project location shall be provided a copy of this notice of approval. At least one complete copy of the approved WPAP and this notice of approval shall be maintained at the project location until all regulated activities are completed.
6. Modification to the activities described in the referenced WPAP application following the date of approval may require the submittal of a plan to modify this approval, including the payment of appropriate fees and all information necessary for its review and approval prior to initiating construction of the modifications.
7. The applicant must provide written notification of intent to commence construction, replacement, or rehabilitation of the referenced project. Notification must be submitted to the San Antonio Regional Office no later than 48 hours prior to commencement of the regulated activity. Written notification must include the date on which the regulated activity will commence, the name of the approved plan and program ID number for the regulated activity, and the name of the prime contractor with the name and telephone number of the contact person. The executive director will use the notification to determine if the approved plan is eligible for an extension.
8. Temporary erosion and sedimentation (E&S) controls, i.e., silt fences, rock berms, stabilized construction entrances, or other controls described in the approved WPAP, must be installed prior to construction and maintained during construction. Temporary E&S controls may be removed when vegetation is established and the construction area is stabilized. If a water quality pond is proposed, it shall be used as a sedimentation basin during construction. The TCEQ may monitor stormwater discharges from the site to evaluate the adequacy of temporary E&S control measures. Additional controls may be necessary if excessive solids are being discharged from the site.
9. All borings with depths greater than or equal to 20 feet must be plugged with non-shrink grout from the bottom of the hole to within three (3) feet of the surface. The remainder of the

hole must be backfilled with cuttings from the boring. All borings less than 20 feet must be backfilled with cuttings from the boring. All borings must be backfilled or plugged within four (4) days of completion of the drilling operation. Voids may be filled with gravel.

During Construction:

10. During the course of regulated activities related to this project, the applicant or agent shall comply with all applicable provisions of 30 TAC Chapter 213, Edwards Aquifer. The applicant shall remain responsible for the provisions and conditions of this approval until such responsibility is legally transferred to another person or entity.
11. This approval does not authorize the installation of temporary aboveground storage tanks on this project. If the contractor desires to install a temporary aboveground storage tank for use during construction, an application to modify this approval must be submitted and approved prior to installation. The application must include information related to tank location and spill containment. Refer to Standard Condition No. 6, above.
12. If any sensitive feature (caves, solution cavities, sink holes, etc.) is discovered during construction, all regulated activities near the feature must be suspended immediately. The applicant or his agent must immediately notify the San Antonio Regional Office of the discovery of the feature. Regulated activities near the feature may not proceed until the executive director has reviewed and approved the methods proposed to protect the feature and the aquifer from potentially adverse impacts to water quality. The plan must be sealed, signed, and dated by a Texas Licensed Professional Engineer.
13. No wells exist on the site. One well is in use and the other has been properly plugged. All water wells, including injection, dewatering, and monitoring wells must be in compliance with the requirements of the Texas Department of Licensing and Regulation under Title 16 TAC Chapter 76 (relating to Water Well Drillers and Pump Installers) and all other locally applicable rules, as appropriate.
14. If sediment escapes the construction site, the sediment must be removed at a frequency sufficient to minimize offsite impacts to water quality (e.g., fugitive sediment in street being washed into surface streams or sensitive features by the next rain). Sediment must be removed from sediment traps or sedimentation ponds not later than when design capacity has been reduced by 50 percent. Litter, construction debris, and construction chemicals shall be prevented from becoming stormwater discharge pollutants.
15. Intentional discharges of sediment laden water are not allowed. If dewatering becomes necessary, the discharge will be filtered through appropriately selected best management practices. These may include vegetated filter strips, sediment traps, rock berms, silt fence rings, etc.
16. The following records shall be maintained and made available to the executive director upon request: the dates when major grading activities occur, the dates when construction activities temporarily or permanently cease on a portion of the site, and the dates when stabilization measures are initiated.
17. Stabilization measures shall be initiated as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, and construction activities will not resume within 21 days. When the initiation of stabilization measures by the 14th day is precluded by weather conditions, stabilization measures shall be initiated as soon as practicable.

After Completion of Construction:

18. A Texas Licensed Professional Engineer must certify in writing that the permanent BMPs or measures were constructed as designed. The certification letter must be submitted to the San Antonio Regional Office within 30 days of site completion.
19. The applicant shall be responsible for maintaining the permanent BMPs after construction until such time as the maintenance obligation is either assumed in writing by another entity having ownership or control of the property (such as without limitation, an owner's association, a new property owner or lessee, a district, or municipality) or the ownership of the property is transferred to the entity. The regulated entity shall then be responsible for maintenance until another entity assumes such obligations in writing or ownership is transferred. A copy of the transfer of responsibility must be filed with the executive director through San Antonio Regional Office within 30 days of the transfer. A copy of the transfer form (TCEQ-10263) is enclosed.
20. Upon legal transfer of this property, the new owner(s) is required to comply with all terms of the approved Edwards Aquifer protection plan. If the new owner intends to commence any new regulated activity on the site, a new Edwards Aquifer protection plan that specifically addresses the new activity must be submitted to the executive director. Approval of the plan for the new regulated activity by the executive director is required prior to commencement of the new regulated activity.
21. An Edwards Aquifer protection plan approval or extension will expire and no extension will be granted if more than 50 percent of the total construction has not been completed within ten years from the initial approval of a plan. A new Edwards Aquifer protection plan must be submitted to the San Antonio Regional Office with the appropriate fees for review and approval by the executive director prior to commencing any additional regulated activities.
22. At project locations where construction is initiated and abandoned, or not completed, the site shall be returned to a condition such that the aquifer is protected from potential contamination.

This action is taken under authority delegated by the Executive Director of the Texas Commission on Environmental Quality. If you have any questions or require additional information, please contact Dianne Pavlicek-Mesa, P.G., of the Edwards Aquifer Protection Program of the San Antonio Regional Office at 210-403-4074.

Sincerely,

Lynn Bumguardner, Water Section Manager
San Antonio Region Office
Texas Commission on Environmental Quality

LB/DPM/eg

Enclosures: Deed Recordation Affidavit, Form TCEQ-0625
Change in Responsibility for Maintenance of Permanent BMPs, Form TCEQ-10263

cc: Mr. Chris Van Heerde, C.F.M., P.E., HMT Engineering & Surveying
Mr. Thomas H. Hornseth, P.E., Comal County Engineer
Mr. Garry Ford, P.E., City of New Braunfels
Mr. Roland Ruiz, Edwards Aquifer Authority
TCEQ Central Records, Building F, MC 212

AMENDED WPAP MASTER PLAN
FOR
MANOR CREEK SUBDIVISION

SCALE: 1"=200'

LEGEND:
U.E. = UTILITY EASEMENT
D.E. = DRAINAGE EASEMENT
L.E. = LANDSCAPE EASEMENT
S.S.E. = SANITARY SEWER EASEMENT
R.O.W. = RIGHT-OF-WAY
M.P.R.C.C.T. = MAP AND PLAT RECORDS, COMAL COUNTY, TEXAS
O.P.R.C.C.T. = OFFICIAL PUBLIC RECORDS, COMAL COUNTY, TEXAS
D.R.C.C.T. = DEED RECORDS, COMAL COUNTY, TEXAS
(XX) = ZONING TYPE
XXXX = LANDUSE
— XX" W — = EXISTING WATER LINE
— XX" SS — = EXISTING SEWER LINE
— E — = OVERHEAD ELECTRIC

LOCATION MAP
SCALE: NTS

20.402 ACRE TRACT
ALICE SCHWANZ
DOC. NO. 200906011153
O.P.R.C.C.T.

20.402 ACRE TRACT
DORA HUMMEL
DOC. NO. 200906011152
O.P.R.C.C.T.

20.402 ACRE TRACT
ALICE SCHWANZ
DOC. NO. 200906011155
O.P.R.C.C.T.

65.965 ACRE TRACT
CPP PARTNERS, LTD
DOC. NO. 201106031689
O.P.R.C.C.T.

55.574 ACRE TRACT
MARILYN HELMKE
DOC. NO. 9906017297
O.P.R.C.C.T.

43.492 ac.
DIANA KNEUPPER
VOL. 244, PG. 899
O.P.R.C.C.T.

10.0 AC.
JIM LAUGHMAN
DOC. NO. 201406137998
O.P.R.C.C.T.

THIS IS BEING PLATTED IN UNIT 6 BUT IS INCLUDED IN THE <20% WPAP

UNIT 5A RESIDENTIAL LOTS WITH PERMANENT BMPS

UNIT 5B RESIDENTIAL LOTS WITH PERMANENT BMPS

UNIT 6 RESIDENTIAL LOTS WITH PERMANENT BMPS

R-1A -6.6 RESIDENTIAL LARGE LOT

NEW BRAUNFELS CITY LIMITS

BRIDGE LOCATION

UNIT FOUR

UNIT ONE

UNIT 2A

UNIT 2B

UNIT THREE

UNIT 5A

UNIT 5B

UNIT SIX

LOT 100

ALLEMANIA DRIVE (60' R.O.W.)

HAMBURG AVENUE (60' R.O.W.)

WARENDES DRIVE (60' R.O.W.)

MAINZ STREET (50' R.O.W.)

HESSEN WAY (50' R.O.W.)

PYRMONT (50' R.O.W.)

HILDESHEIM (60' R.O.W.)

HEIDELBERG RD (50' R.O.W.)

KOELN STREET (50' R.O.W.)

MALINCKRODT (50' R.O.W.)

VARRELMANN (50' R.O.W.)

TOENGES LANE (50' R.O.W.)

KLEMM STREET (50' R.O.W.)

SCHUMER PLACE (50' R.O.W.)

LIERMANN AVE (50' R.O.W.)

ETZEL TERRACE (50' R.O.W.)

ZOELLBERGER (50' R.O.W.)

ANGELROOT (50' R.O.W.)

ESPENCHIED (R.O.W. VARIES)

MILENTZ PARK (50' R.O.W.)

RAUSCHENBACH (50' R.O.W.)

200 OPEN SPACE & D.E.

201 OPEN SPACE D.E. & U.E.

202 OPEN SPACE D.E. & U.E.

203 OPEN SPACE D.E. & U.E.

204 OPEN SPACE D.E. & U.E.

205 NBU LOT

206 OPEN SPACE D.E. & U.E.

201 D.E. & U.E. LOT 68.86 AC. BLOCK 1

206 U.E. & L.E. LOT 0.09 AC.

202 D.E., U.E. & L.E. LOT 1.44 AC.

205 U.E. & L.E. LOT 0.04 AC. BLOCK 3

204 D.E. & U.E. LOT 0.44 AC.

203 D.E., U.E. & L.E. LOT 4.30 AC.

207 ACCESS ESMT & U.E. LOT 0.05 AC.

200 D.E. & U.E. LOT 2.65 AC. BLOCK 4

20' WATER LINE EASEMENT DOC. NO. 9706012826 O.P.R.C.C.T.

R.O.W. CATION

EXISTING 25' R.O.W. EDICATION ICATED IN UNIT ONE

20' U.E. NOR CREEK SUBDIVISION UNIT ONE DOC. NO. 9606053209 M.P.R.C.C.T.

NBU ESMT C. NO. 201066026750

TXDOT PROPOSED ACCESS DENIAL PARCEL 24 PART 1

OT PROPOSED ACCESS DENIAL & NBU ESMT OC. NO. 201066026750 PARCEL 24, PART 1

40' ROAD EASEMENT BAR M RANCH COMMERCIAL 13, PG. 176 M.P.R.C.C.T.

EXISTING T BAR M DRIVEWAY

TXDOT PROPOSED ACCESS DENIAL PARCEL 24, PART 2

NBU ESMT DOC. NO. 201066026750

20' WATER LINE EASEMENT DOC. NO. 9670601282G O.P.R.C.C.T.

20' ACCESS EASEMENT

25' R.O.W. DEDICATION

20' SANITARY SEWER EASEMENT VOL. 1018, PG. 744 O.P.R.C.C.T.

APPROXIMATE LOCATION OF 100-YEAR FLOODPLAIN ZONE AE (SEE NOTE NO. 7)

APPROXIMATE LOCATION OF FLOODWAY

APPROXIMATE LOCATION OF 100-YEAR FLOODPLAIN ZONE AE (SEE NOTE NO. 7)

APPROXIMATE LOCATION OF FLOOD CONTROL EASEMENT VOL. 179, PG. 167 D.R.C.C.T.

SAND FILTER BASIN UPDATED

UNIT 4 RESIDENTIAL LOTS (WPAP WITH PERMANENT BMPS)

SAND FILTER BASIN UPDATED

NORTHWOODS UNIT 1 VOL. 5, PG. 305 M.P.R.C.C.T.

THIS IS A LOT IN UNIT 4 BUT IS INCLUDED IN THE <20% WPAP

71.35 ACRE TRACT
HERMAN BORCHERS III & MARY LOU BORCHERS
VOL. 244, PG. 646
D.R.C.C.T.

LEGEND

- MANOR CREEK SUBDIVISION WPAP TO REMAIN <20% IMP. COVER (171.169 ACRES, 164 LOTS)
- NEW WPAP WITH >20% IMP & PERMANENT BMPS (94.78 ACRES, 197 LOTS)
- COMMUNITY CENTER MANOR CREEK WPAP TO REMAIN THE UNCHANGED (1.081 ACRES)

Manor Creek Subdivision Units 4-6 WPAP Impervious Cover Calculation Modification

Unit	Total Area (AC)	Streets (SF)	Streets (AC)	Lots (SF)	Lots (AC)	Total IC (AC)
4	23.60	166,186	3.82	294,400	6.76	10.57
5	45.67	236,065	5.42	510,450	11.72	17.14
6	25.51	138,758	3.19	317,475	7.29	10.47
Total	94.78	541,009	12.42	1,122,325	25.77	38.18
					Total IC	38.18
					Total Area	94.78
					IC %	40.28%

*THE IMPERVIOUS COVER UNDER THE MANOR CREEK SUBDIVISION UNITS 4-6 WPAP APPROVED JANUARY 8, 2016 WAS 36.02 ACRES.

Manor Creek Subdivision WPAP Impervous Cover Calculations

Unit	Total Area (AC)	Streets (SF)	Streets (AC)	Lots (SF)	Lots (AC)	Total IC (AC)
1	43.468	216,915.27	4980	532,980.00	12.24	17.215
2B	22.445	97,309.09	2234	309,260.00	7.10	9.334
3	18.706	87,625.00	2012	236,880.00	5.44	7.450
Lot 200 (Unit 6)	15.04	-	-	-	-	-
Lot 201 (Unit 4)	68.86	-	-	-	-	-
Lot 200 (Unit 4)	2.65	-	-	-	-	-
TxDOT ROW	-	2,978.00	0068	-	-	0.068
Total	171.169	404,827.36	9294	1,079,120.00	24.77	34.067
					Total IC	34.067
					Total Area	171.169
					IC %	19.90%

STATE OF TEXAS
CHRISTOPHER P. VAN HEERDE
93047
LICENSED
PROFESSIONAL ENGINEER
11/22/16

HMT
ENGINEERING & SURVEYING

410 N. SEGUIN AVE.
NEW BRAUNFELS,
TEXAS, 78130
WWW.HMTNB.COM
PH: (830)625-8555

EXHIBIT C1

Drawing Name: K:_Projects\031 - DR Horton\031.023 - Manor Creek Unit 4\031.023.108 - Construction Documents\Engineering Reports\WPAP Modification\031.023.110 Master Plan-#WPAP-ABOAS.dwg Nov 22, 2016 - 12:45pm User: cathymm

Geologic Site Assessment (WPAP)

Manor Creek Subdivision
New Braunfels, Texas

Frost GeoSciences, Inc.
Project No.: FGS-E15171

June 8, 2015

Prepared exclusively for

DR Horton
210 West Hutchison
San Marcos, Texas 78666

Frost GeoSciences

Geotechnical ▪ Construction Materials
Geologic ▪ Environmental

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SDVOSB VBE DBE SBE
TBPE Firm Registration # F-9227
TBPG Firm Registration # 50040

June 8, 2015

DR HORTON
211 North Loop 1604, Suite 130
San Antonio, Texas 78232

Attn: Ms. Erika Jucknies

Re: Geologic Site Assessment (WPAP)
for Regulated Activities / Development on the
Edwards Aquifer Recharge / Transition Zone
Manor Creek Subdivision
New Braunfels, Texas

Frost GeoSciences, Inc. Control # FGS-E15171

Gentlemen:

Attached is a copy of the Geologic Assessment Report completed for the above referenced project site as it relates to 30 TAC §213.5(b)(3), effective June 1, 1999. Our investigation was conducted and this report was prepared in general accordance with the "Instructions to Geologists", TCEQ-0585-Instructions (Rev. 10-1-04). The results of our investigation, along with any recommendations for Best Management Practices (BMP's), are provided in the following report.

If you have any questions regarding this report, or if Frost GeoSciences, Inc. may be of additional assistance to you on this project, please feel free to call our office. It has been a pleasure to work with you and we wish to thank you for the opportunity to be of service to you on this project. We look forward to being of continued service.

Sincerely,
Frost GeoSciences, Inc.

Chris Wickman, P.G.
Senior Geologist

Distribution: (6) DR HORTON

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Geologic Assessment

Texas Commission on Environmental Quality

For Regulated Activities on The Edwards Aquifer Recharge/transition Zones and Relating to 30 TAC §213.5(b)(3), Effective June 1, 1999

To ensure that the application is administratively complete, confirm that all fields in the form are complete, verify that all requested information is provided, consistently reference the same site and contact person in all forms in the application, and ensure forms are signed by the appropriate party.

Note: Including all the information requested in the form and attachments contributes to more streamlined technical reviews.

Signature

To the best of my knowledge, the responses to this form accurately reflect all information requested concerning the proposed regulated activities and methods to protect the Edwards Aquifer. My signature certifies that I am qualified as a geologist as defined by 30 TAC Chapter 213.

Print Name of Geologist: Chris Wickman Telephone: (210) 372-1315

Date: June 8, 2015 Fax: (210) 372-1318

Representing: Frost Geosciences, Inc. Firm Registration #50040 (Name of Company and TBPG or TBPE registration number)

Signature of Geologist:

Regulated Entity Name: Manor Creek Subdivision

Project Information

1. Date(s) Geologic Assessment was performed: April 5-14 & 21-28 and May 22, 2015
2. Type of Project:
   - ☒ WPAP
   - ☐ SCS
   - ☐ AST
   - ☐ UST
3. Location of Project:
   - ☒ Recharge Zone
   - ☐ Transition Zone
   - ☐ Contributing Zone within the Transition Zone

4. ☒ **Attachment A - Geologic Assessment Table**. Completed Geologic Assessment Table (Form TCEQ-0585-Table) is attached.

5. ☒ Soil cover on the project site is summarized in the table below and uses the SCS Hydrologic Soil Groups* (Urban Hydrology for Small Watersheds, Technical Release No. 55, Appendix A, Soil Conservation Service, 1986). If there is more than one soil type on the project site, show each soil type on the site Geologic Map or a separate soils map.

Table 1 - Soil Units, Infiltration Characteristics and Thickness

Soil Name	Group*	Thickness(feet)
Rumple-Comfort Association	C/D	0.5-1.0
Comfort-Rock outcrop complex	D	0.5-1.0

** Soil Group Definitions (Abbreviated)*

A. Soils having a high infiltration rate when thoroughly wetted.

B. Soils having a moderate infiltration rate when thoroughly wetted.

C. Soils having a slow infiltration rate when thoroughly wetted.

D. Soils having a very slow infiltration rate when thoroughly wetted.

6. ☒ **Attachment B – Stratigraphic Column.** A stratigraphic column showing formations, members, and thicknesses is attached. The outcropping unit, if present, should be at the top of the stratigraphic column. Otherwise, the uppermost unit should be at the top of the stratigraphic column.

7. ☒ **Attachment C – Site Geology.** A narrative description of the site specific geology including any features identified in the Geologic Assessment Table, a discussion of the potential for fluid movement to the Edwards Aquifer, stratigraphy, structure(s), and karst characteristics is attached.

8. ☒ **Attachment D – Site Geologic Map(s).** The Site Geologic Map must be the same scale as the applicant's Site Plan. The minimum scale is 1": 400'

   Applicant's Site Plan Scale: 1" = 200'
   Site Geologic Map Scale: 1" = 200'
   Site Soils Map Scale (if more than 1 soil type): 1" = 1,000'

9. Method of collecting positional data:

   ☒ Global Positioning System (GPS) technology.
   ☒ Other method(s). Please describe method of data collection: 2014 Aerial Photograph

10. ☒ The project site and boundaries are clearly shown and labeled on the Site Geologic Map.

11. ☒ Surface geologic units are shown and labeled on the Site Geologic Map.

12. ☒ Geologic or manmade features were discovered on the project site during the field investigation. They are shown and labeled on the Site Geologic Map and are described in the attached Geologic Assessment Table.

    ☐ Geologic or manmade features were not discovered on the project site during the field investigation.

13. ☒ The Recharge Zone boundary is shown and labeled, if appropriate.

14. All known wells (test holes, water, oil, unplugged, capped and/or abandoned, etc.): If applicable, the information must agree with Item No. 20 of the WPAP Application Section.

    ☐ There are _____ (#) wells present on the project site and the locations are shown and labeled. (Check all of the following that apply.)
    - ☐ The wells are not in use and have been properly abandoned.
    - ☐ The wells are not in use and will be properly abandoned.
    - ☐ The wells are in use and comply with 16 TAC Chapter 76.

    ☒ There are no wells or test holes of any kind known to exist on the project site.

Administrative Information

15. ☒ Submit one (1) original and one (1) copy of the application, plus additional copies as needed for each affected incorporated city, groundwater conservation district, and county in which the project will be located. The TCEQ will distribute the additional copies to these jurisdictions. The copies must be submitted to the appropriate regional office.

Stratigraphic Column

[Hydrogeologic subdivisions modified from Maclay and Small (1976); groups, formations, and members modified from Rose (1972); lithology modified from Dunham (1962); and porosity type modified from Choquette and Pray (1970). CU, confining unit; AQ, aquifer]

Hydrogeologic subdivision			Group, formation, or member			Hydrologic function	Thickness (feet)	Lithology	Field identification	Cavern development	Porosity/ permeability type
Upper Cretaceous	Upper confining units		Eagle Ford Group			CU	30 – 50	Brown, flaggy shale and argillaceous limestone	Thin flagstones; petroliferous	None	Primary porosity lost/ low permeability
			Buda Limestone			CU	40 – 50	Buff, light gray, dense mudstone	Porcelaneous limestone with calcite-filled veins	Minor surface karst	Low porosity/low permeability
			Del Rio Clay			CU	40 – 50	Blue-green to yellow-brown clay	Fossiliferous; *Ilymatogyra arietina*	None	None/primary upper confining unit
Lower Cretaceous	I	Edwards aquifer	Georgetown Formation			Karst AQ; not karst CU	2 – 20	Reddish-brown, gray to light tan marly limestone	Marker fossil; *Waconella waconsis*	None	Low porosity/low permeability
	II		Edwards Group	Person Formation	Cyclic and marine members, undivided	AQ	80 – 90	Mudstone to packstone; *miliolid* grainstone; chert	Thin graded cycles; massive beds to relatively thin beds; crossbeds	Many subsurface; might be associated with earlier karst development	Laterally extensive; both fabric and not fabric/water-yielding
	III				Leached and collapsed members, undivided	AQ	70 – 90	Crystalline limestone; mudstone to grainstone; chert; collapsed breccia	Bioturbated iron-stained beds separated by massive limestone beds; stromatolitic limestone	Extensive lateral development; large rooms	Majority not fabric/one of the most permeable
	IV				Regional dense member	CU	20 – 24	Dense, argillaceous mudstone	Wispy iron-oxide stains	Very few; only vertical fracture enlargement	Not fabric/low permeability; vertical barrier
	V			Kainer Formation	Grainstone member	AQ	50 – 60	*Miliolid* grainstone; mudstone to wackestone; chert	White crossbedded grainstone	Few	Not fabric/ recrystallization reduces permeability
	VI				Kirschberg evaporite member	AQ	50 – 60	Highly altered crystalline limestone; chalky mudstone; chert	Boxwork voids, with neospar and travertine frame	Probably extensive cave development	Majority fabric/one of the most permeable
	VII				Dolomitic member	AQ	110 – 130	Mudstone to grainstone; crystalline limestone; chert	Massively bedded light gray, *Toucasia* abundant	Caves related to structure or bedding planes	Mostly not fabric; some bedding plane-fabric/water-yielding
	VIII				Basal nodular member	Karst AQ; not karst CU	50 – 60	Shaly, nodular limestone; mudstone and *miliolid* grainstone	Massive, nodular and mottled, *Exogyra texana*	Large lateral caves at surface; a few caves near Cibolo Creek	Fabric; stratigraphically controlled/large conduit flow at surface; no permeability in subsurface
	Lower confining unit		Upper member of the Glen Rose Limestone			CU; evaporite beds AQ	350 – 500	Yellowish tan, thinly bedded limestone and marl	Stair-step topography; alternating limestone and marl	Some surface cave development	Some water production at evaporite beds/relatively impermeable

GEOLOGIC ASSESSMENT TABLE

PROJECT NAME: Manor Creek Subdivision — FGS-E15171

LOCATION			FEATURE CHARACTERISTICS												EVALUATION			PHYSICAL SETTING		
1A	1B*	1C*	2A	2B	3	4			5	5A	6	7	8A	8B	9	10		11		12
FEATURE	LATITUDE	LONGITUDE	FEATURE TYPE	POINTS	FORMATION	DIMENSIONS (FEET)			TREND (DEGREES)	DOM	DENSITY (NO/FT²)	APERTURE (FEET)	INFILL	RELATIVE INFILTRATION RATE	TOTAL	SENSITIVITY		CATCHMENT AREA (ACRES)		TOPOGRAPHY
						X	Y	Z		10						< 40	> 40	< 1.6	> 1.6	
S-3	N29° 43' 41.1"	W98° 11' 17"	SC	20	Kep	1	1	1.5	-	-	-	-	O,F	10	30	30		Yes		Hillside
S-4	N29° 43' 37.9"	W98° 11' 12.4"	SC	20	Kep	1	1	2	-	-	-	-	O,F	10	30	30		Yes		Hillside
S-6	N29° 43' 34.5"	W98° 11' 11"	O^VEGR	5	Kep	25	75		45	-	4/1	03/.03	O,F,C	19	24	24			Yes	Drainage
S-7	N29° 43' 33.5"	W98° 11' 7.97"	MB	30	Kep	3	3	?	-	-	-	-	X	7	37	37		Yes		Hillside
S-8	N29° 43' 33.4"	W98° 11' 7.37	O^VR	5	Kep	20	200				3-10	0.08-0.3	O,F,C	19	24	24			Yes	Cliff
S-11	N29° 43' 36.6	W98° 11' 4.18"	MB	30	Kep	3	3	?	-	-	-	-	X	7	37	37		Yes		Hillside
S-12	N29° 43' 38.3"	W98° 11' 3.72"	SC	20	Kep	1	1	1.5	-	-	-	-	O,F	12	32	32		Yes		Hillside
S-13	N29° 43' 33.4"	W98° 11' 4.95"	SC	20	Kep	1	1	1.5	-	-	-	-	O,F	12	32	32		Yes		Hillside
S-14	N29° 43' 32.6"	W98° 11' 4.96"	O^VEGR	5	Kep	15	40		25	10	3-5	0.12	O,F,C	15	30	30		Yes		Drainage
S-15	N29° 43' 30.5"	W98° 11' 3.15"	Z^MISC	30	Kep	20	75		-	-	1-5	0.25	O,F,C	20	50		50		Yes	Drainage
S-16	N29° 43' 33.5"	W98° 11' 0.93"	SC	20	Kep	1	2	2	-	-	-	-	O,F	10	30	30		Yes		Hillside
S-17	N29° 43' 37.4"	W98° 10' 54.7"	SC	20	Kep	2	2	2					O,F	12	32	32		Yes		Hillside

* DATUM 1927 North American Datum (NAD27)

2A TYPE	TYPE	2B POINTS
C	Cave	30
SC	Solution Cavity	20
SF	Solution-enlarged fracture(s)	20
F	Fault	20
O	Other natural bedrock features	5
MB	Manmade feature in bedrock	30
SW	Swallow Hole	30
SH	Sinkhole	20
CD	Non-karst closed depression	5
Z	Zone, clustered or aligned features	30

8A INFILLING

N	None, exposed bedrock
C	Coarse - cobbles, breakdown, sand, gravel
O	Loose or soft mud or soil, organics, leaves, sticks, dark colors
F	Fines, compacted clay-rich sediment, soil profile, gray or red colors
V	Vegetation. Give details in narrative description
FS	Flowstone, cements, cave deposits
X	Other materials

12 TOPOGRAPHY

Cliff, Hilltop, Hillside, Drainage, Floodplain, Streambed

I have read, understood, and I have followed the Texas Commission on Environmental Quality's Instructions to Geologists. The information presented here complies with that document and is a true representation of the conditions observed in the field. My signature certifies that I am qualified as a geologist as defined by 30 TAC 21[illegible]

STATE OF TEXAS — Christopher W. Frost — Geology — 10403 — LICENSED PROFESSIONAL GEOSCIENTIST

Signature _____ Date June 8, 2015 Sheet 1 of 7

GEOLOGIC ASSESSMENT TABLE	PROJECT NAME: Manor Creek Subdivision																		FGS-E15171
LOCATION			FEATURE CHARACTERISTICS												EVALUATION			PHYSICAL SETTING		
1A	1B*	1C*	2A	2B	3	4			5	5A	6	7	8A	8B	9	10		11		12
FEATURE	LATITUDE	LONGITUDE	FEATURE TYPE	POINTS	FORMATION	DIMENSIONS (FEET)			TREND (DEGREES)	DOM	DENSITY (NO/FT²)	APERTURE (FEET)	INFILL	RELATIVE INFILTRATION RATE	TOTAL	SENSITIVITY		CATCHMENT AREA (ACRES)		TOPOGRAPHY
						X	Y	Z		10						< 40	≥ 40	<1.6	>1.6	
S-18	N29° 43' 37.8"	W98° 10' 54.4"	SC	20	Kep	2	2	1.5	-	-	-	-	O,F,C	12	32	32			Yes	Hillside
S-19	N29° 43' 34.2"	W98° 11' 0.26"	SC	20	Kep	0.5	0.5	1.5	-	-	-	-	O,F	12	32	32		Yes		Hillside
S-20	N29° 43' 39.1"	W98° 10' 53.6"	SC	20	Kep	2	2	2	-	-	-	-	O,F,C	12	32	32		Yes		Hillside
S-21	N29° 43' 39.8"	W98° 10' 59.5"	SF	20	Kep	15	30		45	10	1-2	0.25	O,F,C	20	50		50		Yes	Drainage
S-22	N29° 43' 40.8"	W98° 10' 52.9"	MB	30	Kep	3	3	?	-	-	-	-	X	7	37	37		Yes		Hillside
S-23	N29° 43' 42"	W98° 10' 44.4"	SC	20	Kep	0.5	4	1.5	-	-	-	-	O,F	15	35	35		Yes		Hillside
S-24	N29° 43' 38.3"	W98° 11' 3.72"	SC	20	Kep	0.5	4	1.5	-	-	-	-	O,F	15	35	35		Yes		Hillside
S-25	N29° 43' 40.7"	W98° 10' 58.6"	Z/MB/SF	30	Kep	50	100		-	-	1-4	0.25	O,F,C	20	50		50	Yes		Drainage
S-26	N29° 43' 40.6"	W98° 11' 1.51"	SC	20	Kep	1	1	2	-	-	-	-	O,F	12	32	32		Yes		Hillside
S-28	N29° 43' 41.1"	W98° 11' 0.83"	SC	20	Kep	1.5	1	2	-	-	-	-	O,F	10	30	30		Yes		Hillside
S-31	N29° 43' 41.4"	W98° 10' 59.2"	MB	30	Kep	3	3	?	-	-	-	-	X	7	37	37		Yes		Hillside
S-35	N29° 43' 41.2"	W98° 10' 53.2"	SF	20	Kep	10	15		78	10	1	0.20	O,F	20	50		50	Yes		Hillside

* DATUM 1927 North American Datum (NAD27)

2A TYPE	TYPE	2B POINTS
C	Cave	30
SC	Solution Cavity	20
SF	Solution-enlarged fracture(s)	20
F	Fault	20
O	Other natural bedrock features	5
MB	Manmade feature in bedrock	30
SW	Swallow Hole	30
SH	Sinkhole	20
CD	Non-karst closed depression	5
Z	Zone, clustered or aligned features	30

8A INFILLING	
N	None, exposed bedrock
C	Coarse - cobbles, breakdown, sand, gravel
O	Loose or soft mud or soil, organics, leaves, sticks, dark colors
F	Fines, compacted clay-rich sediment, soil profile, gray or red colors
V	Vegetation. Give details in narrative description
FS	Flowstone, cements, cave deposits
X	Other materials

12 TOPOGRAPHY
Cliff, Hilltop, Hillside, Drainage, Floodplain, Streambed

I have read, understood, and I have followed the Texas Commission on Environmental Quality's Instructions to Geologists. The information presented here complies with that document and is a true representation of the conditions observed in the field. My signature certifies that I am qualified as a geologist as defined by 30 TAC 213.

STATE OF TEXAS — Geology 10403 — LICENSED — PROFESSIONAL GEOSCIENTIST

Signature _____ Date June 8, 2015 Sheet 2 of 7

GEOLOGIC ASSESSMENT TABLE | PROJECT NAME: Manor Creek Subdivision | FGS-E15171

LOCATION			FEATURE CHARACTERISTICS												EVALUATION			PHYSICAL SETTING		
1A	1B*	1C*	2A	2B	3	4			5	5A	6	7	8A	8B	9	10		11		12
FEATURE	LATITUDE	LONGITUDE	FEATURE TYPE	POINTS	FORMATION	DIMENSIONS (FEET)			TREND (DEGREES)	DOM	DENSITY (NO/FT)	APERTURE (FEET)	INFILL	RELATIVE INFILTRATION RATE	TOTAL	SENSITIVITY		CATCHMENT AREA (ACRES)		TOPOGRAPHY
						X	Y	Z		10						< 40	≥ 40	< 1.6	≥ 1.6	
S-37	N29° 43' 59.1"	W98° 10' 53.4"	O^{VR}	5	Kep	15	20		-	-	2-4	0.15	O,F	15	20	20		Yes		Drainage
S-38	N29° 43' 59.1"	W98° 10' 51.1"	Z^{VRFR}	30	Kep	20	75		-	-	-	-	O,F	20	50		50		Yes	Drainage
S-43	N29° 43' 42.7"	W98° 10' 47.8"	MB	30	Kep	3	3	?	-	-	-	-	X	7	37	37		Yes		Hillside
S-50	N29° 43' 45.7"	W98° 10' 43.5"	MB	30	Kep	3	3	?	-	-	-	-	X	7	37	37		Yes		Hillside
S-51	N29° 43' 58"	W98° 10' 46.6"	O^{VRFR}	5	Kep	25	75		60	10	1-3	0.1-0.5	O,F	12	27	27		Yes		Hillside
S-52	N29° 43' 54"	W98° 10' 44.3"	O^{VRFR}	5	Kep	50	75		40-55	10	1-4	0.1-0.5	O,F	10	34	34		Yes		Drainage
S-53	N29° 43' 52.9"	W98° 10' 44.9"	O^{VR}	5	Kep	20	40		-	-	3-6	0.1-0.25	O,F,C	12	17	17		Yes		Hillside
S-55	N29° 43' 41.8"	W98° 10' 44.5"	O^{VR}	5	Kep	10	10		-	-	1-4	0.1-0.25	O,F,C	10	15	15		Yes		Hillside
S-56	N29° 43' 43.1"	W98° 10' 43.9"	SC	20	Kep	0.5	0.5	1	-	-	-	-	O,F	12	32	32		Yes		Hillside
S-57	N29° 43' 43.1"	W98° 10' 44.2"	O^{VRFR}	5	Kep	10	50		50-60	-	1-3	0.1-0.25	O,F,C	12	17	17		Yes		Hillside
S-58	N29° 43' 42.8"	W98° 10' 43.2"	O^{VR}	5	Kep	10	50	1	-	-	-	-	O,F	12	17	17		Yes		Hillside
S-59	N29° 43' 41.2"	W98° 10' 53.2"	SC	20	Kep	1	0.5		-	-	-	-	O,F	12	32	32		Yes		Hillside

* DATUM 1927 North American Datum (NAD27)

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Christopher Wickham Geology 10403 LICENSED PROFESSIONAL GEOSCIENTIST STATE OF TEXAS

Signature _____ Date June 8, 2015 Sheet 3 of 7

GEOLOGIC ASSESSMENT TABLE | PROJECT NAME: Manor Creek Subdivision | FGS-EI5171

LOCATION			FEATURE CHARACTERISTICS												EVALUATION			PHYSICAL SETTING		
1A	1B*	1C*	2A	2B	3	4			5	5A	6	7	8A	8B	9	10		11		12
FEATURE	LATITUDE	LONGITUDE	FEATURE TYPE	POINTS	FORMATION	DIMENSIONS (FEET)			TREND (DEGREES)	DOM	DENSITY (NO/FT²)	APERTURE (FEET)	INFILL	RELATIVE INFILTRATION RATE	TOTAL	SENSITIVITY		CATCHMENT AREA (ACRES)		TOPOGRAPHY
						X	Y	Z		10						< 40	≥ 40	<1.6	≥1.6	
S-61	N29° 43' 44.6"	W98° 10' 43.9"	Z[VWPR]	30	Kep	30	100		-	-	1-4	0.1-0.25	O,F,C	20	50		50		Yes	Drainage
S-63	N29° 43' 46.5"	W98° 10' 42.3"	C	30	Kep	4	10	10	-	-		-	N	20	50		50		Yes	Cliff
S-64	N29° 43' 46.5"	W98° 10' 42.3"	O[VII]	5	Kep	15	75	10	-	-	-	-	O,F,C	15	20	20			Yes	Cliff
S-65	N29° 43' 47.5"	W98° 10' 42.8"	O[III]	5	Kep	15	100						O,F	15	20	20			Yes	Drainage
S-66	N29° 43' 49.1"	W98° 10' 40.9"	SC	20	Kep	1	1	1	-	-	-	-	O,F	12	32	32		Yes		Hillside
S-67	N29° 43' 49.1"	W98° 10' 41.7"	SC	20	Kep	1	0.75	1.5	-	-	-	-	O,F	12	32	32		Yes		Hillside
S-68	N29° 43' 51.6"	W98° 10' 42.4"	SC	20	Kep	1	1	1	-	-	-	-	O,F	12	32	32		Yes		Hillside
S-69	N29° 43' 55"	W98° 10' 44"	O[VII]	5	Kep	15	20		18	-	1-4	0.1-0.25	O,F,C	12	17	17		Yes		Hillside
S-70	N29° 43' 55"	W98° 10' 44.2"	SC	20	Kep	3	1	1	-	-	-	-	O,F	20	40		40		Yes	Drainage
S-71	N29° 43' 55.1"	W98° 10' 43.6"	SC	20	Kep	4	4	1.5	-	-	-	-	O,F,C	20			40		Yes	Drainage
S-72	N29° 43' 56.3"	W98° 10' 38.6"	SC	20	Kep	1	1	1	-	-	-	-	O,F	12	32	32		Yes		Hillside

* DATUM 1927 North American Datum (NAD27)

2A TYPE	TYPE	2B POINTS
C	Cave	30
SC	Solution Cavity	20
SF	Solution-enlarged fracture(s)	20
F	Fault	20
O	Other natural bedrock features	5
MB	Manmade feature in bedrock	30
SW	Swallow Hole	30
SH	Sinkhole	20
CD	Non-karst closed depression	5
Z	Zone, clustered or aligned features	30

8A INFILLING	
N	None, exposed bedrock
C	Coarse - cobbles, breakdown, sand, gravel
O	Loose or soft mud or soil, organics, leaves, sticks, dark colors
F	Fines, compacted clay-rich sediment, soil profile, gray or red colors
V	Vegetation. Give details in narrative description
FS	Flowstone, cements, cave deposits
X	Other materials

12 TOPOGRAPHY
Cliff, Hilltop, Hillside, Drainage, Floodplain, Streambed

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STATE OF TEXAS — Christopher W. — Geology — 10403 — LICENSED — PROFESSIONAL GEOSCIENTIST

Signature _____ Date June 8, 2015 Sheet 4 of 7

GEOLOGIC ASSESSMENT TABLE | PROJECT NAME: Manor Creek Subdivision | FGS-E15171

LOCATION			FEATURE CHARACTERISTICS												EVALUATION			PHYSICAL SETTING		
1A	1B*	1C*	2A	2B	3	4			5	5A	6	7	8A	8B	9	10		11		12
FEATURE	LATITUDE	LONGITUDE	FEATURE TYPE	POINTS	FORMATION	DIMENSIONS (FEET)			TREND (DEGREES)	DOM	DENSITY (NO/FT²)	APERTURE (FEET)	INFILL	RELATIVE INFILTRATION RATE	TOTAL	SENSITIVITY		CATCHMENT AREA (ACRES)		TOPOGRAPHY
						X	Y	Z		10						< 40	≥ 40	<1.6	≥1.6	
S-73	N29° 43' 55.8"	W98° 10' 42.4"	O^VH	5	Kep	20	30		-	-	1-4	0.1-0.25	O,F,C	20	25	25			Yes	Drainage
S-74	N29° 43' 57.3"	W98° 10' 39.6"	O^FR	5	Kep	20	30		-	-	1-4	0.1-0.25	O,F,C	20	25	25			Yes	Drainage
S-75	N29° 43' 58.8"	W98° 10' 41.1"	SC	20	Kep	1	1	1	-	-	-	-	O,F	12	32	32			Yes	Hillside
S-76	N29° 43' 8.48"	W98° 10' 40.5"	SC	20	Kep	2	1	1	-	-	-	-	O,F	12	32	32		Yes		Hillside
S-77	N29° 43' 59.8"	W98° 10' 37.9"	SC	20	Kep	1	1	1	-	-	-	-	O,F	12	32	32		Yes		Hillside
S-78	N29° 43' 57.5"	W98° 10' 34.5"	SC	20	Kep	5	5	1	-	-	-	-	O,F	19	39	39		Yes		Hillside
S-79	N29° 43' 58.5"	W98° 10' 31.3"	SC	20	Kep	1	1	1	-	-	-	-	O,F	12	32	32		Yes		Hillside
S-80	N29° 43' 58.4"	W98° 10' 30.5"	SC	20	Kep	1	1	1	-	-	-	-	O,F	12	32	32		Yes		Hillside
S-81	N29° 43' 59.3"	W98° 10' 31.3"	SH	20	Kep	10	10	1	-	-	-	-	O,F,V	20	40		40	Yes		Hillside
S-82	N29° 43' 57.7"	W98° 10' 30.1"	MB	30	Kep	3	3	?	-	-	-	-	X	7	37	37		Yes		Hillside
S-83	N29° 43' 59.2"	W98° 10' 27.3"	SC	20	Kep	1	1	3	-	-	-	-	O,F	12	32	32		Yes		Hillside
S-84	N29° 43' 58.9"	W98° 10' 26.4"	MB	30	Kep	3	3	?	-	-	-	-	X	7	37	37		Yes		Hillside

* DATUM 1927 North American Datum (NAD27)

2A TYPE	TYPE	2B POINTS
C	Cave	30
SC	Solution Cavity	20
SF	Solution-enlarged fracture(s)	20
F	Fault	20
O	Other natural bedrock features	5
MB	Manmade feature in bedrock	30
SW	Swallow Hole	30
SH	Sinkhole	20
CD	Non-karst closed depression	5
Z	Zone, clustered or aligned features	30

8A INFILLING	
N	None, exposed bedrock
C	Coarse - cobbles, breakdown, sand, gravel
O	Loose or soft mud or soil, organics, leaves, sticks, dark colors
F	Fines, compacted clay-rich sediment, soil profile, gray or red colors
V	Vegetation. Give details in narrative description
FS	Flowstone, cements, cave deposits
X	Other materials

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STATE OF TEXAS — Christopher Wickman — Geology 10403 — LICENSED PROFESSIONAL GEOSCIENTIST

Signature _____ Date June 8, 2015 Sheet 5 of 7

GEOLOGIC ASSESSMENT TABLE — PROJECT NAME: Manor Creek Subdivision — FGS-E15171

LOCATION			FEATURE CHARACTERISTICS												EVALUATION			PHYSICAL SETTING		
1A	1B*	1C*	2A	2B	3	4			5	5A	6	7	8A	8B	9	10		11		12
FEATURE	LATITUDE	LONGITUDE	FEATURE TYPE	POINTS	FORMATION	DIMENSIONS (FEET)			TREND (DEGREES)	DOM	DENSITY (NO/FT²)	APERTURE (FEET)	INFILL	RELATIVE INFILTRATION RATE	TOTAL	SENSITIVITY		CATCHMENT AREA (ACRES)		TOPOGRAPHY
						X	Y	Z		10						< 40	≥ 40	<1.6	≥1.6	
S-85	N29° 43' 3.42"	W98° 10' 26.3"	Z^MSC	30	Kep	20	90		-	-	1-4	0.1-0.5	O,F,C	25	55		55		Yes	Floodplain
S-86	N29° 44' 0.19"	W98° 10' 25"	SC	20	Kep	3	2	2	-	-	-	-	O,F	15	35	35		Yes		Hillside
S-87	N29° 43' 56.2"	W98° 10' 35"	MB	30	Kep	3	3	1	-	-	-	-	X	7	37	37		Yes		Hillside
S-88	N29° 44' 3.42"	W98° 10' 42.7"	SC	20	Kep	2	1	1	-	-	-	-	O,F	12	32	32		Yes		Hillside
S-89	N29° 44' 3.3"	W98° 10' 18.1"	Z^MSC	30	Kep	15	40		-	-	1-5	0.1-1	O,F	20	50		50		Yes	Floodplain
S-91	N29° 44' 10.7"	W98° 10' 19.5"	SC	20	Kep	2	2	2	-	-	-	-	O,F	15	35	35		Yes		Hillside
S-92	N29° 44' 7.32"	W98° 10' 32.5"	SC	20	Kep	4	1	2	-	-	-	-	O,F	17	37	37		Yes		Hillside
S-93	N29° 44' 8.33"	W98° 10' 32.1"	SH	20	Kep	4	5	2	-	-	-	-	O,F,C	20	40		40	Yes		Hillside
S-94	N29° 44' 9.1"	W98° 10' 20"	O^VR	5	Kep	10	20		41	-	1-2	0.25-0.33	O,F	19	24	24			Yes	Hillside
S-95	N29° 44' 7.42"	W98° 10' 17.4"	O^VR	5	Kep	20	50		76	-	1-4	0.1-0.33	O,F,C	19	24	24			Yes	Hillside
S-96	N29° 44' 7.87"	W98° 10' 16.1"	SC	20	Kep	1	1	1	-	-	-	-	O,F	19	39	39		Yes		Floodplain

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Christopher Wickmann Geology 10403 LICENSED PROFESSIONAL GEOSCIENTIST

Signature _____ Date June 8, 2015 Sheet 6 of 7

GEOLOGIC ASSESSMENT TABLE | PROJECT NAME: Manor Creek Subdivision | FGS-E15171

LOCATION			FEATURE CHARACTERISTICS												EVALUATION			PHYSICAL SETTING		
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FEATURE	LATITUDE	LONGITUDE	FEATURE TYPE	POINTS	FORMATION	DIMENSIONS (FEET)			TREND (DEGREES)	DOM	DENSITY (NO/FT²)	APERTURE (FEET)	INFILL	RELATIVE INFILTRATION RATE	TOTAL	SENSITIVITY		CATCHMENT AREA (ACRES)		TOPOGRAPHY
						X	Y	Z		10						< 40	> 40	<1.6	>1.6	
S-97	N29° 44' 7.71"	W98° 10' 16.6"	Q^{VR}	5	Kep	15	75		-	-	1-4	0.1-0.25	O,F,C	19	24	24			Yes	Hillside
S-98	N29° 44' 14.6"	W98° 10' 30.2"	SC	20	Kep	1	3	2	-	-	-	-	O,F	12	32	32		Yes		Hillside
S-99	N29° 44' 7.02"	W98° 10' 30.1"	SC	20	Kep	3	3	1.5	-	-	-	-	O,F	19	39	39		Yes		Hillside
S-100	N29° 44' 5.02"	W98° 10' 17.5"	F	20	Kep				-	-	-	-	-	-	-	-	-		Yes	Streambed
S-101	N29° 43' 52.9"	W98° 10' 41.5"	MB	30	Kep	3	3	?	-	-	-	-	X	7	37	37		Yes		Hillside
S-102	N29° 43' 49.9"	W98° 10' 42.7"	MB	30	Kep	3	3	?	-	-	-	-	X	7	37	37		Yes		Hillside

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STATE OF TEXAS — Christopher Mohon — Geology 10403 — LICENSED PROFESSIONAL GEOSCIENTIST

Signature _____ Date June 8, 2015 Sheet 7 of 7

LOCATION

The Site is located along and north of State Highway 46, approximately 3/4 miles northwest of the intersection of State Highway 46 and F.M. 1863, in New Braunfels, Texas. An overall view of the area is shown on copies of the site plan, a street map, the U.S.G.S. Topographic Map, the E.A.A Edwards Aquifer Recharge Zone and Contributing Zone Map, the FIRM Map, the Bureau of Economic Geology Geologic Map of the New Braunfels, Texas 30 X 60 Minute Quadrangle, U.S. Geological Survey Water Resources Investigations 95-4030 Map, a 2014 aerial photograph at a scale of 1"=600', a 2014 aerial photograph at a scale of 1"=1,000', and a 1973 aerial photograph at a scale of 1"=1,000'. Figures 1 through 9 in Appendix A.

METHODOLOGY

The Geologic Assessment was performed by Mr. Chris Wickman, P.G., Senior Geologist with Frost GeoSciences, Inc.. Mr. Wickman is a Licensed Professional Geoscientist in the State of Texas (License # 10403).

Frost GeoSciences, Inc. researched the geology of the area near the intersection of State Highway 46 and F.M. 1863. The research included, but was not limited to, the Bureau of Economic Geology, Geologic Atlas of Texas, San Antonio Sheet, FEMA maps, Edwards Aquifer Recharge Zone Maps, U.S G.S. 7.5 Minute Quadrangle Maps, the Geologic Map of the New Braunfels, Texas 30 X 60 Minute Quadrangle, the U.S.G.S. Water-Resources Investigations Report 94-4117, and the U.S.D.A. Soil Survey of Comal & Hays Counties, Texas.

After reviewing the available information, a field investigation was performed to identify any geologic or man made potential recharge features. A transect spacing of approximately 50 feet, or less depending on vegetation thickness, was used to inspect the project area. A 2014 aerial photograph, in conjunction with a hand held Garmin 72H Global Positioning System with an Estimated Potential Error ranging from 15 to 18 feet, was used to navigate around the property and identify the locations of potential recharge features, as recommended in the "Instructions to Geologists", TCEQ-0585-Instructions (Rev. 10-1-04). The locations of any potential recharge features

noted in the field were marked with blue and white flagging. The flagging is numbered with the same potential recharge feature I.D. # that is used on the Site Geologic Map in Appendix C of this report. The Site Geologic Map indicating the limits of the project site and the locations of potential recharge features is included in Appendix C. A copy of a 2014 Aerial Photograph at an approximate scale of 1"=600' indicating the limits of the project site and the locations of potential recharge features is included on Figure 9 in Appendix A. The Geologic Assessment Form TCEQ-085, (Rev. 2-11-15), Stratigraphic Column, and the Geologic Assessment Table have been filled with the appropriate information for this project site and are included on pages 1-12 of this report.

RESEARCH & OBSERVATIONS

7.5 Minute Quadrangle Map Review

According to the U.S.G.S. 7.5 Minute Quadrangle Map, New Braunfels West, Texas Sheet (1988), the elevation across the project site ranges from 760 to 840 feet above mean sea level. The project site has a total relief of approximately 80 feet. Runoff from the project site flows to the southeast and north into Blieders Creek. Blieders Creek is located along the southeastern property line. State Highway 46 is located immediately southwest of the project site. A few areas of residential development are visible south and southwest of the project site. A flood control - recharge dam is located northeast of the project site along Blieders Creek. A copy of the U.S G.S. 7.5 Minute Quadrangle Map indicating the location of the project site is included on Figure 3 in Appendix A.

Recharge / Transition Zone

According to the E.A.A. Edwards Aquifer Recharge Zone and Contributing Zone Map (1994) and the Official Edwards Aquifer Recharge Zone Map, New Braunfels West, Texas Sheet (1988), the Site is located on the Edwards Aquifer Recharge Zone. A copy of the E.A.A. Edwards Aquifer Recharge and Contributing Zone Map indicating the location of the Site is included on Figure 4 in Appendix A.

100-Year Floodplain

The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map for the Comal County, Texas, Community Panel Numbers 48091C0430F and 48091C0435F (Revised September 2, 2009) was reviewed to determine if the Site is located within the 1% annual chance flood (100-year flood), which is also known as the base flood. A review of the above mentioned Panel Numbers indicate that the majority of the Site is located within Zone X. According to the Panel Legend, Zone X represents areas determined to be outside the 0.2% annual chance floodplain. However, areas located along Bieders Creek located within the southeastern portion of the project are located in Zones A, AE and Zone X (shaded) Zones A and AE are areas included in the Special Flood Hazard Area within the 100-year flood. Zones A and AE are defined by the map panel legend as areas where no base flood elevations have been determined (Zone A) and where base elevations have been determined (Zone AE). Zone X (shaded) is identified as an Other Flood Areas, and is defined as areas of the 2% annual chance flood, areas of the 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile and areas protected by levees from the 1% annual chance flood. A copy of the above referenced FIRM panels indicating the location of the Site is included on Figure 5 in Appendix A.

Soils

According to the United States Department of Agriculture, Soil Conservation Service, Soil Survey of Comal & Hays Counties, Texas, (1977), the project site is located on the Rumple-Comfort Association (RUD), and the Comfort-Rock Complex (CrD). A copy of the 1973 aerial photograph (approximate scale: 1"=1000') from the U.S.D.A. Soil Survey of Comal & Hays Counties, Texas indicating the location of the project site and the soil types is included on Figure 6 in Appendix A.

The Rumple-Comfort Association consists of shallow and moderately deep soils on uplands in the Edwards Plateau Land Resource Area. The surface layer of the Rumple Soil is dark reddish brown very cherty clay loam about 10 inches thick. Rounded chert and limestone cobbles and gravel cover about 20 percent of the surface. The subsoil to a depth of 14 inches is dark reddish-

brown very cherty clay, and to a depth of 28 inches it is dark reddish-brown extremely stony clay. The underlying material is indurated fractured limestone. The Comfort Soil is dark brown, neutral, extremely stony clay about 7 inches thick. The subsoil to a depth of 12 inches is dark reddish-brown, mildly alkaline, extremely stony clay. The underlying material is indurated fractured limestone. The soil is noncalcareous throughout. The soils in this association are well drained. Surface runoff is medium, but varies due to the occurrence of caves, fracture zones, and sinks. Permeability is moderately slow. Water erosion is a moderate hazard.

This soil has a USDA Texture Classification of very cherty clay loam, stony clay, very stony clay, extremely stony clay, and weathered bedrock. The Unified Classification is GC, CL or SC. The AASHO Classification is A-2-6, A-6, and A-2-7. This soil has an average permeability from 0.2 to 0.6 inches/hour.

The Comfort-Rock Outcrop Complex consists of shallow, clayey soils and Rock Outcrop on side slopes and on hilltops and ridge tops on uplands in the Edwards Plateau Land Resource Area. The Comfort Extremely Stony Clay makes up 49 to more than 95 percent of the complex, but on the average it makes up 70 percent. Rock Outcrop and areas of soil less than 4 inches deep make up 5 to 36 percent, but the average is 15 percent. Typically, the surface layer of the Comfort soil is dark brown extremely stony clay about 6 inches thick. Cobbles and stones as much as 4 feet across cover about 45 percent of the surface. The subsoil extends to a depth of 13 inches. It is dark reddish brown extremely stony clay. The underlying material is indurated fractured limestone. The soil is mildly alkaline and noncalcareous throughout The Comfort Soil is well drained. Surface runoff is slow to medium. Permeability is slow, and the available water capacity is very low. Water erosion is a slight hazard.

This soil has a USDA Texture Classification of extremely stony clay, stony clay, very stony clay, and weathered bedrock. The Unified Classification is CH, GC, CL, or SC. The AASHO Classification is A-2-7, and A-7-6. This soil has an average permeability from 0.6 to 0 2 inches/hour.

Narrative Description of the Site Geology

Based on a visual inspection of the ground surface, the overall potential for fluid flow from the project site into the Edwards Aquifer appears to be low to intermediate.

One hundred two features were noted on the project site at the time of the field investigation on April 5-14 and 21-28, 2005. Ninety natural karst features and 12 man-made features were noted on the project site at the time of the field investigation. According to the U.S. Geological Survey Water Resources Investigations 94-4117, a fault (S-100) is located along the southeastern property line. No obvious visual indications of the fault were noted on the project site at the time of the on-site inspection. The natural karst features noted on the site consisted of numerous solution cavities, rock outcrops, and zones of fractured rock, vuggy rock, and solution cavities. A number of the solution cavities appeared to have been dug out by burrowing animals. The man made features consisted of man hole covers associated with a sanitary sewer line crossing the project site. The locations of the Potential Recharge Features are identified on the Site Plan on Figure 1 in Appendix A, on the 2003 aerial photograph on Plate 1h in Appendix A, and on the Site Geologic Map provided in Appendix C. Color photographs of the project site and some of the potential recharge features are included in Appendix B.

Potential Recharge Features #S-3 and S-4 consist of solution cavities noted on the project site at the time of the field investigation. PRF #S-4 appeared to have been dug out by a burrowing animal. Frost GeoSciences, Inc. rates these features as low on Figure 1 of the TCEQ-0585-Instructions (Rev. 10-01-04). These features score a 30 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Feature #S-6 is an outcrop of vuggy and fractured limestone noted within a natural drainage path. The outcrop is about 25 feet wide and 75 feet long. The vugs ranged in size from 1/2 inches to 1 inch with a density of 4 to 5 vugs per foot. The fractures were approximately an inch in width and occurred in a density of 1 fracture per foot. The general trend of the fractures was 45 degrees. Frost GeoSciences, Inc. rates this feature as low on Figure 1 of

the TCEQ-0585-Instructions (Rev. 10-01-04). This feature scores a 24 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Features #S-7, #S-11, #S-22, #S-31, #S-43, #S-50, #S-82, #S-84, #S-87, S-101, and S-102 are man hole covers associated with a sanitary sewer line crossing the project site along the southeastern portion of the property. Frost GeoSciences, Inc. rates these features as low on Figure 1 of the TCEQ-0585-Instructions (Rev. 10-01-04). These features score a 37 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Features #S-8 is an outcrop of vuggy and fractured limestone. PRF #S-8 is a cliff of limestone along Blieders Creek. The cliff is ranges from 3 feet to 15 feet along the length of the outcrop. The fractures are approximately 1 inch in width and occur at a density of 1 fracture per foot. Frost GeoSciences, Inc. rates this feature as low on Figure 1 of the TCEQ-0585-Instructions (Rev. 10-01-04). These features score a 24 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Features #S-12, and #S-13 are solution cavities. PRF #S-12 is a solution cavity noted under a limestone boulder. The feature is about 1 foot wide and 1 foot long and extends about 18 inches downward. PRF #S-13 appears to have been dug out by a burrowing animal. Frost GeoSciences, Inc. rates these features as low on Figure 1 of the TCEQ-0585-Instructions (Rev. 10-01-04). These features score a 32 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Feature #S-14 consists of an outcrop of vuggy and fractured limestone noted in a natural drainage path. The outcrop was about 15 feet wide and 40 feet long. The vugs were approximately 1 to 2 inches in size and occurred at a density of 3 to 5 vugs per foot. The fractures are about 1 in width and occur 1 to 2 fractures per foot. Frost GeoSciences, Inc. rates this feature as low on Figure 1 of the TCEQ-0585-Instructions (Rev. 10-01-04). This feature scores a 30 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Feature #'s S-15, #S-85, and #S-89 are zones of vuggy rock and solution

cavities. The Zones consist of large vugs ranging from 4 inches to 12 inches with several solution cavities ranging from 4 inches to 18 inches. The vugs and solution cavities are infilled with fine soils leaves and other organic materials. PRF#S-15 was noted in a natural drainage path. According to the FEMA, Flood Insurance Rate Map, PRF #S-85 and PRF #S-89 are located in the 100 year flood plain. Frost GeoSciences, Inc. rates these features as intermediate on Figure 1 of the TCEQ-0585-Instructions (Rev. 10-01-04). These features score a 50 to 55 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Features #S-16 through #S-20 are solution cavities noted on the site at the time of the field inspection. PRF #S-16 appears to have been dug out by a burrowing animal. Frost GeoSciences, Inc. rates these features as low on Figure 1 of the TCEQ-0585-Instructions (Rev. 10-01-04). These features score a 32 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Features #S-21 and #S-35 appear to be outcrops of solution enlarged fractures. PRF #S-21 is about 15 feet wide and 30 feet long. The fractures are about 1 to 2 inches in width and occur at a density of 1 to 2 fractures per foot. The dominate trend of the fractures was about 45 degrees. The outcrop was noted in a natural drainage path. PRF #S-35 is about 10 feet wide and 15 feet long. The fractures are about 2 to 4 inches wide and occur at about 1 to 2 fractures per foot. The dominate trend of the fractures was about 78 degrees. Frost GeoSciences, Inc. rates this feature as intermediate on Figure 1 of the TCEQ-0585-Instructions (Rev. 10-01-04). This feature scores a 50 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Features #S-23 and #S-24 are elongated solution cavities approximately 6 inches in width and 4 feet in length. The features are infilled with fine soils and leaves. Frost GeoSciences, Inc. rates these features as low on Figure 1 of the TCEQ-0585-Instructions (Rev. 10-01-04) These features score a 35 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Features #S-25, #S-38, and #S-61 are zones of vuggy and fractured rock. The widths of the zones range from 30 to 50 feet and the lengths range from 75 to 100 feet. Each of the outcrop zones were noted in natural drainage paths. The vugs ranged in size from 1 inch to 3 inches and occurred at a density of 1 to 4 per foot. The fractures ranged in size from 1 to 2 inches in width and occurred at a density of 1 to 3 per foot. The orientation of the fractures varied. Frost GeoSciences, Inc. rates these features as intermediate on Figure 1 of the TCEQ-0585-Instructions (Rev. 10-01-04). These features score a 50 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Features #S-26 and #S-28 are solution cavities noted on the project site at the time of the field inspection. The features are infilled with fine soils and leaves. The features range in size from 12 inches to 18 inches wide and 1 to 4 feet in length. The features were about 18 inches to 2 feet deep. PRF #S-26 and PRF #S-28 appeared to be dug out by a burrowing animal. PRF #S-29 is an elongated solution cavity. Frost GeoSciences, Inc. rates these features as low on Figure 1 of the TCEQ-0585-Instructions (Rev. 10-01-04). These features range in score from 30 to 39 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Feature #S-37 is a outcrop of vuggy rock noted on the project site at the time of the field investigation Frost GeoSciences, Inc. rates this feature as low on Figure 1 of the TCEQ-0585-Instructions (Rev. 10-01-04). This feature scores a 20 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Features #S-51, #S-52, and #S-57 are outcrops of vuggy and fractured rock. PRF #S-52 is located in a natural drainage path. Frost GeoSciences, Inc. rates these features as low on Figure 1 of the TCEQ-0585-Instructions (Rev. 10-01-04). These features range in score from 17 to 34 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Features #S-53, #S-55, and #S-58 are outcrops of vuggy rock noted on the project site at the time of the field inspection. The outcrops all have vugs ranging in size from 1 to 3 inches with a density ranging from 3 to 6 vugs per foot. Frost GeoSciences, Inc. rates these features as

low on Figure 1 of the TCEQ-0585-Instructions (Rev. 10-01-04). These features range in score from 15 to 17 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Features #S-56, #S-59 and #S-66 through #S-68 are solution cavities noted on the project site at the time of the field investigation. The features were infilled with fine soils and leaves and twigs The size of the features range in size from 6 inches to 2 feet wide, 6 inches to 2 feet long, and 1 to 2 feet deep. Frost GeoSciences, Inc. rates these features as low on Figure 1 of the TCEQ-0585-Instructions (Rev. 10-01-04). These features range in score from 30 to 32 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Feature #S-63 is a cave noted in the wall of a cliff. The cliff was noted along a natural drainage path. The opening of the cave was about 4 feet tall and 10 feet wide. The cave extended horizontally approximately 10 feet into the cliff. Frost GeoSciences, Inc. rates this feature as low on Figure 1 of the TCEQ-0585-Instructions (Rev. 10-01-04). This feature scores a 20 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Features #S-64, #S-65 and #S-69 are outcrops of vuggy and fractured rock noted on the project site at the time of the field inspection. #S-65 have fractures ranging in size from 1 to 2 inches wide and the fractures occur about 1 to 2 fractures per foot. #S-69 have vugs ranging in size from 1 to 3 inches with a density ranging from 3 to 6 vugs per foot. Frost GeoSciences, Inc. rates these features as low on Figure 1 of the TCEQ-0585-Instructions (Rev 10-01-04). These features range in score from 17 to 20 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Features #S-70 and #S-71 are solution cavities noted in a natural drainage path. The features were infilled with fine soils and leaves and twigs. Frost GeoSciences, Inc. rates these features as intermediate on Figure 1 of the TCEQ-0585-Instructions (Rev. 10-01-04). These features score 40 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Features #S-72, #S-75 through #S-80, and #S-83 are solution cavities noted on the project site at the time of the field investigation. The features were infilled with fine soils and leaves and twigs. The size of the features range in size from 6 inches to 2 feet wide, 6 inches to 2 feet long, and 1 to 2 feet deep. PRF #S-75 appears to have been dug out by a burrowing animal at one time. PRF #S-78 is about 5 feet wide, 5 feet long and 1 foot deep. Frost GeoSciences, Inc. rates these features as low on Figure 1 of the TCEQ-0585-Instructions (Rev. 10-01-04). These features range in score from 32 to 39 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Features #S-73 and #S-74 are outcrops of vuggy and fractured rock noted on the project site at the time of the field inspection. PRF #S-73 have vugs ranging in size from 1 to 3 inches with a density ranging from 3 to 6 vugs per foot. PRF #S-74 have fractures ranging in size from 1 to 2 inches wide and the fractures occur about 1 to 2 fractures per foot. Frost GeoSciences, Inc. rates these features as intermediate on Figure 1 of the TCEQ-0585-Instructions (Rev. 10-01-04). These features score 25 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Features #S-81 and #S-93 are sinkholes. PRF S#-81 is about 10 feet around and 1 foot deep. A tree was noted growing in the middle of the feature. The feature was infilled with fine soils, coarse sand, cobbles, and with grass and shrubs. PRF #S-93 is 4 feet wide, 5 feet long, and 2 feet deep. The feature is infilled with coarse soils and gravel as well as leaves and twigs. Frost GeoSciences, Inc. rates these features as intermediate on Figure 1 of the TCEQ-0585-Instructions (Rev. 10-01-04). These features score 40 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Features #S-86, #S-88, and #S-91 and #S-92 are solution cavities noted on the project site at the time of the field investigation. The features were infilled with fine soils and leaves and twigs. The size of features PRF #S-86, PRF #S-88, PRF #S-91 and PRF #S-92 range in size from 1 foot to 4 feet wide, 1 foot to 2 feet long, and 1 to 2 feet deep. PRF #S-92 appears to have been dug out

by a burrowing animal at one time. Frost GeoSciences, Inc. rates these features as low on Figure 1 of the TCEQ-0585-Instructions (Rev. 10-01-04). These features range in score from 32 to 39 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Features #S-94, #S-95 and #S-97 are outcrops of vuggy rock noted on the project site at the time of the field inspection. The outcrops have vugs ranging in size from 1 to 3 inches with a density ranging from 3 to 6 vugs per foot. Frost GeoSciences, Inc. rates these features as low on Figure 1 of the TCEQ-0585-Instructions (Rev. 10-01-04). These features score 24 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

Potential Recharge Features #S-96, #S-98, and #S-99 are solution cavities noted on the project site at the time of the field investigation. The features were infilled with fine soils and leaves and twigs. According to the FEMA, Flood Insurance Rate Map, PRF #S-96 are located in the 100 year flood plain. PRF #S-98 and PRF #S-99 appears to have been dug out by a burrowing animal at one time. Frost GeoSciences, Inc. rates these features as low on Figure 1 of the TCEQ-0585-Instructions (Rev. 10-01-04). These features range in score from 32 to 39 on the sensitivity scale in column 10 of the Geologic Assessment Table on Pages 5-11 of this report.

According to the U.S. Geological Survey Water Resources Investigations 94-4117, Potential Recharge Feature #S-100 is a fault located along the southeastern property line. No obvious visual indications of the fault were noted on the project site at the time of the on-site inspection.

The project site supports a dense stand of vegetative cover with a several open grassy areas. Overall vegetation on the project site consists of ashe juniper (*Juniperus ashei*), live oak (*Quercus virginiana*), cedar elm (*Ulmus crassifolia*), and mesquite (*Prosopis glandulosa*), with Texas persimmon (*Diospyros texana*), agarita (*Berberis trifoliolata*), huisache (*Acacia farnesiana*), sage (*Leucophyllum*), whitebrush (*Aloysia gratissima*), Yucca, mountain laurel, and prickly pear cactus (*Opuntia lindheimeri*).

According to the U.S. Geological Survey Water Resources Investigations (WRI) 94-4117, Texas and the Geologic Map of the New Braunfels, Texas 30 X 60 Minute Quadrangle, the Site is located on the Edwards Person Limestone. The USGS Water Resources Investigations (WRI) Report Map subdivides

the Edwards Person limestone into three separate geologic members. The USGS WRI Report Map indicates the Site is located on the upper two geologic members of the Edwards Person limestone, the Cyclic and Marine and the Leached and Collapsed members of the Edwards Person limestone A copy of the WRI map and the Geologic Map of the New Braunfels, Texas 30 X 60 Minute Quadrangle are included on Figures 7 and 7A in Appendix A. A copy of the Stratigraphic Column highlighting the outcropping formations is included on Page 4 of this report.

The Cyclic and Marine Member of the Edwards Person Limestone consists of mudstone to packstone with milliolid grainstone and chert. This member occurs as thin graded cycles of massive to relatively thin beds with some crossbeds. Typically, cavern development in this member is common, but occurs mainly in the subsurface. The caverns within this member might be associated with earlier episodes of karst development.

The Leached and Collapsed Member of the Cretaceous Edwards Person Limestone consists of crystalline limestone, mudstone, and grainstone with chert and collapsed breccia. Bioturbated iron-stained beds are common and are separated by massive limestone beds with stromatolitic limestone. This member forms extensive lateral karst development with large rooms. The overall thickness of this member ranges from 70 to 90 feet thick.

According to the site plan provided by HMT Engineers, the surveyed elevations on the Site range from 760 to 864 feet. According to this survey, the total relief on the Site is approximately 104 feet. A copy of the site plan indicating the boundary of the Site and the elevations is included on the Site Plan on Figure 1 in Appendix A and the Site Geologic Map in Appendix C of this report

BEST MANAGEMENT PRACTICE (BMP)

Based on a visual inspection of the ground surface and the research performed for this project, the overall potential for fluid flow from the project site into the Edwards Aquifer appears to be low to intermediate. According to the U S Geological Survey Water Resources Investigations 94-4117, a fault located along the southeastern property line. No obvious visual indications of the fault were noted on the project site at the time of the on-site inspection. However, the potential always exists

to encounter subsurface features that lack a surface expression. Construction personnel should be informed of the potential to encounter subsurface karst features associated with the fault, vuggy outcrops, or outcrops zones during excavating activities. Construction personnel should also be informed of the proper protocol to follow in the event that a solution cavity and/or cave is encountered during the excavation and development of the property.

DISCLAIMER

This report has been prepared in general accordance with the "Instructions to Geologists", TCEQ-0585-Instructions (Rev. 10-1-04) by a Licensed Texas Professional Geoscientist. All areas of the project site were carefully inspected for features that could contribute to the recharge of the Edwards Aquifer, however, this survey cannot preclude the presence of subsurface karst features that lack surface expression. This report is not intended to be a definitive investigation of all possible geologic or karst features at this site. All conclusions, opinions, and recommendations for Best Management Practices (BMP's) in this report are based on information obtained while researching the project, and on the site conditions at the time of our field investigation.

This report has been prepared for the exclusive use of DR HORTON. This report is based on available known records, a visual inspection of the project site, and the work generally accepted for a Geologic Assessment for Regulated Activities / Developments on the Edwards Aquifer Recharge / Transition Zone, relating to 30 TAC §213.5(b)(3), effective June 1, 1999.

REFERENCES

1) U.S.G.S. 7.5 Minute Quadrangle Map, New Braunfels West, Texas Sheet (1988).

2) E.A.A. Edwards Aquifer Recharge and Contributing Zone Map, New Braufels West, TX (1999).

3) Small, Ted A., and Hanson, John A., 1994, Geologic Framework and Hydrogeologic Characteristics of the Edwards Aquifer Outcrop, Comal County, Texas. U.S. Geological Survey Water Resources Investigations 94-4117.

4) Barnes, V.L., 1983, Geologic Atlas of Texas, San Antonio Sheet, Bureau of Economic Geology, The University of Texas at Austin, Texas.

5) Federal Emergency Management Agency (FEMA), May 15, 1991, Comal County, Texas and Incorporated Areas, Flood Insurance Rate Map (FIRM), Panel #'s 48091C0430E and 48091C0435E, revised September 9, 2009, FEMA, Washington D.C.

6) U.S.D.A. Soil Conservation Service, Soil Survey of Comal and Hayes County, Texas (1984).

7) TCEQ-0585-Instructions (Rev. 10-1-04). "Instructions to Geologists for Geologic Assessments on the Edwards Aquifer Recharge/Transition Zone".

8) Collins, Edward, W., 2000, Geologic Map of the New Braunfels, Texas 30 X 60 Minute Quadrangle, Bureau of Economic Geology, The University of Texas at Austin, Texas.

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UNIT FOUR
LOT 100 UNIT 2B
UNIT 2A
LOT 100
UNIT ONE
LOT 100
UNIT THREE
LOT 100
UNIT FIVE
LOT 100
UNIT SIX
UNIT FOUR
STATE HIGHWAY 46
SIGEL AVENUE
BISCHOFF PLACE
BAMBERGER AVE
Kep
Fault
Inferred Fault
North

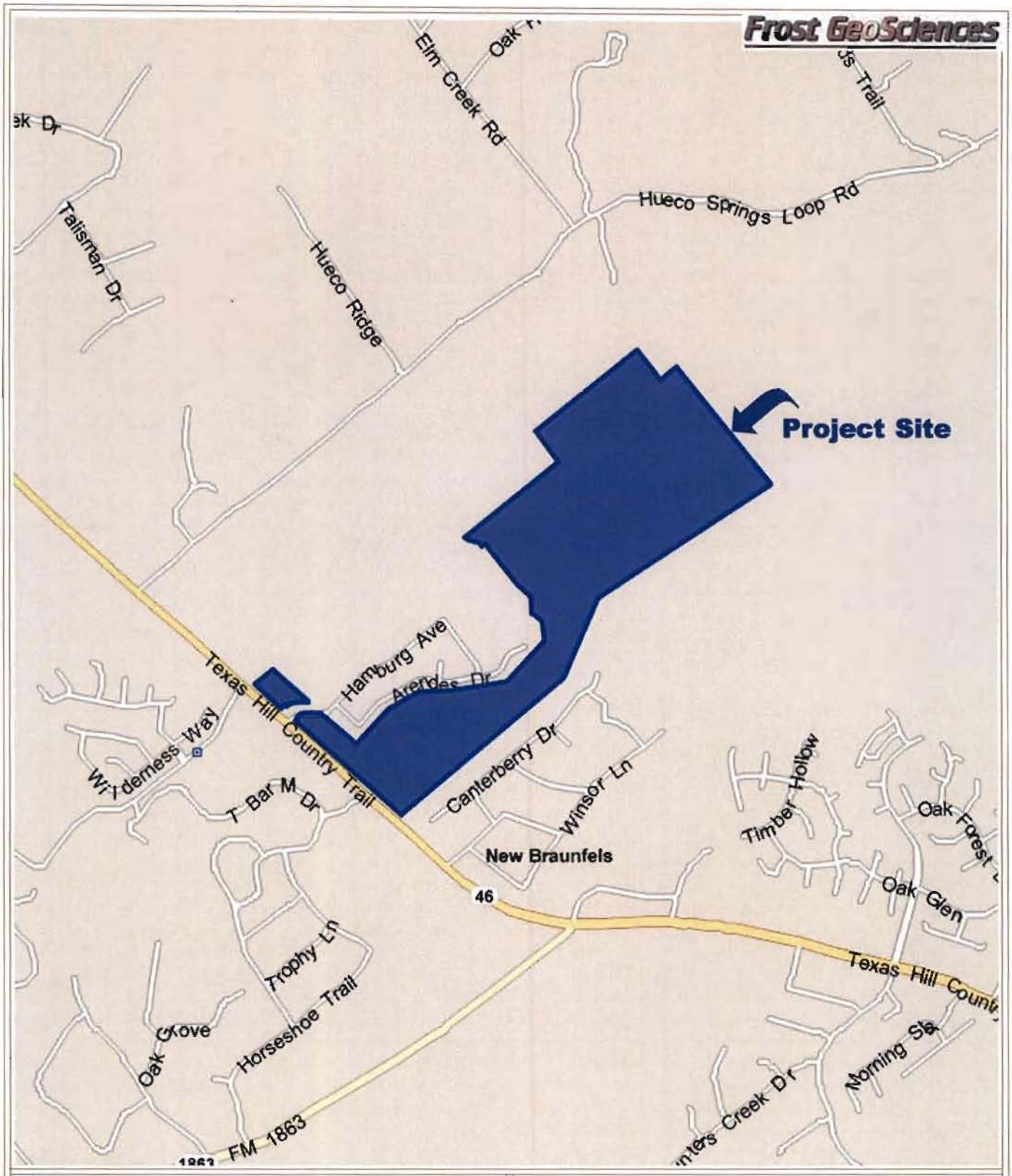
PROJECT NAME:
Geologic Site Assessment (WPAP)
for Regulated Activities / Development on the
Edwards Aquifer Recharge / Transition Zone
Manor Creek Subdivision
Comal County, Texas

Site Layout

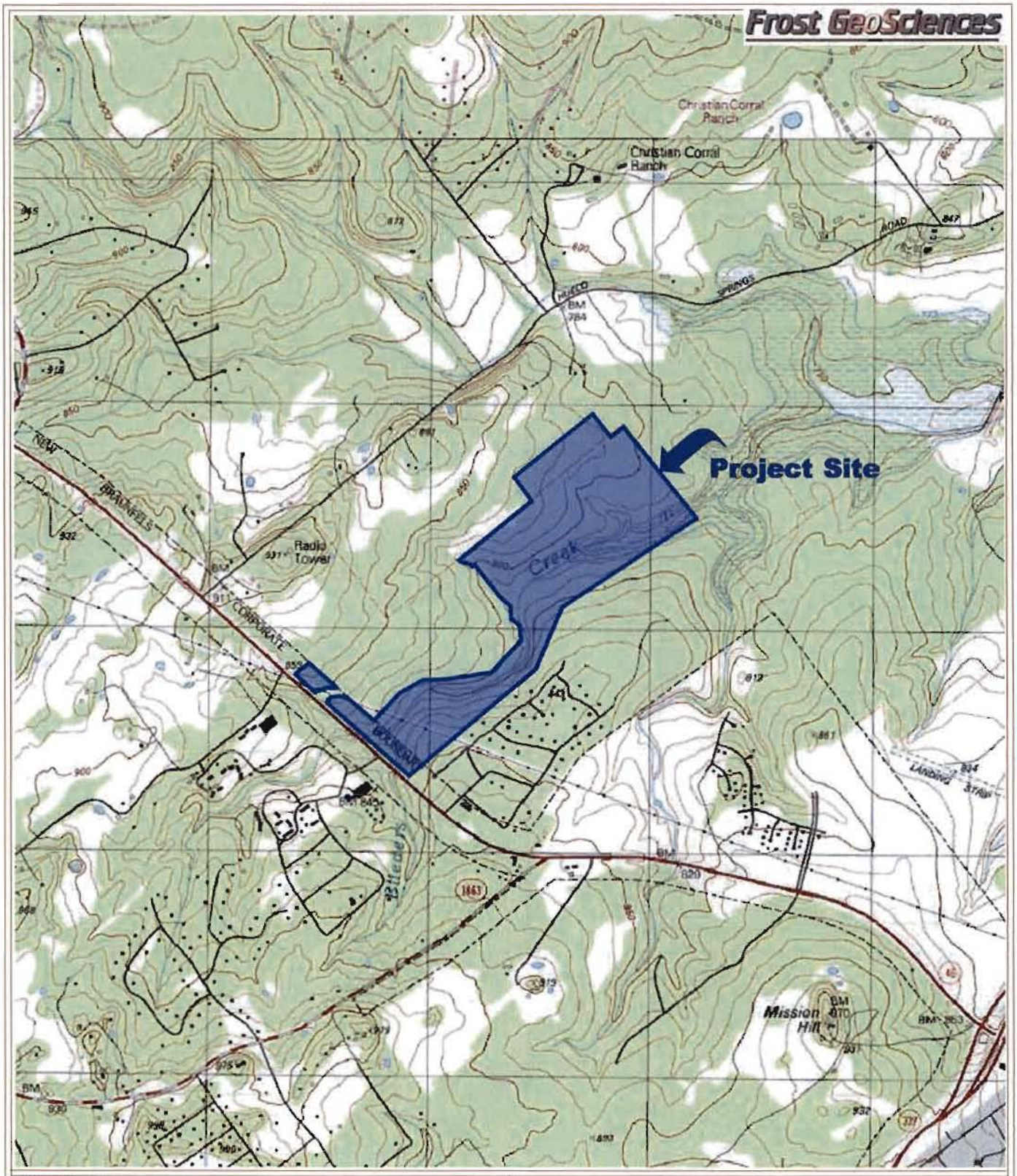
PROJECT NO.: FGS-E15171

DATE: June 8, 2015

FIGURE 1



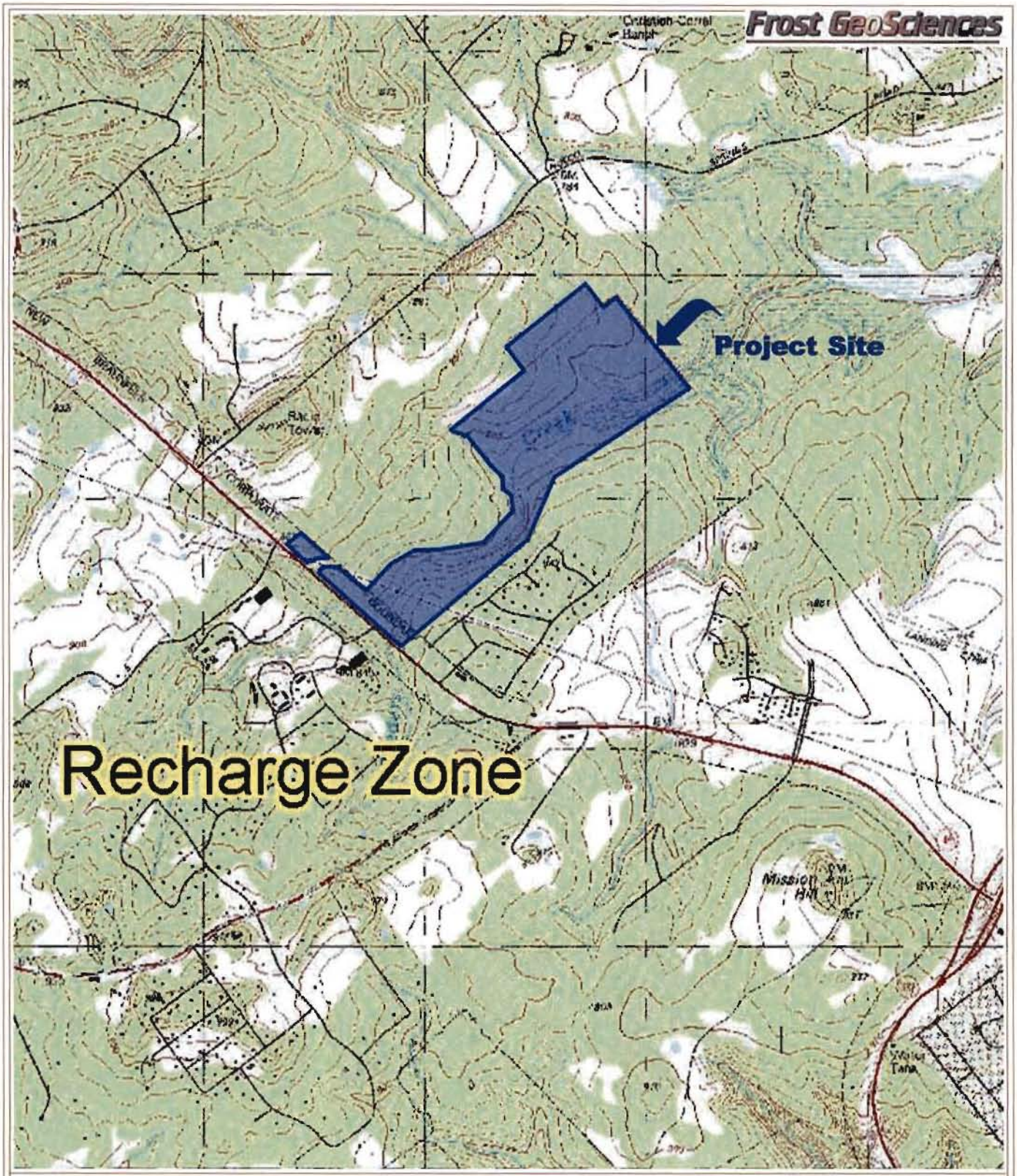
PROJECT NAME: Geologic Site Assessment (SCS) for Regulated Activities / Development on the Edwards Aquifer Recharge / Transition Zone Manor Creek Subdivision Comal County, Texas	Street Map
	PROJECT NO.: FGS-E15171 / **DATE:** June 8, 2015



PROJECT NAME:
Geologic Site Assessment (SCS)
for Regulated Activities / Development on the
Edwards Aquifer Recharge / Transition Zone
Manor Creek Subdivision
Comal County, Texas

U.S.G.S. 7.5 Minute Quadrangle Map
New Braunfels West, Texas Sheet (1988)

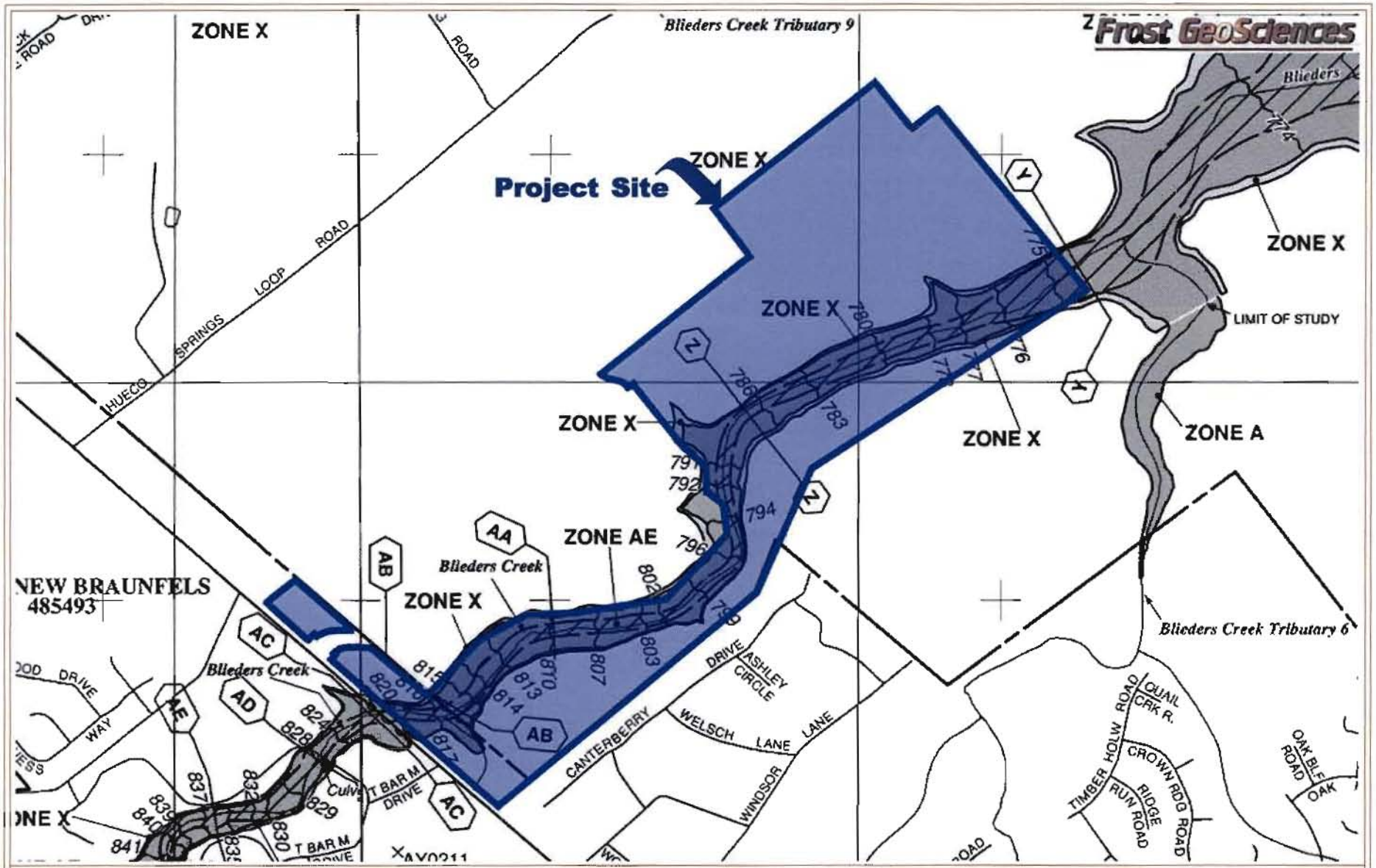
PROJECT NO.:	DATE:
FGS-E15171	June 8, 2015



PROJECT NAME:
Geologic Site Assessment (SCS)
for Regulated Activities / Development on the
Edwards Aquifer Recharge / Transition Zone
Manor Creek Subdivision
Comal County, Texas

EAA-Edwards Aquifer Recharge and Contributing Zone Map
New Braunfels West, Texas Quadrangle (1998)

PROJECT NO.:	DATE:
FGS-E15171	June 8, 2015

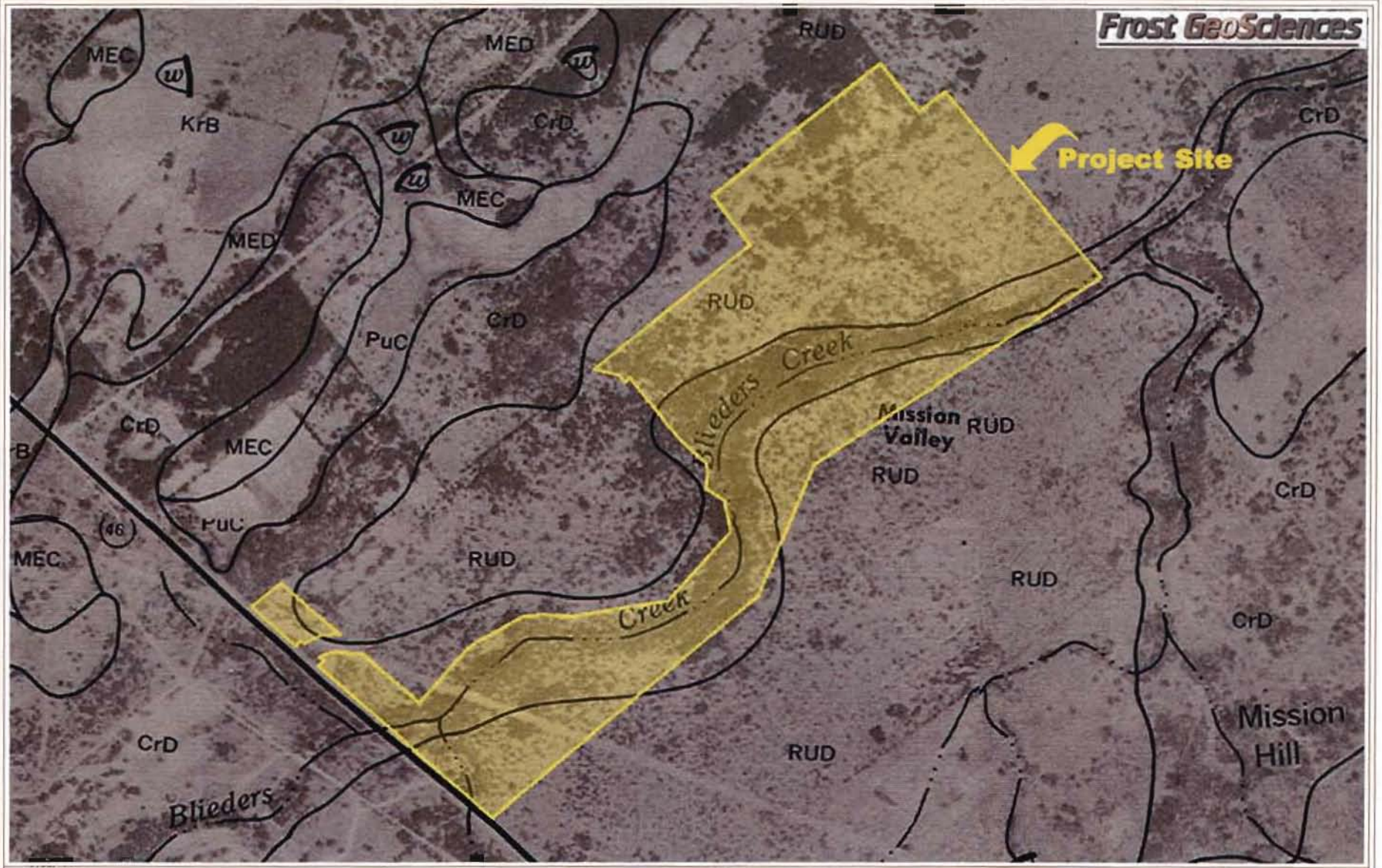


PROJECT NAME:
Geologic Site Assessment (SCS)
for Regulated Activities / Development on the
Edwards Aquifer Recharge / Transition Zone
Manor Creek Subdivision
Comal County, Texas

Flood Insurance Rate Map (FIRM)
Community Panel #s 48091C0430F and 48091C0435F
September 9, 2009

PROJECT NO.: FGS-E15171

DATE: June 8, 2015



PROJECT NAME:
Geologic Site Assessment (SCS)
for Regulated Activities / Development on the
Edwards Aquifer Recharge / Transition Zone
Manor Creek Subdivision
Comal County, Texas

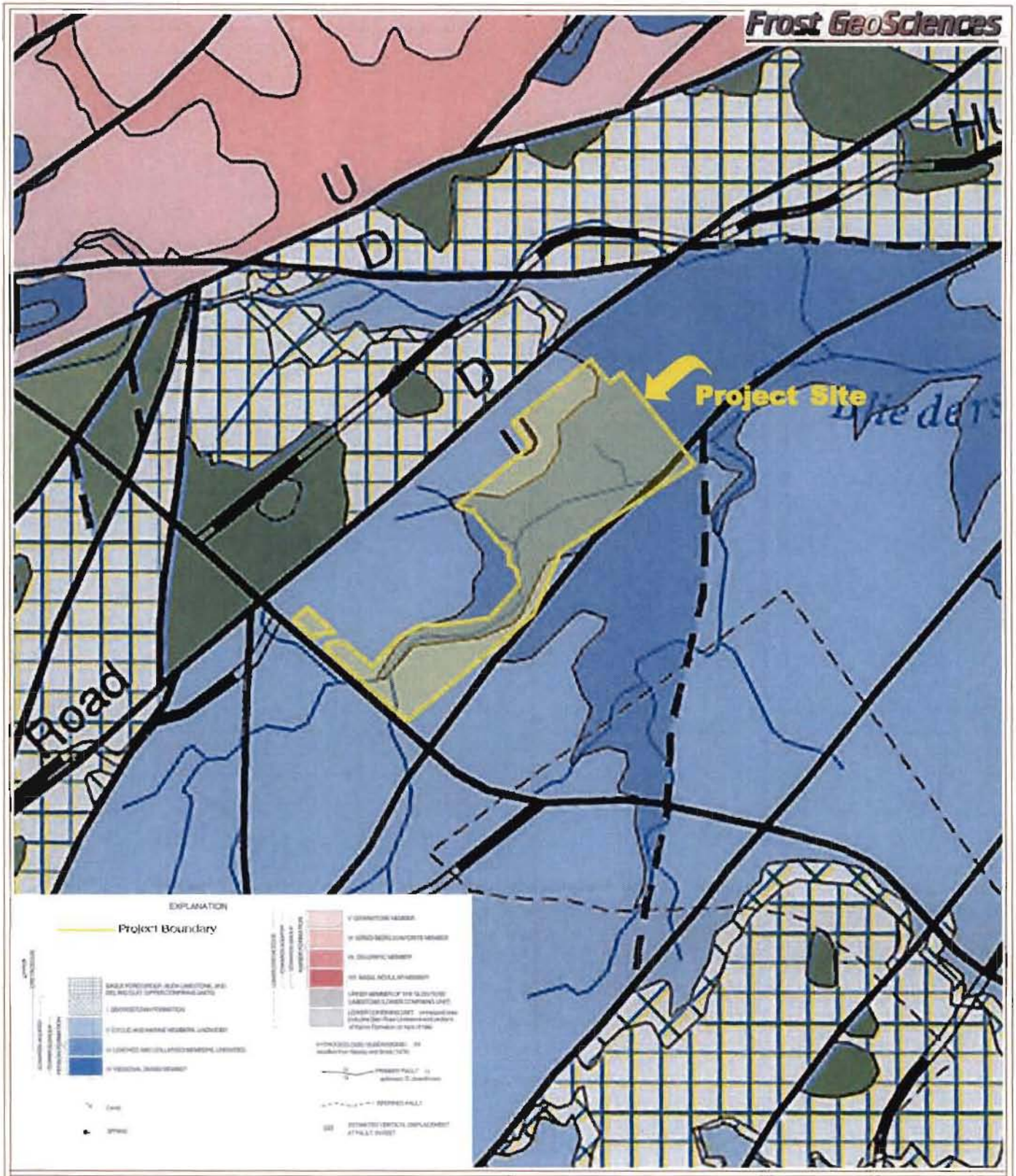
1973 Aerial Photograph
United States Department of Agriculture
Soil Survey of Comal & Hays County, Texas

PROJECT NO.: FGS-E15171

DATE: June 8, 2015

Geotechnical • Construction Materials • Geologic • Environmental

FIGURE 6



PROJECT NAME: Geologic Site Assessment (SCS) for Regulated Activities / Development on the Edwards Aquifer Recharge / Transition Zone Manor Creek Subdivision Comal County, Texas	United States Geologic Survey Water Resources Investigations #4117-94 Geologic Map of Comal County, Texas
PROJECT NO.: FGS-E15171	**DATE:** June 8, 2015

PROJECT NAME:	Bureau of Economic Geology Geologic Map of the Comal County, Texas 30 X 60 Minute Quadrangle (2000)	
Geologic Site Assessment (SCS) for Regulated Activities / Development on the Edwards Aquifer Recharge / Transition Zone Manor Creek Subdivision Comal County, Texas	PROJECT NO.: FGS-E15171	DATE: March 28, 2015

PROJECT NAME:
Geologic Site Assessment (SCS)
for Regulated Activities / Development on the
Edwards Aquifer Recharge / Transition Zone
Manor Creek Subdivision
Comal County, Texas

2014 Aerial Photograph
National Agricultural Imagery Program

PROJECT NO.: FGS-E15171

DATE: June 8, 2015

Geotechnical • Construction Materials • Geologic • Environmental

FIGURE 8

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PROJECT NAME:
Geologic Site Assessment (WPAP)
for Regulated Activities / Development on the
Edwards Aquifer Recharge / Transition Zone
Manor Creek Subdivision
Comal County, Texas

2014 Aerial Photograph with PRFs
National Agricultural Imagery Program

PROJECT NO.: FGS-E15171

DATE: June 8, 2015

FIGURE 9

Water Pollution Abatement Plan Application

Texas Commission on Environmental Quality

for Regulated Activities on the Edwards Aquifer Recharge Zone and Relating to 30 TAC §213.5(b), Effective June 1, 1999

To ensure that the application is administratively complete, confirm that all fields in the form are complete, verify that all requested information is provided, consistently reference the same site and contact person in all forms in the application, and ensure forms are signed by the appropriate party.

Note: Including all the information requested in the form and attachments contributes to more streamlined technical reviews.

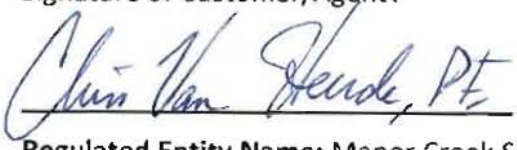
Signature

To the best of my knowledge, the responses to this form accurately reflect all information requested concerning the proposed regulated activities and methods to protect the Edwards Aquifer. This **Water Pollution Abatement Plan Application Form** is hereby submitted for TCEQ review and Executive Director approval. The form was prepared by:

Print Name of Customer/Agent: Chris Van Heerde, C.F.M., P.E.

Date: 11/1/2016

Signature of Customer/Agent:



Regulated Entity Name: Manor Creek Subdivision Units 4-6

Regulated Entity Information

1. The type of project is:

   ☒ Residential: Number of Lots:197
   ☐ Residential: Number of Living Unit Equivalents:_____
   ☐ Commercial
   ☐ Industrial
   ☐ Other:_____

2. Total site acreage (size of property):94.78

3. Estimated projected population:591

4. The amount and type of impervious cover expected after construction are shown below:

Table 1 - Impervious Cover Table

Impervious Cover of Proposed Project	Sq. Ft.	Sq. Ft./Acre	Acres
Structures/Rooftops	1,133,431.2	÷ 43,560 =	26.02
Parking		÷ 43,560 =	
Other paved surfaces	529,745	÷ 43,560 =	12.16
Total Impervious Cover	1,663,120.8	÷ 43,560 =	38.18

Total Impervious Cover 38.18 ÷ **Total Acreage** 94.78 **X 100 =** 40.28**% Impervious Cover**

5. ☒ **Attachment A - Factors Affecting Surface Water Quality**. A detailed description of all factors that could affect surface water and groundwater quality that addresses ultimate land use is attached.

6. ☒ Only inert materials as defined by 30 TAC §330.2 will be used as fill material.

For Road Projects Only

Complete questions 7 - 12 if this application is exclusively for a road project.

7. Type of project:

   ☐ TXDOT road project.
   ☐ County road or roads built to county specifications.
   ☐ City thoroughfare or roads to be dedicated to a municipality.
   ☐ Street or road providing access to private driveways.

8. Type of pavement or road surface to be used:

   ☐ Concrete
   ☐ Asphaltic concrete pavement
   ☐ Other: _____

9. Length of Right of Way (R.O.W.): _____ feet.

   Width of R.O.W.: _____ feet.
   L x W = _____ Ft^2 ÷ 43,560 Ft^2/Acre = _____ acres.

10. Length of pavement area: _____ feet.

    Width of pavement area: _____ feet.
    L x W = _____ Ft^2 ÷ 43,560 Ft^2/Acre = _____ acres.
    Pavement area _____ acres ÷ R.O.W. area _____ acres x 100 = _____% impervious cover.

11. ☐ A rest stop will be included in this project.

    ☐ A rest stop will not be included in this project.

12. ☐ Maintenance and repair of existing roadways that do not require approval from the TCEQ Executive Director. Modifications to existing roadways such as widening roads/adding shoulders totaling more than one-half (1/2) the width of one (1) existing lane require prior approval from the TCEQ.

Stormwater to be generated by the Proposed Project

13. ☒ **Attachment B - Volume and Character of Stormwater.** A detailed description of the volume (quantity) and character (quality) of the stormwater runoff which is expected to occur from the proposed project is attached. The estimates of stormwater runoff quality and quantity are based on the area and type of impervious cover. Include the runoff coefficient of the site for both pre-construction and post-construction conditions.

Wastewater to be generated by the Proposed Project

14. The character and volume of wastewater is shown below:

100% Domestic	59,100 Gallons/day
_____% Industrial	_____ Gallons/day
_____% Commingled	_____ Gallons/day
TOTAL gallons/day 59,100	

15. Wastewater will be disposed of by:

☐ On-Site Sewage Facility (OSSF/Septic Tank):

☐ **Attachment C - Suitability Letter from Authorized Agent.** An on-site sewage facility will be used to treat and dispose of the wastewater from this site. The appropriate licensing authority's (authorized agent) written approval is attached. It states that the land is suitable for the use of private sewage facilities and will meet or exceed the requirements for on-site sewage facilities as specified under 30 TAC Chapter 285 relating to On-site Sewage Facilities.

☐ Each lot in this project/development is at least one (1) acre (43,560 square feet) in size. The system will be designed by a licensed professional engineer or registered sanitarian and installed by a licensed installer in compliance with 30 TAC Chapter 285.

☒ Sewage Collection System (Sewer Lines):

☐ Private service laterals from the wastewater generating facilities will be connected to an existing SCS.

☒ Private service laterals from the wastewater generating facilities will be connected to a proposed SCS.

☐ The SCS was previously submitted on_____.

☒ The SCS was submitted with this application.

☒ The SCS will be submitted at a later date. The owner is aware that the SCS may not be installed prior to Executive Director approval.

☒ The sewage collection system will convey the wastewater to the New Braunfels Utilities (name) Treatment Plant. The treatment facility is:

☒ Existing.
☐ Proposed.

16. ☒ All private service laterals will be inspected as required in 30 TAC §213.5.

Site Plan Requirements

Items 17 – 28 must be included on the Site Plan.

17. ☒ The Site Plan must have a minimum scale of 1" = 400'.

Site Plan Scale: 1" = 200'.

18. 100-year floodplain boundaries:

☒ Some part(s) of the project site is located within the 100-year floodplain. The floodplain is shown and labeled.
☐ No part of the project site is located within the 100-year floodplain.
The 100-year floodplain boundaries are based on the following specific (including date of material) sources(s): FIRM 48091C0435F (effective September 2, 2009)

19. ☒ The layout of the development is shown with existing and finished contours at appropriate, but not greater than ten-foot contour intervals. Lots, recreation centers, buildings, roads, open space, etc. are shown on the plan.

☐ The layout of the development is shown with existing contours at appropriate, but not greater than ten-foot intervals. Finished topographic contours will not differ from the existing topographic configuration and are not shown. Lots, recreation centers, buildings, roads, open space, etc. are shown on the site plan.

20. All known wells (oil, water, unplugged, capped and/or abandoned, test holes, etc.):

☐ There are _____ (#) wells present on the project site and the locations are shown and labeled. (Check all of the following that apply)

☐ The wells are not in use and have been properly abandoned.
☐ The wells are not in use and will be properly abandoned.
☐ The wells are in use and comply with 16 TAC §76.

☒ There are no wells or test holes of any kind known to exist on the project site.

21. Geologic or manmade features which are on the site:

☒ All sensitive geologic or manmade features identified in the Geologic Assessment are shown and labeled.
☐ No sensitive geologic or manmade features were identified in the Geologic Assessment.
☐ **Attachment D - Exception to the Required Geologic Assessment**. A request and justification for an exception to a portion of the Geologic Assessment is attached.

22. ☒ The drainage patterns and approximate slopes anticipated after major grading activities.

23. ☒ Areas of soil disturbance and areas which will not be disturbed.

24. ☒ Locations of major structural and nonstructural controls. These are the temporary and permanent best management practices.

25. ☒ Locations where soil stabilization practices are expected to occur.

26. ☐ Surface waters (including wetlands).

    ☒ N/A

27. ☒ Locations where stormwater discharges to surface water or sensitive features are to occur.

    ☐ There will be no discharges to surface water or sensitive features.

28. ☒ Legal boundaries of the site are shown.

Administrative Information

29. ☒ Submit one (1) original and one (1) copy of the application, plus additional copies as needed for each affected incorporated city, groundwater conservation district, and county in which the project will be located. The TCEQ will distribute the additional copies to these jurisdictions. The copies must be submitted to the appropriate regional office.

30. ☒ Any modification of this WPAP will require Executive Director approval, prior to construction, and may require submission of a revised application, with appropriate fees.

WATER POLLUTION ABATEMENT PLAN
ATTACHMENT A
Factors Affecting Water Quality

The Manor Creek Subdivision Units 4-6 includes the construction of 8" gravity wastewater line, a lift station, 197 lots with 26.02 acres of structures/rooftops, and 12.16 acres of streets. The gravity wastewater lines will be installed under approval of a separate SCS. The factor affecting water quality is runoff sediment transport from the trench work and construction being performed. However, temporary BMP measures are being taken to insure water quality is not impaired by construction.

WATER POLLUTION ABATEMENT PLAN
ATTACHMENT B
Volume and Character of Stormwater

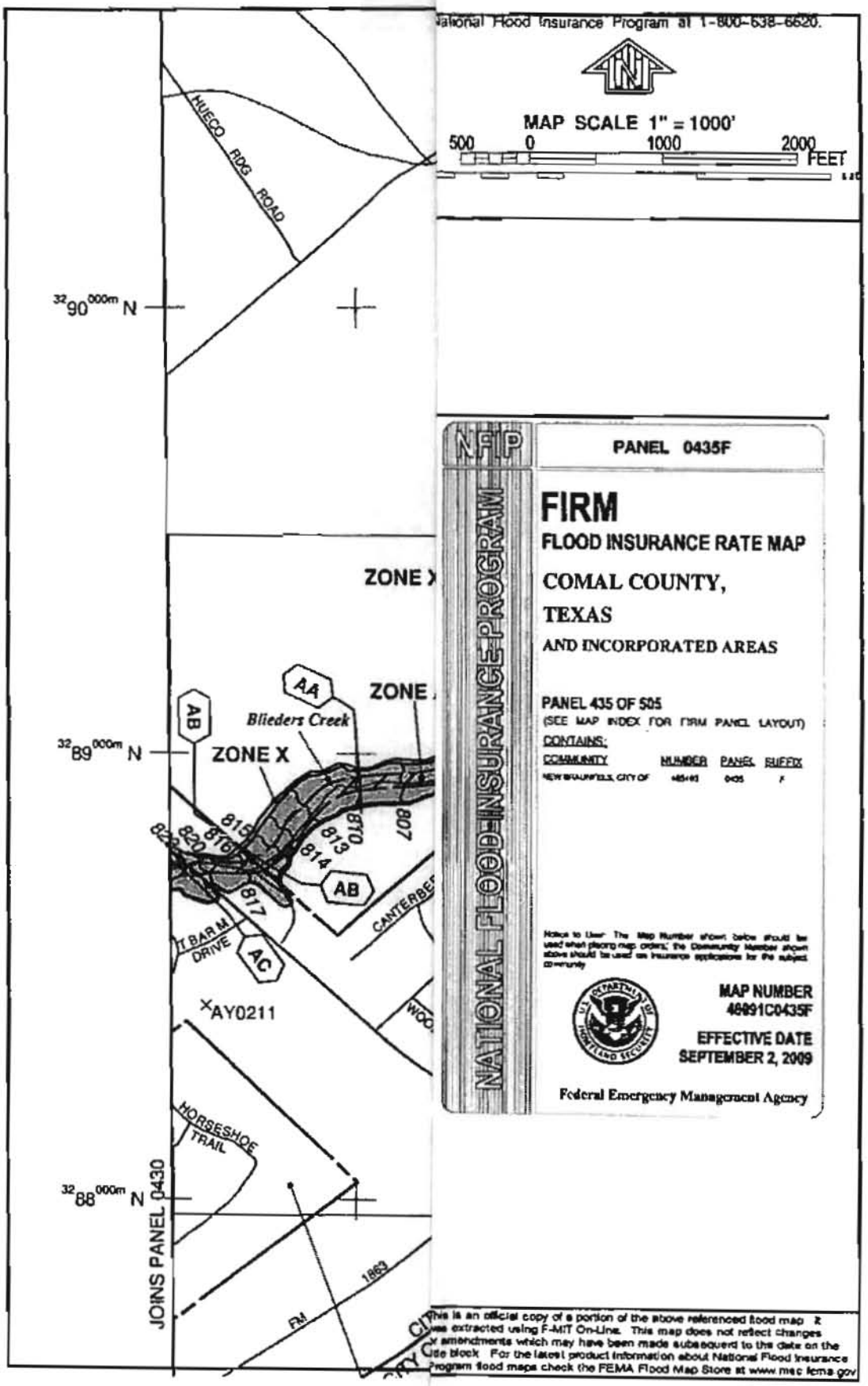
The Manor Creek Subdivision Units 4-6 cover 94.78 acres. The Existing Drainage Area Map and Proposed Drainage Area Maps and flow calculations for Unit 4 can be found on sheets 9 and 10, respectively, of the Manor Creek, Unit 4 Civil Site Construction Plans.

The Existing Drainage Area Map and Proposed Drainage Area Map and flow calculations for Unit 5 can be found on sheets 7 and 8, respectively, of the Manor Creek Subdivision Unit 5 Civil Site Construction Plans.

The Existing Drainage Area Map and Proposed Drainage Area Map and flow calculations for Unit 6 can be found on sheets 4 and 5, respectively, of the Manor Creek Subdivision, Unit 6 Civil Site Construction Plans.

There is no existing impervious cover on the 94.78 acres. The proposed subdivision will increase the impervious cover to be 38.18 acres or 40.28% at full development of the subdivision (including the homes). The plans include permanent BMPs to treat the increase of TSS due to this development. The resulting TSS removal from the proposed development is 34,025 pounds; which meets the 80% TSS removal standard set by TCEQ. The proposed Permanent BMPs include Vegetative Filter Strips, Sand Filter Systems, and Grassy Swales.

The existing runoff from the site was determined using the Rational Method. The runoff coefficient for the undeveloped site ranges from 0.38 to 0.53 based on the storm return interval. The proposed conditions runoff coefficient is 0.53 for large lot single-family homes on a 2-7% slope. These values were derived from the most current revision of the City of New Braunfels Drainage Criteria Manual. Tables showing the drainage areas and resulting flows are the drainage area maps contained within the construction plans for their respective unit.


National Flood Insurance Program at 1-800-638-6620.
MAP SCALE 1" = 1000'
500 0 1000 2000 FEET
MUECO RDG ROAD
32 90 000m N
ZONE X
ZONE A
AA
AB
Blieders Creek
32 89 000m N
ZONE X
815
816
820
810
813
814
807
817
AB
CANTERBE
T BAR M DRIVE
AC
AY0211
HORSESHOE TRAIL
32 88 000m N
JOINS PANEL 0430
1863
FM
NFIP
NATIONAL FLOOD INSURANCE PROGRAM
PANEL 0435F
FIRM
FLOOD INSURANCE RATE MAP
COMAL COUNTY,
TEXAS
AND INCORPORATED AREAS
PANEL 435 OF 505
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
NEW BRAUNFELS, CITY OF 485493 0435 F
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.
MAP NUMBER
48091C0435F
EFFECTIVE DATE
SEPTEMBER 2, 2009
Federal Emergency Management Agency
This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Temporary Stormwater Section

Texas Commission on Environmental Quality

for Regulated Activities on the Edwards Aquifer Recharge Zone and Relating to 30 TAC §213.5(b)(4)(A), (B), (D)(I) and (G); Effective June 1, 1999

To ensure that the application is administratively complete, confirm that all fields in the form are complete, verify that all requested information is provided, consistently reference the same site and contact person in all forms in the application, and ensure forms are signed by the appropriate party.

Note: Including all the information requested in the form and attachments contributes to more streamlined technical reviews.

Signature

To the best of my knowledge, the responses to this form accurately reflect all information requested concerning the proposed regulated activities and methods to protect the Edwards Aquifer. This **Temporary Stormwater Section** is hereby submitted for TCEQ review and executive director approval. The application was prepared by:

Print Name of Customer/Agent: Chris Van Heerde, C.F.M., P.E.

Date: 11/1/2016

Signature of Customer/Agent:

Chris Van Heerde, PE

Regulated Entity Name: Manor Creek Subdivision Units 4-6

Project Information

Potential Sources of Contamination

Examples: Fuel storage and use, chemical storage and use, use of asphaltic products, construction vehicles tracking onto public roads, and existing solid waste.

1. Fuels for construction equipment and hazardous substances which will be used during construction:

   ☐ The following fuels and/or hazardous substances will be stored on the site: _____

   These fuels and/or hazardous substances will be stored in:

   ☐ Aboveground storage tanks with a cumulative storage capacity of less than 250 gallons will be stored on the site for less than one (1) year.

☐ Aboveground storage tanks with a cumulative storage capacity between 250 gallons and 499 gallons will be stored on the site for less than one (1) year.

☐ Aboveground storage tanks with a cumulative storage capacity of 500 gallons or more will be stored on the site. An Aboveground Storage Tank Facility Plan application must be submitted to the appropriate regional office of the TCEQ prior to moving the tanks onto the project.

☒ Fuels and hazardous substances will not be stored on the site.

2. ☒ **Attachment A - Spill Response Actions.** A site specific description of the measures to be taken to contain any spill of hydrocarbons or hazardous substances is attached.

3. ☐ Temporary aboveground storage tank systems of 250 gallons or more cumulative storage capacity must be located a minimum horizontal distance of 150 feet from any domestic, industrial, irrigation, or public water supply well, or other sensitive feature.

4. ☒ **Attachment B - Potential Sources of Contamination.** A description of any activities or processes which may be a potential source of contamination affecting surface water quality is attached.

Sequence of Construction

5. ☒ **Attachment C - Sequence of Major Activities.** A description of the sequence of major activities which will disturb soils for major portions of the site (grubbing, excavation, grading, utilities, and infrastructure installation) is attached.

   ☒ For each activity described, an estimate (in acres) of the total area of the site to be disturbed by each activity is given.

   ☒ For each activity described, include a description of appropriate temporary control measures and the general timing (or sequence) during the construction process that the measures will be implemented.

6. ☒ Name the receiving water(s) at or near the site which will be disturbed or which will receive discharges from disturbed areas of the project: Bleiders Creek

Temporary Best Management Practices (TBMPs)

Erosion control examples: tree protection, interceptor swales, level spreaders, outlet stabilization, blankets or matting, mulch, and sod. Sediment control examples: stabilized construction exit, silt fence, filter dikes, rock berms, buffer strips, sediment traps, and sediment basins. Please refer to the Technical Guidance Manual for guidelines and specifications. All structural BMPs must be shown on the site plan.

7. ☒ **Attachment D – Temporary Best Management Practices and Measures.** TBMPs and measures will prevent pollution of surface water, groundwater, and stormwater. The construction-phase BMPs for erosion and sediment controls have been designed to retain sediment on site to the extent practicable. The following information is attached:

☒ A description of how BMPs and measures will prevent pollution of surface water, groundwater or stormwater that originates upgradient from the site and flows across the site.

☒ A description of how BMPs and measures will prevent pollution of surface water or groundwater that originates on-site or flows off site, including pollution caused by contaminated stormwater runoff from the site.

☒ A description of how BMPs and measures will prevent pollutants from entering surface streams, sensitive features, or the aquifer.

☒ A description of how, to the maximum extent practicable, BMPs and measures will maintain flow to naturally-occurring sensitive features identified in either the geologic assessment, TCEQ inspections, or during excavation, blasting, or construction.

8. ☒ The temporary sealing of a naturally-occurring sensitive feature which accepts recharge to the Edwards Aquifer as a temporary pollution abatement measure during active construction should be avoided.

   ☐ **Attachment E - Request to Temporarily Seal a Feature**. A request to temporarily seal a feature is attached. The request includes justification as to why no reasonable and practicable alternative exists for each feature.

   ☒ There will be no temporary sealing of naturally-occurring sensitive features on the site.

9. ☒ **Attachment F - Structural Practices**. A description of the structural practices that will be used to divert flows away from exposed soils, to store flows, or to otherwise limit runoff discharge of pollutants from exposed areas of the site is attached. Placement of structural practices in floodplains has been avoided.

10. ☒ **Attachment G - Drainage Area Map**. A drainage area map supporting the following requirements is attached:

    ☐ For areas that will have more than 10 acres within a common drainage area disturbed at one time, a sediment basin will be provided.

    ☐ For areas that will have more than 10 acres within a common drainage area disturbed at one time, a smaller sediment basin and/or sediment trap(s) will be used.

    ☐ For areas that will have more than 10 acres within a common drainage area disturbed at one time, a sediment basin or other equivalent controls are not attainable, but other TBMPs and measures will be used in combination to protect down slope and side slope boundaries of the construction area.

    ☐ There are no areas greater than 10 acres within a common drainage area that will be disturbed at one time. A smaller sediment basin and/or sediment trap(s) will be used in combination with other erosion and sediment controls within each disturbed drainage area.

☒ There are no areas greater than 10 acres within a common drainage area that will be disturbed at one time. Erosion and sediment controls other than sediment basins or sediment traps within each disturbed drainage area will be used.

11. ☐ **Attachment H - Temporary Sediment Pond(s) Plans and Calculations.** Temporary sediment pond or basin construction plans and design calculations for a proposed temporary BMP or measure have been prepared by or under the direct supervision of a Texas Licensed Professional Engineer. All construction plans and design information must be signed, sealed, and dated by the Texas Licensed Professional Engineer. Construction plans for the proposed temporary BMPs and measures are attached.

☒ N/A

12. ☒ **Attachment I - Inspection and Maintenance for BMPs.** A plan for the inspection of each temporary BMP(s) and measure(s) and for their timely maintenance, repairs, and, if necessary, retrofit is attached. A description of the documentation procedures, recordkeeping practices, and inspection frequency are included in the plan and are specific to the site and/or BMP.

13. ☒ All control measures must be properly selected, installed, and maintained in accordance with the manufacturer's specifications and good engineering practices. If periodic inspections by the applicant or the executive director, or other information indicate a control has been used inappropriately, or incorrectly, the applicant must replace or modify the control for site situations.

14. ☒ If sediment escapes the construction site, off-site accumulations of sediment must be removed at a frequency sufficient to minimize offsite impacts to water quality (e.g., fugitive sediment in street being washed into surface streams or sensitive features by the next rain).

15. ☒ Sediment must be removed from sediment traps or sedimentation ponds not later than when design capacity has been reduced by 50%. A permanent stake will be provided that can indicate when the sediment occupies 50% of the basin volume.

16. ☒ Litter, construction debris, and construction chemicals exposed to stormwater shall be prevented from becoming a pollutant source for stormwater discharges (e.g., screening outfalls, picked up daily).

Soil Stabilization Practices

Examples: establishment of temporary vegetation, establishment of permanent vegetation, mulching, geotextiles, sod stabilization, vegetative buffer strips, protection of trees, or preservation of mature vegetation.

17. ☒ **Attachment J - Schedule of Interim and Permanent Soil Stabilization Practices.** A schedule of the interim and permanent soil stabilization practices for the site is attached.

18. ☒ Records must be kept at the site of the dates when major grading activities occur, the dates when construction activities temporarily or permanently cease on a portion of the site, and the dates when stabilization measures are initiated.

19. ☒ Stabilization practices must be initiated as soon as practicable where construction activities have temporarily or permanently ceased.

Administrative Information

20. ☒ All structural controls will be inspected and maintained according to the submitted and approved operation and maintenance plan for the project.

21. ☒ If any geologic or manmade features, such as caves, faults, sinkholes, etc., are discovered, all regulated activities near the feature will be immediately suspended. The appropriate TCEQ Regional Office shall be immediately notified. Regulated activities must cease and not continue until the TCEQ has reviewed and approved the methods proposed to protect the aquifer from any adverse impacts.

22. ☒ Silt fences, diversion berms, and other temporary erosion and sediment controls will be constructed and maintained as appropriate to prevent pollutants from entering sensitive features discovered during construction.

TEMPORARY STORMWATER SECTION
ATTACHMENT A
Spill Response Actions

Contractor to notify all appropriate authorities if more than 25 gallons of hydrocarbons are spilled. The construction plans include the required notes regarding appropriate spill response actions as directed by TECQ. There will be no temporary storage vessels of fuel or hydrocarbons to be stored on site.

If spills of any hydrocarbons occur, construction must contain spills by immediate action. Earthen materials must be kept readily available to provide a Dike. Sand should be used to help soak fuels. Property disposal of any materials used will be required.

Contractor must promote job site awareness to all employees involved. All employees must be made aware of the provisions in this report.

Spill Prevention and Control

The objective of this section is to describe measures to prevent or reduce the discharge of pollutants to drainage systems or watercourses from leaks and spills by reducing the chance for spills, stopping the source of spills, containing and cleaning up spills, properly disposing of spill materials, and training employees.

The following steps will help reduce the stormwater impacts of leaks and spills:

Education

(1) Be aware that different materials pollute in different amounts. Make sure that each employee knows what a "significant spill" is for each material they use, and what is the appropriate response for "significant" and "insignificant" spills. Employees should also be aware of when spill must be reported to the TCEQ. Information available in 30 TAC 327.4 and 40 CFR 302.4

(2) Educate employees and subcontractors on potential dangers to humans and the environment from spills and leaks.

(3) Hold regular meetings to discuss and reinforce appropriate disposal procedures (incorporate into regular safety meetings).

(4) Establish a continuing education program to indoctrinate new employees.

(5) Have contractor's superintendent or representative oversee and enforce proper spill prevention and control measures.

General Measures

(1) To the extent that the work can be accomplished safely, spills of oil, petroleum products, substances listed under 40 CFR parts 110, 117, and 302, and sanitary and septic wastes should be contained and cleaned up immediately.

(2) Store hazardous materials and wastes in covered containers and protect from vandalism.

(3) Place a stockpile of spill cleanup materials where it will be readily accessible.

(4) Train employees in spill prevention and cleanup.

(5) Designate responsible individuals to oversee and enforce control measures.

(6) Spills should be covered and protected from stormwater runoff during rainfall to the extent that it doesn't compromise cleanup activities.

(7) Do not bury or wash spills with water.

(8) Store and dispose of used clean up materials, contaminated materials, and recovered spill material that is no longer suitable for the intended purpose in conformance with the provisions in applicable BMPs.

(9) Do not allow water used for cleaning and decontamination to enter storm drains or watercourses. Collect and dispose of contaminated water in accordance with applicable regulations.

(10) Contain water overflow or minor water spillage and do not allow it to discharge into drainage facilities or watercourses.

(11) Place Material Safety Data Sheets (MSDS), as well as proper storage, cleanup, and spill reporting instructions for hazardous materials stored or used on the project site in an open, conspicuous, and accessible location.

(12) Keep waste storage areas clean, well-organized, and equipped with ample cleanup supplies as appropriate for the materials being stored. Perimeter controls, containment structures, covers, and liners should be repaired or replaced as needed to maintain proper function

Clean up

(1) Clean up leaks and spills immediately.

(2) Use a rag for small spills on paved surfaces, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be disposed of as hazardous waste.

(3) Never hose down or bury dry material spills. Clean up as much of the material as possible and dispose of properly. See the waste management BMP's in this section for specific information.

Minor Spills

(1) Minor spills typically involve small quantities of oil, gasoline, paint, etc. which can be controlled by the first responder at the discovery of the spill.

(2) Use absorbent materials on small spills rather than hosing down or burying the spill.

(3) Absorbent materials should be promptly removed and disposed of properly.

(4) Follow the practice below for a minor spill:

(a) Contain the spread of the spill.

(b) Recover spilled materials.

(c) Clean the contaminated area and properly dispose of contaminated materials.

Semi-Significant Spills

Semi-significant spills still can be controlled by the first responder along with the aid of other personnel such as laborers and the foreman, etc. This response may require the cessation of all other activities.

Spills should be cleaned up immediately:

(1) Contain spread of the spill.

(2) Notify the project foreman immediately.

(3) If the spill occurs on paved or impermeable surfaces, clean up using "dry" methods (absorbent materials, cat litter and/or rags). Contain the spill by encircling with the absorbent materials and do not let the spill spread widely.

(4) If the spill occurs in dirt areas immediately contain the spill by constructing an earthen dike. Dig up and properly dispose of contaminated soil.

(5) If the spill occurs during rain, cover spill with tarps or other material to prevent contaminating runoff.

Significant/Hazardous Spills

For significant or hazardous spills that are in reportable quantities:

(1) Notify the TCEQ by telephone as soon as possible and within 24 hours at 512-339-2929 (Austin) or 210-490-3096 (San Antonio) between 8 AM and 5 PM. After hours, contact

the Environmental Release Hotline at 1-800-832-8224. It is the contractor's responsibility to have all emergency phone numbers at the construction site.

(2) For spills of federal reportable quantities, in conformance with the requirements in 40 CFR parts 110, 119 and 302, the contractor should notify the National Response Center at (800) 424-8802.

(3) Notification should first be made by telephone and followed up with a written report.

(4) The services of a spills contractor or a Haz-Mat team should be obtained immediately. Construction personnel should not attempt to clean up until the appropriate and qualified staffs have arrived at the job site.

(5) Other agencies which may need to be consulted include, but are not limited to, the City of Police Department, County Sheriff Office, Fire Departments, etc.

More information on spill rules and appropriate responses is available on the TCEQ website at:

Vehicle and Equipment Maintenance

(1) If maintenance must occur onsite, use a designated area and a secondary containment, located away from drainage courses, to prevent the runon of stormwater and the runoff of spills.

(2) Regularly inspect onsite vehicles and equipment for leaks and repair immediately.

(3) Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allows leaking vehicles or equipment onsite.

(4) Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.

(5) Place drip pans or absorbent materials under paving equipment when not in use.

(6) Use absorbent materials on small spills rather than hosing down or burying the spill. Remove the absorbent materials promptly and dispose of properly.

(7) Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.

(8) Oil filters disposed of in trashcans or dumpsters can leak oil and pollute stormwater. Place the oil filter in a funnel over a waste oil-recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask the oil supplier or recycler about recycling oil filters.

(9) Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are not sure it is not leaking.

Vehicle and Equipment Fueling

(1) If fueling must occur on site, use designated areas, located away from drainage courses, to prevent the runon of stormwater and the runoff of spills.

(2) Discourage "topping off" of fuel tanks.

(3) Always use secondary containment, such as a drain pan, when fueling to catch spills/leaks.

TEMPORARY STORMWATER SECTION
ATTACHMENT B
Potential Sources of Contamination

This project includes the construction of gravity wastewater lines within Unit 5 only, force mains, water lines, limited storm drain, lift station, and street paving. Units 4 and 6 will have a separate SCS submittal. The possible sources of contamination include sediment transport from runoff and fuel spills by the Contractor while refueling equipment. Other small quantities of solvent for construction may be present. Contractor shall keep all fuel transfers and any other contaminants used secure. Silt Fences, rock berms, and filter curb inlet protection will aid in the removal of transported sediment from the runoff. Additionally, filter dams will be established below the sand filter system outlet structure.

Please see Attachment "A" for response actions.

TEMPORARY STORMWATER SECTION
ATTACHMENT C
Sequence of Major Activities

Construction sequencing- The construction will be performed in three phases. Phase 1 will be Unit 5, Phase 2 will be Unit 6, and Phase 3 will be Unit 4.

1. Call New Braunfels Utilities and TCEQ 48-hours prior to beginning any work. Call Dig TESS for utilities locations.
2. Install temporary erosion controls prior to any clearing and grubbing.
3. Begin site clearing. (Phase 1 – 5.44 acres disturbed)
4. Inspect erosion controls at weekly intervals, before and after significant rainfall events to insure they are functioning properly.
5. Road cuts to subgrade elevation. (Phase 1 – 5.44 acres already disturbed)
6. Install onsite sewer laterals. (Phase 1 – 5.44 acres already disturbed)
7. Install water lines. (Phase 1 – 5.44 acres already disturbed)
8. Construct drainage improvements. (Phase 1 – 5.44 acres already disturbed)
9. Complete fill and compaction on site to match subgrade elevations. (Phase 1 – 5.44 acres already disturbed)
10. Construct curb inlet protection at the time of curb inlet installation. (Phase 1 – 5.44 acres already disturbed)
11. Complete all construction per approved plans and stabilize all disturbed areas.
12. Install Streetscape and/or landscaping improvements.
13. Contact project engineer to inspect site. Final City inspection to be scheduled.
14. Complete any necessary final dress up of areas that were disturbed.
15. Remove and dispose of temporary erosion controls after site re-vegetation has occurred.

The construction will be repeated for phases 2 and 3. Phase 2 will disturb 3.19 acres and Phase 3 will disturb 3.25 acres.

TEMPORARY STORMWATER SECTION
ATTACHMENT F
Structural Practices

During construction, silt fences will be used until construction is complete and vegetation and paving has been established. Rough cutting of the proposed streets will divert flows from entering the trench area. Additionally, the contractor will pile the spoils from trench excavation on the uphill side of the trench, with a minimum of one foot between the trench and the pile, in order to prevent storm water from entering the trench.

In addition, the contractor will be directed to minimize site disturbance and avoid having equipment in areas that are not necessary for the construction. Natural vegetation shall be left undisturbed and will help remove sediment if any bypass at silt fences or other structural measures occurs.

TEMPORARY STORMWATER SECTION
ATTACHMENT G
Drainage Area Map

The Existing Drainage Area Map and Proposed Drainage Area Map for Unit 4 can be found on sheets 9 and 10, respectively, of the Manor Creek, Unit 4 Civil Site Construction Plans.

The Existing Drainage Area Map and Proposed Drainage Area Map for Unit 5 can be found on sheets 7 and 8, respectively, of the Manor Creek Subdivision Unit 5 Civil Site Construction Plans.

The Existing Drainage Area Map and Proposed Drainage Area Map for Unit 6 can be found on sheets 4 and 5, respectively, of the Manor Creek Subdivision, Unit 6 Civil Site Construction Plans.

TEMPORARY STORMWATER SECTION
ATTACHMENT I
Inspection and Maintenance of BMPs

The Contractor will be directed to inspect and maintain all temporary BMPs. The design engineer will also make regular visits to the project and will provide visual inspections as well. Any deficiency noted must be corrected immediately by the contractor.

Maintenance:

1. Inspect all silt fence, rock berms, concrete wash out areas, filter dams, and stabilized concrete entrances and exits weekly and after any rainfalls. Inspect the filter curb inlet protection daily.
2. Remove sediment when buildup reaches 6 inches on silt fence or rock berms or install a second line of silt fence parallel. Remove sediment when buildup reaches 2 inches in filter curb inlet protection.
3. Replace any torn fabric in the silt fence, filter dams, or filter curb inlet protection.
4. Replace or repair any sections crushed or collapsed in the course of construction.
5. See stormwater pollution plan details as shown in the construction plans for proper size and installation.
6. Contractor to maintain a daily log and note any deficiencies to temporary BMPs and corrective action taken. Rainfall events shall also be noted.

SWPPP Inspection Report
Attachment I

Operator: _____ Date: _____
Job Name: _____ Receiving Waters: _____
Location: _____ Map Grid: _____
Inspector: _____ Inspector Qualifications: _____
Is this site over the Aquifer recharge or contributing zone ___ If this site is in compliance with the SWPPP and Permit _____

Visual Inspection of the Site	Y	N	N/A	Comments
NOI Posted?				
Site Notice Posted?				
Was a copy of the NOI sent to the Reporting agency?				
SWPPP Plan in Box?				
Copy of WPAP in the box? (if applies)				
SWPPP Information updates				
Material list updated?				
Project Milestone current with intended dates?				
All current locations of BMP's identified on plans?				
Areas under operators control clearly identified on site map?				
Trash Containers and Restrooms noted?				
Stabilized areas updated or noted on plans?				
Site Conditions				
Entrance and exits free from off site tracking?				
Trash and Debrl being contained on site?				
Material storage area effectively controlling pollutants?				
Wash out pit working order?				
Are all pollutants contained on site?				
Erosion Control devices in working order?				
Are all BMP's Adequate for this site at this times				
Hazardous Waste				
Is there materials being exposed to storm water runoff?				
Any signs of major leaks or spills?				
Any leaks or spills of reputable Quanitiy need to be reported?				

SWPPP Inspection Report
Attachment I

Job Name: _____ Date: _____

Location	What Failed and Amount	Reason	Modification to be made	Correction Date
Location	What Failed and Amount	Reason	Modification to be made	Correction Date
Location	What Failed and Amount	Reason	Modification to be made	Correction Date
Location	What Failed and Amount	Reason	Modification to be made	Correction Date
Location	What Failed and Amount	Reason	Modification to be made	Correction Date

I certify under the penalty of law that this document and all attachments were prepared under my direction or Supervision in accordance with a system designed to assure that qualified personnel properly gathered and Evaluate the information submitted. Based on my inquiry of the person or persons who manage the system? Or those persons directly responsible for gathering the information, the information submitted is, too the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for Submitting false information, including the possibility of fine and imprisonment for knowing violations.

Qualified BMP Inspector: _____

SWPPP Inspection Report
Attachment I

Job Name: _____ Date: _____

Construction Activities and location

Block/Lot or Address	Work being done	Date

NOTES: _____

TEMPORARY STORMWATER SECTION
ATTACHMENT J
Schedule of Interim and Permanent Soil Stabilization Practices

Stabilization measures shall be initiated as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased. Where the initiation of stabilization measures by the 14th day after construction activity temporary or permanently cease is precluded by weather conditions, stabilization measures shall be initiated as soon as practicable. Where construction activity on a portion of the site is temporarily ceased, and earth disturbing activities will be resumed within 21 days, temporary stabilization measures do not have to be initiated on that portion of site.

If after 21 days, and construction activity will not resume, hydromulch shall be applied to all disturbed areas except in drainage channels or where slopes exceed 3:1. In areas experiencing droughts where the initiation of stabilization measures by the 14th day after construction activity has temporarily or permanently ceased is precluded by seasonal arid conditions, stabilization measures shall be initiated as soon as practicable.

All erosion control measures must remain in place until such stabilization has successfully occurred.

Rock berms shall be used as indicated. Owner shall consult with design engineer to determine all necessary measures to stabilize the site if construction does not resume.

TCEQ RG 348 dated July 2005 shall be used as a guide in determining these areas that may require stabilization.

Permanent Stormwater Section

Texas Commission on Environmental Quality

for Regulated Activities on the Edwards Aquifer Recharge Zone and Relating to 30 TAC §213.5(b)(4)(C), (D)(li), (E), and (S), Effective June 1, 1999

To ensure that the application is administratively complete, confirm that all fields in the form are complete, verify that all requested information is provided, consistently reference the same site and contact person in all forms in the application, and ensure forms are signed by the appropriate party.

Note: Including all the information requested in the form and attachments contributes to more streamlined technical reviews.

Signature

To the best of my knowledge, the responses to this form accurately reflect all information requested concerning the proposed regulated activities and methods to protect the Edwards Aquifer. This **Permanent Stormwater Section** is hereby submitted for TCEQ review and executive director approval. The application was prepared by:

Print Name of Customer/Agent: Chris Van Heerde, C.F.M., P.E.

Date: 11/1/2016

Signature of Customer/Agent

Chris Van Heerde, PE

Regulated Entity Name: Manor Creek Subdivision Units 4-6

Permanent Best Management Practices (BMPs)

Permanent best management practices and measures that will be used during and after construction is completed.

1. ☒ Permanent BMPs and measures must be implemented to control the discharge of pollution from regulated activities after the completion of construction.

   ☐ N/A

2. ☒ These practices and measures have been designed, and will be constructed, operated, and maintained to insure that 80% of the incremental increase in the annual mass loading of total suspended solids (TSS) from the site caused by the regulated activity is removed. These quantities have been calculated in accordance with technical guidance prepared or accepted by the executive director.

   ☒ The TCEQ Technical Guidance Manual (TGM) was used to design permanent BMPs and measures for this site.

☐ A technical guidance other than the TCEQ TGM was used to design permanent BMPs and measures for this site. The complete citation for the technical guidance that was used is: _____

☐ N/A

3. ☒ Owners must insure that permanent BMPs and measures are constructed and function as designed. A Texas Licensed Professional Engineer must certify in writing that the permanent BMPs or measures were constructed as designed. The certification letter must be submitted to the appropriate regional office within 30 days of site completion.

   ☐ N/A

4. Where a site is used for low density single-family residential development and has 20 % or less impervious cover, other permanent BMPs are not required. This exemption from permanent BMPs must be recorded in the county deed records, with a notice that if the percent impervious cover increases above 20% or land use changes, the exemption for the whole site as described in the property boundaries required by 30 TAC §213.4(g) (relating to Application Processing and Approval), may no longer apply and the property owner must notify the appropriate regional office of these changes.

   ☐ The site will be used for low density single-family residential development and has 20% or less impervious cover.
   ☐ The site will be used for low density single-family residential development but has more than 20% impervious cover.
   ☒ The site will not be used for low density single-family residential development.

5. The executive director may waive the requirement for other permanent BMPs for multi-family residential developments, schools, or small business sites where 20% or less impervious cover is used at the site. This exemption from permanent BMPs must be recorded in the county deed records, with a notice that if the percent impervious cover increases above 20% or land use changes, the exemption for the whole site as described in the property boundaries required by 30 TAC §213.4(g) (relating to Application Processing and Approval), may no longer apply and the property owner must notify the appropriate regional office of these changes.

   ☐ **Attachment A - 20% or Less Impervious Cover Waiver.** The site will be used for multi-family residential developments, schools, or small business sites and has 20% or less impervious cover. A request to waive the requirements for other permanent BMPs and measures is attached.
   ☐ The site will be used for multi-family residential developments, schools, or small business sites but has more than 20% impervious cover.
   ☒ The site will not be used for multi-family residential developments, schools, or small business sites.

6. ☒ **Attachment B - BMPs for Upgradient Stormwater.**

☒ A description of the BMPs and measures that will be used to prevent pollution of surface water, groundwater, or stormwater that originates upgradient from the site and flows across the site is attached.

☐ No surface water, groundwater or stormwater originates upgradient from the site and flows across the site, and an explanation is attached.

☐ Permanent BMPs or measures are not required to prevent pollution of surface water, groundwater, or stormwater that originates upgradient from the site and flows across the site, and an explanation is attached.

7. ☒ **Attachment C - BMPs for On-site Stormwater.**

☒ A description of the BMPs and measures that will be used to prevent pollution of surface water or groundwater that originates on-site or flows off the site, including pollution caused by contaminated stormwater runoff from the site is attached.

☐ Permanent BMPs or measures are not required to prevent pollution of surface water or groundwater that originates on-site or flows off the site, including pollution caused by contaminated stormwater runoff, and an explanation is attached.

8. ☒ **Attachment D - BMPs for Surface Streams.** A description of the BMPs and measures that prevent pollutants from entering surface streams, sensitive features, or the aquifer is attached. Each feature identified in the Geologic Assessment as sensitive has been addressed.

☐ N/A

9. ☒ The applicant understands that to the extent practicable, BMPs and measures must maintain flow to naturally occurring sensitive features identified in either the geologic assessment, executive director review, or during excavation, blasting, or construction.

☒ The permanent sealing of or diversion of flow from a naturally-occurring sensitive feature that accepts recharge to the Edwards Aquifer as a permanent pollution abatement measure has not been proposed.

☐ **Attachment E - Request to Seal Features.** A request to seal a naturally-occurring sensitive feature, that includes, for each feature, a justification as to why no reasonable and practicable alternative exists, is attached.

10. ☒ **Attachment F - Construction Plans.** All construction plans and design calculations for the proposed permanent BMP(s) and measures have been prepared by or under the direct supervision of a Texas Licensed Professional Engineer, and are signed, sealed, and dated. The plans are attached and, if applicable include:

☒ Design calculations (TSS removal calculations)
☒ TCEQ construction notes
☒ All geologic features
☒ All proposed structural BMP(s) plans and specifications

☐ N/A

11. ☒ **Attachment G - Inspection, Maintenance, Repair and Retrofit Plan**. A plan for the inspection, maintenance, repairs, and, if necessary, retrofit of the permanent BMPs and measures is attached. The plan includes all of the following:

    ☒ Prepared and certified by the engineer designing the permanent BMPs and measures
    ☒ Signed by the owner or responsible party
    ☒ Procedures for documenting inspections, maintenance, repairs, and, if necessary retrofit
    ☒ A discussion of record keeping procedures

    ☐ N/A

12. ☐ **Attachment H - Pilot-Scale Field Testing Plan**. Pilot studies for BMPs that are not recognized by the Executive Director require prior approval from the TCEQ. A plan for pilot-scale field testing is attached.

    ☒ N/A

13. ☒ **Attachment I -Measures for Minimizing Surface Stream Contamination**. A description of the measures that will be used to avoid or minimize surface stream contamination and changes in the way in which water enters a stream as a result of the construction and development is attached. The measures address increased stream flashing, the creation of stronger flows and in-stream velocities, and other in-stream effects caused by the regulated activity, which increase erosion that results in water quality degradation.

    ☐ N/A

Responsibility for Maintenance of Permanent BMP(s)

Responsibility for maintenance of best management practices and measures after construction is complete.

14. ☒ The applicant is responsible for maintaining the permanent BMPs after construction until such time as the maintenance obligation is either assumed in writing by another entity having ownership or control of the property (such as without limitation, an owner's association, a new property owner or lessee, a district, or municipality) or the ownership of the property is transferred to the entity. Such entity shall then be responsible for maintenance until another entity assumes such obligations in writing or ownership is transferred.

    ☐ N/A

15. ☒ A copy of the transfer of responsibility must be filed with the executive director at the appropriate regional office within 30 days of the transfer if the site is for use as a multiple single-family residential development, a multi-family residential development, or a non-residential development such as commercial, industrial, institutional, schools, and other sites where regulated activities occur.

    ☐ N/A

PERMANENT STORMWATER SECTION
ATTACHMENT B
BMPs for Upgradient Stormwater

There are no permanent BMPs for upgradient stormwater for the Manor Creek Subdivision Units 4-6 site because the runoff from surrounding properties that flows from offsite to the site will be diverted into interceptor swales directly inside the property line. The swales will bypass the upgradient flow and will be vegetated upon completion of the subdivision.

PERMANENT STORMWATER SECTION
ATTACHMENT C
BMPs for On-Site Stormwater

There are three types of proposed Permanent BMPs for the on-site stormwater for the Manor Creek Subdivision Units 4-6 that will remove 80% of the incremental increase in the annual mass loading of total suspended solids (TSS) as per TCEQ standards. The BMPs include vegetative filter strips, grassy swales, and sand filter systems. The permanent BMPs will be constructed to TCEQ standards and the design plans and details can be found on sheets 14, and 15 of the Manor Creek Subdivision Phase 4, sheets 11, and 12 of the Manor Creek Subdivision Phase 5A, sheets 10, and 11 of the Manor Creek Subdivision Phase 5B, and sheet 10 of the Manor Creek Subdivision Phase 6 Site Construction Plans.

PERMANENT STORMWATER SECTION
ATTACHMENT D
BMPs for Surface Streams

The stormwater runoff from surrounding properties that flows from offsite to the site will be diverted into interceptor swales directly inside the property line. The swales will bypass the upgradient flow and will be vegetated upon completion of the subdivision. The on-site flow will be treated using vegetative filter strips, grassy swales, and sand filter systems.

The vegetative filter strips, grassy swales, and sand filter systems will reduce the velocity of the runoff therefore reducing the chance of erosion from the site. The BMPs will also filter out runoff sediment meeting TCEQ standards. The sand filter systems will retain water until after the peak of the storm therefore decreasing the likelihood of stream flashing. The storm water from the proposed subdivision will enter into the surface stream system as sheet flow, thereby further reducing the likelihood of erosion. Additionally, there are buffers from the floodplain that are included in the subdivision plat to provide natural filtration before entering surface streams.

PERMANENT STORMWATER SECTION
ATTACHMENT F
Construction Plans

There are three types of proposed Permanent BMPs for the on-site stormwater for the Manor Creek Subdivision Unit 4-6. The BMPs include vegetative filter strips, sand filter systems, and grassy swales. The permanent BMPs will be constructed to TCEQ standards and the design plans and details can be found on sheets 16, and 17 of the Manor Creek Subdivision Unit 4, sheets 13, and 14 of the Manor Creek Subdivision Unit 5A, sheets 12, and 13 of the Manor Creek Subdivision Unit 5B, and sheets 11, and 12 of the Manor Creek Subdivision Unit 6 Site Construction Plans.

PERMANENT STORMWATER SECTION
ATTACHMENT G
Inspection, Maintenance, Repair and Retrofit Plan

The contractor will be directed to inspect and maintain all permanent BMPs during construction. One year after construction is complete the permanent BMPs will be turned over to the Manor Creek Home Owners Association. Any deficiency noted must be corrected immediately by the Home Owners Association. The maintenance guidelines were pulled from the TCEQ Document "Complying with the Edwards Aquifer Rules Technical Guidance on Best Management Practices", the document can be referenced for a more in depth explanation of maintenance guidelines.

Maintenance and Inspection:

(1) Specification of routine and non-routine maintenance activities to be performed;
   a. Sand Filter Systems
      i. Inspection- Inspect systems on a quarterly basis during the first year of operation. Subsequent inspections can be limited to semi-annually or more often if deemed necessary; however additional inspection should occur at least twice a year (once during or immediately following wet weather) to evaluate facility operation. Any damage to the structural elements of the system (pipes, concrete drainage structures, retaining walls, etc.) must be identified and repaired immediately. Cracks, voids and undermining should be patched/filled to prevent additional structural damage. Trees and root systems should be removed to prevent growth in crack and joints that can cause structural damage.
      ii. Sediment Removal- Remove sediment when the depth reaches 6 inches or when the proper functioning of inlet and outlet structures is impaired. Sediment should be cleared from the inlet structure at least every year and from the sedimentation basin at least every 5 years.
      iii. Media Replacement- When the drain time exceeds 48, the filter media should be removed and replaced with new material meeting the original specifications (media must be completely level). Any discolored sand should be removed and replaced. In filters that have been regularly maintained, this should be limited to the top 2 to 3 inches.
      iv. Erosion- During each inspection, erosion areas inside and downstream of the BMP must be identified and repaired or revegetated immediately.
      v. Vegetation- All dead and diseased vegetation considered beyond treatment shall be removed and replaced during semi-annual inspections. Aggressive plant species and weeds will be removed during routine inspection.
      vi. Mowing- Grass areas in and around basins must be mowed at least twice annually to limit vegetation height to 18 inches. When mowing is performed, a mulching mower should be used, or grass clippings should be caught and removed. Vegetation on the pond embankments should be mowed as appropriate to prevent the establishment of woody vegetation.

vii. Debris and Litter Removal- Debris and litter should be removed during regular mowing operations and inspections. Particular attention should be paid to floating debris that can eventually clog the control device or riser.

viii. Filter Underdrain- Clean underdrain piping network to remove any sediment buildup every 5 years, or as needed to maintain design drawdown time.

b. Grassy Swales

i. Seasonal Mowing- Lawn mowing should be performed routinely, as needed, throughout the growing season. Grass height should not exceed 18 inches. When mowing is performed, a mulching mower should be used, or grass clippings should be caught and removed.

ii. Inspection-Inspect swales at least twice annually for erosion or damage to vegetation; however, additional inspection after periods of heavy runoff is most desirable.

iii. Debris and Litter Removal- The need for this practice is determined through periodic inspection, but should be performed no less than two times per year.

iv. Sediment Removal- Sediment should be removed when it has accumulated to 3 inches at any spot, or cover vegetation. Excess sediment should be removed by hand or with flat-bottomed shovel.

v. Grass Reseeding and Mulching- A healthy dense grass should be maintained in the channel and side slopes. Grass damaged during sediment removal should be promptly replaced using the same seed mix used during swale establishment.

c. Vegetative Filter Strips

i. Seasonal Mowing- Should be mowed to limit the vegetation height to 18 inches, but a minimum of twice annually. When mowing is performed, a mulching mower should be used, or grass clippings should be caught and removed.

ii. Inspection-Inspect swales at least twice annually for erosion or damage to vegetation; however, additional inspection after periods of heavy runoff is most desirable.

iii. Debris and Litter Removal- The need for this practice is determined through periodic inspection, but should be performed no less than four times per year.

iv. Sediment Removal- Sediment should be removed when it has accumulated to 3 inches at any spot, or cover vegetation. Excess sediment should be removed by hand or with flat-bottomed shovel.

v. Grass Reseeding and Mulching- A healthy dense grass should be maintained in the channel and side slopes. Grass damaged during sediment removal should be promptly replaced using the same seed mix used during swale establishment.

(2) A schedule for maintenance activities;

a. Inspection and maintenance will be held quarterly and after rainfall events of more than one inch

(3) The grassy swales and sand filter basins can be accessed by vehicle as they are directly adjacent to a paved roadway. The vegetative filter strips can be accessed by foot or small equipment via easements;
(4) The HOA Board of Directors for Manor Creek will be in charge of the oversight and scheduling of inspections and maintenance. Robert Daigle of DR Horton will sit on the Board of Directors for as long as DR Horton is named Declarant and will establish the inspection and maintenance plans for the Organization; and
(5) Inspection records will be maintained in the San Marcos DR Horton office.

Robert Daigle
Party Responsible for Maintenance

11/2/16
Date

PERMANENT STORMWATER SECTION
ATTACHMENT I
Measures for Minimizing Surface Stream Contamination

There are three types of proposed Permanent BMPs for the on-site stormwater for the Manor Creek Subdivision Units 4-6. The BMPs include vegetative filter strips, grassy swales, and sand filter systems. The permanent BMPs will be constructed to TCEQ standards and the design plans and details can be found on sheets 13 and 14 of the Manor Creek Subdivision Unit 5 Site Construction Plans.

The vegetative filter strips, grassy swales, and sand filter systems will reduce the velocity of the runoff therefore reducing the chance of erosion from the site. The BMPs will also filter out runoff sediment meeting TCEQ standards. The sand filter systems will retain water until after the peak of the storm therefore not increasing stream flashing. The storm water from the proposed subdivision will enter into the surface stream system as sheet flow, thereby further reducing the likelihood of erosion.

Permanent BMP Inspection Report
Attachment I

Operator: _____ Date: _____
Job Name: _____ Receiving Waters: _____
Location: _____ Map Grid: _____
Inspector: _____ Inspector Qualifications: _____
Is this site over the Aquifer recharge or contributing zone ____ If this site is in compliance with the SWPPP and Permit _____

Visual Inspection of the Site	Y	N	N/A	Comments
NOI Posted?				
Site Notice Posted?				
Was a copy of the NOI sent to the Reporting agency?				
SWPPP Plan in Box?				
Copy of WPAP in the box? (If applies)				
SWPPP Information updates				
Material list updated?				
Project Milestone current with intended dates?				
All current locations of BMP's identified on plans?				
Areas under operators control clearly identified on site map?				
Trash Containers and Restrooms noted?				
Stabilized areas updated or noted on plans?				
Site Conditions				
Entrance and exits free from off site tracking?				
Trash and Debri being contained on site?				
Material storage area effectively controlling pollutants?				
Wash out pit working order?				
Are all pollutants contained on site?				
Erosion Control devices in working order?				
Are all BMP's Adequate for this site at this times				
Hazardous Waste				
Is there materials being exposed to storm water runoff?				
Any signs of major leaks or spills?				

Permanent BMP Inspection Report
Attachment I

Job Name: _____ Date: _____

Location	What Failed and Amount	Reason	Modification to be made	Correction Date
Location	What Failed and Amount	Reason	Modification to be made	Correction Date
Location	What Failed and Amount	Reason	Modification to be made	Correction Date
Location	What Failed and Amount	Reason	Modification to be made	Correction Date
Location	What Failed and Amount	Reason	Modification to be made	Correction Date

I certify under the penalty of law that this document and all attachments were prepared under my direction or Supervision in accordance with a system designed to assure that qualified personnel properly gathered and Evaluated the information submitted. Based on my inquiry of the person or persons who manage the system? Or those persons directly responsible for gathering the information, the information submitted is, too the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for Submitting false information, including the possibility of fine and imprisonment for knowing violations.

Qualified BMP Inspector: _____

Permanent BMP Inspection Report
Attachment I

Job Name: _____ Date: _____

Construction Activities and location

Block/Lot or Address	Work being done	Date

NOTES:

Agent Authorization Form
For Required Signature
Edwards Aquifer Protection Program
Relating to 30 TAC Chapter 213
Effective June 1, 1999

I Robert Daigle,
Print Name

City Manager – South Central Texas,
Title - Owner/President/Other

of Continental Homes of Texas, L.P.,
Corporation/Partnership/Entity Name

have authorized Chris Van Heerde, C.F.M., P.E.
Print Name of Agent/Engineer

of HMT Engineering & Surveying
Print Name of Firm

to represent and act on the behalf of the above named Corporation, Partnership, or Entity for the purpose of preparing and submitting this plan application to the Texas Commission on Environmental Quality (TCEQ) for the review and approval consideration of regulated activities.

I also understand that:

1. The applicant is responsible for compliance with 30 Texas Administrative Code Chapter 213 and any condition of the TCEQ's approval letter. The TCEQ is authorized to assess administrative penalties of up to $10,000 per day per violation.

2. For those submitting an application who are not the property owner, but who have the right to control and possess the property, additional authorization is required from the owner.

3. Application fees are due and payable at the time the application is submitted. The application fee must be sent to the TCEQ cashier or to the appropriate regional office. The application will not be considered until the correct fee is received by the commission.

4. A notarized copy of the Agent Authorization Form must be provided for the person preparing the application, and this form must accompany the completed application.

5. No person shall commence any regulated activity on the Edwards Aquifer Recharge Zone, Contributing Zone or Transition Zone until the appropriate application for the activity has been filed with and approved by the Executive Director.

SIGNATURE PAGE:

Robert Daisle
Applicant's Signature

11/2/16
Date

THE STATE OF TEXAS §

County of Hays §

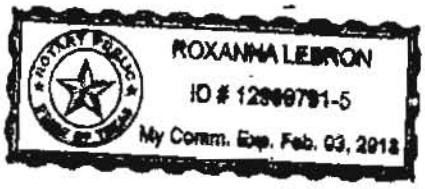
BEFORE ME, the undersigned authority, on this day personally appeared Robert Daisle known to me to be the person whose name is subscribed to the foregoing instrument, and acknowledged to me that (s)he executed same for the purpose and consideration therein expressed.

GIVEN under my hand and seal of office on this 3 day of November 2016.

NOTARY PUBLIC

Roxanna Lebron
Typed or Printed Name of Notary

MY COMMISSION EXPIRES: Feb. 03, 2018



Application Fee Form

Texas Commission on Environmental Quality

Name of Proposed Regulated Entity: Manor Creek Subdivsion Units 4-6
Regulated Entity Location: Allemania Drive, New Braunfels, Texas 78132-5123
Name of Customer: Continental Homes of Texas, L.P.
Contact Person: Robert Daigle Phone: 512-805-3600
Customer Reference Number (if issued):CN 601213523
Regulated Entity Reference Number (if issued):RN 108449968

Austin Regional Office (3373)

☐ Hays ☐ Travis ☐ Williamson

San Antonio Regional Office (3362)

☐ Bexar ☐ Medina ☐ Uvalde
☒ Comal ☐ Kinney

Application fees must be paid by check, certified check, or money order, payable to the **Texas Commission on Environmental Quality**. Your canceled check will serve as your receipt. **This form must be submitted with your fee payment**. This payment is being submitted to:

☐ Austin Regional Office
☐ Mailed to: TCEQ - Cashier
Revenues Section
Mail Code 214
P.O. Box 13088
Austin, TX 78711-3088

☒ San Antonio Regional Office
☐ Overnight Delivery to: TCEQ - Cashier
12100 Park 35 Circle
Building A, 3rd Floor
Austin, TX 78753
(512)239-0357

Site Location (Check All That Apply):

☒ Recharge Zone ☐ Contributing Zone ☐ Transition Zone

Type of Plan	*Size*	*Fee Due*
Water Pollution Abatement Plan, Contributing Zone Plan: One Single Family Residential Dwelling	Acres	$
Water Pollution Abatement Plan, Contributing Zone Plan: Multiple Single Family Residential and Parks	94.78 Acres	$ 6,500
Water Pollution Abatement Plan, Contributing Zone Plan: Non-residential	Acres	$
Sewage Collection System	L.F.	$
Lift Stations without sewer lines	Acres	$
Underground or Aboveground Storage Tank Facility	Tanks	$
Piping System(s)(only)	Each	$
Exception	Each	$
Extension of Time	Each	$

Signature: Chris Van Steenderen

Application Fee Schedule

Texas Commission on Environmental Quality
Edwards Aquifer Protection Program 30 TAC Chapter 213 (effective 05/01/2008)

Water Pollution Abatement Plans and Modifications

Contributing Zone Plans and Modifications

Project	*Project Area in Acres*	*Fee*
One Single Family Residential Dwelling	< 5	$650
Multiple Single Family Residential and Parks	< 5 5 < 10 10 < 40 40 < 100 100 < 500 ≥ 500	$1,500 $3,000 $4,000 $6,500 $8,000 $10,000
Non-residential (Commercial, industrial, institutional, multi-family residential, schools, and other sites where regulated activities will occur)	< 1 1 < 5 5 < 10 10 < 40 40 < 100 ≥ 100	$3,000 $4,000 $5,000 $6,500 $8,000 $10,000

Organized Sewage Collection Systems and Modifications

Project	*Cost per Linear Foot*	*Minimum Fee-Maximum Fee*
Sewage Collection Systems	$0.50	$650 - $6,500

Underground and Aboveground Storage Tank System Facility Plans and Modifications

Project	*Cost per Tank or Piping System*	*Minimum Fee-Maximum Fee*
Underground and Aboveground Storage Tank Facility	$650	$650 - $6,500

Exception Requests

Project	*Fee*
Exception Request	$500

Extension of Time Requests

Project	*Fee*
Extension of Time Request	$150

Extension of Time Requests

Project	*Fee*
Extension of Time Request	$150

TCEQ Core Data Form

TCEQ Use Only

For detailed instructions regarding completion of this form, please read the Core Data Form Instructions or call 512-239-5175.

SECTION I: General Information

1. Reason for Submission (If other is checked please describe in space provided.)

☐ New Permit, Registration or Authorization (Core Data Form should be submitted with the program application.)

☐ Renewal (Core Data Form should be submitted with the renewal form) ☒ Other Modification

2. Customer Reference Number (if issued): CN 601213523

Follow this link to search for CN or RN numbers in Central Registry**

3. Regulated Entity Reference Number (if issued): RN 108449968

SECTION II: Customer Information

4. General Customer Information | 5. Effective Date for Customer Information Updates (mm/dd/yyyy)

☐ New Customer ☐ Update to Customer Information ☐ Change in Regulated Entity Ownership

☐ Change in Legal Name (Verifiable with the Texas Secretary of State or Texas Comptroller of Public Accounts)

The Customer Name submitted here may be updated automatically based on what is current and active with the Texas Secretary of State (SOS) or Texas Comptroller of Public Accounts (CPA).

6. Customer Legal Name (If an individual, print last name first: e.g.: Doe, John) | If new Customer, enter previous Customer below:

7. TX SOS/CPA Filing Number | 8. TX State Tax ID (11 digits) | 9. Federal Tax ID (9 digits) | 10. DUNS Number (if applicable)

11. Type of Customer: ☐ Corporation ☐ Individual Partnership: ☐ General ☐ Limited

Government: ☐ City ☐ County ☐ Federal ☐ State ☐ Other ☐ Sole Proprietorship ☐ Other:

12. Number of Employees ☐ 0-20 ☐ 21-100 ☐ 101-250 ☐ 251-500 ☐ 501 and higher

13. Independently Owned and Operated? ☐ Yes ☐ No

14. Customer Role (Proposed or Actual) - as it relates to the Regulated Entity listed on this form. Please check one of the following:

☐ Owner ☐ Operator ☐ Owner & Operator ☐ Occupational Licensee ☐ Responsible Party ☐ Voluntary Cleanup Applicant ☐ Other:

15. Mailing Address:

City | State | ZIP | ZIP + 4

16. Country Mailing Information (if outside USA) | 17. E-Mail Address (if applicable)

18. Telephone Number ( ) - | 19. Extension or Code | 20. Fax Number (if applicable) ( ) -

SECTION III: Regulated Entity Information

21. General Regulated Entity Information (If 'New Regulated Entity' is selected below this form should be accompanied by a permit application)

☐ New Regulated Entity ☐ Update to Regulated Entity Name ☒ Update to Regulated Entity Information

The Regulated Entity Name submitted may be updated in order to meet TCEQ Agency Data Standards (removal of organizational endings such as Inc, LP, or LLC).

22. Regulated Entity Name (Enter name of the site where the regulated action is taking place.)

Manor Creek Subdivision Units 4-6

23. Street Address of the Regulated Entity: (No PO Boxes)							
	City		State		ZIP		ZIP + 4	
24. County	Comal						

Enter Physical Location Description if no street address is provided.

25. Description to Physical Location:	Located on Allemania Dr. off Hamburg Ave. (turn left on Klemm St. and then deadend into Allemania), which is 2.2 miles northwest of the TX-46 and TX-337 Loop intersection (directly off TX-46E)		
26. Nearest City		State	Nearest ZIP Code
New Braunfels		TX	78132

27. Latitude (N) In Decimal:	29.727598		28. Longitude (W) In Decimal:	-98.181221		
Degrees	Minutes	Seconds	Degrees	Minutes	Seconds	
29	43	39.3528	-98	10	52.395	

29. Primary SIC Code (4 digits)	30. Secondary SIC Code (4 digits)	31. Primary NAICS Code (5 or 6 digits)	32. Secondary NAICS Code (5 or 6 digits)
1521		236115	

33. What is the Primary Business of this entity? (Do not repeat the SIC or NAICS description.)							
Land Development- Residential Subdivision							
34. Mailing Address:	210 West Hutchison Street						
	City	San Marcos	State	TX	ZIP	78132	ZIP + 4	5123
35. E-Mail Address:	radaigle@drhorton.com						

36. Telephone Number	37. Extension or Code	38. Fax Number (if applicable)
(512) 805 - 3600		( ) -

39. TCEQ Programs and ID Numbers Check all Programs and write in the permits/registration numbers that will be affected by the updates submitted on this form. See the Core Data Form instructions for additional guidance.

☐ Dam Safety	☐ Districts	☒ Edwards Aquifer	☐ Emissions Inventory Air	☐ Industrial Hazardous Waste
☐ Municipal Solid Waste	☐ New Source Review Air	☐ OSSF	☐ Petroleum Storage Tank	☐ PWS
☐ Sludge	☐ Storm Water	☐ Title V Air	☐ Tires	☐ Used Oil
☐ Voluntary Cleanup	☐ Waste Water	☐ Wastewater Agriculture	☐ Water Rights	☒ Other: WPAP

SECTION IV: Preparer Information

40. Name: Caitlynn Morris, E.I.T.			41. Title: Engineer-in-Training
42. Telephone Number	43. Ext./Code	44. Fax Number	45. E-Mail Address
(830) 625 - 8555		( ) -	caitlynnm@hmtnb.com

SECTION V: Authorized Signature

46. By my signature below, I certify, to the best of my knowledge, that the information provided in this form is true and complete, and that I have signature authority to submit this form on behalf of the entity specified in Section II, Field 6 and/or as required for the updates to the ID numbers identified in field 39.

Company:	HMT Engineering & Surveying	Job Title:	Managing Partner
Name(In Print):	Chris Van Heerde, C.F.M., P.E.	Phone:	(830) 625-8555
Signature	Chris Van Heerde, PE	Date:	11/22/16

Lot 8 Block 2 Section 2504-09A

Doc# 200506047873 Parent Tra

→ DHI TITLE

SPECIAL WARRANTY DEED

8/7

Date: December 13, 2005

Grantor: Ann Lou Hillert Tschirhart, joined pro forma by Leonard L. Tschirhart

Grantor's Mailing Address (including county):

2422 Northwoods Drive
New Braunfels, Comal County, Texas 78132

Grantee: Continental Homes of Texas, L.P., a Texas limited partnership

Grantee's Mailing Address (including county):

211 North Loop 1604 East, Suite 130
San Antonio, Bexar County, Texas 78232

Consideration: Ten Dollars ($10.00) and other valuable consideration.

Property (including any improvements): See Exhibit "A" attached hereto and incorporated herein by reference for all purposes; which Property includes, but is not limited to, all interest of Grantor, if any, in (1) strips and gores, if any, between the Property and any abutting properties, whether owned or claimed by deed, limitations, or otherwise, and whether located inside or outside the Property; and (2) any land lying in or under the bed of any creek, stream, or waterway or any highway, avenue, street, road, alley, easement or right-of-way, open or proposed, in, on, across, abutting, or adjacent to the Property.

Reservations from and Exceptions to Conveyance and Warranty: Any and all restrictions and easements of record to the extent the same are valid and still in force and effect.

Grantor, for the consideration and subject to the reservations from and exceptions to conveyance and warranty, grants, sells and conveys unto Grantee, the Property, together with all and singular the rights and appurtenances thereto in anywise belonging, TO HAVE AND TO HOLD it to Grantee, Grantee's heirs, executors, administrators, successors or assigns forever. Grantor binds Grantor and Grantor's heirs, executors, administrators and successors to WARRANT AND FOREVER DEFEND all and singular the Property to Grantee, Grantee's heirs, executors, administrators, successors and assigns, against every person whomsoever lawfully claiming or to claim the same or any part thereof, except as to the reservations from and exceptions to conveyance and warranty by, through or under Grantor but not otherwise.

GRANTEE IS PURCHASING THE PROPERTY "AS IS" WITH ALL FAULTS AND DEFECTS, AND GRANTEE ACKNOWLEDGES AND AGREES THAT, EXCEPT FOR THE WARRANTIES OF TITLE SET FORTH HEREIN, GRANTOR HAS NOT MADE, DOES NOT MAKE AND SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, WARRANTIES, PROMISES, COVENANTS, AGREEMENTS, OR GUARANTIES OF ANY KIND OR CHARACTER WHATSOEVER, WHETHER

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EXPRESS OR IMPLIED, ORAL OR WRITTEN, PAST, PRESENT OR FUTURE, OF, AS TO, CONCERNING OR WITH RESPECT TO (A) THE NATURE, QUALITY OR CONDITION OF THE PROPERTY, INCLUDING, WITHOUT LIMITATION, ENVIRONMENTAL OR DRAINAGE CONSIDERATIONS AND THE WATER, SOIL, AND GEOLOGY, OR THE PRESENCE OR ABSENCE OF ANY POLLUTANT, HAZARDOUS WASTE, GAS OR SUBSTANCE OR SOLID WASTE ON OR ABOUT THE PROPERTY, (B) THE AVAILABILITY OF UTILITIES OR QUALITY OF ACCESS TO THE PROPERTY, (C) THE SUITABILITY OF THE PROPERTY FOR ANY AND ALL ACTIVITIES AND USES WHICH GRANTEE MAY INTEND TO CONDUCT THEREON, (D) THE COMPLIANCE OF OR BY THE PROPERTY AND/OR ITS OPERATION WITH ANY LAWS, RULES, ORDINANCES OR REGULATIONS OF ANY GOVERNMENTAL AUTHORITIES OR BODY HAVING JURISDICTION INCLUDING, WITHOUT LIMITATION, ALL APPLICABLE ZONING LAWS, (E) THE HABITABILITY, MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE OR PURPOSE OF THE PROPERTY, OR (F) ANY OTHER MATTER RELATED TO OR CONCERNING THE PROPERTY, EXCEPT AS EXPRESSLY SET FORTH IN THIS AGREEMENT AND THE WARRANTIES OF TITLE SET FORTH AND LIMITED HEREIN, AND GRANTEE SHALL NOT SEEK RECOURSE AGAINST GRANTOR ON ACCOUNT OF ANY LOSS, COST OR EXPENSE SUFFERED OR INCURRED BY GRANTEE WITH REGARD TO ANY OF THE MATTERS DESCRIBED IN CLAUSES (A) THROUGH (F) ABOVE. GRANTEE ACKNOWLEDGES THAT GRANTEE, HAVING BEEN GIVEN THE OPPORTUNITY TO INSPECT THE PROPERTY, IS RELYING SOLELY ON ITS OWN INVESTIGATION OF THE PROPERTY AND NOT ON ANY INFORMATION PROVIDED OR TO BE PROVIDED BY GRANTOR. GRANTEE FURTHER ACKNOWLEDGES THAT NO INDEPENDENT INVESTIGATION OR VERIFICATION HAS BEEN OR WILL BE MADE BY GRANTOR WITH RESPECT TO ANY INFORMATION SUPPLIED BY GRANTOR CONCERNING THE PROPERTY, AND GRANTOR MAKES NO REPRESENTATION AS TO THE ACCURACY OR COMPLETENESS OF SUCH INFORMATION, IT BEING INTENDED BY THE PARTIES THAT GRANTEE SHALL VERIFY THE ACCURACY AND COMPLETENESS OF SUCH INFORMATION ITSELF. GRANTEE ACKNOWLEDGES THAT THE DISCLAIMERS, AGREEMENTS AND OTHER STATEMENTS SET FORTH HEREIN ARE AN INTEGRAL PORTION OF THIS SPECIAL WARRANTY DEED AND THAT GRANTOR WOULD NOT AGREE TO SELL THE PROPERTY TO GRANTEE FOR THE CONSIDERATION WITHOUT THE DISCLAIMERS, AGREEMENTS AND OTHER STATEMENTS SET FORTH HEREIN, WHICH DISCLAIMERS, AGREEMENTS, AND OTHER STATEMENTS SHALL SPECIFICALLY SURVIVE THE EXECUTION OF THIS SPECIAL WARRANTY DEED AND SHALL NOT MERGE THEREWITH.

Payment of current ad valorem taxes is assumed by Grantee.

When the context requires, singular nouns and pronouns include the plural.

GRANTOR:

Ann Lou Hillert Tschirhart
Ann Lou Hillert Tschirhart

Joined Pro Forma By:

Ann Lou Hillert Tschirhart
Leonard L. Tschirhart, by and through Ann Lou Hillert Tschirhart pursuant to a Special Power of Attorney dated December 28, 2004

Acknowledged and Accepted this
13 day of December, 2005

GRANTEE:

CONTINENTAL HOMES OF TEXAS, L.P.,
a Texas limited partnership

By: CHTEX of Texas, Inc., a Delaware corporation, General Partner

By:
Name: Timothy D Pruski
Title: Assistant Secretary

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STATE OF TEXAS §
§
COUNTY OF Bexar §

This instrument was acknowledged before me on the 23rd day of December, 2005, by Ann Lou Hillert Tschirhart.

DEANNA DUNCAN
Notary Public, State of Texas
My Commission Expires
July 29, 2007

Deanna Duncan
Notary Public, State of Texas

STATE OF TEXAS §
§
COUNTY OF Bexar §

This instrument was acknowledged before me on the 23rd day of December, 2005, by Leonard L. Tschirhart, by and through Ann Lou Hillert Tschirhart pursuant to a Special Power of Attorney dated December 28, 2004.

DEANNA DUNCAN
Notary Public, State of Texas
My Commission Expires
July 29, 2007

Deanna Duncan
Notary Public, State of Texas

STATE OF TEXAS §
§
COUNTY OF Bexar §

This instrument was acknowledged before me on the 13th day of December, 2005, by Timothy D. Rusk, Assistant Secretary of CHTEX of Texas, Inc., a Delaware corporation, General Partner of Continental Homes of Texas, L.P., a Texas limited partnership, on behalf of said limited partnership.

Catherine M. Cook
Notary Public, State of Texas
My Comm. Expires 03/30/07

Catherine M Cook
Notary Public, State of Texas

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Doc# 20050047873

After recording, return to:

Continental Homes of Texas, L.P.
211 North Loop 1604 East, Suite 130
San Antonio, Texas 78232
Attention: Brian N. Jaeckle

837669 1

EXHIBIT "A"

Doc# 2005056047873

THE Schultz Group INC.
P.O. Box 810461 • New Braunfels, TX 78131-0461 • Phone (830) 606-3616 • Fax (830) 606-2204

LEGAL DESCRIPTION
OF

252.038 acres of land out of the following surveys; Edwardo Hernandez Survey No. 454, Abstract No. 263, Christian Pape Survey No. 831, Abstract No. 777, and the S.A. & M.G.-R.R. Co. survey No. 280, Abstract No. 591, Comal County, Texas, and being designated as the SECOND TRACT and being a 251.35 acre tract as described in a partition dated October 20, 1976 and recorded in Volume 244, Pages 646-655 of the Deed Records of Comal County, Texas, said 252.038 acres of land being more particularly described as follows:

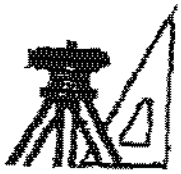
BEGINNING: at a found ½" iron pin in the Northeast Right of Way Line of State Highway No. 46 and being the Westernmost corner of this parcel and the Southernmost corner of a 71.35 acre tract as recorded in Volume 342, Pages 771-773 of the Deed Records of Comal County, Texas, and being South 49 deg. 00' 17" East (All bearings in this description are referenced to Grid North in the Texas Coordinate System, Zone 4204, NAD 83 (93)), a distance of 1699.19 feet from a set ½" iron pin with plastic cap being a cutback corner at the Northeast intersection of State Highway No. 46 and Blanco Springs Loop Road;

THENCE: (1) NORTH 51 deg. 25' 03" East, a distance of 1610.65 feet along the Northwest boundary line of this parcel and said 251.35 acre tract and the Southeast boundary line of said 71.35 acre tract to a found ½" iron pin being the Easternmost corner of said 71.35 acre tract;

THENCE: (2) SOUTH 39 deg. 07' 49" East, a distance of 161.93 feet along the Northeast boundary line of this parcel and said 251.35 acre tract and the Southwest boundary line of a 66.01 acre tract as recorded in Document No. 9906017297 of the Official Public Records of Comal County, Texas, to a found ½" iron pin being the Southernmost corner of said 66.01 acre tract;

THENCE: the following courses along the Northwest boundary line of this parcel and the Southeast boundary line of said 66.01 acre tract, and a 55.574 acre tract as described in a partition Deed, Document No. 9906017297 of the Official Public Records of Comal County, Texas:

LOIS M. SCHULTZ PRESIDENT
STEPHEN E. SCHULTZ, R.P.L.S. VICE-PRESIDENT
ROBERT L. HARRIS, III, R.P.L.S. CHIEF ENGINEER
CONSULTING ENGINEERS AND LAND SURVEYORS



Recorder's Memorandum-Comal County
At the time of recordation, this instrument was found to be inadequate for the best photographic reproduction because of illegibility.

(5) NORTH 52 deg. 09' 22" East, a distance of 537.97 feet to a found ½" iron pin being an angle point;

(4) NORTH 51 deg. 41' 11" East, a distance of 474.71 feet to a found ½" iron pin being an angle point;

(5) NORTH 51 deg. 09' 35" East, a distance of 1266.80 feet to a found ½" iron pin being an angle point;

(6) NORTH 50 deg. 48' 24" East, a distance of 1443.84 feet to a found ½" iron pin being an angle point; and

(7) NORTH 51 deg. 23' 59" East, a distance of 764.01 feet to a found ½" iron pin being the Northernmost corner of this parcel and said 251.35 acre tract and a corner of a 17.900 acre tract as recorded in Document No. 9606021591 of the Official Public Records of Comal County, Texas, and the Westernmost corner of a 49.972 acre tract as recorded in Document No. 9506474912 of the Official Public Records of Comal County, Texas;

THENCE: (8) SOUTH 40 deg. 07' 39" East, a distance of 1184.74 feet along the Northeast boundary line of this parcel and said 251.35 tract and the Southwest line of said 49.972 acre tract to a set ½" iron pin with plastic cap being an angle point;

THENCE: (9) SOUTH 39 deg. 55' 39" East, a distance of 473.59 feet along the Northeast boundary line of this parcel and the Southwest boundary line of said 49.972 acre tract to a set ½" iron pin with plastic cap being an angle point; and

THENCE: (10) SOUTH 39 deg. 34' 39" East, a distance of 62.04 feet along the Northeast boundary line of this parcel and said 251.35 acre tract to a found ½" iron pin being the Easternmost corner of this parcel and said 251.35 acre tract and the Northernmost corner of a 218.51 acre tract and designated as THIRD TRACT and recorded in said partition recorded in Volume 244, Pages 646-655 of the Deed Records of Comal County, Texas;

THENCE: the following courses along the Southeast boundary line of this parcel and said 251.35 acre tract and the Northwest boundary line of said 218.15 acre tract and the Northwest boundary line of NORTHWOODS-UNIT 1 as recorded in Volume 5, Page 305 of the Map and Plat Records of Comal County, Texas, and NORTHWOODS-UNIT 3 as recorded in Volume 5, Page 342 of the Map and Plat Records of Comal County, Texas:

Recorder's Memorandum-Comal County
At the time of recordation, this instrument was found to be inadequate for the best photographic reproduction because of illegibility

Doc# 200506047873

(11) SOUTH 56 deg. 16' 19" West, a distance of 2411.61 feet to a found ½" iron pin being an angle point;

(12) SOUTH 22 deg. 28' 06" West, a distance of 1009.92 feet to a found ½" iron pin being an angle point; and

(13) SOUTH 49 deg. 39' 15" West, a distance of 2447.28 feet to a found ½" iron pin being the Southernmost corner of this parcel and said 251.35 acre tract and the Westernmost corner of said NORTHWOODS-UNIT 3;

THENCE: (14) NORTH 49 deg. 00' 17" West, a distance of 2264.77 feet along the Southwest boundary line of this parcel and said 251.35 acre tract and the Northeast Right of Way Line of said State Highway [illegible] to a found ½" iron pin being the POINT OF BEGIN[illegible], and containing 252.038 acres of land.

THIS LEGAL DESCRIPTION WAS WRITTEN IN CONJUNCTION WITH A SURVEY PLAT PREPARED IN THIS OFFICE ON 8/13/04, JOB NO. 08-03-2004.

REVISED 9/27/04.

STATE OF TEXAS
REGISTERED
STEPHEN E. SCHULTZ
4233
LICENSED
LAND SURVEYOR

[illegible]\Word\Revised Legal Description

Stephen E. Schultz, R.P.L.S.
Registration No. 4233

Doc# 200506047873
8 Pages 8
12/16/2005 11:16AM
Official Records of
COMAL COUNTY
JOY STREATER
COUNTY CLERK
Fees $41.00

Joy Streater

Doc# 200506047873

Recorder's Memorandum-Comal County
At the time of recordation, this instrument was found to be inadequate for the best photographic reproduction because of illegibility.

Manor Creek Unit 4 Permanent BMP Summary Table									
Subbasin Data	Area Treated	Treatment Method	Total Area (acres)	Acreage Treated	Impervious Area (acres)	Imp %	L_R (lbs)	L_M (lbs)	L_M (lbs) Desired
A 4-1	DA 4.8+DA 4.11	Sand Filter	4.67	4.67	2.98	63.8%	3,030	2,676	2,681
A 4-2	DA 4.12	Grassy Swale	0.49	0.49	0.36	73.3%	289	322	289
A 4-3	DA 4.14	Vegetated Filter Strips	2.38	2.38	1.48	62.1%	1,363	1,327	1,327
A 4-4	DA 4.5	Vegetated Filter Strips	1.65	1.64	0.95	57.6%	878	853	853
A 4-5	DA 4.6+ DA 4.7	Sand Filter	6.63	6.63	3.89	58.7%	3,946	3,491	3,796
A 4-6	DA 4.9	Vegetated Filter Strips	0.61	0.61	0.11	17.3%	104	95	95
A 4-7	DA 4.4	Grassy Swale	0.68	0.68	0.57	83.5%	455	510	455
A 4-15	DA 4.15	Untreated Release	1.37	1.37	0.24	17.7%	-	217	-
Total			**18.48**	**17.10**	**10.57**	**59.5%**	**10,065**	**9,491**	**9,496**
								Required TSS Removal	9,491

Chris Van Heerde, PE
11/1/16

Permanent BMP Summary Table

TSS Removal Calculations

Project Name: Manor Creek Unit 4
Date Prepared: 11/1/2016

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3. $L_M = 27.2(A_N \times P)$

where
$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data Determine Required Load Removal Based on the Entire Project

County =	Comal							
Total project area included in plan * =	23.60	acres			Streets			
Predevelopment impervious area within the limits of the plan * =	0.00	acres					153,177	3.52
Total post-development impervious area within the limits of the plan * =	10.57	acres	Lots		SF/Lot			
Total post-development impervious cover fraction * =	0.45			64	4,600		294,400	6.76
P =	33	inches			U Channel			
							3,787	0.09
$L_{M\ TOTAL\ PROJECT}$ =	9491	lbs			Fire Access			
* The values entered in these fields should be for the total project area.							9222	0.21
Number of drainage basins / outfalls areas leaving the plan area =	8							10.57
							6819	

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. =	A 4-1						
Total drainage basin/outfall area =	4.67	acres	# of Lots		SF/Lot		
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres		17	4,600	1.80	acres of IC for lots
Post-development impervious area within drainage basin/outfall area =	2.98	acres			44,977	1.13	acres of street
Post-development impervious fraction within drainage basin/outfall area =	0.64			24	4,224		ROW Driveways
$L_{M\ THIS\ BASIN}$ =	2676	lbs.			2403	0.06	acres of Fire Access

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

Aquafogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7. $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where
A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	4.67	acres					
A_I =	2.95	acres	# of Lots		SF/Lot		
A_P =	1.72	acres		17	4600	1.80	acres of IC for lots
L_R =	3030	lbs			44,977	1.10	acres of street
					2403	0.06	acres of Fire Access
					2992		

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 2681 lbs.

F = 0.88

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	1.50	inches
Post Development Runoff Coefficient =	0.45	
On-site Water Quality Volume =	11321	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.09	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	2264	
Total Capture Volume (required water quality volume(s) x 1.20) =	13585	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations

Soil infiltration/permeability rate =	0.1	in/hr	**Enter determined permeability rate or assumed value of 0.1**
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	13585	cubic feet	
Minimum filter basin area =	629	square feet	
Maximum sedimentation basin area =	5660	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	1415	square feet	**For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

			SF @ Given Depth	Given Depth	Width	Length
Water Quality Volume for combined basins =	13585	cubic feet	2,716.95		5	95 28.60
Minimum filter basin area =	1132	square feet				95 11.91643
Maximum sedimentation basin area =	4528	square feet	**For minimum water depth of 2 feet**			95 47.66573
Minimum sedimentation basin area =	283	square feet	**For maximum water depth of 8 feet**			95 2.979108

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	**Permanent Pool Capacity is 1.20 times the WQV**
Required capacity at WQV Elevation =	NA	cubic feet	**Total Capacity should be the Permanent Pool Capacity plus a second WQV.**

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

**** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™.**

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (RtA_F) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales Designed as Required in RG-348 Pages 3-51 to 3-54

Design parameters for the swale.

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall intensity = i =	1.1	in/hr
Swale Slope =	0.0205	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{CS} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_W = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{CS}/P_W =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{CS} R_H^{2/3} S^{0.5}$

$$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$$ = #DIV/0! feet

Q = CIA = #DIV/0! cfs

To calculate the flow velocity in the swale:

V (Velocity of Flow in the swale) = Q/A_{CS} = #DIV/0! ft/sec

To calculate the resulting swale length:

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun.

15B. Alternative Method using Excel Solver

Design Q = CIA =	#DIV/0!	cfs		
Manning's Equation Q =	2.38	cfs	Error 1 =	#DIV/0!
Swale Width=	13.61	ft		

Instructions are provided to the right (green comments).

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	16	ft		
Design Discharge =	2.74	cfs	Error 2 =	#DIV/0!
Design Depth =	0.33	ft		
Flow Velocity =	0.49	cfs		
Minimum Length =	146.89	ft		

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun.
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible.

16. Vegetated Filter Strips Designed as Required in RG-348 Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips.
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and
the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or
across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348.

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = NA lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CiA$

C = runoff coefficient for the drainage area = 0.46 — C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.51 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.51 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_1 AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_1 X 34.6 X A_P X 0.54) =$ 3199.89 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= NA lbs
Impervious Cover Overtreatment= 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_{or}
Rounded Overflow Rate = #VALUE! V_{or}
BMP Efficiency % = #VALUE! %
L_R Value = #VALUE! lbs

TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs
BMP Sizing		
Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7 10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Permanent BMP Summary Table

TSS Removal Calculations

Project Name: Manor Creek Unit 4
Date Prepared: 11/1/2016

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3 $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal							
Total project area included in plan * =	23.60	acres			Streets			
Predevelopment impervious area within the limits of the plan * =	0.00	acres					153,177	3.52
Total post-development impervious area within the limits of the plan * =	10.57	acres	Lots		SF/Lot			
Total post-development impervious cover fraction * =	0.45			64		4,600	294,400	6.76
P =	33	inches			U Channel			
							3,787	0.09
$L_{M\ TOTAL\ PROJECT}$ =	9491	lbs			Fire Access			
							9222	0.21
Number of drainage basins / outfalls areas leaving the plan area =	8							10.57
							9222	

* The values entered in these fields should be for the total project area.

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A 4-2

Total drainage basin/outfall area =	0.49	acres	# of Lots	SF/Lot			
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	0	4600	-	acres of IC	
Post-development impervious area within drainage basin/outfall area =	0.36	acres		15635	0.36	acres of str	
Post-development impervious fraction within drainage basin/outfall area =	0.73						
$L_{M\ THIS\ BASIN}$ =	322	lbs					

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Grassy Swale
Removal efficiency = 70 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	0.49	acres					
A_I =	0.36	acres	# of Lots	SF/Lot			
A_P =	0.13	acres	0	4500	-	acres of IC	
L_R =	289	lbs		15817	0.36	acres of str	

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ =	289	lbs.	
F =	1.00		

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	4.00	inches
Post Development Runoff Coefficient =	0.54	
On-site Water Quality Volume =	3859	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	772	
Total Capture Volume (required water quality volume(s) x 1.20) =	4631	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin =	NA	cubic feet	
Irrigation Area Calculations:			
Soil infiltration/permeability rate =	0.1	in/hr	**Enter determined permeability rate or assumed value of 0.1**
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin =	NA	cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	NA	square feet	**For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

			SF @ Given Depth	Given Depth	Width
Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!	5	60
Minimum filter basin area =	NA	square feet			60
Maximum sedimentation basin area =	NA	square feet	**For minimum water depth of 2 feet**		60
	NA	square feet	**For Given water depth**		60
Minimum sedimentation basin area =	NA	square feet	**For maximum water depth of 8 feet**		60

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin =	NA	cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	**Permanent Pool Capacity is 1.20 times the WQV**
Required capacity at WQV Elevation =	NA	cubic feet	**Total Capacity should be the Permanent Pool Capacity plus a second WQV.**

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands =	NA	cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™.

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (RIA_F) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales Designed as Required in RG-348 Pages 3-51 to 3-54

Design parameters for the swale:

Drainage Area to be Treated by the Swale = A =	0.49 acres
Impervious Cover in Drainage Area =	0.36 acres
Rainfall intensity = i =	1.1 in/hr
Swale Slope =	0.01 ft/ft
Side Slope (z) =	3
Design Water Depth = y =	0.33 ft
Weighted Runoff Coefficient = C =	0.63
A_{cs} = cross-sectional area of flow in Swale =	0.95 sf
P_w = Wetted Perimeter =	3.96 feet
R_H = hydraulic radius of flow cross-section = A_{CS}/P_W =	0.24 feet
n = Manning's roughness coefficient =	0.2

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{CS} R_H^{2/3} S^{0.5}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = 1.85 feet

Q = CIA = 0.34 cfs

To calculate the flow velocity in the swale:

V (Velocity of Flow in the swale) = Q/A_{CS} = 0.36 ft/sec

To calculate the resulting swale length:

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = 107.24 feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun

15B. Alternative Method using Excel Solver

Design Q = CIA =	0.34 cfs		
Manning's Equation Q =	0.76 cfs	Error 1 =	-0.42
Swale Width=	6.00 ft		

Instructions are provided to the right (green comments).

Flow Velocity	0.36 ft/s
Minimum Length =	107.24 ft

Instructions are provided to the right (blue comments).

Design Width =	6 ft		
Design Discharge =	0.76 cfs	Error 2 =	-0.42
Design Depth =	0.33 ft		
Flow Velocity =	0.32 cfs		
Minimum Length =	97.48 ft		

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun.
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible.

16. Vegetated Filter Strips Designed as Required in RG-348 Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips.
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348.

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = NA lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CiA$

C = runoff coefficient for the drainage area = 0.56 — **C = Runoff Coefficient = 0.546 (IC)^3 + 0.328 (IC) + 0.03**
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.62 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.62 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_I AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_I X 34.6 X A_P X 0.54) =$ 388.58 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= NA lbs
Impervious Cover Overtreatment= 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_{or}
Rounded Overflow Rate = #VALUE! V_{or}
BMP Efficiency % = #VALUE! %

L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Permanent BMP Summary Table

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 4
Date Prepared: 11/1/2016

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:
$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data Determine Required Load Removal Based on the Entire Project

County =	Comal							
Total project area included in plan * =	23.60	acres			Streets			
Predevelopment impervious area within the limits of the plan * =	0.00	acres					153,177	3.52
Total post-development impervious area within the limits of the plan * =	10.57	acres	Lots		SF/Lot			
Total post-development impervious cover fraction * =	0.45			64		4,600	294,400	6.76
P =	33	inches			U Channel			
							3,787	0.09
$L_{M\ TOTAL\ PROJECT}$ =	9491	lbs.			Fire Access			
							9222	0.21
Number of drainage basins / outfalls areas leaving the plan area =	8							10.57
							9222	

* The values entered in these fields should be for the total project area.

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. =	A 4-3						
Total drainage basin/outfall area =	2.38	acres	# of Lots	SF/Lot			
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	14		4600	1.48	acres of IC for lots
Post-development impervious area within drainage basin/outfall area =	1.48	acres				-	acres of street
Post-development impervious fraction within drainage basin/outfall area =	0.62						
$L_{M\ THIS\ BASIN}$ =	1327	lbs.					

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Vegetated Filter Strips
Removal efficiency = 80 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where:
A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	2.38	acres					
A_I =	1.48	acres	# of Lots	SF/Lot			
A_P =	0.90	acres	14		4600	1.48	acres of IC for lots
L_R =	1363	lbs				0	acres of street

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 1327 lbs.

F = 0.97

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	3.00	inches
Post Development Runoff Coefficient =	0.44	
On-site Water Quality Volume =	11305	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site Impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	2261	
Total Capture Volume (required water quality volume(s) x 1.20) =	13566	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations.

Soil Infiltration/permeability rate =	0.1	in/hr	**Enter determined permeability rate or assumed value of 0.1**
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	NA	square feet	**For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!	sf at 4' of depth
Minimum filter basin area =	NA	square feet		
Maximum sedimentation basin area =	NA	square feet	**For minimum water depth of 2 feet**	
Minimum sedimentation basin area =	NA	square feet	**For maximum water depth of 8 feet**	

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	**Permanent Pool Capacity is 1.20 times the WQV**
Required capacity at WQV Elevation =	NA	cubic feet	**Total Capacity should be the Permanent Pool Capacity plus a second WQV.**

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™.

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (RIA_F) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales Designed as Required in RG-348 Pages 3-51 to 3-54

Design parameters for the swale.

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall intensity = i =	1.1	in/hr
Swale Slope =	0.01	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{CS} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_W = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{CS}/P_W =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation $Q = \frac{1.49}{n} A_{CS} R_H^{2/3} S^{0.5}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = #DIV/0! feet

Q = CIA = #DIV/0! cfs

To calculate the flow velocity in the swale:

V (Velocity of Flow in the swale) = Q/A_{CS} = #DIV/0! ft/sec

To calculate the resulting swale length:

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun

15B. Alternative Method using Excel Solver

Design Q = CIA = #DIV/0! cfs

Manning's Equation Q = 0.76 cfs Error 1 = #DIV/0!
Swale Width= 6.00 ft

Instructions are provided to the right (green comments).

Flow Velocity #DIV/0! ft/s
Minimum Length = #DIV/0! ft

Instructions are provided to the right (blue comments).

Design Width = 6 ft
Design Discharge = 0.76 cfs Error 2 = #DIV/0!
Design Depth = 0.33 ft
Flow Velocity = 0.32 cfs
Minimum Length = 97.48 ft

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun.
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible.

16. Vegetated Filter Strips Designed as Required in RG-348 Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips.
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348.

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = NA lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CiA$

C = runoff coefficient for the drainage area = 0.44 — C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.49 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.49 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_I AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_I X 34.6 X A_P X 0.54) =$ 1601.96 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= NA lbs
Impervious Cover Overtreatment= 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_{or}
Rounded Overflow Rate = #VALUE! V_{or}
BMP Efficiency % = #VALUE! %
L_R Value = #VALUE! lbs

TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs
BMP Sizing		
Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Permanent BMP Summary Table

TSS Removal Calculations

Project Name: Manor Creek Unit 4
Date Prepared: 11/1/2016

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data. Determine Required Load Removal Based on the Entire Project

County =	Comal							
Total project area included in plan * =	23.60	acres			Streets			
Predevelopment impervious area within the limits of the plan * =	0.00	acres					153,177	3.52
Total post-development impervious area within the limits of the plan * =	10.57	acres	Lots		SF/Lot			
Total post-development impervious cover fraction * =	0.45			64		4,600	294,400	6.76
P =	33	inches			U Channel			
							3,787	0.09
$L_{M\ TOTAL\ PROJECT}$ =	9491	lbs.			Fire Access			
							9222	0.21
Number of drainage basins / outfalls areas leaving the plan area =	8							10.57
							9222	

* The values entered in these fields should be for the total project area.

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. =	A 4-4						
Total drainage basin/outfall area =	1.65	acres	# of Lots	SF/Lot			
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	9	4600	0.95	acres of IC for lots	
Post-development impervious area within drainage basin/outfall area =	0.95	acres			-	acres of street	
Post-development impervious fraction within drainage basin/outfall area =	0.58						
$L_{M\ THIS\ BASIN}$ =	853	lbs.					

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Vegetated Filter Strips
Removal efficiency = 80 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	1.64	acres					
A_I =	0.95	acres	# of Lots	SF/Lot			
A_P =	0.69	acres	9	4600	0.95	acres of IC for lots	
L_R =	878	lbs			0	acres of street	

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 853 lbs.

F = 0.97

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	3.00	inches
Post Development Runoff Coefficient =	0.41	
On-site Water Quality Volume =	7250	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site Impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	1450	
Total Capture Volume (required water quality volume(s) x 1.20) =	8700	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP. The values for BMP Types not selected in cell C45 will show NA.

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations:

Soil Infiltration/permeability rate =	0.1	in/hr	**Enter determined permeability rate or assumed value of 0.1**
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	NA	square feet	**For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!	sf at 4' of depth
Minimum filter basin area =	NA	square feet		
Maximum sedimentation basin area =	NA	square feet	**For minimum water depth of 2 feet**	
Minimum sedimentation basin area =	NA	square feet	**For maximum water depth of 8 feet**	

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	**Permanent Pool Capacity is 1.20 times the WQV**
Required capacity at WQV Elevation =	NA	cubic feet	**Total Capacity should be the Permanent Pool Capacity plus a second WQV.**

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

**** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™.**

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (RIA_F) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

16. Grassy Swales — Designed as Required in RG-348 — Pages 3-51 to 3-54

Design parameters for the swale:

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall Intensity = i =	1.1	in/hr
Swale Slope =	0.01	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{CS} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_W = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{CS}/P_W =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation $Q = \frac{1.49}{n} A_{CS} R_H^{2/3} S^{0.5}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = #DIV/0! feet

Q = CiA = #DIV/0! cfs

To calculate the flow velocity in the swale:

V (Velocity of Flow in the swale) = Q/A_{CS} = #DIV/0! ft/sec

To calculate the resulting swale length:

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun.

15B. Alternative Method using Excel Solver

Design Q = CiA =	#DIV/0!	cfs	
Manning's Equation Q =	0.76	cfs	Error 1 = #DIV/0!
Swale Width=	6.00	ft	

Instructions are provided to the right (green comments).

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft	
Design Discharge =	0.76	cfs	Error 2 = #DIV/0!
Design Depth =	0.33	ft	
Flow Velocity =	0.32	cfs	
Minimum Length =	97.48	ft	

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun.
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible.

16. Vegetated Filter Strips — Designed as Required in RG-348 — Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips.
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348.

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = NA lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CiA$

C = runoff coefficient for the drainage area = 0.40 — **C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$**
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.44 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.44 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE.
(A_I AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_I X 34.6 X A_P X 0.54) =$ 1031.58 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= NA lbs
Impervious Cover Overtreatment= 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_{or}
Rounded Overflow Rate = #VALUE! V_{or}
BMP Efficiency % = #VALUE! %
L_R Value = #VALUE! lbs

TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Z1 Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_e Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Permanent BMP Summary Table

TSS Removal Calculations

Project Name: Manor Creek Unit 4
Date Prepared: 11/1/2016

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3. $L_M = 27.2(A_N \times P)$

where $L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal							
Total project area included in plan * =	23.60	acres			Streets			
Predevelopment impervious area within the limits of the plan * =	0.00	acres					153,177	3.52
Total post-development impervious area within the limits of the plan * =	10.57	acres	Lots		SF/Lot			
Total post-development impervious cover fraction * =	0.45			64	4,600		294,400	6.76
P =	33	inches			U Channel			
							3,787	0.09
$L_{M\ TOTAL\ PROJECT}$ =	9491	lbs.			Fire Access			
							9222	0.21
Number of drainage basins / outfalls areas leaving the plan area =	8							10.57
							9222	

* The values entered in these fields should be for the total project area.

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. =	A 4-5						
Total drainage basin/outfall area =	6.63	acres	# of Lots		SF/Lot		
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres		23	4600	2.43	acres of IC for lots
Post-development impervious area within drainage basin/outfall area =	3.89	acres			57265	1.46	acres of street
Post-development impervious fraction within drainage basin/outfall area =	0.59			36	6336		
$L_{M\ THIS\ BASIN}$ =	3491	lbs.					

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where, A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	6.63	acres					
A_I =	3.84	acres	# of Lots		SF/Lot		
A_P =	2.79	acres		23	4600	2.43	acres of IC for lots
L_R =	3946	lbs			57399	1.41	acres of street
					4048		

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 3796 lbs.

F = 0.96

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	2.80	inches
Post Development Runoff Coefficient =	0.41	
On-site Water Quality Volume =	27337	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site Impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	5467	
Total Capture Volume (required water quality volume(s) x 1.20) =	**32805**	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations.

Soil infiltration/permeability rate =	0.1	in/hr	**Enter determined permeability rate or assumed value of 0.1**
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	32805	cubic feet	
Minimum filter basin area =	1519	square feet	
Maximum sedimentation basin area =	13669	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	3417	square feet	**For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

			SF @ Given Depth	Given Depth	Width	Length
Water Quality Volume for combined basins =	32805	cubic feet	6,560.98	5	90	72.90
Minimum filter basin area =	2734	square feet			90	30.37491
Maximum sedimentation basin area =	10935	square feet	**For minimum water depth of 2 feet**		90	121.4996
Minimum sedimentation basin area =	683	square feet	**For maximum water depth of 8 feet**		90	7.593727

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	**Permanent Pool Capacity is 1.20 times the WQV**
Required capacity at WQV Elevation =	NA	cubic feet	**Total Capacity should be the Permanent Pool Capacity plus a second WQV.**

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

**** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™.**

Required Sedimentation chamber capacity = NA cubic feet

Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (RIA_F) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales — Designed as Required in RG-348 — Pages 3-51 to 3-54

Design parameters for the swale:

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall Intensity = i =	1.1	in/hr
Swale Slope =	0.025	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{CS} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_W = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{CS}/P_W =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation $Q = \frac{1.49}{n} A_{CS} R_H^{2/3} S^{0.5}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = #DIV/0! feet

Q = CIA = #DIV/0! cfs

To calculate the flow velocity in the swale:

V (Velocity of Flow in the swale) = Q/A_{CS} = #DIV/0! ft/sec

To calculate the resulting swale length:

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun.

15B. Alternative Method using Excel Solver

Design Q = CIA = #DIV/0! cfs

Manning's Equation Q =	1.20	cfs	Error 1 = #DIV/0!
Swale Width=	6.00	ft	

Instructions are provided to the right (green comments).

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft	
Design Discharge =	1.20	cfs	Error 2 = #DIV/0!
Design Depth =	0.33	ft	
Flow Velocity =	0.51	cfs	
Minimum Length =	154.12	ft	

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun.
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible.

16. Vegetated Filter Strips — Designed as Required in RG-348 — Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips.

The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348.

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = NA lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: Q = CIA

C = runoff coefficient for the drainage area = 0.41 — **C = Runoff Coefficient = 0.546 (IC)^2 + 0.328 (IC) + 0.03**
I = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.45 cubic feet/sec

RG-348 Page 3-31 Equation 3.5 V_{OR} = Q/A

Q = Runoff rate calculated above = 0.45 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_t AND A_p VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_t X 34.6 X A_p X 0.54) =$ 4167.83 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= NA lbs
Impervious Cover Overtreatment= 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_{or}
Rounded Overflow Rate = #VALUE! V_{or}
BMP Efficiency % = #VALUE! %
L_R Value = #VALUE! lbs

TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft²
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_T Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Permanent BMP Summary Table

TSS Removal Calculations

Project Name: Manor Creek Unit 4
Date Prepared: 11/1/2016

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where
$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data Determine Required Load Removal Based on the Entire Project

County =	Comal							
Total project area included in plan * =	23.60	acres			Streets			
Predevelopment impervious area within the limits of the plan * =	0.00	acres					153,177	3.52
Total post-development impervious area within the limits of the plan * =	10.57	acres	Lots		SF/Lot			
Total post-development impervious cover fraction * =	0.45			64		4,600	294,400	6.76
P =	33	inches			U Channel			
							3,787	0.09
$L_{M\ TOTAL\ PROJECT}$ =	9491	lbs			Fire Access			
							9222	0.21
Number of drainage basins / outfalls areas leaving the plan area =	8							10.57
							9222	

* The values entered in these fields should be for the total project area.

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. =	A 4-6						
Total drainage basin/outfall area =	0.61	acres	# of Lots	SF/Lot			
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	1	4600	0.11	acres of IC for lots	
Post-development impervious area within drainage basin/outfall area =	0.11	acres			-	acres of street	
Post-development impervious fraction within drainage basin/outfall area =	0.17						
$L_{M\ THIS\ BASIN}$ =	95	lbs.					

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Vegetated Filter Strips
Removal efficiency = 80 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where:
A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	0.61	acres					
A_I =	0.11	acres	# of Lots	SF/Lot			
A_P =	0.50	acres	1	4600	0.11	acres of IC for lots	
L_R =	104	lbs			0	acres of street	

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 95 lbs.

F = 0.92

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	2.00	inches
Post Development Runoff Coefficient =	0.18	
On-site Water Quality Volume =	810	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site Impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	162	
Total Capture Volume (required water quality volume(s) x 1.20) =	972	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations:

Soil infiltration/permeability rate =	0.1	in/hr	**Enter determined permeability rate or assumed value of 0.1**
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	NA	square feet	**For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!	sf at 4' of depth
Minimum filter basin area =	NA	square feet		
Maximum sedimentation basin area =	NA	square feet	**For minimum water depth of 2 feet**	
Minimum sedimentation basin area =	NA	square feet	**For maximum water depth of 8 feet**	

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	**Permanent Pool Capacity is 1.20 times the WQV**
Required capacity at WQV Elevation =	NA	cubic feet	**Total Capacity should be the Permanent Pool Capacity plus a second WQV.**

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

**** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™.**

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (RIA_F) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales Designed as Required in RG-348 Pages 3-51 to 3-54

Design parameters for the swale:

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall intensity = i =	1.1	in/hr
Swale Slope =	0.01	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{cs} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_w = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{CS}/P_w =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation $Q = \frac{1.49}{n} A_{cs} R_H^{2/3} S^{0.5}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = #DIV/0! feet

Q = CIA = #DIV/0! cfs

To calculate the flow velocity in the swale:

V (Velocity of Flow in the swale) = Q/A_{CS} = #DIV/0! ft/sec

To calculate the resulting swale length:

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun.

15B. Alternative Method using Excel Solver

Design Q = CIA =	#DIV/0!	cfs		
Manning's Equation Q =	0.76	cfs	Error 1 =	#DIV/0!
Swale Width=	6.00	ft		

Instructions are provided to the right (green comments).

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft		
Design Discharge =	0.76	cfs	Error 2 =	#DIV/0!
Design Depth =	0.33	ft		
Flow Velocity =	0.32	cfs		
Minimum Length =	97.48	ft		

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun.
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible.

16. Vegetated Filter Strips Designed as Required in RG-348 Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips.
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348.

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = **NA** lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CiA$

C = runoff coefficient for the drainage area = 0.10 — **C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$**
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.11 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.11 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_I AND A_C VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_I X 34.6 X A_C X 0.54) =$ 121.80 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= **NA** lbs
Impervious Cover Overtreatment= 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_o
Rounded Overflow Rate = #VALUE! V_o
BMP Efficiency % = #VALUE! %
L_R Value = #VALUE! lbs

TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs
BMP Sizing		
Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Permanent BMP Summary Table

TSS Removal Calculations

Project Name: Manor Creek Unit 4
Date Prepared: 11/1/2016

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal						
Total project area included in plan * =	23.60	acres		Streets			
Predevelopment impervious area within the limits of the plan * =	0.00	acres				153,177	3.52
Total post-development impervious area within the limits of the plan * =	10.57	acres	Lots	SF/Lot			
Total post-development impervious cover fraction * =	0.45		64	4,600		294,400	6.76
P =	33	inches		U Channel			
						3,787	0.09
$L_{M\ TOTAL\ PROJECT}$ =	9491	lbs.		Fire Access			
* The values entered in these fields should be for the total project area.						9222	0.21
Number of drainage basins / outfalls areas leaving the plan area =	8						10.57
						9222	

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No =	A 4-7						
Total drainage basin/outfall area =	0.68	acres	# of Lots	SF/Lot			
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	0	4600		-	acres of IC
Post-development impervious area within drainage basin/outfall area =	0.57	acres		24037		0.57	acres of str
Post-development impervious fraction within drainage basin/outfall area =	0.84		4	704			
$L_{M\ THIS\ BASIN}$ =	510	lbs.					

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Grassy Swale
Removal efficiency = 70 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	0.68	acres					
A_I =	0.57	acres	# of Lots	SF/Lot			
A_P =	0.11	acres	0	4600		-	acres of IC
L_R =	455	lbs		24037		0.57	acres of str
			4	704			

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 455 lbs

F = 1.00

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	4.00	inches
Post Development Runoff Coefficient =	0.68	
On-site Water Quality Volume =	6667	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	1333	
Total Capture Volume (required water quality volume(s) x 1.20) =	8001	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations:

Soil Infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

			SF @ Given Depth	Given Depth	Width	
Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!		5	60
Minimum filter basin area =	NA	square feet				60
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet			60
	NA	square feet	For Given water depth			60
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet			60

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus a second WQV.

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™.

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (RIA_F) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales — Designed as Required in RG-348 — Pages 3-51 to 3-54

Design parameters for the swale:

Drainage Area to be Treated by the Swale = A =	0.68 acres
Impervious Cover in Drainage Area =	0.57 acres
Rainfall intensity = I =	1.1 in/hr
Swale Slope =	0.005 ft/ft
Side Slope (z) =	3
Design Water Depth = y =	0.33 ft
Weighted Runoff Coefficient = C =	0.67

A_{CS} = cross-sectional area of flow in Swale =	1.99 sf
P_W = Wetted Perimeter =	7.08 feet
R_H = hydraulic radius of flow cross-section = A_{CS}/P_W =	0.28 feet
n = Manning's roughness coefficient =	0.2

15A. Using the Method Described in the RG-348

Manning's Equation. $Q = \frac{1.49}{n} A_{CS} R_H^{2/3} S^{0.5}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = 4.97 feet

Q = CIA = 0.50 cfs

To calculate the flow velocity in the swale:

V (Velocity of Flow in the swale) = Q/A_{CS} = 0.25 ft/sec

To calculate the resulting swale length:

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = 75.83 feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun

15B. Alternative Method using Excel Solver

Design Q = CIA =	0.50 cfs		
Manning's Equation Q =	0.54 cfs	Error 1 =	-0.03
Swale Width=	6.00 ft		

Instructions are provided to the right (green comments).

Flow Velocity	0.25 ft/s
Minimum Length =	75.83 ft

Instructions are provided to the right (blue comments).

Design Width =	6 ft		
Design Discharge =	0.54 cfs	Error 2 =	-0.03
Design Depth =	0.33 ft		
Flow Velocity =	0.23 cfs		
Minimum Length =	68.93 ft		

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun.
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible.

16. Vegetated Filter Strips — Designed as Required in RG-348 — Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips.
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348.

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = NA lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CiA$

C = runoff coefficient for the drainage area = 0.68 — C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.75 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.75 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.01 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE.
(A_t AND A_p VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_t X 34.6 X A_p X 0.54) =$ 611.51 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= NA lbs
Impervious Cover Overtreatment= 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_{or}
Rounded Overflow Rate = #VALUE! V_{or}
BMP Efficiency % = #VALUE! %

L_e Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21_Vortech

Required TSS Removal in BMP Drainage Area	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_e Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Permanent BMP Summary Table

TSS Removal Calculations

Project Name: Manor Creek Unit 4
Date Prepared: 11/1/2016

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3. $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal						
Total project area included in plan * =	23.60	acres		Streets			
Predevelopment impervious area within the limits of the plan * =	0.00	acres				153,177	3.52
Total post-development impervious area within the limits of the plan * =	10.57	acres	Lots	SF/Lot			
Total post-development impervious cover fraction * =	0.45		64	4,600		294,400	6.76
P =	33	inches		U Channel			
						3,787	0.09
$L_{M\ TOTAL\ PROJECT}$ =	9491	lbs		Fire Access			
						9222	0.21
Number of drainage basins / outfalls areas leaving the plan area =	8						10.57
						9222	

* The values entered in these fields should be for the total project area.

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. =	A 4-15				
Total drainage basin/outfall area =	1.37	acres			
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	6819	0.15	
Post-development impervious area within drainage basin/outfall area =	0.24	acres	3,787	0.09	
Post-development impervious fraction within drainage basin/outfall area =	0.18			0.24	
$L_{M\ THIS\ BASIN}$ =	217	lbs.			

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = None
Removal efficiency = 0 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	1.37	acres
A_I =	0.25	acres
A_P =	1.12	acres
L_R =	0	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 0 lbs.

F = 0.00

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth = #N/A inches
Post Development Runoff Coefficient = 0.19
On-site Water Quality Volume = #N/A cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP = 0.00 acres
Off-site Impervious cover draining to BMP = 0.00 acres
Impervious fraction of off-site area = 0
Off-site Runoff Coefficient = 0.00
Off-site Water Quality Volume = #N/A cubic feet

Storage for Sediment = #N/A
Total Capture Volume (required water quality volume(s) x 1.20) = #N/A cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations:

Soil infiltration/permeability rate = 0.1 in/hr **Enter determined permeability rate or assumed value of 0.1**
Irrigation area = NA square feet
NA acres

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin = NA cubic feet

Minimum filter basin area = NA square feet

Maximum sedimentation basin area = NA square feet **For minimum water depth of 2 feet**
Minimum sedimentation basin area = NA square feet **For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

			SF @ Given Depth	Given Depth	Width
Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!	5	60
Minimum filter basin area =	NA	square feet			60
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet		60
	NA	square feet	For Given water depth		60
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet		60

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool = NA cubic feet **Permanent Pool Capacity is 1.20 times the WQV**
Required capacity at WQV Elevation = NA cubic feet **Total Capacity should be the Permanent Pool Capacity plus a second WQV.**

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

**** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™.**

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (RIA_F) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales — Designed as Required in RG-348 — Pages 3-51 to 3-54

Design paramgters for the swale:

Drainage Area to be Treated by the Swale = A =	1.37 acres
Impervious Cover in Drainage Area =	0.25 acres
Rainfall intensity = i =	1.1 in/hr
Swale Slope =	0.005 ft/ft
Side Slope (z) =	3
Design Water Depth = y =	0.33 ft
Weighted Runoff Coefficient = C =	0.40
A_{Cs} = cross-sectional area of flow in Swale =	2.41 sf
P_w = Wetted Perimeter =	8.35 feet
R_H = hydraulic radius of flow cross-section = A_{CS}/P_w =	0.29 feet
n = Manning's roughness coefficient =	0.2

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{CS} R_H^{2/3} S^{0.5}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = 6.24 feet

Q = CIA = 0.61 cfs

To calculate the flow velocity in the swale:

V (Velocity of Flow in the swale) = Q/A_{CS} = 0.25 ft/sec

To calculate the resulting swale length:

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = 75.83 feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun.

15B. Alternative Method using Excel Solver

Design Q = CIA =	0.61 cfs		
Manning's Equation Q =	0.54 cfs	Error 1 =	0.07
Swale Width=	6.00 ft		

Instructions are provided to the right (green comments).

Flow Velocity	0.25 ft/s
Minimum Length =	75.83 ft

Instructions are provided to the right (blue comments).

Design Width =	6 ft		
Design Discharge =	0.54 cfs	Error 2 =	0.07
Design Depth =	0.33 ft		
Flow Velocity =	0.23 cfs		
Minimum Length =	68.93 ft		

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun.
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible.

16. Vegetated Filter Strips — Designed as Required in RG-348 — Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips.
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348.

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = **NA** lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CiA$

C = runoff coefficient for the drainage area = 0.10 — C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.12 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.12 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE
(A_1 AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_1 X 34.6 X A_P X 0.54) =$ 287.10 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= NA lbs
Impervious Cover Overtreatment= 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (If multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_{or}
Rounded Overflow Rate = #VALUE! V_{or}
BMP Efficiency % = #VALUE! %

L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Z1 Vortech

Required TSS Removal in BMP Drainage Area =	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Phase 5A & 5B Permanent BMP Summary Table									
Subbasin Data	Area Treated	Treatment Method	Total Area (acres)	Acreage Treated	Impervious Area (acres)	Imp %	L_R (lbs)	L_M (lbs)	Desired L_M (lbs)
A 5-1	DA 5.8+DA5.7	Sand Filter	12.56	12.56	5.77	46.0%	5976	5183	5441
A 5-2	DA 5.5	Grassy Swale	1.02	0.86	0.68	66.6%	546	610	377
A 5-3	DA 5.4	Vegetated Filter Strips	0.28	0.28	0.07	25.5%	68	64	64
A 5-4	DA 5.6	Vegetated Filter Strips	5.24	5.24	0.71	13.6%	717	641	641
A 5-5	DA 5.11	Vegetated Filter Strips	0.83	0.83	0.29	34.4%	269	257	257
A 5-6	DA 5.9A +DA 5.9B+DA 5.9C	Sand Filter	14.39	14.09	6.66	46.3%	6891	5982	6294
A 5-7	DA 5.16	Vegetated Filter Strips	3.96	3.96	1.43	36.1%	1341	1283	1283
A 5-8	DA 5.13	Vegetated Filter Strips	2.88	2.88	0.57	19.8%	555	513	513
A 5-9	DA 5.10	Vegetated Filter Strips	2.6	2.6	0.57	22.0%	551	513	513
A 5-12	DA 5.12	Untreated Release	0.3	0.3	0.20	68.1%	0	183	0
A 5-4A	DA 5.4A	Untreated Release	0.28	0.28	0.17	60.6%	0	152	0
Total			**44.06**	**43.60**	**17.14**	**38.8%**	**16914**	**15383**	**15383**

Required TSS Removal 15383

Phase 5A Permanent BMP Summary Table									
Subbasin Data	Area Treated	Treatment Method	Total Area (acres)	Acreage Treated	Impervious Area (acres)	Imp %	L_R (lbs)	L_M (lbs)	Desired L_M (lbs)
A 5-1 (5A)	DA 5.8+DA5.7	Sand Filter	12.56	12.56	5.49	43.7%	5690	4927	5441
A 5-2 (5A)	DA 5.5	Grassy Swale	1.02	0.86	0.68	66.6%	377	610	377
A 5-3 (5A)	DA 5.4	Vegetated Filter Strips	0.28	0.28	0.07	25.5%	68	64	64
A 5-4 (5A)	DA 5.6	Vegetated Filter Strips	5.24	5.24	0.71	13.6%	717	641	641
A 5-5 (5A)	DA 5.11	Vegetated Filter Strips	0.83	0.83	0.29	34.4%	269	257	257
A 5-7 (5A)		Vegetated Filter Strips	3.96	3.96	0.43	10.8%	442	385	385
A 5-4A (5A)	DA 5.4 A	Untreated Release	0.28	0.28	0.17	60.6%	0	152	0
Total			**23.89**	**23.73**	**7.84**	**45.3%**	**7563**	**7036**	**7165**

Required TSS Removal 7036

Chris Van Heerde, PE

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 5
Date Prepared: 3/10/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where,

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal							
Total project area included in plan * =	45.67	acres		Streets			236,065	5 419
Predevelopment impervious area within the limits of the plan * =	0.00	acres						
Total post-development impervious area within the limits of the plan* =	17.14	acres	Lots	SF/Lot				
Total post-development impervious cover fraction * =	0.38		82	6,225		510,450		11 718
P =	33	inches						17 14
$L_{M\ TOTAL\ PROJECT}$ =	15383	lbs.						

* The values entered in these fields should be for the total project area

Number of drainage basins / outfalls areas leaving the plan area = 9

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A 5-1

Total drainage basin/outfall area =	12.56	acres	# of Lots	SF/Lot		
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	25	6225		3 57 acres of IC for lots
Post-development impervious area within drainage basin/outfall area =	5.77	acres		95920		2 20 acres of street
Post-development impervious fraction within drainage basin/outfall area =	0.46					5.77 Total IC (acres)
$L_{M\ THIS\ BASIN}$ =	5183	lbs				

3. Indicate the proposed BMP Code for this basin

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	12.56	acres				
A_I =	5.77	acres	# of Lots	SF/Lot		
A_P =	6.79	acres	25	6225		3 57 acres of IC for lots
L_R =	5976	lbs		95920		2 20 acres of street

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 5441 lbs

F = 0.91

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	1.80	inches
Post Development Runoff Coefficient =	0.34	
On-site Water Quality Volume =	27595	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	5519	
Total Capture Volume (required water quality volume(s) x 1.20) =	33114	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations:

Soil infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	33114	cubic feet	
Minimum filter basin area =	1533	square feet	
Maximum sedimentation basin area =	13797	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	3449	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

			SF @ Given Depth	Given Depth	Width	Length
Water Quality Volume for combined basins =	33114	cubic feet	6,064.80	5.46	90	67.39
Minimum filter basin area =	2759	square feet			90	30.66093
Maximum sedimentation basin area =	11038	square feet	For minimum water depth of 2 feet		90	122.6437
	2295	square feet	For Given water depth		90	25.49462
Minimum sedimentation basin area =	690	square feet	For maximum water depth of 8 feet		90	7.665231

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus a second WQV

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (RIA_F) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales Designed as Required in RG-348 Pages 3-51 to 3-54

Design parameters for the swale:

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall Intensity = I =	1.1	in/hr
Swale Slope =	0.01	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.25	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{cs} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_w = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{cs}/P_w =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{cs} R_H^{2/3} S^{1/2}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy =$ #DIV/0! feet

$Q = CIA =$ #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{cs} = #DIV/0! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun.

15B. Alternative Method using Excel Solver

Design Q = CiA =	#DIV/0!	cfs		
Manning's Equation Q =	2.74	cfs	Error 1 =	5.82
Swale Width=	38.91	ft		

Instructions are provided to the right (green comments)

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft	
Design Discharge =	0.76	cfs	Error 2 = #DIV/0!
Design Depth =	0.33	ft	
Flow Velocity =	0.32	cfs	
Minimum Length =	97.48	ft	

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible

16. Vegetated Filter Strips Designed as Required in RG-348 Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips.
The 60% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-58 of RG-348

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = **NA** lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CiA$

C = runoff coefficient for the drainage area = 0.30 — C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$
I = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.33 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.33 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2005

$E_{TOT} = [1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} \times P \times (A \times 34.6 \times A_P \times 0.54) =$ 6311.91 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= NA lbs
Impervious Cover Overtreatment= 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_{or}
Rounded Overflow Rate = #VALUE! V_{or}
BMP Efficiency % = #VALUE! %

L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 5
Date Prepared: 3/10/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal							
Total project area included in plan * =	45.67	acres			Streets		236,065	5.419
Predevelopment impervious area within the limits of the plan * =	0.00	acres						
Total post-development impervious area within the limits of the plan* =	17.14	acres	Lots		SF/Lot			
Total post-development impervious cover fraction * =	0.38			82		6,225	510,450	11.718
P =	33	inches						17.14
$L_{M\ TOTAL\ PROJECT}$ =	15383	lbs						

* The values entered in these fields should be for the total project area

Number of drainage basins / outfalls areas leaving the plan area = 9

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A 5-2

Total drainage basin/outfall area =	1.02	acres	# of Lots	SF/Lot		
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	3.5	6225		0.50 acres of IC for lots
Post-development impervious area within drainage basin/outfall area =	0.68	acres		7825.4103		0.18 acres of street
Post-development impervious fraction within drainage basin/outfall area =	0.67					0.68 Total IC (acres)
$L_{M\ THIS\ BASIN}$ =	610	lbs				

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Grassy Swale
Removal efficiency = 70 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	0.86	acres				
A_I =	0.47	acres	# of Lots	SF/Lot		
A_P =	0.39	acres	2	6225		0.29 acres of IC for lots
L_R =	377	lbs		7825.4		0.18 acres of street
						0.47 Total IC (acres)

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 377 lbs

F = 1.00

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	4.00	inches
Post Development Runoff Coefficient =	0.38	
On-site Water Quality Volume =	4762	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site Impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	952	
Total Capture Volume (required water quality volume(s) x 1.20) =	5714	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP
The values for BMP Types not selected in cell C45 will show NA.

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations

Soil Infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet				
Minimum filter basin area =	NA	square feet				
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet			
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet			

9B. Partial Sedimentation and Filtration System

			SF @ Given Depth	Given Depth	Width	Length
Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!		5	90 #VALUE!
Minimum filter basin area =	NA	square feet				90 #VALUE!
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet			90 #VALUE!
	NA	square feet	For Given water depth			90 #VALUE!
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet			90 #VALUE!

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus a second WQV

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (BIA_F) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales Designed as Required in RG-348 Pages 3-51 to 3-54

Design parameters for the swale:

Drainage Area to be Treated by the Swale = A =	1.02	acres
Impervious Cover in Drainage Area =	#VALUE!	acres
Rainfall Intensity = i =	1.1	in/hr
Swale Slope =	0.025	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.25	ft
Weighted Runoff Coefficient = C =	#VALUE!	

A_{CS} = cross-sectional area of flow in Swale =	#VALUE!	sf
P_W = Wetted Perimeter =	#VALUE!	feet
R_H = hydraulic radius of flow cross-section = A_{CS}/P_W =	#VALUE!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{CS} R_H^{2/3} S^{0.5}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = #VALUE! feet

Q = CIA = #VALUE! cfs

To calculate the flow velocity in the swale:

V (Velocity of Flow in the swale) = Q/A_{CS} = #VALUE! ft/sec

To calculate the resulting swale length:

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #VALUE! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun.

15B. Alternative Method using Excel Solver

Design Q = CiA =	#VALUE!	cfs
Manning's Equation Q =	4.34	cfs
Swale Width=	36.91	ft

Error 1 = 5.82

Instructions are provided to the right (green comments)

Flow Velocity	#VALUE!	ft/s
Minimum Length =	#VALUE!	ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft
Design Discharge =	1.20	cfs
Design Depth =	0.33	ft
Flow Velocity =	0.51	cfs
Minimum Length =	154.12	ft

Error 2 = #VALUE!

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun.
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible.

16. Vegetated Filter Strips Designed as Required in RG-348 Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and
the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or
across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-58 of RG-348

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = NA lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CiA$

C = runoff coefficient for the drainage area = 0.49 — C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$
I = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.54 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.54 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D. P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.55 on May 3, 2006

$E_{TOT} = \{1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))\} X 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_1 AND A_2 VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_1 X 34.6 X A_2 X 0.54) =$ 506.21 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= NA lbs
Impervious Cover Overtreatment= 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_o
Rounded Overflow Rate = #VALUE! V_o
BMP Efficiency % = #VALUE! %

L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs
BMP Sizing		
Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 5
Date Prepared: 3/10/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal							
Total project area included in plan * =	45.67	acres			Streets			
Predevelopment impervious area within the limits of the plan * =	0.00	acres					236,065	5.419
Total post-development impervious area within the limits of the plan * =	17.14	acres	Lots		SF/Lot			
Total post-development impervious cover fraction * =	0.38			82		6,235	510,450	11.718
P =	33	inches						17.14
$L_{M\ TOTAL\ PROJECT}$ =	15383	lbs.						

* The values entered in these fields should be for the total project area

Number of drainage basins / outfalls areas leaving the plan area = 9

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A 5-3

Total drainage basin/outfall area =	0.28	acres	# of Lots		SF/Lot		
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres		0.5	6225	0.07	acres of IC for lots
Post-development impervious area within drainage basin/outfall area =	0.07	acres				-	acres of street
Post-development impervious fraction within drainage basin/outfall area =	0.25						
$L_{M\ THIS\ BASIN}$ =	64	lbs					

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Vegetated Filter Strips
Removal efficiency = 80 percent

Aquaglogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	0.28	acres					
A_I =	0.07	acres	# of Lots		SF/Lot		
A_P =	0.21	acres		0.5	6225	0.07	acres of IC for lots
L_R =	58	lbs				0	acres of street

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{o\ THIS\ BASIN}$ = 64 lbs

F = 0.94

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth = 2.40 Inches
Post Development Runoff Coefficient = 0.23
On-site Water Quality Volume = 571 cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP = 0.00 acres
Off-site impervious cover draining to BMP = 0.00 acres
Impervious fraction of off-site area = 0
Off-site Runoff Coefficient = 0.00
Off-site Water Quality Volume = 0 cubic feet

Storage for Sediment = 114
Total Capture Volume (required water quality volume(s) x 1.20) = 685 cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP
The values for BMP Types not selected in cell C45 will show NA

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations

Soil infiltration/permeability rate = 0.1 in/hr Enter determined permeability rate or assumed value of 0.1
Irrigation area = NA square feet
NA acres

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin = NA cubic feet

Minimum filter basin area = NA square feet

Maximum sedimentation basin area = NA square feet For minimum water depth of 2 feet
Minimum sedimentation basin area = NA square feet For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins = NA cubic feet #VALUE! sf at 4' of depth

Minimum filter basin area = NA square feet

Maximum sedimentation basin area = NA square feet For minimum water depth of 2 feet
Minimum sedimentation basin area = NA square feet For maximum water depth of 8 feet

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool = NA cubic feet Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation = NA cubic feet Total Capacity should be the Permanent Pool Capacity plus a second WQV

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (FIA_f) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales Designed as Required in RG-348 Pages 3-51 to 3-54

Design parameters for the swale.

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall intensity = I =	1.1	in/hr
Swale Slope =	0.01	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{cs} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_w = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{cs}/P_w =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{cs} R_H^{2/3} S^{0.5}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = #DIV/0! feet

Q = CIA = #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{cs} = #DIV/0! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun.

15B. Alternative Method using Excel Solver

Design Q = CIA = #DIV/0! cfs

Manning's Equation Q = 0.76 cfs Error 1 = #DIV/0!
Swale Width= 6.00 ft

Instructions are provided to the right (green comments)

Flow Velocity #DIV/0! ft/s
Minimum Length = #DIV/0! ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft	
Design Discharge =	0.76	cfs	Error 2 = #DIV/0!
Design Depth =	0.33	ft	
Flow Velocity =	0.32	cfs	
Minimum Length =	97.48	ft	

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible.

16. Vegetated Filter Strips Designed as Required in RG-348 Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-58 of RG-348.

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = **NA** lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CIA$

C = runoff coefficient for the drainage area = 0.15 — C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$
I = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.16 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.16 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_i AND A_p VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_i X 34.6 X A_p X 0.54) =$ 80.19 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area = **NA** lbs
Impervious Cover Overtreatment = 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_o
Rounded Overflow Rate = #VALUE! V_o
BMP Efficiency % = #VALUE! %
L_o Value = #VALUE! lbs

TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_a Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 5
Date Prepared: 3/10/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where,

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal							
Total project area included in plan * =	45.67	acres		Streets				
Predevelopment impervious area within the limits of the plan * =	0.00	acres				236,065	5.419	
Total post-development impervious area within the limits of the plan * =	17.14	acres	Lots	SF/Lot				
Total post-development impervious cover fraction * =	0.38		82	6,225		510,450	11.718	
P =	33	inches					17.14	
$L_{M\ TOTAL\ PROJECT}$ =	15383	lbs.						

* The values entered in these fields should be for the total project area

Number of drainage basins / outfalls areas leaving the plan area = 9

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A 5-4

Total drainage basin/outfall area =	5.24	acres	# of Lots	SF/Lot			
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	5	6225	0.71	acres of IC for lots	
Post-development impervious area within drainage basin/outfall area =	0.71	acres			-	acres of street	
Post-development impervious fraction within drainage basin/outfall area =	0.14						
$L_{M\ THIS\ BASIN}$ =	641	lbs					

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Vegetated Filter Strips
Removal efficiency = 80 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_C x 34.8 + A_P x 0.54)

where

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	5.24	acres					
A_I =	0.71	acres	# of Lots	SF/Lot			
A_P =	4.53	acres	5	6225	0.71	acres of IC for lots	
L_R =	717	lbs			0	acres of street	

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{U\ THIS\ BASIN}$ = 641 lbs

F = 0.89

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	1.60	inches
Post Development Runoff Coefficient =	0.16	
On-site Water Quality Volume =	4731	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	946	
Total Capture Volume (required water quality volume(s) x 1.20) =	5677	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP
The values for BMP Types not selected in cell C45 will show NA.

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations

Soil Infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!	sf at 4' of depth
Minimum filter basin area =	NA	square feet		
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet	
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet	

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus a second WQV

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-76

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (R/A_F) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System = NA cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales Designed as Required in RG-348 Pages 3-51 to 3-54

Design parameters for the swale.

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall Intensity = I =	1.1	in/hr
Swale Slope =	0.01	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{cs} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_w = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{cs}/P_w =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{cs} R_H^{2/3} S^{1/2}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = #DIV/0! feet

Q = CIA = #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{cs} = #DIV/0! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun

15B. Alternative Method using Excel Solver

Design Q = CIA = #DIV/0! cfs

Manning's Equation Q = 0.76 cfs Error 1 = #DIV/0!
Swale Width= 6.00 ft

Instructions are provided to the right (green comments)

Flow Velocity #DIV/0! ft/s
Minimum Length = #DIV/0! ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft
Design Discharge =	0.76	cfs
Design Depth =	0.33	ft
Flow Velocity =	0.32	cfs
Minimum Length =	97.48	ft

Error 2 = #DIV/0!

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible

16. Vegetated Filter Strips Designed as Required in RG-348 Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips.
The 60% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348.

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = NA lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CIA$

C = runoff coefficient for the drainage area = 0.08 — C = Runoff Coefficient = $0.546 (IC)^3 + 0.328 (IC) + 0.03$
I = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.09 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.09 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed In a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_1 AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} \times P \times (A_1 \times 34.6 \times A_P \times 0.54) =$ 842.75 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= NA lbs
Impervious Cover Overtreatment= 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_o
Rounded Overflow Rate = #VALUE! V_o
BMP Efficiency % = #VALUE! %
L_R Value = #VALUE! lbs

TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_o Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 5
Date Prepared: 3/10/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3. $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal							
Total project area included in plan * =	45.67	acres		Streets			236,065	5.419
Predevelopment impervious area within the limits of the plan * =	0.00	acres						
Total post-development impervious area within the limits of the plan * =	17.14	acres	Lots		SF/Lot		510,450	11.718
Total post-development impervious cover fraction * =	0.38			82	6,225			
P =	33	inches						17.14

$L_{M\ TOTAL\ PROJECT}$ = 15383 lbs

* The values entered in these fields should be for the total project area

Number of drainage basins / outfalls areas leaving the plan area = 9

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A 5-5

Total drainage basin/outfall area =	0.83	acres	# of Lots	SF/Lot			
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	2	6225	0.29	acres of IC for lots	
Post-development impervious area within drainage basin/outfall area =	0.29	acres			-	acres of street	
Post-development impervious fraction within drainage basin/outfall area =	0.34						
$L_{M\ THIS\ BASIN}$ =	257	lbs					

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Vegetated Filter Strips
Removal efficiency = 80 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7 $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	0.83	acres				
A_I =	0.29	acres	# of Lots	SF/Lot		
A_P =	0.54	acres	2	6225	0.29 acres of IC for lots	
L_R =	269	lbs			0 acres of street	

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M \text{ THIS BASIN}}$ = 257 lbs

F = 0.95

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	2.60	inches
Post Development Runoff Coefficient =	0.28	
On-site Water Quality Volume =	2364	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site Impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	473	
Total Capture Volume (required water quality volume(s) x 1.20) =	2838	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations

Soil Infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet		
Minimum filter basin area =	NA	square feet		
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet	
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet	

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!	sf at 4' of depth
Minimum filter basin area =	NA	square feet		
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet	
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet	

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus a second WQV

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™.

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (RIA_c) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System = NA cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales Designed as Required in RG-348 Pages 3-51 to 3-54

Design parameters for the swale

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall intensity = i =	1.1	in/hr
Swale Slope =	0.01	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{cs} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_w = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{cs}/P_w =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{cs} R_H^{2/3} S^{0.5}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = #DIV/0! feet

Q = CIA = #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{cs} = #DIV/0! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun

15B. Alternative Method using Excel Solver

Design Q = CIA = #DIV/0! cfs

Manning's Equation Q = 0.76 cfs Error 1 = #DIV/0!
Swale Width= 6.00 ft

Instructions are provided to the right (green comments)

Flow Velocity #DIV/0! ft/s
Minimum Length = #DIV/0! ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft
Design Discharge =	0.76	cfs
Design Depth =	0.33	ft
Flow Velocity =	0.32	cfs
Minimum Length =	97.48	ft

Error 2 = #DIV/0!

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun
If any of the resulting values still do not meet the design requirement set forth in RG-348 widening the swale bottom value may not be possible

16. Vegetated Filter Strips Designed as Required in RG-348 Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and
the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or
across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348.

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = **NA** lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CiA$

C = runoff coefficient for the drainage area = 0.21 — C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.23 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.23 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - \{(1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3)\}] \times 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_I AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} \times P \times (A_I \times 34.6 \times A_P \times 0.54) =$ 315.89 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= **NA** lbs
Impervious Cover Overtreatment= 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_{or}
Rounded Overflow Rate = #VALUE! V_{or}
BMP Efficiency % = #VALUE! %
L_R Value = #VALUE! lbs

TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 5 & 6
Date Prepared: 3/10/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3 $L_M = 27.2(A_N \times P)$

where
$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal							
Total project area included in plan * =	45.67	acres			Streets		238,065	5.419
Predevelopment impervious area within the limits of the plan * =	0.00	acres						
Total post-development impervious area within the limits of the plan* =	17.14	acres	Lots		SF/Lot		510,450	11.718
Total post-development impervious cover fraction * =	0.38			82	6,225			17.14
P =	33	Inches						
$L_{M\ TOTAL\ PROJECT}$ =	15383	lbs.						

* The values entered in these fields should be for the total project area.

Number of drainage basins / outfalls areas leaving the plan area = 9

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A 5-6

Total drainage basin/outfall area =	14.39	acres	# of Lots	SF/Lot		
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	28	6225		4.00 acres of IC
Post-development impervious area within drainage basin/outfall area =	6.66	acres		116018		2.66 acres of str
Post-development impervious fraction within drainage basin/outfall area =	0.46					6.66 Total IC (a
$L_{M\ THIS\ BASIN}$ =	5962	lbs				

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7 L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where
A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	14.09	acres	# of Lots	SF/Lot			
A_I =	6.81	acres	29	6225		4.14 acres of IC	
A_P =	7.28	acres		116018		2.66 acres of str	
L_R =	7933	lbs				6.81 Total IC (a	

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 6294 lbs

F = 0.89

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	1.60	inches
Post Development Runoff Coefficient =	0.35	
On-site Water Quality Volume =	28511	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	5702	
Total Capture Volume (required water quality volume(s) x 1.20) =	34214	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP
The values for BMP Types not selected in cell C45 will show NA.

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations

Soil infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	34214	cubic feet	
Minimum filter basin area =	1584	square feet	
Maximum sedimentation basin area =	14256	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	3564	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

			SF @ Given Depth	Given Depth	Width	
Water Quality Volume for combined basins =	34214	cubic feet	5,842.72		5	60
Minimum filter basin area =	2851	square feet				60
Maximum sedimentation basin area =	11405	square feet	For minimum water depth of 2 feet			60
	2851	square feet	For Given water depth			60
Minimum sedimentation basin area =	713	square feet	For maximum water depth of 8 feet			60

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus a second WQV.

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (BIA_F) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales Designed as Required in RG-348 Pages 3-51 to 3-54

Design parameters for the swale:

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall Intensity = i =	1.1	in/hr
Swale Slope =	0.01	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{cs} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_w = Wetted Perimeter =	#DIV/0!	feet
R_h = hydraulic radius of flow cross-section = A_{cs}/P_w =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{cs} R_h^{2/3} S^{0.5}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = #DIV/0! feet

Q = CIA = #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{cs} = #DIV/0! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun

15B. Alternative Method using Excel Solver

Design Q = CIA = #DIV/0! cfs

Manning's Equation Q = 0.76 cfs Error 1 = #DIV/0!
Swale Width= 6.00 ft

Instructions are provided to the right (green comments)

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft
Design Discharge =	0.76	cfs
Design Depth =	0.33	ft
Flow Velocity =	0.32	cfs
Minimum Length =	97.48	ft

Error 2 = #DIV/0!

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible

16. Vegetated Filter Strips Designed as Required in RG-348 Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and
the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or
across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348.

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = NA lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CiA$

C = runoff coefficient for the drainage area = 0.30 — C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.33 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.33 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_3 be changed from 0.5 to 0.65 on May 3, 2005

$E_{TOT} = \{1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))\} X 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_1 AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_1 X 34.6 X A_P X 0.54) =$ 7429.02 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= NA lbs
Impervious Cover Overtreatment= 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_o
Rounded Overflow Rate = #VALUE! V_o
BMP Efficiency % = #VALUE! %

L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 5
Date Prepared: 3/10/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal							
Total project area included in plan * =	45.67	acres			Streets			
Predevelopment impervious area within the limits of the plan * =	0.00	acres					236,065	5.419
Total post-development impervious area within the limits of the plan * =	17.14	acres	Lots		SF/Lot			
Total post-development impervious cover fraction * =	0.38			82		6,225	510,450	11.718
P =	33	inches						17.14
$L_{M\ TOTAL\ PROJECT}$ =	15383	lbs						

* The values entered in these fields should be for the total project area

Number of drainage basins / outfalls areas leaving the plan area = 9

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A 5-7

Total drainage basin/outfall area =	3.96	acres	# of Lots		SF/Lot		
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres		10	6225	1.43	acres of IC for lots
Post-development impervious area within drainage basin/outfall area =	1.43	acres				-	acres of street
Post-development impervious fraction within drainage basin/outfall area =	0.36						
$L_{M\ THIS\ BASIN}$ =	1283	lbs					

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Vegetated Filter Strips
Removal efficiency = 80 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7 L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	3.96	acres					
A_I =	1.43	acres	# of Lots		SF/Lot		
A_P =	2.53	acres		10	6225	1.43	acres of IC for lots
L_R =	1341	lbs				0	acres of street

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 1283 lbs

F = 0.96

5. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	2.80	inches
Post Development Runoff Coefficient =	0.29	
On-site Water Quality Volume =	11598	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	2320	
Total Capture Volume (required water quality volume(s) x 1.20) =	13918	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP
The values for BMP Types not selected in cell C45 will show NA

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations

Soil Infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!	sf at 4' of depth
Minimum filter basin area =	NA	square feet		
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet	
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet	

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus a second WQV.

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (BIA_F) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales — Designed as Required in RG-348 — Pages 3-51 to 3-54

Design parameters for the swale:

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall intensity = I =	1.1	in/hr
Swale Slope =	0.01	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{cs} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_w = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{cs}/P_w =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{cs} R_H^{2/3} S^{1/2}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = #DIV/0! feet

Q = CiA = #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{cs} = #DIV/0! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters **must be** modified and the solver rerun.

15B. Alternative Method using Excel Solver

Design Q = CIA = #DIV/0! cfs

Manning's Equation Q =	0.76	cfs	Error 1 = #DIV/0!
Swale Width =	6.00	ft	

Instructions are provided to the right (green comments)

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft	
Design Discharge =	0.76	cfs	Error 2 = #DIV/0!
Design Depth =	0.33	ft	
Flow Velocity =	0.32	cfs	
Minimum Length =	97.48	ft	

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible

16. Vegetated Filter Strips — Designed as Required in RG-348 — Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and
the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or
across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = NA lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CIA$

C = runoff coefficient for the drainage area = 0.22 — C = Runoff Coefficient = $0.545\ (IC)^2 + 0.328\ (IC) + 0.03$
I = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.24 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.24 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_1 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE
(A_1 AND A_2 VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} \times P \times (A_1 \times 34.6 \times A_2 \times 0.54) =$ 1576.28 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= NA lbs
Impervious Cover Overtreatment= 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_o
Rounded Overflow Rate = #VALUE! V_o
BMP Efficiency % = #VALUE! %
L_R Value = #VALUE! lbs

TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.9000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (If choosing target model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 5
Date Prepared: 3/10/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3. $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal							
Total project area included in plan * =	45.67	acres		Streets			236,065	5.419
Predevelopment impervious area within the limits of the plan * =	0.00	acres						
Total post-development impervious area within the limits of the plan* =	17.14	acres	Lots		SF/Lot		510,450	11.718
Total post-development impervious cover fraction * =	0.38			82	6,225			
P =	33	inches						17.14
$L_{M\ TOTAL\ PROJECT}$ =	15383	lbs						

* The values entered in these fields should be for the total project area.

Number of drainage basins / outfalls areas leaving the plan area = 9

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A S-6

Total drainage basin/outfall area =	2.88	acres	# of Lots	SF/Lot		
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	4	6225	0.57	acres of IC for lots
Post-development impervious area within drainage basin/outfall area =	0.57	acres			-	acres of street
Post-development impervious fraction within drainage basin/outfall area =	0.20					
$L_{M\ THIS\ BASIN}$ =	513	lbs				

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Vegetated Filter Strips
Removal efficiency = 80 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7 L_R = (BMP efficiency) x P x (A_C x 34.6 + A_P x 0.54)

where

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	2.88	acres					
A_I =	0.57	acres	# of Lots	SF/Lot			
A_P =	2.31	acres	4	6225	0.57	acres of IC for lots	
L_R =	555	lbs			0	acres of street	

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 513 lbs

F = 0.82

5. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	2.00	inches
Post Development Runoff Coefficient =	0.20	
On-site Water Quality Volume =	4181	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	836	
Total Capture Volume (required water quality volume(s) x 1.20) =	5017	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin =	NA	cubic feet	
Irrigation Area Calculations:			
Soil infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin =	NA	cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!	sf at 4' of depth
Minimum filter basin area =	NA	square feet		
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet	
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet	

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin =	NA	cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus a second WQV

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands =	NA	cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-76

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (RtA_F) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System = NA cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales Designed as Required in RG-348 Pages 3-51 to 3-54

Design parameters for the swale.

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall Intensity = i =	1.1	in/hr
Swale Slope =	0.01	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{CS} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_W = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{CS}/P_W =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{CS} R_H^{2/3} S^{1/2}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{1/2}} - zy$ = #DIV/0! feet

Q = CIA = #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{CS} = #DIV/0! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun

15B. Alternative Method using Excel Solver

Design Q = CiA = #DIV/0! cfs

Manning's Equation Q =	0.76	cfs	Error 1 =	#DIV/0!
Swale Width=	6.00	ft		

Instructions are provided to the right (green comments)

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft	
Design Discharge =	0.76	cfs	Error 2 = #DIV/0!
Design Depth =	0.33	ft	
Flow Velocity =	0.32	cfs	
Minimum Length =	97.48	ft	

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible

16. Vegetated Filter Strips Designed as Required in RG-348 Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and
the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or
across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348.

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = **NA** lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CiA$

C = runoff coefficient for the drainage area = 0.12 — C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.13 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.13 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE
(A_1 AND A_2 VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_1 X 34.6 X A_2 X 0.54) =$ 852.22 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= **NA** lbs
Impervious Cover Overtreatment= 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_o
Rounded Overflow Rate = #VALUE! V_o
BMP Efficiency % = #VALUE! %
L_R Value = #VALUE! lbs

TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 5
Date Prepared: 3/10/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal							
Total project area included in plan * =	45.67	acres		Streets				
Predevelopment impervious area within the limits of the plan * =	0.00	acres				236,065	5.419	
Total post-development impervious area within the limits of the plan* =	17.14	acres	Lots	SF/Lot				
Total post-development impervious cover fraction * =	0.38		82	6,225		510,450	11.718	
P =	33	inches					17.14	
$L_{M\ TOTAL\ PROJECT}$ =	15383	lbs						

* The values entered in these fields should be for the total project area.

Number of drainage basins / outfalls areas leaving the plan area = 9

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A 5-9

Total drainage basin/outfall area =	2.60	acres	# of Lots	SF/Lot			
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	4	6225	0.57	acres of IC for lots	
Post-development impervious area within drainage basin/outfall area =	0.57	acres			-	acres of street	
Post-development impervious fraction within drainage basin/outfall area =	0.22						
$L_{M\ THIS\ BASIN}$ =	813	lbs					

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Vegetated Filter Strips
Removal efficiency = 80 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	2.60	acres					
A_I =	0.57	acres	# of Lots	SF/Lot			
A_P =	2.03	acres	4	6225	0.57	acres of IC for lots	
L_R =	551	lbs			0	acres of street	

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 813 lbs

F = 0.93

5. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	2.20	inches
Post Development Runoff Coefficient =	0.21	
On-site Water Quality Volume =	4433	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	887	
Total Capture Volume (required water quality volume(s) x 1.20) =	5319	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin =	NA	cubic feet	
Irrigation Area Calculations:			
Soil infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin =	NA	cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet		
Minimum filter basin area =	NA	square feet		
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet	
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet	

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!	sf at 4' of depth
Minimum filter basin area =	NA	square feet		
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet	
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet	

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin =	NA	cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus a second WQV

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands =	NA	cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (RIA_b) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales Designed as Required in RG-348 Pages 3-51 to 3-54

Design parameters for the swale:

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall intensity = I =	1.1	in/hr
Swale Slope =	0.01	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{CS} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_W = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{CS}/P_W =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{CS} R_H^{2/3} S^{0.5}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = #DIV/0! feet

Q = CIA = #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{CS} = #DIV/0! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun

15B. Alternative Method using Excel Solver

Design Q = CIA =	#DIV/0!	cfs		
Manning's Equation Q =	0.75	cfs	Error 1 =	#DIV/0!
Swale Width=	6.00	ft		

Instructions are provided to the right (green comments).

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft	
Design Discharge =	0.75	cfs	Error 2 = #DIV/0!
Design Depth =	0.33	ft	
Flow Velocity =	0.32	cfs	
Minimum Length =	97.48	ft	

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible

16. Vegetated Filter Strips Designed as Required in RG-348 Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and
the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or
across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348

17. Wet Vaults Designed as Required in RG-348 Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3 3 = NA lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CiA$

C = runoff coefficient for the drainage area = 0 13 C = Runoff Coefficient = 0 546 $(IC)^2$ + 0 328 (IC) + 0 03
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0 14 cubic feet/sec

RG-348 Page 3-31 Equation 3 5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.14 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0 5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0 75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete Designed as Required in RG-348 Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series Designed as Required in RG-348 Pages 3-32

Michael E Barrett Ph D P E recommended that the coefficient for E_2 be changed from 0 5 to 0 65 on May 3 2006

$E_{TOT} = [1 - \{(1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3)\}] \times 100 =$ 94 01 percent NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89 00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70 00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0 00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_I AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} \times P \times (A_I \times 34.6 \times A_P \times 0.54) =$ 647 53 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= NA lbs
Impervious Cover Overtreatment= 0 0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_o
Rounded Overflow Rate = #VALUE! V_o
BMP Efficiency % = #VALUE! %
L_R Value = #VALUE! lbs

TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area =	NA	lbs
Impervious Cover Overtreatment =	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Modal Size (If choosing larger model size) =	Vx1000	Pick Modal Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
La Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 5 & 6
Date Prepared: 3/10/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal							
Total project area included in plan * =	45.57	acres		Streets			236,065	5.419
Predevelopment impervious area within the limits of the plan * =	0.00	acres						
Total post-development impervious area within the limits of the plan* =	17.14	acres	Lots		SF/Lot		510,450	11.718
Total post-development impervious cover fraction * =	0.38			82	6,225			17.14
P =	33	inches						
$L_{M\ TOTAL\ PROJECT}$ =	15383	lbs.						

* The values entered in these fields should be for the total project area

Number of drainage basins / outfalls areas leaving the plan area = 9

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A 5-12

Total drainage basin/outfall area =	0.30	acres	# of Lots	SF/Lot		
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	0	6225		0.00 acres of IC
Post-development impervious area within drainage basin/outfall area =	0.20	acres		8905		0.20 acres of str
Post-development impervious fraction within drainage basin/outfall area =	0.66					0.20 Total IC (a
$L_{M\ THIS\ BASIN}$ =	183	lbs				

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = None
Removal efficiency = 0 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7 L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	0.30	acres	# of Lots	SF/Lot		
A_I =	0.20	acres	0	6225		0.00 acres of IC
A_P =	0.10	acres		8905		0.20 acres of str
L_R =	0	lbs				0.20 Total IC (a

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 0 lbs

F = #DIV/0!

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	#DIV/0!	inches
Post Development Runoff Coefficient =	0.49	
On-site Water Quality Volume =	#DIV/0!	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	#DIV/0!	cubic feet
Storage for Sediment =	#DIV/0!	
Total Capture Volume (required water quality volume(s) x 1.20) =	#DIV/0!	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP
The values for BMP Types not selected in cell C45 will show NA.

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations:

Soil Infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet			
Minimum filter basin area =	NA	square feet			
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet		
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet		

9B. Partial Sedimentation and Filtration System

			SF @ Given Depth	Given Depth	Width	
Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!		5	60
Minimum filter basin area =	NA	square feet				60
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet			60
	NA	square feet	For Given water depth			60
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet			60

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus a second WQV

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (BIA_F) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales Designed as Required in RG-348 Pages 3-51 to 3-54

Design parameters for the swale

Drainage Area to be Treated by the Swale = A =	0.00 acres
Impervious Cover in Drainage Area =	0.00 acres
Rainfall Intensity = i =	1.1 in/hr
Swale Slope =	0.01 ft/ft
Side Slope (z) =	3
Design Water Depth = y =	0.33 ft
Weighted Runoff Coefficient = C =	#DIV/0!

A_{CS} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_W = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{CS}/P_W =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{CS} R_H^{2/3} S^{0.5}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = #DIV/0! feet

Q = CIA = #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{CS} = #DIV/0! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun.

15B. Alternative Method using Excel Solver

Design Q = CIA =	#DIV/0!	cfs	
Manning's Equation Q =	0.76 cfs		Error 1 = #DIV/0!
Swale Width=	6.00 ft		

Instructions are provided to the right (green comments)

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	6 ft	
Design Discharge =	0.76 cfs	Error 2 = #DIV/0!
Design Depth =	0.33 ft	
Flow Velocity =	0.32 cfs	
Minimum Length =	97.46 ft	

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible

16. Vegetated Filter Strips Designed as Required in RG-348 Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-58 of RG-348.

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 =	NA	lbs	

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CiA$

C = runoff coefficient for the drainage area =	0.51		C = Runoff Coefficient = $0.549\ (IC)^2 + 0.328\ (IC) + 0.03$
i = design rainfall intensity =	1.1	in/hour	
A = drainage area in acres =	1	acres	
Q = flow rate in cubic feet per second =	0.56	cubic feet/sec	

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above =	0.56	cubic feet/sec
A = Water surface area in the wet vault =	150	square feet
V_{OR} = Overflow Rate =	0.00	feet/sec
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	53	percent
Load removed by Wet Vault =	#VALUE!	lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs =	0.5	in/hour
Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 =	0.75	percent
Efficiency Reduction for Actual Rainfall Intensity =	0.83	percent
Resultant TSS Load removed by Wet Vault =	#VALUE!	lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100 =$	94.01	percent	NET EFFICIENCY OF THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 =	89.00	percent	
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 =	70.00	percent	
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 =	0.00	percent	

THEREFORE, THE NET LOAD REMOVAL WOULD BE
(A_1 AND A_2 VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} \times P \times (A_1 \times 34.8 \times A_2 \times 0.54) =$ 221.03 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area=	NA	lbs	
Impervious Cover Overtreatment=	0.0000	ac	
TSS Removal for Uncaptured Area =	0.00	lbs	

BMP Sizing

Effective Area =	NA	EA	
Calculated Model Size(s) =	#N/A		
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) =	0	Model Size	
Surface Area =	#N/A	ft^2	
Overflow Rate =	#VALUE!	V_o	
Rounded Overflow Rate =	#VALUE!	V_o	
BMP Efficiency % =	#VALUE!	%	

L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size [If choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	? ft	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 5 & 6
Date Prepared: 3/10/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3. $L_M = 27.2(A_N \times P)$

where,

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data. Determine Required Load Removal Based on the Entire Project

County =	Comal						
Total project area included in plan * =	45.67	acres		Streets			
Predevelopment impervious area within the limits of the plan * =	0.00	acres				236,065	5.419
Total post-development impervious area within the limits of the plan * =	17.14	acres	Lots	SF/Lot			
Total post-development impervious cover fraction * =	0.38		82	6,225		510,450	11.716
P =	33	inches					17.14
$L_{M\ TOTAL\ PROJECT}$ =	15383	lbs					

* The values entered in these fields should be for the total project area.

Number of drainage basins / outfalls areas leaving the plan area = 9

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A 5-4A

Total drainage basin/outfall area =	0.28	acres	# of Lots	SF/Lot		
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	0	6225		0.00 acres of IC
Post-development impervious area within drainage basin/outfall area =	0.17	acres		7396		0.17 acres of str
Post-development impervious fraction within drainage basin/outfall area =	0.61					0.17 Total IC (a
$L_{M\ THIS\ BASIN}$ =	152	lbs				

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = None
Removal efficiency = 0 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7 $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	0.28	acres	# of Lots	SF/Lot		
A_I =	0.17	acres	0	6225		0.00 acres of IC
A_P =	0.11	acres		7396		0.17 acres of str
L_R =	0	lbs				0.17 Total IC (a

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 0 lbs.

F = #DIV/0!

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	#DIV/0!	inches
Post Development Runoff Coefficient =	0.42	
On-site Water Quality Volume =	#DIV/0!	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	#DIV/0!	cubic feet
Storage for Sediment =	#DIV/0!	
Total Capture Volume (required water quality volume(s) x 1.20) =	#DIV/0!	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP
The values for BMP Types not selected in cell C45 will show NA.

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations

Soil infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

			SF @ Given Depth	Given Depth	Width	
Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!		5	60
Minimum filter basin area =	NA	square feet				60
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet			60
	NA	square feet	For Given water depth			60
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet			60

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus a second WQV

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (FIA_a) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales Designed as Required in RG-348 Pages 3-51 to 3-54

Design parameters for the swale.

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall Intensity = i =	1.1	in/hr
Swale Slope =	0.01	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{CS} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_W = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{CS}/P_W =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{CS} R_H^{2/3} S^{0.5}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = #DIV/0! feet

Q = CiA = #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{CS} = #DIV/0! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun.

15B. Alternative Method using Excel Solver

Design Q = CIA =	#DIV/0!	cfs	
Manning's Equation Q =	0.76	cfs	Error 1 = #DIV/0!
Swale Width=	6.00	ft	

Instructions are provided to the right (green comments)

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft	
Design Discharge =	0.76	cfs	Error 2 = #DIV/0!
Design Depth =	0.33	ft	
Flow Velocity =	0.32	cfs	
Minimum Length =	97.48	ft	

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible

16. Vegetated Filter Strips Designed as Required in RG-348 Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348.

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = NA lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: Q = CiA

C = runoff coefficient for the drainage area = 0.43 — C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.47 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.47 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - \{(1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3)\}] \times 100$ = 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 69.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE
(A_I AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} \times P \times (A_I \times 34.6 \times A_P \times 0.54)$ = 184.08 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= NA lbs
Impervious Cover Overtreatment= 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_o
Rounded Overflow Rate = #VALUE! V_o
BMP Efficiency % = #VALUE! %

L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_R
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 5
Date Prepared: 3/10/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where: $L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data. Determine Required Load Removal Based on the Entire Project

County =	Comal							
Total project area included in plan * =	45.67	acres			Streets		111,142	2.551
Predevelopment impervious area within the limits of the plan * =	0.00	acres						
Total post-development impervious area within the limits of the plan* =	7.84	acres	Lots		SF/Lot			
Total post-development impervious cover fraction * =	0.17			37	6,225		230,325	5.288
P =	33	inches						7.84

$L_{M\ TOTAL\ PROJECT}$ = **7036** lbs

* The values entered in these fields should be for the total project area.

Number of drainage basins / outfalls areas leaving the plan area = 6

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A 5-1

Total drainage basin/outfall area =	12.56	acres	# of Lots	SF/Lot		
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	23	6225		3.29 acres of IC for lots
Post-development impervious area within drainage basin/outfall area =	5.49	acres		95920	4406	2.20 acres of street
Post-development impervious fraction within drainage basin/outfall area =	0.44					5.49 Total IC (acres)
$L_{M\ THIS\ BASIN}$ =	4927	lbs				

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where: A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	12.56	acres				
A_I =	5.49	acres	# of Lots	SF/Lot		
A_P =	7.07	acres	23	6225		3.29 acres of IC for lots
L_R =	5690	lbs		95920		2.20 acres of street

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 5441 lbs

F = 0.98

8. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	2.80	inches
Post Development Runoff Coefficient =	0.32	
On-site Water Quality Volume =	41470	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	8294	
Total Capture Volume (required water quality volume(s) x 1.20) =	49764	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP
The values for BMP Types not selected in cell C45 will show NA

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations:

Soil infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	49764	cubic feet	
Minimum filter basin area =	2304	square feet	
Maximum sedimentation basin area =	20735	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	5184	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

				SF @ Given Depth	Given Depth	Width	Length
Water Quality Volume for combined basins =	49764	cubic feet		9,114.26	5.46	90	101.27
Minimum filter basin area =	4147	square feet				90	46.07765
Maximum sedimentation basin area =	16588	square feet	For minimum water depth of 2 feet			90	184.3106
	3448	square feet	For Given water depth			90	38.31363
Minimum sedimentation basin area =	1037	square feet	For maximum water depth of 8 feet			90	11.51941

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus a second WQV

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (BIA_F) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales — Designed as Required in RG-348 — Pages 3-51 to 3-54

Design parameters for the swale

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall Intensity = i =	1.1	in/hr
Swale Slope =	0.01	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.25	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{cs} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_w = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{cs}/P_w =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{cs} R_H^{2/3} S^{1/2}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = #DIV/0! feet

Q = CIA = #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{cs} = #DIV/0! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun

15B. Alternative Method using Excel Solver

Design Q = CIA =	#DIV/0!	cfs		
Manning's Equation Q =	2.74	cfs	Error 1 =	5.82
Swale Width=	36.91	ft		

Instructions are provided to the right (green comments)

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft	
Design Discharge =	0.76	cfs	Error 2 = #DIV/0!
Design Depth =	0.33	ft	
Flow Velocity =	0.32	cfs	
Minimum Length =	97.48	ft	

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible

16. Vegetated Filter Strips — Designed as Required in RG-348 — Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips.
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 =	NA	lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CiA$

C = runoff coefficient for the drainage area =	0.28	C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$
I = design rainfall intensity =	1.1	in/hour
A = drainage area in acres =	1	acres
Q = flow rate in cubic feet per second =	0.31	cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above =	0.31	cubic feet/sec
A = Water surface area in the wet vault =	160	square feet
V_{OR} = Overflow Rate =	0.00	feet/sec
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	53	percent
Load removed by Wet Vault =	#VALUE!	lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs =	0.5	in/hour
Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 =	0.75	percent
Efficiency Reduction for Actual Rainfall Intensity =	0.83	percent
Resultant TSS Load removed by Wet Vault =	#VALUE!	lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$	94.01	percent — NET EFFICIENCY OF THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 =	89.00	percent
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 =	70.00	percent
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 =	0.00	percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE
(A_1 AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_1 X 34.8 X A_P X 0.54) =$ 6009.92 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) =	0	Model Size
Surface Area =	#N/A	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%

L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area =	NA	lbs
Impervious Cover Overtreatment =	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 5
Date Prepared: 3/10/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal							
Total project area included in plan * =	45.67	acres			Streets		121,983	2.800
Predevelopment impervious area within the limits of the plan * =	0.00	acres						
Total post-development impervious area within the limits of the plan* =	8.231	acres	Lots	38	SF/Lot 6,225		236,550	5.430
Total post-development impervious cover fraction * =	0.18							8.23
P =	33	inches						
$L_{M\ TOTAL\ PROJECT}$ =	7388	lbs						

* The values entered in these fields should be for the total project area.

Number of drainage basins / outfalls areas leaving the plan area = 9

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A 5-2

Total drainage basin/outfall area =	1.02	acres	# of Lots	SF/Lot		
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	3 5	6225		0.50 acres of IC for lots
Post-development impervious area within drainage basin/outfall area =	0.68	acres		7825 4103		0 18 acres of street
Post-development impervious fraction within drainage basin/outfall area =	0.67					0.68 Total IC (acres)
$L_{M\ THIS\ BASIN}$ =	610	lbs				

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Grassy Swale
Removal efficiency = 70 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_C x 34.6 + A_P x 0.54)

where

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	0.86	acres				
A_I =	0.47	acres	# of Lots	SF/Lot		
A_P =	0.39	acres	2	6225		0.29 acres of IC for lots
L_R =	377	lbs		7825 4		0 18 acres of street
						0.47 Total IC (acres)

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 377 lbs

F = 1.00

8. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	4.00	inches
Post Development Runoff Coefficient =	0.38	
On-site Water Quality Volume =	4762	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	952	
Total Capture Volume (required water quality volume(s) x 1.20) =	5714	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP
The values for BMP Types not selected in cell C45 will show NA

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations

Soil infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet				
Minimum filter basin area =	NA	square feet				
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet			
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet			

9B. Partial Sedimentation and Filtration System

			SF @ Given Depth	Given Depth	Width	Length
Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!		5	90 #VALUE!
Minimum filter basin area =	NA	square feet				90 #VALUE!
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet			90 #VALUE!
	NA	square feet	For Given water depth			90 #VALUE!
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet			90 #VALUE!

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus a second WQV

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (BIA_F) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales Designed as Required in RG-348 Pages 3-51 to 3-54

Design parameters for the swale

Drainage Area to be Treated by the Swale = A =	1.02	acres
Impervious Cover in Drainage Area =	#VALUE!	acres
Rainfall intensity = i =	1.1	in/hr
Swale Slope =	0.025	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.25	ft
Weighted Runoff Coefficient = C =	#VALUE!	

A_{CS} = cross-sectional area of flow in Swale =	#VALUE!	sf
P_W = Wetted Perimeter =	#VALUE!	feet
R_H = hydraulic radius of flow cross-section = A_{CS}/P_W =	#VALUE!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{CS} R_H^{2/3} S^{0.5}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = #VALUE! feet

Q = CIA = #VALUE! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{CS} = #VALUE! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #VALUE! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun.

15B. Alternative Method using Excel Solver

Design Q = CIA = #VALUE! cfs

Manning's Equation Q =	4.34	cfs	Error 1 = 5.82
Swale Width=	36.91	ft	

Instructions are provided to the right (green comments)

Flow Velocity	#VALUE!	ft/s
Minimum Length =	#VALUE!	ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft	
Design Discharge =	1.20	cfs	Error 2 = #VALUE!
Design Depth =	0.33	ft	
Flow Velocity =	0.51	cfs	
Minimum Length =	154.12	ft	

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible

16. Vegetated Filter Strips Designed as Required in RG-348 Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and
the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or
across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348.

17. Wet Vaults Designed as Required in RG-348 Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = NA lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4 $Q = CIA$

C = runoff coefficient for the drainage area = 0.49 C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.54 cubic feet/sec

RG-348 Page 3-31 Equation 3.5 $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.54 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete Designed as Required in RG-348 Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs installed in a Series Designed as Required in RG-348 Pages 3-32

Michael E. Barrett, Ph.D. P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$ 94.01 percent NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A, AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_1 X 34.6 X A_P X 0.54) =$ 506.21 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area = NA lbs
Impervious Cover Overtreatment = 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_o
Rounded Overflow Rate = #VALUE! V_o
BMP Efficiency % = #VALUE! %

L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (If choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 5
Date Prepared: 3/10/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal							
Total project area included in plan * =	45.67	acres		Streets		121,983	2.800	
Predevelopment impervious area within the limits of the plan * =	0.00	acres						
Total post-development impervious area within the limits of the plan * =	8.231	acres	Lots	SF/Lot		235,550	5.430	
Total post-development impervious cover fraction * =	0.18		38	6,225				
P =	33	inches					8.23	
$L_{M\ TOTAL\ PROJECT}$ =	7388	lbs						

* The values entered in these fields should be for the total project area

Number of drainage basins / outfalls areas leaving the plan area = 9

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A 5-3

Total drainage basin/outfall area =	0.28	acres	# of Lots	SF/Lot			
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	0.5	6225	0.07	acres of IC for lots	
Post-development impervious area within drainage basin/outfall area =	0.07	acres			-	acres of street	
Post-development impervious fraction within drainage basin/outfall area =	0.26						
$L_{M\ THIS\ BASIN}$ =	64	lbs					

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Vegetated Filter Strips
Removal efficiency = 80 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7 L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	0.28	acres					
A_I =	0.07	acres	# of Lots	SF/Lot			
A_P =	0.21	acres	0.5	6225	0.07	acres of IC for lots	
L_R =	66	lbs			0	acres of street	

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 64 lbs

F = 0.94

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	2.40	inches
Post Development Runoff Coefficient =	0.23	
On-site Water Quality Volume =	571	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	114	
Total Capture Volume (required water quality volume(s) x 1.20) =	685	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP
The values for BMP Types not selected in cell C45 will show NA

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations

Soil infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!	sf at 4' of depth
Minimum filter basin area =	NA	square feet		
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet	
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet	

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus a second WQV

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (BIA_F) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales Designed as Required in RG-348 Pages 3-51 to 3-54

Design parameters for the swale:

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall Intensity = i =	1.1	in/hr
Swale Slope =	0.01	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{CS} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_W = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{CS}/P_W =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{CS} R_H^{2/3} S^{1/2}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = #DIV/0! feet

Q = CiA = #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{CS} = #DIV/0! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun

15B. Alternative Method using Excel Solver

Design Q = CiA =	#DIV/0!	cfs		
Manning's Equation Q =	0.76	cfs	Error 1 =	#DIV/0!
Swale Width =	6.00	ft		

Instructions are provided to the right (green comments)

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft		
Design Discharge =	0.76	cfs	Error 2 =	#DIV/0!
Design Depth =	0.33	ft		
Flow Velocity =	0.32	cfs		
Minimum Length =	97.48	ft		

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible

16. Vegetated Filter Strips Designed as Required in RG-348 Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips
The 60% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and
the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or
across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348.

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3 3 = NA lbs

First calculate the load removal at 1 1 in/hour

RG-348 Page 3-30 Equation 3 4 $Q = CiA$

C = runoff coefficient for the drainage area = 0.15 — C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0 16 cubic feet/sec

RG-348 Page 3-31 Equation 3.5 $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.16 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1 1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0 5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0 75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E Barrett, Ph D P E recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2005

$E_{TOT} = [1 - \{(1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3)\}] \times 100 =$ 94 01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE
(A_1 AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} \times P \times (A_1 \times 34.6 \times A_P \times 0.54) =$ 80 19 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= NA lbs
Impervious Cover Overtreatment= 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_o
Rounded Overflow Rate = #VALUE! V_o
BMP Efficiency % = #VALUE! %
L_R Value = #VALUE! lbs

TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Unoccupied Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 5
Date Prepared: 3/10/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal							
Total project area included in plan * =	45.67	acres			Streets			
Predevelopment impervious area within the limits of the plan * =	0.00	acres					121.983	2 800
Total post-development impervious area within the limits of the plan* =	8.231	acres	Lots		SF/Lot			
Total post-development impervious cover fraction * =	0.18			38	6,225		236,550	5 430
P =	33	inches						8.23
$L_{M\ TOTAL\ PROJECT}$ =	7388	lbs						

* The values entered in these fields should be for the total project area

Number of drainage basins / outfalls areas leaving the plan area = 9

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A 5-4

Total drainage basin/outfall area =	5.24	acres	# of Lots	SF/Lot			
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	5	6225	0.71	acres of IC for lots	
Post-development impervious area within drainage basin/outfall area =	0.71	acres			-	acres of street	
Post-development impervious fraction within drainage basin/outfall area =	0.14						
$L_{M\ THIS\ BASIN}$ =	641	lbs					

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Vegetated Filter Strips
Removal efficiency = 80 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7 $L_R = (\text{BMP efficiency}) \times P \times (A \times 34.6 + A_P \times 0.54)$

where

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	5.24	acres					
A_I =	0.71	acres	# of Lots	SF/Lot			
A_P =	4.53	acres	5	6225	0.71	acres of IC for lots	
L_R =	717	lbs			0	acres of street	

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 641 lbs

F = 0.89

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	1.60	inches
Post Development Runoff Coefficient =	0.15	
On-site Water Quality Volume =	4731	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	946	
Total Capture Volume (required water quality volume(s) x 1.20) =	5677	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP
The values for BMP Types not selected in cell C45 will show NA

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-45

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations

Soil infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!	sf at 4' of depth
Minimum filter basin area =	NA	square feet		
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet	
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet	

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus a second WQV

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (FIA_s) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System = NA cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales Designed as Required in RG-348 Pages 3-51 to 3-54

Design parameters for the swale:

Drainage Area to be Treated by the Swale = A =	0.00 acres
Impervious Cover in Drainage Area =	0.00 acres
Rainfall Intensity = I =	1.1 in/hr
Swale Slope =	0.01 ft/ft
Side Slope (z) =	3
Design Water Depth = y =	0.33 ft
Weighted Runoff Coefficient = C =	#DIV/0!

A_{CS} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_w = Wetted Perimeter =	#DIV/0!	feet
R_h = hydraulic radius of flow cross-section = A_{CS}/P_w =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation. $Q = \frac{1.49}{n} A_{CS} R_h^{2/3} S^{0.5}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = #DIV/0! feet

Q = CiA = #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{CS} = #DIV/0! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun

15B. Alternative Method using Excel Solver

Design Q = CiA = #DIV/0! cfs

Manning's Equation Q = 0.76 cfs Error 1 = #DIV/0!
Swale Width= 5.00 ft

Instructions are provided to the right (green comments)

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft
Design Discharge =	0.76	cfs
Design Depth =	0.33	ft
Flow Velocity =	0.32	cfs
Minimum Length =	97.48	ft

Error 2 = #DIV/0!

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible.

16. Vegetated Filter Strips Designed as Required in RG-348 Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips.
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and
the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or
across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-58 of RG-348

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = **NA** lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: Q = CiA

C = runoff coefficient for the drainage area = 0.08 — C = Runoff Coefficient = $0.546(IC)^2 + 0.328(IC) + 0.03$
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.09 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.09 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_1 AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} \times P \times (A_1 \times 34.6 \times A_P \times 0.54) =$ 842.75 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area = NA lbs
Impervious Cover Overtreatment = 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_o
Rounded Overflow Rate = #VALUE! V_o
BMP Efficiency % = #VALUE! %
L_R Value = #VALUE! lbs

TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vodech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 5
Date Prepared: 3/10/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal							
Total project area included in plan * =	45.67	acres			Streets			
Predevelopment impervious area within the limits of the plan * =	0.00	acres					121,983	2 800
Total post-development impervious area within the limits of the plan* =	8.231	acres	Lots		SF/Lot			
Total post-development impervious cover fraction * =	0.18			38		6,225	236,550	5 430
P =	33	inches						8.23
$L_{M\ TOTAL\ PROJECT}$ =	7388	lbs						

* The values entered in these fields should be for the total project area.

Number of drainage basins / outfalls areas leaving the plan area = 9

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A 5-5

Total drainage basin/outfall area =	0.83	acres	# of Lots	SF/Lot			
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	2	6225	0.29	acres of IC for lots	
Post-development impervious area within drainage basin/outfall area =	0.29	acres			-	acres of street	
Post-development impervious fraction within drainage basin/outfall area =	0.34						
$L_{M\ THIS\ BASIN}$ =	257	lbs					

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Vegetated Filter Strips
Removal efficiency = 80 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	0.83	acres					
A_I =	0.29	acres	# of Lots	SF/Lot			
A_P =	0.54	acres	2	6225	0.29	acres of IC for lots	
L_R =	259	lbs			0	acres of street	

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 257 lbs

F = 0.98

5. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	2.80	Inches
Post Development Runoff Coefficient =	0.28	
On-site Water Quality Volume =	2364	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	473	
Total Capture Volume (required water quality volume(s) x 1.20) =	2836	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin =	NA	cubic feet	
Irrigation Area Calculations			
Soil infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin =	NA	cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet		
Minimum filter basin area =	NA	square feet		
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet	
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet	

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!	sf at 4' of depth
Minimum filter basin area =	NA	square feet		
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet	
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet	

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin =	NA	cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus a second WQV

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands =	NA	cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™.

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (RIA_F) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales — Designed as Required in RG-348 — Pages 3-51 to 3-54

Design parameters for the swale

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall intensity = I =	1.1	in/hr
Swale Slope =	0.01	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{cs} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_w = Wetted Perimeter =	#DIV/0!	feet
R_h = hydraulic radius of flow cross-section = A_{CS}/P_W =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{cs} R_h^{2/3} S^{0.5}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = #DIV/0! feet

Q = CiA = #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{CS} = #DIV/0! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun.

15B. Alternative Method using Excel Solver

Design Q = CiA =	#DIV/0!	cfs		
Manning's Equation Q =	0.76	cfs	Error 1 =	#DIV/0!
Swale Width =	6.00	ft		

Instructions are provided to the right (green comments)

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft	
Design Discharge =	0.76	cfs	Error 2 = #DIV/0!
Design Depth =	0.33	ft	
Flow Velocity =	0.32	cfs	
Minimum Length =	97.48	ft	

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun.
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible.

16. Vegetated Filter Strips — Designed as Required in RG-348 — Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and
the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or
across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = **NA** lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CiA$

C = runoff coefficient for the drainage area = 0.21 — C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.23 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.23 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 93 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - \{(1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3)\}] \times 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} \times P \times [A_I \times 34.6 \times A_P \times 0.54] =$ 315.88 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area = **NA** lbs
Impervious Cover Overtreatment = 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_o
Rounded Overflow Rate = #VALUE! V_o
BMP Efficiency % = #VALUE! %
L_R Value = #VALUE! lbs

	TSS Load Credit =	#VALUE!	lbs
	Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
	TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

11. Vortech

	Required TSS Removal in BMP Drainage Area=	NA	lbs
	Impervious Cover Overtreatment=	0.0000	ac
	TSS Removal for Uncaptured Area =	0.00	lbs
BMP Sizing			
	Effective Area =	NA	EA
	Calculated Model Size(s) =	#N/A	
	Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
	Surface Area =	7.10	ft^2
	Overflow Rate =	#VALUE!	V_w
	Rounded Overflow Rate =	#VALUE!	V_w
	BMP Efficiency % =	#VALUE!	%
	L_A Value =	#VALUE!	lbs
	TSS Load Credit =	#VALUE!	lbs
	Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
	TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 5
Date Prepared: 3/10/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, Inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal							
Total project area included in plan * =	45.67	acres		Streets		121,993	2.800	
Predevelopment impervious area within the limits of the plan * =	0.00	acres						
Total post-development impervious area within the limits of the plan* =	8.231	acres	Lots		SF/Lot			
Total post-development impervious cover fraction * =	0.18			38	6,225	236,550	5.430	
P =	33	inches					8.23	

$L_{M\ TOTAL\ PROJECT}$ = **7386** lbs.

* The values entered in these fields should be for the total project area

Number of drainage basins / outfalls areas leaving the plan area = 9

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A 5-7

Total drainage basin/outfall area =	3.96	acres	# of Lots	SF/Lot			
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	3	6225	0.43	acres of IC for lots	
Post-development impervious area within drainage basin/outfall area =	0.43	acres		0	-	acres of street	
Post-development impervious fraction within drainage basin/outfall area =	0.11						
$L_{M\ THIS\ BASIN}$ =	385	lbs					

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Vegetated Filter Strips
Removal efficiency = 80 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7 L_R = (BMP efficiency) x P x [A_C x 34.6 + A_P x 0.54)

where

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	3.96	acres				
A_I =	0.43	acres	# of Lots	SF/Lot		
A_P =	3.53	acres	3	6225	0.43	acres of IC for lots
L_R =	442	lbs		0	0.00	acres of street

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 385 lbs

F = 0.67

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	1.44	inches
Post Development Runoff Coefficient =	0.13	
On-site Water Quality Volume =	2738	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	548	
Total Capture Volume (required water quality volume(s) x 1.20) =	3285	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations:

Soil infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!	sf at 4' of depth
Minimum filter basin area =	NA	square feet		
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet	
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet	

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus a second WQV

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-76

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™.

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (RIA_F) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales — Designed as Required in RG-348 — Pages 3-51 to 3-54

Design parameters for the swale:

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall intensity = I =	1.1	in/hr
Swale Slope =	0.01	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{CS} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_W = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{CS}/P_W =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation $Q = \frac{1.49}{n} A_{CS} R_H^{2/3} S^{0.5}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = #DIV/0! feet

Q = CIA = #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{CS} = #DIV/0! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun

15B. Alternative Method using Excel Solver

Design Q = CIA = #DIV/0! cfs

Manning's Equation Q = 0.76 cfs — Error 1 = #DIV/0!
Swale Width= 6.00 ft

Instructions are provided to the right (green comments)

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft
Design Discharge =	0.76	cfs
Design Depth =	0.33	ft
Flow Velocity =	0.32	cfs
Minimum Length =	97.48	ft

Error 2 = #DIV/0!

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible

16. Vegetated Filter Strips — Designed as Required in RG-348 — Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and
the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or
across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348.

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = NA lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CiA$

C = runoff coefficient for the drainage area = 0.07 — C = Runoff Coefficient = $0.546\ (IC)^2 + 0.328\ (IC) + 0.03$
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.08 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.08 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE
(A_1 AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} \times P \times (A_1 \times 34.6 \times A_P \times 0.54) =$ 519.32 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= NA lbs
Impervious Cover Overtreatment= 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Modal Size(s) = #N/A
Actual Modal Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_o
Rounded Overflow Rate = #VALUE! V_o
BMP Efficiency % = #VALUE! %
L_R Value = #VALUE! lbs

TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_M Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 5 & 6
Date Prepared: 3/10/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal						
Total project area included in plan * =	45.67	acres		Streets		236,065	5.419
Predevelopment impervious area within the limits of the plan * =	0.00	acres					
Total post-development impervious area within the limits of the plan * =	17.14	acres	Lots	SF/Lot		510,450	11.718
Total post-development impervious cover fraction * =	0.38		82	6,225			17.14
P =	33	inches					
$L_{M\ TOTAL\ PROJECT}$ =	15383	lbs					

* The values entered in these fields should be for the total project area

Number of drainage basins / outfalls areas leaving the plan area = 9

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A S-4A

Total drainage basin/outfall area =	0.28	acres	# of Lots	SF/Lot		
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	0	6225		0.00 acres of IC
Post-development impervious area within drainage basin/outfall area =	0.17	acres		7396		0.17 acres of str
Post-development impervious fraction within drainage basin/outfall area =	0.61					0.17 Total IC (a
$L_{M\ THIS\ BASIN}$ =	152	lbs				

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = None
Removal efficiency = 0 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	0.28	acres	# of Lots	SF/Lot		
A_I =	0.17	acres	0	6225		0.00 acres of IC
A_P =	0.11	acres		7396		0.17 acres of str
L_R =	0	lbs				0.17 Total IC (a

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 0 lbs

F = #DIV/0!

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	#DIV/0!	inches
Post Development Runoff Coefficient =	0.42	
On-site Water Quality Volume =	#DIV/0!	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	#DIV/0!	cubic feet
Storage for Sediment =	#DIV/0!	
Total Capture Volume (required water quality volume(s) x 1.20) =	#DIV/0!	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin =	NA	cubic feet	
Irrigation Area Calculations:			
Soil infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin =	NA	cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet			
Minimum filter basin area =	NA	square feet			
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet		
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet		

9B. Partial Sedimentation and Filtration System

			SF @ Given Depth	Given Depth	Width
Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!	5	60
Minimum filter basin area =	NA	square feet			60
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet		60
	NA	square feet	For Given water depth		60
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet		60

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin =	NA	cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus a second WQV

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands =	NA	cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™.

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (RIA_F) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales Designed as Required in RG-348 Pages 3-51 to 3-54

Design parameters for the swale:

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall Intensity = I =	1.1	in/hr
Swale Slope =	0.01	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{CS} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_W = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{CS}/P_W =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{CS} R_H^{2/3} S^{1/2}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = #DIV/0! feet

Q = CIA = #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{CS} = #DIV/0! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun.

15B. Alternative Method using Excel Solver

Design Q = CiA = #DIV/0! cfs

Manning's Equation Q =	0.76 cfs	Error 1 =	#DIV/0!
Swale Width=	6.00 ft		

Instructions are provided to the right (green comments).

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	6 ft		
Design Discharge =	0.76 cfs	Error 2 =	#DIV/0!
Design Depth =	0.33 ft		
Flow Velocity =	0.32 cfs		
Minimum Length =	97.48 ft		

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun.
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible.

16. Vegetated Filter Strips Designed as Required in RG-348 Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and
the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or
across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348

17. Wet Vaults Designed as Required in RG-348 Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = NA lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: Q = CiA

C = runoff coefficient for the drainage area = 0.43 C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.47 cubic feet/sec

RG-348 Page 3-31 Equation 3.5 $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.47 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete Designed as Required in RG-348 Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series Designed as Required in RG-348 Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$ 94.01 percent NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_I X 34.6 X A_P X 0.54) =$ 164.09 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= NA lbs
Impervious Cover Overtreatment= 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_o
Rounded Overflow Rate = #VALUE! V_o
BMP Efficiency % = #VALUE! %

L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs
BMP Sizing		
Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Manor Creek 6 Permanent BMP Summary Table									
Subbasin Data	Area Treated	Treatment Method	Total Area (acres)	Acreage Treated	Impervious Area (acres)	Imp %	L_R (lbs)	L_M (lbs)	Desired L_M (lbs)
A 6-1	DA 6.5 & DA 6.6	Sand Filter	15.59	15.07	6.695	42.9%	6936	6009	6323
A 6-2	DA 6.13	Vegetated Filter Strips	1.56	1.56	0.572	36.6%	536	513	513
A 6-3	DA 6.11	Vegetated Filter Strips	1.68	1.68	0.572	34.0%	538	513	513
A 6-4	DA 6.10	Vegetated Filter Strips	1.91	1.91	0.857	44.9%	798	770	770
A 6-5	DA 6.9	Vegetated Filter Strips	2.24	2.24	0.857	38.3%	803	770	770
A 6-6	DA 6.7	Vegetated Filter Strips	1.55	1.55	0.572	36.9%	536	513	513
A 6-8	DA 6.8	Untreated Release	0.22	0.22	0.15	66.2%	-	131	-
A 6-12	DA 6.12	Untreated Release	0.30	0.30	0.20	67.9%	-	183	-
Total			**25.05**	**24.53**	**10.47**	**46.0%**	**10147**	**9401**	**9402**

Required TSS Removal 9401

11/1/16

Chris Van Heeroe, PE

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 6
Date Prepared: 6/1/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal based on the Entire Project

County =	Comal							
Total project area included in plan * =	40.55	acres			Streets			
Predevelopment impervious area within the limits of the plan * =	0.00	acres					135,756	3.185
Total post-development impervious area within the limits of the plan * =	10.47	acres	Lots		SF/Lot			
Total post-development impervious cover fraction * =	0.26			51	6,225		311,475	7.283
P =	33	inches						10.47
$L_{M\ TOTAL\ PROJECT}$ =	8491	lbs						

* The values entered in these fields should be for the total project area.

Number of drainage basins / outfalls areas leaving the plan area = 6

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A 6-1

Total drainage basin/outfall area =	13.59	acres	# of Lots	SF/Lot		
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	27	6225		3.86 acres of IC for lots
Post-development impervious area within drainage basin/outfall area =	5.69	acres		123536.85		2.84 acres of street
Post-development impervious fraction within drainage basin/outfall area =	0.43					6.69 Total IC (acres)
$L_{M\ THIS\ BASIN}$ =	3009	lbs				

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_I x 34.8 + A_P x 0.54)

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	13.07	acres				
A_I =	8.59	acres	# of Lots	SF/Lot		
A_P =	5.36	acres	27	6225		3.86 acres of IC for lots
L_R =	8935	lbs		123536.85		2.84 acres of street

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{in\ this\ basin}$ = 6321 lbs.

F = 0.91

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	1.80	inches
Post Development Runoff Coefficient =	0.33	
On-site Water Quality Volume =	32339	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	6468	
Total Capture Volume (required water quality volume(s) x 1.20) =	**38807**	**cubic feet**

The following sections are used to calculate the required water quality volume(s) for the selected BMP
The values for BMP Types not selected in cell C45 will show NA

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations:

Soil Infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	38807	cubic feet	
Minimum filter basin area =	1797	square feet	
Maximum sedimentation basin area =	16170	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	4042	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

			SF @ Given Depth	Given Depth	Width	Length
Water Quality Volume for combined basins =	38807	cubic feet	7,761.35	5	90	86.24
Minimum filter basin area =	3234	square feet			90	35.93232
Maximum sedimentation basin area =	12936	square feet	For minimum water depth of 2 feet		90	143.7293
	3234	square feet	For Given water depth		90	35.93232
Minimum sedimentation basin area =	808	square feet	For maximum water depth of 8 feet		90	8.983308

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus a second WQV.

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-76

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (FIA_C) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassed Swales — Designed as Required in RG-348 — Pages 3-51 to 3-54

Design parameters for the swale:

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall Intensity = I =	1.1	in/hr
Swale Slope =	0.005	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{CS} = cross-sectional area of flow in Swale =	#DIV/0!	sf	
P_W = Wetted Perimeter =	#DIV/0!	feet	
R_H = hydraulic radius of flow cross-section = A_{CS}/P_W =	#DIV/0!	feet	
n = Manning's roughness coefficient =	0.2		

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{CS} R_H^{2/3} S^{1/2}$

$$b = \frac{0.134 \times Q}{y^{5/3} S^{1/2}} - zy = \text{#DIV/0!} \text{ feet}$$

Q = CIA = #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{CS} = #DIV/0! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348 the design parameters must be modified and the solver rerun.

15B. Alternative Method using Excel Solver

Design Q = CIA =	#DIV/0!	cfs	
Manning's Equation Q =	8.92	cfs	Error 1 = 5.89
Swale Width =	36.91	ft	

Instructions are provided to the right (green comments)

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	5	ft	
Design Discharge =	1.30	cfs	Error 2 = #DIV/0!
Design Depth =	0.33	ft	
Flow Velocity =	0.51	cfs	
Minimum Length =	594.12	ft	

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver return
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible

16. Vegetated Filter Strips — Designed as Required in RG-348 — Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and
the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or
across 50 feet of natural vegetation with a maximum slope of 15%. There can be a break in grade as long as no slope exceeds 20%

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348.

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = NA lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-33 Equation 3.4: $Q = CIA$

C = runoff coefficient for the drainage area = 0.27 — C = Runoff Coefficient = $0.546\ (IC)^2 + 0.328\ (IC) + 0.00$
I = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.30 cubic feet/sec

RG-348 Page 3-31 Equation 3.3: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.30 cubic feet/sec
A = Water surface area in the wet vault = 159 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2005

$E_{TOT} = [1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100 =$ 94.61 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE
(A_1 AND A_2 VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} \times P \times (A_1 \times 34.6 \times A_2 \times 0.54) =$ 7323.83 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= NA lbs
Impervious Cover Overtreatment= 0.0000 ac
TSS Removal for Unrestored Area = 0.00 lbs

BMP Sizing

Effective Area = NA SA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_o
Rounded Overflow Rate = #VALUE! V_o
BMP Efficiency % = #VALUE! %

L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM = TSS Uncapt.) =	#VALUE!	

23. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (If choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM = TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 6
Date Prepared: 6/1/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-28 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data. Determine Required Load Removal Based on the Entire Project

County =	Comal						
Total project area included in plan * =	40.55	acres		Streets		138,758	3.19
Predevelopment impervious area within the limits of the plan * =	0.00	acres					
Total post-development impervious area within the limits of the plan * =	10.47	acres	Lots	SF/Lot			
Total post-development impervious cover fraction * =	0.26		51	6,225	317,475	7.29	
P =	30	inches					10.47

$L_{M\ TOTAL\ PROJECT}$ = 5491 lbs.

* The values entered in these fields should be for the total project area

Number of drainage basins / outfalls areas leaving the plan area = 6

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A 6-2

Total drainage basin/outfall area =	1.56	acres	# of Lots	SF/Lot		
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	4	6225	0.57	acres of IC for lots
Post-development impervious area within drainage basin/outfall area =	0.57	acres		0	0.00	acres of street
Post-development impervious fraction within drainage basin/outfall area =	0.37				0.57	Total IC (acres)
$L_{M\ THIS\ BASIN}$ =	513	lbs				

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Vegetated Filter Strips
Removal efficiency = 80 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	1.56	acres				
A_I =	0.57	acres	# of Lots	SF/Lot		
A_P =	0.99	acres	4	6225	0.57	acres of IC for lots
L_R =	536	lbs		0	0.00	acres of street
					0.57	Total IC (acres)

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired L_{annual} = $13 lbs.

F = 0.98

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	2.80	inches
Post Development Runoff Coefficient =	0.29	
On-site Water Quality Volume =	4911	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	922	
Total Capture Volume (required water quality volume(s) x 1.20) =	6833	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-44

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations.

Soil infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-48 to 3-61

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

			SF @ Given Depth	Given Depth	Width	Length	
Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!		5	90	#VALUE!
Minimum filter basin area =	NA	square feet				90	#VALUE!
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet			90	#VALUE!
	NA	square feet	For Given water depth			90	#VALUE!
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet			90	#VALUE!

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus a second WQV

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-79

** 2006 Technical Guidance Manual (RG-348) does not exceed the required 20% increase with maintenance contract with AquaLogic™

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (RIA_C) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System = NA cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales Designed as Required in RG-348 Pages 3-51 to 3-54

Design parameters for the swale:

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall Intensity = I =	1.1	in/hr
Swale Slope =	0.025	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.25	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{cs} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_w = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{cs}/P_w =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation, $Q = \frac{1.49}{n} A_{cs} R_H^{2/3} S^{0.5}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = #DIV/0! feet

Q = CIA = #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{CS} = #DIV/0! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun.

15B. Alternative Method using Excel Solver

Design Q = CIA = #DIV/0! cfs

Manning's Equation Q = 4.34 cfs Error 1 = 5.82
Swale Width = 36.91 ft

Instructions are provided to the right (green comments)

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft
Design Discharge =	1.20	cfs
Design Depth =	0.33	ft
Flow Velocity =	0.51	cfs
Minimum Length =	154.12	ft

Error 2 = #DIV/0!

If any of the resulting values do not meet the design requirement set forth in RG-348 the design parameters may be modified and the solver rerun
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible

16. Vegetated Filter Strips Designed as Required in RG-348 Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips.
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and
the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or
across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = NA lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $C = CiA$

C = runoff coefficient for the drainage area = 0.22 — C = Runoff Coefficient = $0.546 (IC)^2 + 0.326 (IC) + 0.03$
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.25 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.25 cubic feet/sec
A = Water surface area in the wet vault = 1500 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.78 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE.

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 80.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_1 AND A_2 VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} \times P \times (A_1 \times 34.6 \times A_2 \times 0.54) =$ 639.11 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= NA lbs
Impervious Cover Overtreatment= 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_{or}
Rounded Overflow Rate = #VALUE! V_{or}
BMP Efficiency % = #VALUE! %

L_a Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	V-1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_a Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 6
Date Prepared: 6/1/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where: $L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal							
Total project area included in plan * =	40.55	acres		Streets				
Predevelopment impervious area within the limits of the plan * =	0.00	acres				136,735	3.14	
Total post-development impervious area within the limits of the plan* =	10.47	acres	Lots	SF/Lot				
Total post-development impervious cover fraction * =	0.26		51	6,225	317,475	7.29		
P =	35	inches				10.47		
$L_{M\ TOTAL\ PROJECT}$ =	3401	lbs						

* The values entered in these fields should be for the total project area

Number of drainage basins / outfalls areas leaving the plan area = 6

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A-6-5

Total drainage basin/outfall area =	1.66	acres	# of Lots	SF/Lot			
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	4	6225	0.57	acres of IC for lots	
Post-development impervious area within drainage basin/outfall area =	0.57	acres		0	-	acres of street	
Post-development impervious fraction within drainage basin/outfall area =	0.34						
$L_{M\ THIS\ BASIN}$ =	513	lbs					

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Vegetated Filter Strips
Removal efficiency = 60 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A x 34.6 + A_P x 0.54)

where: A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	1.66	acres				
A_I =	0.57	acres	# of Lots	SF/Lot		
A_P =	1.11	acres	4	6225	0.57	acres of IC for lots
L_R =	538	lbs		0	0	acres of street

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired L for this basin = 513 lbs

F = 0.55

8. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-35

Rainfall Depth =	2.60	inches
Post Development Runoff Coefficient =	0.28	
On-site Water Quality Volume =	4411	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	882	
Total Capture Volume (required water quality volume(s) x 1.20) =	5293	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP
The values for BMP Types not selected in cell C45 will show NA

1. Retention/Irrigation System — Designed as Required in RG-348 — Pages 3-42 to 3-45

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations

Soil infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

6. Extended Detention Basin System — Designed as Required in RG-348 — Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters — Designed as Required in RG-348 — Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation base =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!	sf at 4' of depth
Minimum filter basin area =	NA	square feet		
Maximum sedimentation basin area =	NA	square feet	For maximum water depth of 2 feet	
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet	

10. Bioretention System — Designed as Required in RG-348 — Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins — Designed as Required in RG-348 — Pages 3-66 to 3-71

Required capacity at Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus a second WQV

12. Constructed Wetlands — Designed as Required in RG-348 — Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System — Designed as Required in RG-348 — Pages 3-74 to 3-78

** 2005 Technical Guidance Manual (RG 348) does not exempt the required 20% increase with maintenance contract with AquaLogic™

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (PCs) to treat WQV =	NA	cartridges
Filter basin area [FBA_w] =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE METHODOLOGIES FOR THE FOLLOWING BMPs (LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales — Designed as Required in RG-348 — Pages 3-51 to 3-54

Design parameters for the swale:

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall Intensity = I =	1.1	in/hr
Swale Slope =	0.01	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{cs} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_w = Wetted Perimeter =	#DIV/0!	feet
R_h = hydraulic radius of flow cross-section = A_{cs}/P_w =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{cs} R_h^{2/3} S^{1/2}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = #DIV/0! feet

Q = CIA = #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{cs} = #DIV/0! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun

15B. Alternative Method using Excel Solver

Design Q = CIA = #DIV/0! cfs

Manning's Equation Q = 0.78 cfs — Error 1 = #DIV/0!
Swale Width= 6.00 ft

Instructions are provided to the right (green comments)

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft
Design Discharge =	0.75	cfs
Design Depth =	0.33	ft
Flow Velocity =	0.32	cfs
Minimum Length =	97.48	ft

Error 2 = #DIV/0!

If any of the resulting values do not meet the design requirement set forth in RG-348 the design parameters may be modified and the solver rerun
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible

16. Vegetated Filter Strips — Designed as Required in RG-348 — Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips
The 60% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and
the sheet flow leaving the impervious cover is directed across 13 feet of engineered filter strips with maximum slope of 20% or
across 50 feet of natural vegetation with a maximum slope of 15%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-55 of RG-348.

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = NA lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CiA$

C = runoff coefficient for the drainage area = 0.20 — C = Runoff Coefficient = $0.546 (IC)^2 + 0.323 (IC) + 0.03$
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.23 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.23 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.63 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2005

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 88.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 75.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE
(A_1 AND A_T VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_1 X 34.6 X A_T X 0.54) =$ 632.12 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= NA lbs
Impervious Cover Overtreatment = 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_o
Rounded Overflow Rate = #VALUE! V_o
BMP Efficiency % = #VALUE! %
L_R Value = #VALUE! lbs

TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs	
Impervious Cover Overtreatment=	0.0000	ac	
TSS Removal for Uncaptured Area =	0.00	lbs	
BMP Sizing			
Effective Area =	NA	EA	
Calculated Model Size(s) =	#N/A		
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size	
Surface Area =	7.10	ft^2	
Overflow Rate =	#VALUE!	V_o	
Rounded Overflow Rate =	#VALUE!	V_o	
BMP Efficiency % =	#VALUE!	%	
L_R Value =	#VALUE!	lbs	
TSS Load Credit =	#VALUE!	lbs	
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!		
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!		

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 6
Date Prepared: 8/1/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-28 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data. Determine Required Load Removal Based on the Entire Project

County =	Comal						
Total project area included in plan * =	40.56	acres		Streets			
Predevelopment impervious area within the limits of the plan * =	0.00	acres			136,758	3.19	
Total post-development impervious area within the limits of the plan * =	19.47	acres	Lots	SFA.ot			
Total post-development impervious cover fraction * =	0.29		51	6,225	317,475	7.29	
P =	33	inches				10.47	
$L_{M\ TOTAL\ PROJECT}$ =	9481	lbs.					

* The values entered in these fields should be for the total project area

Number of drainage basins / outfalls areas leaving the plan area = 6

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A B-4

Total drainage basin/outfall area =	1.91	acres	# of Lots	SF/Lot		
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	6	6225	0.86	acres of IC for lots
Post-development impervious area within drainage basin/outfall area =	0.86	acres		0	-	acres of street
Post-development impervious fraction within drainage basin/outfall area =	0.45					
$L_{M\ THIS\ BASIN}$ =	778	lbs				

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Vegetated Filter Strips
Removal efficiency = 80 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_C x 34.6 + A_P x 0.54)

where

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	1.91	acres				
A_I =	0.86	acres	# of Lots	SFA.ot		
A_P =	1.05	acres	6	6225	0.86	acres of IC for lots
L_R =	788	lbs		0	0	acres of street

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{0\ net\ basin}$ = 710 lbs

F = 0.96

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth = 2.60 inches
Post Development Runoff Coefficient = 0.33
On-site Water Quality Volume = 6421 cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP = 0.00 acres
Off-site impervious cover draining to BMP = 0.00 acres
Impervious fraction of off-site area = 0
Off-site Runoff Coefficient = 0.00
Off-site Water Quality Volume = 0 cubic feet

Storage for Sediment = 1284
Total Capture Volume (required water quality volume(s) x 1.20) = 7705 cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP
The values for BMP Types not selected in cell C45 will show NA

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations

Soil infiltration/permeability rate = 0.1 in/hr Enter determined permeability rate or assumed value of 0.1
Irrigation area = NA square feet
NA acres

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-56 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin = NA cubic feet

Minimum filter basin area = NA square feet

Maximum sedimentation basin area = NA square feet For minimum water depth of 2 feet
Minimum sedimentation basin area = NA square feet For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins = NA cubic feet #VALUE! sf at 4' of depth

Minimum filter basin area = NA square feet

Maximum sedimentation basin area = NA square feet For minimum water depth of 2 feet
Minimum sedimentation basin area = NA square feet For maximum water depth of 8 feet

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool = NA cubic feet Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation = NA cubic feet Total Capacity should be the Permanent Pool Capacity plus a second WQV

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AqueLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

** 2003 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AqueLogic™

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area ($FilA_R$) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales — Designed as Required in RG-348 — Pages 3-51 to 3-54

Design parameters for the swale

Drainage Area to be Treated by the Swale = A =	0.60	acres
Impervious Cover in Drainage Area =	0.60	acres
Rainfall Intensity = I =	1.1	in/hr
Swale Slope =	0.01	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{CS} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_W = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{CS}/P_W =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{CS} R_H^{2/3} S^{1/2}$

$b = \frac{0.124 \times Q}{y^{1.67} S^{0.5}} - zy$ = #DIV/0! feet

Q = CIA = #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{CS} = #DIV/0! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun

15B. Alternative Method using Excel Solver

Design Q = CIA = #DIV/0! cfs

Manning's Equation Q = 0.76 cfs — Error 1 = #DIV/0!
Swale Width = 5.60 ft

Instructions are provided to the right (green comments)

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft
Design Discharge =	0.76	cfs — Error 2 = #DIV/0!
Design Depth =	0.33	ft
Flow Velocity =	0.32	cfs
Minimum Length =	97.48	ft

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible

16. Vegetated Filter Strips — Designed as Required in RG-348 — Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips.
The 60% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or across 30 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-58 of RG-348

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-72

Required Load Removal Based upon Equation 3.3 = NA lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4 $Q = CIA$

C = runoff coefficient for the drainage area = 0.29 — C = Runoff Coefficient = $0.044\,(IC)^2 + 0.329\,(IC) + 0.03$
I = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.32 cubic feet/sec

RG-348 Page 3-31 Equation 3.5 $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.32 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.63 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett Ph.D. P.E. recommended that the coefficient for E_1 be changed from 0.9 to 0.85 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 85.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 75.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE
(A_1 AND A_2 VALUES ARE FROM SECTION 9 ABOVE)

$L_R = E_{TOT} \times P \times (A_1 \times 34.6 \times A_2 \times 0.54) =$ 937.95 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area= NA lbs
Impervious Cover Overcustment= 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_o
Rounded Overflow Rate = #VALUE! V_o
BMP Efficiency % = #VALUE! %
L_R Value = #VALUE! lbs

TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

#1. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_M Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 6
Date Prepared: 6/1/2013

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where: $L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal						
Total project area included in plan * =	48.55	acres		Streets			
Predevelopment impervious area within the limits of the plan * =	0.00	acres			138,758	3.19	
Total post-development impervious area within the limits of the plan* =	16.47	acres	Lots	SFA.ot			
Total post-development impervious cover fraction * =	0.26		51	6,225	317,475	7.29	
P =	33	inches				10.47	
$L_{M\ TOTAL\ PROJECT}$ =	8401	lbs					

* The values entered in these fields should be for the total project area

Number of drainage basins / outfalls areas leaving the plan area = 6

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A 6-5

Total drainage basin/outfall area =	2.24	acres	# of Lots	SFA.ot		
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	6	6225	0.86	acres of IC for lots
Post-development impervious area within drainage basin/outfall area =	0.86	acres		0	-	acres of street
Post-development impervious fraction within drainage basin/outfall area =	0.38					
$L_{M\ THIS\ AREA}$ =	770	lbs				

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Vegetated Filter Strips
Removal efficiency = 60 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-29 Equation 3.7: L_R = (BMP efficiency) x P x (A_P x 34.8 + A_P x 0.54)

where: A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	2.24	acres			
A_I =	0.86	acres	# of Lots	SFA.ot	
A_P =	1.38	acres	6	6225	0.86 acres of IC for lots
L_R =	503	lbs		0	0 acres of street

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{w\,(this\ basin)}$ = 770 lbs

F = 0.95

5. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth = 2.80 inches
Post Development Runoff Coefficient = 0.33
On-site Water Quality Volume = 3795 cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP = 0.00 acres
Off-site impervious cover draining to BMP = 0.00 acres
Impervious fraction of off-site area = 0
Off-site Runoff Coefficient = 0.00
Off-site Water Quality Volume = 0 cubic feet

Storage for Sediment = 1360

Total Capture Volume (required water quality volume(s) x 1.20) = 5155 cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP
The values for BMP Types not selected in cell C45 will show NA

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-45

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations

Soil Infiltration/permeability rate = 0.1 in/hr Enter determined permeability rate or assumed value of 0.1
Irrigation area = NA square feet
NA acres

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin = NA cubic feet

Minimum filter basin area = NA square feet

Maximum sedimentation basin area = NA square feet For minimum water depth of 2 feet
Minimum sedimentation basin area = NA square feet For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins = NA cubic feet #VALUE! sf at 4' of depth

Minimum filter basin area = NA square feet

Maximum sedimentation basin area = NA square feet For minimum water depth of 2 feet
Minimum sedimentation basin area = NA square feet For maximum water depth of 8 feet

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-65 to 3-71

Required capacity of Permanent Pool = NA cubic feet Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation = NA cubic feet Total Capacity should be the Permanent Pool Capacity plus a second WQV

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-76

** 2006 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (BA_F) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales — Designed as Required in RG-348 — Pages 3-51 to 3-54

Design parameters for the swale

Drainage Area to be Treated by the Swale = A =	0.60	acres
Impervious Cover in Drainage Area =	0.09	acres
Rainfall Intensity = i =	1.1	in/hr
Swale Slope =	0.01	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{CS} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_W = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{CS}/P_W =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{CS} R_H^{2/3} S^{0.5}$

$b = \frac{0.134 \times Q}{y^{5/3} S^{0.5}} - zy$ = #DIV/0! feet

Q = CiA = #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{CS} = #DIV/0! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun.

15B. Alternative Method using Excel Solver

Design Q = CiA = #DIV/0! cfs

Manning's Equation Q = 0.75 cfs — Error 1 = #DIV/0!
Swale Width = 6.00 ft

Instructions are provided to the right (green comments)

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	6 ft	
Design Discharge =	0.75 cfs	Error 2 = #DIV/0
Design Depth =	0.33 ft	
Flow Velocity =	0.32 cfs	
Minimum Length =	97.48 ft	

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun.
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible.

16. Vegetated Filter Strips — Designed as Required in RG-348 — Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips.
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and
the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or
across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = NA lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CiA$

C = runoff coefficient for the drainage area = 0.24 — C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.26 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.26 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 33 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_3 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 89.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 75.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE
(A_1 AND A_2 VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_1 X 34.6 X A_2 X 0.54) =$ 943.49 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area = NA lbs
Impervious Cover Overtreatment = 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (If multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_{or}
Rounded Overflow Rate = #VALUE! V_{or}
BMP Efficiency % = #VALUE! %
L_R Value = #VALUE! lbs

TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overestimate=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_o Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 6
Date Prepared: 6/1/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3 $L_M = 27.2(A_N \times P)$

where $L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal						
Total project area included in plan * =	40.55	acres		Streets			
Predevelopment impervious area within the limits of the plan * =	0.00	acres				138,758	3.19
Total post-development impervious area within the limits of the plan * =	10.47	acres	Lots	SF/Lot			
Total post-development impervious cover fraction * =	0.26		61	6,225		317,475	7.29
P =	33	inches					10.47

$L_{M\ TOTAL\ PROJECT}$ = 9401 lbs.

* The values entered in these fields should be for the total project area

Number of drainage basins / outfalls areas leaving the plan area = 6

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A 6-6

Total drainage basin/outfall area =	1.55	acres	# of Lots	SF/Lot		
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	4	6225	0.57	acres of IC
Post-development impervious area within drainage basin/outfall area =	0.57	acres		0	0.00	acres of str
Post-development impervious fraction within drainage basin/outfall area =	0.37				0.57	Total IC (a
$L_{M\ THIS\ BASIN}$ =	813	lbs				

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Vegetated Filter Strips
Removal efficiency = 80 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
StormceptorVegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7 L_R = (BMP efficiency) x P x (A_C x 34.6 + A_P x 0.54)

where A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	1.55	acres	# of Lots	SF/Lot		
A_I =	0.57	acres	4	6225	0.57	acres of IC
A_P =	0.98	acres		0	0.00	acres of str
L_R =	539	lbs		0	0.57	Total IC (a

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired [illegible] = 513 lbs.

F = 0.95

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-35

Rainfall Depth =	2.80	inches
Post Development Runoff Coefficient =	0.29	
On-site Water Quality Volume =	4599	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	920	
Total Capture Volume (required water quality volume(s) x 1.20) =	5519	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP
The values for BMP Types not selected in cell C45 will show NA

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations:

Soil infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

			SF @ Given Depth	Given Depth	Width
Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!	5	60
Minimum filter basin area =	NA	square feet			60
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet		60
	NA	square feet	For Given water depth		60
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet		60

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus the WQV.

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (BIA_F) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System = NA cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales — Designed as Required in RG-348 — Pages 3-51 to 3-54

Design parameters for the swale

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall Intensity = I =	1.1	in/hr
Swale Slope =	0.01	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{CS} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_W = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{CS}/P_W =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation: $Q = \frac{1.49}{n} A_{CS} R_H^{2/3} S^{0.5}$

$b = \frac{0.134 \times Q}{y^{5/3} S^{0.5}} - zy$ = #DIV/0! feet

Q = CiA = #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{CS} = #DIV/0! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun.

15B. Alternative Method using Excel Solver

Design Q = CiA = #DIV/0! cfs

Manning's Equation Q = 0.78 cfs — Error 1 = #DIV/0!
Swale Width = 6.00 ft

Instructions are provided to the right (green comments)

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft
Design Discharge =	0.78	cfs — Error 2 = #DIV/0!
Design Depth =	0.33	ft
Flow Velocity =	0.32	cfs
Minimum Length =	97.48	ft

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible

16. Vegetated Filter Strips — Designed as Required in RG-348 — Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips
The 90% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and
the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or
across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = NA lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CIA$

C = runoff coefficient for the drainage area = 0.23 — C = Runoff Coefficient = (0.549 (SO)^2 + 0.329 (SO) + 0.03
I = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.25 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.25 cubic feet/sec
A = Water surface area in the wet vault = 100 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.6 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-78 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_1 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 80.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE
(A_1 AND A_2 VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_1 X 34.8 X A_2 X 0.54) =$ 926.94 lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area = NA lbs
Impervious Cover Overnessments = 0.0000 ac
TSS Removal for Undeducted Area = 0.00 lbs

BMP Sizing

Effective Area = NA SA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_{OR}
Rounded Overflow Rate = #VALUE! V_{OR}
BMP Efficiency % = #VALUE! %

L_a Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area=	NA	lbs
Impervious Cover Overage/acre=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	SA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_x
Rounded Overflow Rate =	#VALUE!	V_x
BMP Efficiency % =	#VALUE!	%
L_a Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 6
Date Prepared: 6/1/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where: $L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal						
Total project area included in plan * =	40.55	acres		Streets			
Predevelopment impervious area within the limits of the plan * =	0.00	acres			138,750		3.185
Total post-development impervious area within the limits of the plan* =	10.47	acres	Lots	SFA,cr			
Total post-development impervious cover fraction * =	0.26		51	6,225	317,475		7.288
P =	33	inches					10.47

$L_{M\ TOTAL\ PROJECT}$ = 9491 lbs.

* The values entered in these fields should be for the total project area

Number of drainage basins / outfalls areas leaving the plan area = 6

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A 6-12

Total drainage basin/outfall area =	0.22	acres	# of Lots	SF/Lot		
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	0	6225		0.00 acres of IC for lots
Post-development impervious area within drainage basin/outfall area =	0.15	acres		6344.5158		0.15 acres of street
Post-development impervious fraction within drainage basin/outfall area =	0.68					0.15 Total IC (acres)
$L_{M\ THIS\ BASIN}$ =	131	lbs				

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = None
Removal efficiency = 0 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A x 34.6 + A_P x 0.54)

where: A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	0.22	acres			
A_I =	0.15	acres	# of Lots	SF/Lot	
A_P =	0.07	acres	0	6225	0.00 acres of IC for lots
L_R =	0	lbs		6344.5158	0.15 acres of street

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 0 lbs.

F = #DIV/0!

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	#DIV/0!	inches
Post Development Runoff Coefficient =	0.47	
On-site Water Quality Volume =	#DIV/0!	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	#DIV/0!	cubic feet
Storage for Sediment =	#DIV/0!	
Total Capture Volume (required water quality volume(s) x 1.20) =	#DIV/0!	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP
The values for BMP Types not selected in cell C45 will show NA

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations:

Soil infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-56 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

			SF @ Given Depth	Given Depth	Width	Length
Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!	5	90	#VALUE!
Minimum filter basin area =	NA	square feet			90	#VALUE!
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet		90	#VALUE!
	NA	square feet	For Given water depth		90	#VALUE!
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet		90	#VALUE!

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus a second WQV

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-76

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (BIA_R) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE NEXT REQUIREMENTS FOR THE FOLLOWING TYPES (FLOW REMOVAL) ARE BASED UPON FLOW RATES - NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales — Designed as Required in RG-348 — Pages 3-51 to 3-54

Design parameters for the swale:

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall Intensity = i =	1.3	in/hr
Swale Slope =	0.025	ft/ft
Side Slope [z] =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{cs} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_w = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{cs}/P_w =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation $Q = \frac{1.49}{n} A_{cs} R_H^{2/3} S^{1/2}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.5}} - zy$ = #DIV/0! feet

Q = CiA = #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{cs} = #DIV/0! ft/sec

To calculate the resulting swale length

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun.

15B. Alternative Method using Excel Solver

Design Q = CiA = #DIV/0! cfs

Manning's Equation Q =	6.90 cfs	Error 1 =	5.62
Swale Width =	35.91 ft		

Instructions are provided to the right (green comments)

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	6 ft		
Design Discharge =	1.20 cfs	Error 2 =	#DIV/0!
Design Depth =	0.33 ft		
Flow Velocity =	0.51 cfs		
Minimum Length =	154.12 ft		

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible

16. Vegetated Filter Strips — Designed as Required in RG-348 — Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips.
The 50% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and
the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 30% or
across 50 feet of natural vegetation with a maximum slope of 15%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = NA lbs

First calculate the load removed at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CiA$

C = runoff coefficient for the drainage area = 0.49 — C = Runoff Coefficient = $0.545\,(ID)^3 + 0.328\,(ID)^2 + 0.60$
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.54 cubic feet/sec

RG-348 Page 3-91 Equation 3.6: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.54 cubic feet/sec
A = Water surface area in the wet vault = 100 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 [RG-348 Page 3-31] = 52 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-81

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. has determined that the coefficient for E_2 be changed from 0.5 to 0.65 on May 1, 2005

$E_{TOT} = [1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100 =$ 84.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 80.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_1 AND A_2 VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} \times P \times [A_1 \times 34.8 \times A_2 \times 0.54] =$ 157.58 lbs

20. Stormceptor:

Required TSS Removal in BMP Drainage Area= NA lbs
Impervious Cover Overmeasurement= 0.0000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_o
Rounded Overflow Rate = #VALUE! V_o
BMP Efficiency % = #VALUE! %

L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area =	NA	lbs
Impervious Cover Overtreatment =	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: Manor Creek Unit 6
Date Prepared: 6/1/2015

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where: $L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Comal						
Total project area included in plan * =	40.55	acres		Streets			
Predevelopment impervious area within the limits of the plan * =	0.00	acres			[illegible]		3.185
Total post-development impervious area within the limits of the plan * =	10.47	acres	Lots	SFA.ol			
Total post-development impervious cover fraction * =	0.26		51	6,225	[illegible]		7.288
P =	33	inches					10.47

$L_{M\ TOTAL\ PROJECT}$ = 9481 lbs

* The values entered in these fields should be for the total project area

Number of drainage basins / outfalls areas leaving the plan area = 6

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = A 6-12

Total drainage basin/outfall area =	0.30	acres	# of Lots	SFA.ol	
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres	0	6225	0.00 acres of IC for lots
Post-development impervious area within drainage basin/outfall area =	0.20	acres		8875.7696	0.20 acres of street
Post-development impervious fraction within drainage basin/outfall area =	0.68				0.20 Total IC (acres)
$L_{M\ THIS\ BASIN}$ =	183	lbs			

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = None
Removal efficiency = 0 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_C \times 34.6 + A_P \times 0.54)$

where: A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	0.30	acres				
A_I =	0.20	acres	# of Lots	SFA.ol		
A_P =	0.10	acres	0	6225	0.00 acres of IC for lots	
L_R =	0	lbs		8875.7696	0.20 acres of street	

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{TOTAL\ BASIN}$ = 0 lbs.

F = #DIV/0!

5. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348 Pages 3-34 to 3-36

Rainfall Depth =	#DIV/0!	inches
Post Development Runoff Coefficient =	0.49	
On-site Water Quality Volume =	#DIV/0!	cubic feet

Calculations from RG-348 Pages 3-26 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	#DIV/0!	cubic feet
Storage for Sediment =	#DIV/0!	
Total Capture Volume (required water quality volume(s) x 1.20) =	#DIV/0!	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell D43 will show NA.

7. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-49

Required Water Quality Volume for retention basin = NA cubic feet

Irrigation Area Calculations

Soil infiltration/permeability rate =	0.1	in/hr	Enter determined permeability rate or assumed value of 0.1
Irrigation area =	NA	square feet	
	NA	acres	

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = NA cubic feet

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 3 feet
Maximum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

			SF @ Given Depth	Given Depth	Width	Length
Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!		5	90 #VALUE!
Minimum filter basin area =	NA	square feet				90 #VALUE!
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 3 feet			90 #VALUE!
	NA	square feet	For Given water depth			90 #VALUE!
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet			90 #VALUE!

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = NA cubic feet

11. Wet Basins Designed as Required in RG-348 Pages 3-66 to 3-71

Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool Capacity plus a second WQV

12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73

Required Water Quality Volume for Constructed Wetlands = NA cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG-348 Pages 3-74 to 3-78

** 2008 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic™

Required Sedimentation chamber capacity =	NA	cubic feet
Filter canisters (FCs) to treat WQV =	NA	cartridges
Filter basin area (BA) =	NA	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System =	NA	cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FLOW RATES , NOT CALCULATED WATER QUALITY VOLUMES

15. Grassy Swales — Designed as Required in RG-348 — Pages 3-51 to 3-54

Design parameters for the swale.

Drainage Area to be Treated by the Swale = A =	0.00	acres
Impervious Cover in Drainage Area =	0.00	acres
Rainfall intensity = i =	1.1	in/hr
Swale Slope =	0.025	ft/ft
Side Slope (z) =	3	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	#DIV/0!	

A_{cs} = cross-sectional area of flow in Swale =	#DIV/0!	sf
P_w = Wetted Perimeter =	#DIV/0!	feet
R_H = hydraulic radius of flow cross-section = A_{cs}/P_w =	#DIV/0!	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation. $Q = \frac{1.49}{n} A_{cs} R_H^{2/3} S^{1/2}$

$b = \frac{0.134 \times Q}{y^{1.67} S^{0.3}} - zy$ = #DIV/0! feet

Q = CIA = #DIV/0! cfs

To calculate the flow velocity in the swale

V (Velocity of Flow in the swale) = Q/A_{cs} = #DIV/0! ft/sec

To calculate the resulting swale length.

L = Minimum Swale Length = V (ft/sec) * 300 (sec) = #DIV/0! feet

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters must be modified and the solver rerun.

15B. Alternative Method using Excel Solver

Design Q = CIA = #DIV/0! cfs

Manning's Equation Q = 6.93 cfs — Error 1 = 5.93
Swale Width= 38.91 ft

Instructions are provided to the right (green comments)

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =	6	ft	
Design Discharge =	1.20	cfs	Error 2 = #DIV/0!
Design Depth =	0.33	ft	
Flow Velocity =	0.51	cfs	
Minimum Length =	154.12	ft	

If any of the resulting values do not meet the design requirement set forth in RG-348, the design parameters may be modified and the solver rerun.
If any of the resulting values still do not meet the design requirement set forth in RG-348, widening the swale bottom value may not be possible.

16. Vegetated Filter Strips — Designed as Required in RG-348 — Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips
The 60% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and
the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or
across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348.

17. Wet Vaults — Designed as Required in RG-348 — Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = NA lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: $Q = CiA$

C = runoff coefficient for the drainage area = 0.50 — C = Runoff Coefficient = $0.645\ (IC)^3 + 0.335\ (IC) + 0.03$
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.55 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$

Q = Runoff rate calculated above = 0.55 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 80 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.91 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete — Designed as Required in RG-348 — Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series — Designed as Required in RG-348 — Pages 3-32

Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 1, 2005

$E_{TOT} = [1 - (1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3)] \times 100 =$ 94.01 percent — NET EFFICIENCY OF THE BMPs IN THE SERIES

EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 = 80.00 percent

EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 = 70.00 percent

EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 = 0.00 percent

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_1 AND A_2 VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} \times P \times (A_1 \times 34.6 \times A_2 \times 0.54) =$ 220.32 lbs

20. Stormceptor

Required TSS Removal = BMP Drainage Area = NA lbs
Impervious Cover Overtreatment = 0.000 ac
TSS Removal for Uncaptured Area = 0.00 lbs

BMP Sizing

Effective Area = NA EA
Calculated Model Size(s) = #N/A
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) = 0 Model Size

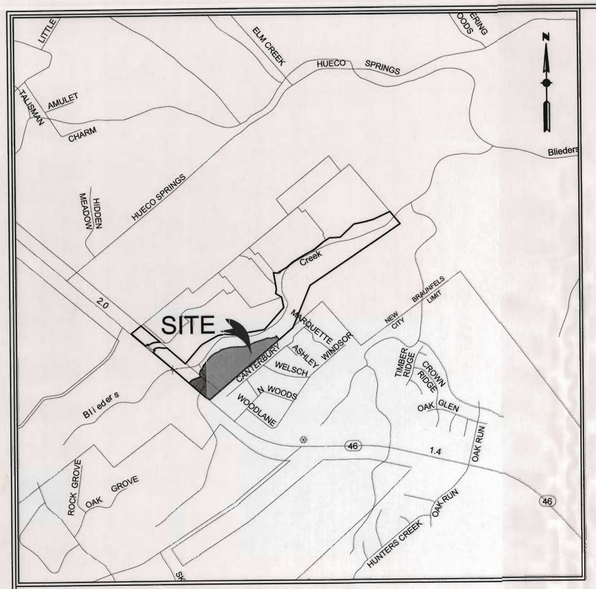
Surface Area = #N/A ft^2
Overflow Rate = #VALUE! V_{or}
Rounded Overflow Rate = #VALUE! V_{or}
BMP Efficiency % = #VALUE! %

L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

21. Vortech

Required TSS Removal in BMP Drainage Area =	NA	lbs
Impervious Cover Overtreatment =	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs
BMP Sizing		
Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
Surface Area =	7.10	ft^2
Overflow Rate =	#VALUE!	V_o
Rounded Overflow Rate =	#VALUE!	V_o
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

MANOR CREEK SUBDIVISION
UNIT 4
NEW BRAUNFELS, TEXAS 78132
CIVIL SITE CONSTRUCTION PLANS
PROJECT # 031.023.106



PROJECT LOCATION MAP SCALE: N.T.S.

PROJECT BENCHMARK

SITE TBM #1
SET "LL" UN MULLER ON TOP OF FIRE HYDRANT
N: 13814868.51
E: 2228186.56
ELEV: 816.88

SITE TBM #2
SET MAG NAIL IN CONCRETE WALL
N: 13814312.27
E: 2227983.35
ELEV: 827.13

DATUM: NAVD 88
MONUMENT: AY1565 (ADJUSTED BY NATIONAL GEODETIC SURVEY 1991)

LEGAL DESCRIPTION

BEING A 95.11 ACRE TRACT OF LAND OUT OF THE S.A. & M.G.R.R. CO. SURVEY NO. 280, ABSTRACT NO. 591, AND THE CHRISTIAN PAPE SURVEY NO. 831, ABSTRACT NO. 777, COMAL COUNTY, TEXAS, AND BEING PORTION OF A 252.038 ACRE TRACT RECORDED IN DOCUMENT NO. 200506047873, OFFICIAL PUBLIC RECORDS, COMAL COUNTY, TEXAS.

PLEASE NOTE: NBU REQUIRES GPS POINTS FOR CERTAIN ELECTRIC, WATER AND WASTEWATER ATTRIBUTES, SOME OF WHICH MUST BE TAKEN PRIOR TO BACKFILL DURING CONSTRUCTION.

GPS POINTS SHALL BE REQUIRED FROM THE DEVELOPER'S CONTRACTOR OR ENGINEER. A MINIMUM OF THREE COORDINATE POINTS FOR GEOREFERENCING SHALL BE REQUIRED. THE WATER AND WASTEWATER GPS POINTS SHALL BE TO SURVEY GRADE. THE ELECTRIC GPS POINTS SHALL BE TO MAP GRADE.

WATER
VERTICAL BENDS AND EDGE OF STEEL CASING (IF APPLICABLE) PRIOR TO BACKFILL
HORIZONTAL BENDS PRIOR TO BACKFILL
TEES PRIOR TO BACKFILL
FITTINGS (REDUCERS AND COUPLINGS) PRIOR TO BACKFILL
FIRE HYDRANTS (TOP OF FLANGE)
VALVES
METERS (TOP CENTER OF BOX)
BLOW OFF ASSEMBLY
CORNER SLAB OF WATER TANK & GATE VALVE ON WATER TANK

WASTEWATER
MANHOLES
CLEANOUTS
CORNER SLAB OF LIFT STATION

ELECTRIC
POLES
TRANSFORMERS, BOTH ABOVE AND UNDERGROUND (FRONT LOCK)
PULL BOXES
STREET LIGHTS

COORDINATE GPS REQUIREMENTS WITH NBU INSPECTOR

GENERAL NOTES:

1. IF CONSTRUCTION HAS NOT COMMENCED WITHIN ONE-YEAR OF CITY APPROVAL FOR CONSTRUCTION INSPECTION, THAT APPROVAL IS NO LONGER VALID.
2. THE MOST CURRENT EDITIONS OF THE CITY OF NEW BRAUNFELS STANDARD SPECIFICATIONS AND THE TEXAS DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR CONSTRUCTION OF HIGHWAYS, STREETS AND BRIDGES SHALL BE FOLLOWED FOR ALL CONSTRUCTION EXCEPT AS AMENDED BY THE CITY OF NEW BRAUNFELS STANDARD DETAILS.
3. ALL RESPONSIBILITY FOR THE ADEQUACY OF THESE PLANS REMAINS WITH THE ENGINEER OF RECORD. IN ACCEPTING THESE PLANS, THE CITY OF NEW BRAUNFELS MUST RELY UPON THE ADEQUACY OF THE WORK OF THE ENGINEER IN RECORD.
4. PRIOR TO THE START OF CONSTRUCTION THE CONTRACTOR SHALL CONTACT THE CITY OF NEW BRAUNFELS TO SET A PRECONSTRUCTION MEETING. A 48-HOUR ADVANCED NOTIFICATION IS REQUIRED FOR ALL INSPECTION REQUESTS.
   - 4.1 ALL INSPECTIONS ARE TO BE CALLED IN AT 830-221-4068 OR,
   - 4.2 FAXED IN AT 830-608-2117 OR,
   - 4.3 E-MAILED AT INSPECTIONS@NBTEXAS.ORG.
5. IT IS THE CONTRACTOR'S RESPONSIBILITY TO SEE THAT ALL TEMPORARY AND PERMANENT TRAFFIC CONTROL DEVICES ARE PROPERLY INSTALLED AND MAINTAINED IN ACCORDANCE WITH THE PLANS AND LATEST EDITION OF THE TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES. IF THE NEED ARISES, ADDITIONAL TEMPORARY TRAFFIC CONTROL DEVICES MAY BE ORDERED BY THE ENGINEERING REPRESENTATIVE AT THE CONTRACTOR'S EXPENSE.
6. DRAINAGE IMPROVEMENTS SUFFICIENT TO MITIGATE OFFSITE IMPACT OF CONSTRUCTION MUST BE COMPLETED AND IN PLACE PRIOR TO ADDING IMPERVIOUS COVER TO THE SITE.
7. THIS DEVELOPMENT IS A TYPE 3 DEVELOPMENT.
8. A PORTION OF THE SUBDIVISION IS LOCATED IN THE SPECIAL FLOOD HAZARD AREA (100 YR. FLOOD), AS DEFINED BY THE COMAL COUNTY, TEXAS FLOOD INSURANCE RATE MAP NUMBER 48091C0435F, EFFECTIVE DATE SEPTEMBER 2, 2009, AS PREPARED BY THE FEDERAL EMERGENCY MANAGEMENT AGENCY. NO RESIDENTIAL LOT IS LOCATED WITHIN THE 100 YR FEMA FLOOD PLAIN.
9. THIS PROJECT IS LOCATED WITHIN THE EDWARDS AQUIFER RECHARGE ZONE.

NOVEMBER 2016

STATE OF TEXAS
CHRISTOPHER P. VAN HEERDE
93047
LICENSED
PROFESSIONAL ENGINEER
11/1/16

ALL RESPONSIBILITY FOR THE ADEQUACY OF THESE PLANS REMAINS WITH THE ENGINEER OF RECORD. IN ACCEPTING THESE PLANS, THE CITY OF NEW BRAUNFELS MUST RELY UPON THE ADEQUACY OF THE WORK OF THE ENGINEER OF RECORD.

Christopher P. Van Heerde
P.E. Registration No. 93047

PREPARED BY:

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ENGINEERING & SURVEYING

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TBPLS FIRM 10153600

DR HORTON
210 W. HUTCHISON STREET
SAN MARCOS, TEXAS 78666

Sheet List Table	
NO	TITLE
1	COVER SHEET
2	CONSTRUCTION NOTES
3	TCEQ GENERAL NOTES
4	TxDOT GENERAL NOTES
5	SUBDIVISION PLAT SHEET 1
6	SUBDIVISION PLAT SHEET 2
7	SUBDIVISION PLAT SHEET 3
8	SUBDIVISION PLAT SHEET 4
9	SUBDIVISION PLAT SHEET 5
10	EXISTING DRAINAGE AREA MAP
11	PROPOSED DRAINAGE AREA MAP
12	PROPOSED SIDEWALK BOX DRAINAGE AREA MAP
13	WATER QUALITY TREATMENT
14	SAND FILTER BASIN A4-1
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16	WATER QUALITY TREATMENT DETAILS (1 OF 2)
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25	SIGEL AVE PLAN & PROFILE (2 OF 2)
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35	SIDEWALK DETAILS (1 OF 5)
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38	SIDEWALK DETAILS (4 OF 5)
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40	TxDOT SIGN DETAILS (1 OF 2)
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42	HAMBURG AVE TRAFFIC CONTROL PLAN
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44	TxDOT BARRICADE & CONSTRUCTION DETAILS (2 OF 6)
45	TxDOT BARRICADE & CONSTRUCTION DETAILS (3 OF 6)
46	TxDOT BARRICADE & CONSTRUCTION DETAILS (4 OF 6)
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48	TxDOT BARRICADE & CONSTRUCTION DETAILS (6 OF 6)
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50	CULVERT 'B' PLAN & PROFILE
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57	WATER DETAILS
58	OVERALL WASTEWATER PLAN
59	WASTEWATER LINE 'A' & LINE 'B' PLAN & PROFILE
60	WASTEWATER LINE 'C' PLAN & PROFILE
61	WASTEWATER LINE 'D' PLAN & PROFILE
62	WASTEWATER LINE 'E' PLAN & PROFILE
63	WASTEWATER DETAIL (1 OF 2)
64	WASTEWATER DETAIL (2 OF 2)

NOTE TO CONTRACTOR:

BY THE ACT OF SUBMITTING A BID FOR THIS PROPOSED CONTRACT, THE BIDDER WARRANTS THAT THE BIDDER, AND ALL SUBCONTRACTORS AND MATERIAL SUPPLIERS HE INTENDS TO USE HAVE CAREFULLY AND THOROUGHLY REVIEWED THE DRAWINGS, SPECIFICATIONS AND ALL OTHER CONTRACT DOCUMENTS AND HAVE FOUND THEM COMPLETE AND FREE FROM ANY AMBIGUITIES AND SUFFICIENT FOR THE PURPOSE INTENDED. THE BIDDER FURTHER WARRANTS THAT TO THE BEST OF HIS OR HIS SUBCONTRACTORS' AND MATERIAL SUPPLIERS' KNOWLEDGE, ALL MATERIALS AND PRODUCTS SPECIFIED OR INDICATED HEREIN ARE ACCEPTABLE FOR ALL APPLICABLE CODES AND AUTHORITIES.

THE LOCATION OF ALL EXISTING UTILITIES SHOWN ON THESE PLANS HAS BEEN BASED UPON RECORD INFORMATION ONLY AND MAY NOT MATCH LOCATIONS AND/OR DEPTHS AS CONSTRUCTED. THE CONTRACTOR SHALL CONTACT EACH OF THE INDIVIDUAL UTILITIES FOR ASSISTANCE IN DETERMINING EXISTING UTILITY LOCATIONS AND DEPTHS PRIOR TO BEGINNING ANY CONSTRUCTION. CONTRACTOR SHALL FIELD VERIFY LOCATIONS OF ALL UTILITY CROSSINGS PRIOR TO BEGINNING ANY CONSTRUCTION.

THIS SUBDIVISION WILL INCLUDE NATURAL GAS INFRASTRUCTURE. CONTRACTOR SHALL COORDINATE AND ENSURE ALL STREET CROSSINGS ARE IN PLACE PRIOR TO STREET CONSTRUCTION. ALL CROSSINGS ARE TO BE INSTALLED BY CENTER POINT PRIOR TO STREET CONSTRUCTION. NATURAL GAS INFRASTRUCTURE LAYOUT SHALL BE INCLUDED WITH AS BUILT PACKAGE.

MANOR CREEK, UNIT 4
CIVIL SITE CONSTRUCTION PLANS

PROJECT NO. 031.023.106

Drawing Name: N:_Projects\031 - DR Horton\031.023 - Manor Creek Unit 4\031.023.106 - Construction Documents\031.023.106-COVR-NOTES.dwg User: cathymm Nov 22, 2016 - 10:56am

GENERAL NOTES:

ALL MATERIALS AND CONSTRUCTION PROCEDURES WITHIN THE SCOPE OF THIS CONTRACT SHALL COMPLY WITH:

A. CURRENT CITY OF NEW BRAUNFELS CONSTRUCTION SPECIFICATIONS AND STANDARDS AS OF THE DATE OF THIS CONTRACT

B. THE MOST CURRENT EDITION OF TEXAS DEPARTMENT OF TRANSPORTATION "STANDARD SPECIFICATIONS FOR CONSTRUCTION OF HIGHWAYS, STREETS, AND BRIDGES".

ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE MOST CURRENT TEXAS DEPARTMENT OF TRANSPORTATION "STANDARD SPECIFICATIONS FOR CONSTRUCTION OF HIGHWAYS, STREETS, AND BRIDGES." ALONG WITH CURRENT CITY OF NEW BRAUNFELS AND COMAL COUNTY SPECIFICATIONS. ANY DISCREPANCIES BETWEEN SPECIFICATIONS SHALL BE RESOLVED BY THE ENGINEER PRIOR TO PROCEEDING WITH CONSTRUCTION.

CONTRACTOR SHALL PROCURE ALL PERMITS AND LICENSES, PAY ALL CHARGES, FEES, AND TAXES AND GIVE ALL NOTICES NECESSARY AND INCIDENTAL TO THE DUE AND LAWFUL PROSECUTION OF THE WORK.

ANY EXISTING OFF-SITE IMPROVEMENTS THAT ARE DAMAGED OR UNDERCUT BY THE CONTRACTOR'S OPERATIONS SHALL BE REPAIRED OR REPLACED AS DIRECTED BY THE ENGINEER AND APPROVED BY THE OWNER OF THE EXISTING IMPROVEMENT AT THE CONTRACTOR'S EXPENSE. (NO SEPARATE PAY ITEM)

WORK COMPLETED BY THE CONTRACTOR WHICH HAS NOT RECEIVED A WORK ORDER OR CONSENT OF THE OWNER OR ENGINEER WILL BE SUBJECT TO REMOVAL AND REPLACEMENT BY AND AT THE EXPENSE OF THE CONTRACTOR.

CONTRACTOR IS RESPONSIBLE FOR REMOVAL OF ALL WASTE MATERIALS UPON PROJECT COMPLETION. THE CONTRACTOR SHALL NOT PLACE ANY WASTE MATERIAL IN THE 100YR FLOOD PLAIN WITHOUT FIRST OBTAINING AN APPROVED FLOOD PLAIN DEVELOPMENT PERMIT.

BARRICADES AND WARNING SIGNS SHALL CONFORM TO THE "TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" AND SHALL BE LOCATED TO PROVIDE MAXIMUM PROTECTION TO THE PUBLIC AS WELL AS CONSTRUCTION PERSONNEL AND EQUIPMENT WHILE PROVIDING CONTINUOUS TRAFFIC FLOW AT ALL TIMES DURING CONSTRUCTION. THE CONTRACTOR IS RESPONSIBLE FOR MAINTAINING ALL DEVICES DURING CONSTRUCTION.

CONTRACTOR IS REQUIRED TO VERIFY PROJECT ELEVATIONS. THE TERM "MATCH EXISTING" SHALL BE UNDERSTOOD TO SIGNIFY BOTH HORIZONTAL AND VERTICAL ALIGNMENT.

WHEN MATCHING EXISTING PAVEMENTS, CURBS, DRIVES, AND WALKS, THEY SHALL BE SAW CUT FULL DEPTH AND REMOVED TO ALLOW FOR PROPOSED CONSTRUCTION. IF ANY EXISTING JOINT IS ENCOUNTERED, PRECAUTION SHALL BE TAKEN DURING REMOVAL OF CONCRETE SO AS NOT TO DAMAGE EXISTING DOWELS. ALL EXISTING DOWELS SHALL BE EXPOSED AND CLEANED.

ITEM OF WORK DESIGNATED "BY OTHERS" SHALL NOT BE CONSIDERED PART OF THIS CONTRACT.

ALL "COMPACTED SUBGRADE" SHALL CONSIST OF NATIVE MATERIAL SCARIFIED TO A MINIMUM DEPTH OF SIX INCHES AND COMPACTED TO 95% DENSITY ACCORDING TO DENSITY TEST METHOD TEX-115E OR ACCORDING TO ASTM D-698 AND TESTED BY ASTM D-2922.

ALL "FLEXIBLE BASE" SHALL BE TYPE "A", GRADE 4, ACCORDING TO TXDOT ITEM 247, COMPACTED TO 95% MODIFIED DENSITY AT A MOISTURE CONTENT BETWEEN -2 AND +3 OF OPTIMUM PERCENT MOISTURE ACCORDING TO ASTM D-1557 (MODIFIED PROCTOR) AND TESTED BY ASTM D-2922.

ASPHALT PAVEMENT SHALL BE THE TYPE SPECIFIED ON THE PLANS AND ACCORDING TO TXDOT ITEM 340 "HOT MIX ASPHALT CONCRETE PAVEMENT".

PRIME COAT USING MC-30 AT A RATE OF 0.2 GALLONS PER SQUARE YARD SHALL BE PLACED OVER PREPARED BASE AT LEAST ONE DAY PRIOR TO LAYING ASPHALTIC CONCRETE PAVEMENT. ANY NECESSARY TACK COAT SHALL BE MC-30 AT 0.05 GALLONS PER SQUARE YARD. IT IS REQUIRED THAT BOTH THE PRIME COAT AND THE TACK COAT BE APPLIED AT THE TEMPERATURE SPECIFIED UNDER TXDOT ITEM 300.3.

CONCRETE SHALL BE CLASS "A" ACCORDING TO TXDOT ITEM 421 UNLESS OTHERWISE ON PLANS.

REINFORCING STEEL SHALL BE FROM NEW BILLET AND SHALL CONFORM TO TXDOT ITEM 440. ALL DIMENSIONS RELATING TO REINFORCING STEEL ARE TO CENTER OF BARS EXCEPT WHEN REFERRING TO CLEARANCE.

ALL SAWED JOINTS SHALL BE SAWED WITHIN 24 HOURS OF POURING,

ABSOLUTELY NO WELDING OF REINFORCING BARS OR TORCHING TO BEND REINFORCING BARS SHALL BE ALLOWED WITHOUT THE SPECIFIC APPROVAL OF THE ENGINEER.

ORDINARY COMPACTION CONTROL IS REQUIRED ON THIS PROJECT.

ALL ROLLING FOR COMPACTION OF ASPHALTIC CONCRETE PAVEMENT SHALL BE COMPLETED BEFORE THE MIXTURE TEMPERATURE DROPS BELOW 175 DEG. (F).

ALL FILL MATERIAL SHALL BE SUBJECT TO THE ENGINEER'S APPROVAL.

CONTRACTOR AGREES TO ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE CONSTRUCTION OF THE PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY; THAT THIS REQUIREMENT SHALL APPLY CONTINUOUSLY AND SHALL NOT BE LIMITED TO THE NORMAL WORKING HOURS; AND THAT THE CONTRACTOR SHALL DEFEND, INDEMNIFY AND HOLD THE OWNERS AND THE ENGINEER AND HIS EMPLOYEES, PARTNERS, OFFICES, DIRECTORS, OR CONSULTANTS, HARMLESS FROM ANY AND ALL LIABILITY, REAL OR ALLEGED, IN CONNECTION WITH THE PERFORMANCE OF THE WORK ON THIS PROJECT, EXCEPTING FROM LIABILITY ARISING FROM SOLE NEGLIGENCE OF THE OWNER OR ENGINEER, ENGINEER'S DIRECTORS, OFFICERS, EMPLOYEES, OR CONSULTANTS.

ALL CMP (CORRUGATED METAL PIPE) USED ON THIS PROJECT SHALL HAVE A MANNING'S "N" VALUE OF 0.024., UNLESS OTHERWISE SHOWN ON PLANS.

CONTRACTOR WILL BE RESPONSIBLE FOR ALL CONSTRUCTION TESTING PER CURRENT CITY OF NEW BRAUNFELS REQUIREMENTS. ALL TEST RESULTS SHALL BE SUBMITTED TO THE ENGINEER FOR REVIEW AND APPROVAL. ENGINEER AND OWNER RESERVE THE RIGHT TO HAVE THE CONTRACTOR REMOVE AND REPLACE ANY MATERIAL THAT WAS NOT TESTED OR FAILED TESTING. ALL COST ASSOCIATED WITH THE REMOVAL, REPLACEMENT AND TESTING SHALL BE PAID BY THE CONTRACTOR.

ALL PVC SLEEVES SHALL BE INSTALLED 3 FEET BELOW FINISHED GRADE AND ENDS SHALL BE MARKED SO THAT LOCATIONS OF SLEEVES CAN BE EASILY IDENTIFIED.

PRE-CONSTRUCTION CONFERENCE IS REQUIRED, ENGINEER WILL ARRANGE SUCH CONFERENCE IN COORDINATION WITH CITY OF NEW BRAUNFELS STREET INSPECTOR & NEW BRAUNFELS UTILITIES INSPECTOR. NO CONSTRUCTION MAY BEGIN PRIOR TO THE PRE-CONSTRUCTION CONFERENCE.

CONTRACTOR SHALL COORDINATE WITH DRY UTILITY INSTALLERS AND SHARED TRENCHING SHALL BE UTILIZED. CUTTING THE STREETS AFTER COMPLETION BY DRY UTILITIES SHALL NOT BE ACCEPTABLE.

AS PER PLATTING ORDINANCE SECTION 118-38M.: WHEN ALL IMPROVEMENTS ARE FOUND TO BE CONSTRUCTED AND COMPLETED IN ACCORDANCE WITH THE APPROVED PLANS AND SPECIFICATIONS AND WITH THE CITY'S STANDARDS, AND UPON RECEIPT OF ONE SET OF "RECORD DRAWINGS" PLANS, AND A DIGITAL COPY OF ALL PLANS (AUTOCAD 2000 MINIMUM) THE CITY ENGINEER SHALL ACCEPT SUCH IMPROVEMENTS FOR THE CITY OF NEW BRAUNFELS, SUBJECT TO THE GUARANTY OF MATERIAL AND WORKMANSHIP PROVISIONS IN THIS SECTION.

EROSION / SEDIMENTATION CONTROL:

AT A MINIMUM, THESE CONTROLS SHALL CONSIST OF ROCK BERMS AND/OR SILT FENCES CONSTRUCTED PARALLEL TO AND DOWN GRADIENT FROM THE TRENCHES. THE ROCK BERMS OR SILT FENCES SHALL BE INSTALLED IN A MANNER SUCH THAT ANY RAINFALL RUNOFF SHALL BE FILTERED. HAY BALES SHALL NOT BE USED FOR TEMPORARY EROSION AND SEDIMENTATION CONTROLS.

ALL TEMPORARY EROSION AND SEDIMENTATION CONTROLS MUST BE INSTALLED PRIOR TO CONSTRUCTION AND SHALL BE MAINTAINED DURING CONSTRUCTION BY THE CONTRACTOR. THE CONTRACTOR SHALL REMOVE THE CONTROLS WHEN VEGETATION IS ESTABLISHED AND THE CONSTRUCTION AREA IS STABILIZED (31 TAC 313.5 (C)(12)). ADDITIONAL PROTECTION MAY BE REQUIRED IF EXCESSIVE SOLIDS ARE BEING DISCHARGED FROM THE SITE.

ALL TEMPORARY EROSION AND SEDIMENTATION CONTROLS SHALL BE REMOVED BY THE CONTRACTOR AT FINAL ACCEPTANCE OF THE PROJECT BY THE OWNER/ENGINEER.

PLACEMENT OF TEMPORARY EROSION AND SEDIMENTATION CONTROLS SHALL BE IN ACCORDANCE WITH THE CONSTRUCTION PLANS. ACTUAL LOCATIONS MAY VARY SLIGHTLY FROM THE PLANS, BUT WILL BE VERIFIED BY THE ENGINEER/INSPECTOR IN THE FIELD PRIOR TO CONSTRUCTION. THE CONTRACTOR SHALL INSPECT THE CONTROLS AT WEEKLY INTERVALS AND AFTER EVERY SIGNIFICANT RAINFALL TO INSURE DISTURBANCE OF THE STRUCTURES HAS NOT OCCURRED. SEDIMENT DEPOSITED AFTER A RAINFALL SHALL BE REMOVED FROM THE SITE OR PLACED IN AN ENGINEER APPROVED DESIGNATED DISPOSAL AREA.

CONTRACTOR SHALL BE RESPONSIBLE TO INSURE THAT NO EROSION CONTROL MEASURES BLOCK THE DRAINAGE SYSTEM FROM WORKING AS DESIGNED.

UTILITIES

LOCATION AND DEPTH OF EXISTING UTILITIES SHOWN HERE ARE APPROXIMATE ONLY. ACTUAL LOCATIONS AND DEPTHS MUST BE VERIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROTECTION OF ALL EXISTING UTILITIES ENCOUNTERED DURING CONSTRUCTION, INCLUDING THOSE NOT SHOWN ON THE DRAWINGS.

ANY EXISTING UTILITIES, ON OR OFF THE SITE, THAT ARE DAMAGED OR UNDERCUT BY THE CONTRACTOR'S OPERATIONS SHALL BE REPAIRED OR REPLACED AS DIRECTED BY THE ENGINEER AND APPROVED BY THE RESPECTIVE UTILITY COMPANY AT THE CONTRACTOR'S EXPENSE.

CONTRACTOR SHALL NOTIFY APPROPRIATE UTILITY COMPANIES AND GOVERNMENTAL AGENCIES AT LEAST 48 HOURS PRIOR TO CONSTRUCTION AT:

THE CONTRACTOR SHALL NOTIFY THE FOLLOWING UTILITY COMPANIES 48 HOURS PRIOR TO EXCAVATION

NEW BRAUNFELS UTILITIES (WATER AND SEWER)	(830) 608-8971
NEW BRAUNFELS UTILITIES (ELECTRIC)	(830) 608-8951
TIME WARNER CABLE	(830) 625-3408
CENTERPOINT ENERGY (GAS)	(830) 643-6434
AT&T	(830) 303-1333
TEXAS ONE CALL SYSTEM	(800) 245-4545
ENERGY TRANSFER (PETROLEUM PIPELINE)	(210) 262-2486

DUE TO FEDERAL REGULATIONS TITLE 49, PART 192(8), GAS COMPANIES MUST MAINTAIN ACCESS TO GAS VALVES AT ALL TIMES. THE CONTRACTOR MUST PROTECT THE WORK AROUND ANY GAS VALVES THAT ARE IN THE PROJECT AREA.

CONTRACTOR SHALL REFERENCE NEW BRAUNFELS UTILITIES PLANS FOR FINAL ELECTRICAL LINE DESIGNS AND LAYOUT.

SEWER NOTES

1. THE CONTRACTOR SHALL MAINTAIN SERVICE TO EXISTING SANITARY SEWERS AT ALL TIMES DURING CONSTRUCTION.
2. A MINIMUM OF 8" WASTEWATER PIPE AND FITTINGS (PVC SDR-26, ASTM D-3034, D-3212, F-477) ARE REQUIRED ON ALL NEW INSTALLATION.
3. ALL RESIDENTIAL WASTEWATER SERVICE LATERALS SHALL BE EXTENDED TO THE PROPERTY LINE AND A CLEANOUT SHALL BE INSTALLED AT THE PROPERTY LINE. SERVICES TO LOTS WILL EXTEND SEVEN (7) FEET PAST THE UNDERGROUND ELECTRIC CONDUIT IF ELECTRIC IS INSTALLED IN THE FRONT EASEMENT.
4. PIPE BEDDING OF WASTEWATER LINES SHALL BE MANUFACTURED SAND OR PEA GRAVEL AS PER NBU SPECIFICATIONS.
5. SECONDARY BACKFILL OF SEWER LINES SHALL GENERALLY CONSIST OF MATERIALS REMOVED FROM THE TRENCH AND SHALL BE FREE FROM BRUSH, DEBRIS, AND TRASH, NO ROCKS OR STONES HAVING ANY DIMENSION LARGER THAN 6 INCHES AT THE LARGEST DIMENSION.
6. ALL SEWER PIPES SHALL HAVE COMPRESSION OR MECHANICAL JOINTS AS PER 30 TAC 217.53 (C)(2).
7. FOR WASTEWATER LINES LESS THAN 24" IN DIAMETER, SELECT INITIAL BACKFILL MATERIAL SHALL BE PLACED IN TWO LIFTS.
   A. THE FIRST LIFT SHALL BE SPREAD UNIFORMLY AND SIMULTANEOUSLY ON EACH SIDE AND UNDER THE SHOULDERS OF THE PIPE TO THE MID POINT OF SPRING LINE OF THE PIPE.
   B. THE SECOND LIFT SHALL BE PLACED TO A DEPTH AS SHOWN ON THE PIPE BACKFILL DETAIL. FOR PIPES LARGER THAN 24", 12" MAXIMUM LIFTS SHALL BE USED.
8. ALL MANHOLES MUST BE WATER TIGHT. EITHER MONOLITHIC, CAST-IN-PLACE CONCRETE STRUCTURES OR PREFABRICATED MANHOLES SPECIFICALLY APPROVED BY NBU. THE MANHOLES SHALL HAVE WATER TIGHT RINGS AND COVERS. WHEREVER THEY ARE WITHIN THE 100 YEAR FLOODPLAIN, THE MANHOLE COVERS SHALL BE BOLTED. EVERY FOURTH MANHOLE IN SEQUENCE SHALL HAVE AN ALTERNATIVE MEANS OF VENTING [30 TAC 213.5(C)(3)(A) AND 30 TAC 217.55(O).
9. ALL MANHOLES SHALL BE CONSTRUCTED SO THAT THE TOP OF THE RING IS 2" ABOVE THE SURROUNDING GROUND EXCEPT WHEN LOCATED IN PAVED AREAS. IN PAVED AREAS, THE MANHOLE RING SHALL BE FLUSH WITH PAVEMENT.
10. ALL NEW MANHOLES ARE TO HAVE COVERS WITH 32" OPENINGS. MANHOLES SHALL BE CONSTRUCTED OF OR LINED WITH A CORROSION MATERIAL RESISTANT MATERIAL. WHERE NEW CONSTRUCTION TIES INTO AN EXISTING MANHOLE, THE EXISTING MANHOLE MUST BE LINED, COATED, OR REPLACED WITH A CORROSION RESISTANT MATERIAL.
11. WASTEWATER PIPE CONNECTIONS TO PRE-CAST MANHOLES WILL BE COMPRESSION JOINTS OF MECHANICAL "BOOT TYPE" JOINT AS APPROVED BY NBU.
12. WASTEWATER LINES SHALL BE TESTED FROM MANHOLE TO MANHOLE.
13. IN AREAS WHERE A NEW WASTEWATER MANHOLE IS TO BE CONSTRUCTED OVER AN EXISTING WASTEWATER SYSTEM, IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO TEST THE EXISTING MANHOLES BEFORE CONSTRUCTION. AFTER PROPOSED MANHOLE HAS BEEN BUILT, THE CONTRACTOR SHALL RE-TEST THE EXISTING SYSTEM TO THE SATISFACTION OF THE CONSTRUCTION INSPECTOR. (NO SEPARATE PAY ITEM).
14. WHERE THE MINIMUM 9 FOOT SEPARATION DISTANCE BETWEEN WASTEWATER LINES AND WATER LINES/MAINS CANNOT BE MAINTAINED, THE INSTALLATION OF WASTEWATER LINES SHALL BE IN STRICT ACCORDANCE WITH TCEQ. THE WASTEWATER LINE SHALL BE CONSTRUCTED OF CAST IRON, DUCTILE IRON, OR PVC MEETING THE ASTM SPECIFICATION FOR BOTH PIPES AND JOINTS OF 150 PSI AND SHALL BE IN ACCORDANCE WITH 30 TAC 217.53(D)(3)(A)(I).
15. AFTER CONSTRUCTION TESTING WILL BE DONE BY TV CAMERA BY THE CONTRACTOR AND OBSERVED BY THE INSPECTOR OR WATER SYSTEMS ENGINEERING PERSONNEL. AS THE CAMERA IS RUN THROUGH THE LINES (NSPI). ANY ABNORMALITIES FOUND IN THE LINE, SUCH AS BROKEN PIPE OR MISALIGNED JOINTS, MUST BE REPLACED BY THE CONTRACTOR AT HIS EXPENSE. CONTRACTOR TO PROVIDE TV TAPES TO CONSTRUCTION INSPECTION FOR REVIEW PRIOR TO FINAL INSPECTION OF THE PROJECT.
16. WATER JETTING THE BACKFILL WITHIN A STREET WILL NOT BE PERMITTED. SANITARY SEWER TRENCHES SUBJECT TO TRAFFIC SHALL CONFORM TO NBU CONNECTION & CONSTRUCTION POLICY MANUAL.
17. NO TESTING WILL BE PERFORMED PRIOR TO 30 DAYS FROM COMPLETE INSTALLATION OF THE SANITARY SEWER LINES. THE FOLLOWING SEQUENCE WILL BE STRICTLY ADHERED TO:
   A. PULL MANDREL
   B. PERFORM AIR TEST
   C. CLEANING OF ANY DEBRIS
   D. FLUSHING OF SYSTEM
   E. TV INSPECTION (WITHIN 72 HOURS OF FLUSHING)
18. A MINIMUM OF 3 FEET OF COVER IS TO BE MAINTAINED OVER THE SANITARY SEWER MAIN AND LATERALS AT SUBGRADE, OTHERWISE CONCRETE ENCASEMENT WILL BE REQUIRED.
19. SANITARY SEWER MAIN CONNECTIONS MADE DIRECTLY TO EXISTING MANHOLES WILL REQUIRE SUCCESSFUL TESTING OF THE MANHOLE IN ACCORDANCE WITH NBU CONNECTION & CONSTRUCTION POLICY MANUAL.
20. TCEQ AND EPA REQUIRE EROSION AND SEDIMENTATION CONTROL FOR CONSTRUCTION OF SEWER COLLECTION SYSTEMS. CONTRACTOR SHALL PROVIDE EROSION AND SEDIMENTATION CONTROL PER THE PROJECT PLANS. ALL TEMPORARY EROSION AND SEDIMENTATION CONTROLS SHALL BE REMOVED BY THE CONTRACTOR AT FINAL ACCEPTANCE OF THE PROJECT BY NBU WATER SYSTEMS.
21. ALL MANHOLES NOT WITHIN PAVED STREETS SHALL HAVE LOCKING CONCRETE COLLAR TO SECURE RING AND COVER TO MANHOLE CONE PER NBU DETAIL DRAWING #329. (NO SEPARATE PAY ITEM)
22. ALL MANHOLES OVER THE EDWARD'S AQUIFER RECHARGE ZONE SHALL HAVE LOCKING CONCRETE COLLAR TO SECURE RING AND COVER TO MANHOLE CONE PER NBU DETAIL DRAWING #329. (NO SEPARATE PAY ITEM)
23. ALL SEWER SERVICES SHALL HAVE CLEANOUTS INSTALLED AT PROPERTY LINE PER NBU DRAWING #302 AND #303. (NO SEPARATE PAY ITEM)
24. EACH LOT OWNER SHALL BE RESPONSIBLE FOR VERIFYING THE DEPTH OF THE SEWER SERVICE STUB OUT, AND DETERMINE THE MINIMUM SERVICEABLE FINISHED FLOOR ELEVATION.
25. VERTICAL SEWER SERVICE STACKS SHALL BE REQUIRED WHERE THE TOP OF THE SEWER MAIN IS AT A DEPTH OF 8 FEET OF GREATER, UNLESS SHOWN OTHERWISE ON PLANS.
26. DUE TO FEDERAL REGULATIONS TITLE 49, PART 192.181 CENTER POINT ENERGY MUST MAINTAIN ACCESS TO GAS VALVES AT ALL TIMES. THE CONTRACTOR MUST PROTECT AND WORK AROUND GAS VALVES THAT ARE IN THE PROJECT AREAS.

WATER NOTES:

1. ALL WATER MAINS SHALL BE AWWA C900 (CLASS 150 OR GREATER).
2. WATER SERVICES SHALL BE SINGLE 1" COPPER TUBING.
3. WATER LINE IS TO BE CONSTRUCTED IN ACCORDANCE WITH THE NBU SYSTEMS CONNECTION & CONSTRUCTION POLICY.
4. WATER MAIN SHALL HAVE A MINIMUM OF 42 INCHES OF COVER, OTHERWISE CONCRETE ENCASEMENT WILL BE REQUIRED.
5. EACH UNIT IN A DUPLEX, TRIPLEX, FOURPLEX, OR CONDOMINIUM SHALL BE PROVIDED WITH AN INDIVIDUAL WATER METER. A MASTER METER CAN BE CONSIDERED FOR SEPARATE BUILDINGS, HOWEVER, THOSE BUILDINGS MUST BE PLUMBED TO ALLOW SEPARATE METERS FOR FUTURE CONSIDERATION.
6. CONTRACTOR WILL KEEP THE AREA ON TOP OF AND AROUND THE WATER METER BOX FREE OF ALL OBJECTS AND DEBRIS.
7. INITIAL BACKFILL OF WATER LINES SHALL BE MANUFACTURED SAND OR PEA GRAVEL AS PER NBU SYSTEMS CONNECTION & CONSTRUCTION POLICY.
8. SECONDARY BACKFILL OF WATER LINES SHALL GENERALLY CONSIST OF MATERIAL REMOVED FROM THE TRENCH AND SHALL BE FREE FROM BRUSH, DEBRIS AND TRASH OR STONES HAVING ANY DIMENSION LARGER THAN 6" INCHES AT THE LARGEST DIMENSION.
9. HYDROSTATIC TESTING IS DONE FROM VALVE TO VALVE.
10. NO METER BOXES TO BE SET IN DRIVEWAYS OR SIDEWALKS. ANY METER BOXES SET IN DRIVEWAYS OR SIDEWALKS WILL BE RELOCATED AT CONTRACTOR'S AND/OR DEVELOPER'S EXPENSE.
11. METER BOXES MUST BE SET AT THE PROPOSED GRADE. ANY METER BOXES THAT ARE NOT SET AT THE FINAL GRADE WILL BE ADJUSTED AT CONTRACTOR'S AND/OR DEVELOPER'S EXPENSE.
12. ACCEPTABLE METER BOXES ARE D13-BAMR AND D15-BAMR. NEW RESIDENTIAL LOTS ARE REQUIRED TO USE THE D15-BAMR METER BOXES (DOUBLE AMR). COMMERCIAL LOTS SHOULD CHOOSE WHICH BOX APPLIES TO THE DOMESTIC AND/OR IRRIGATION METER LAYOUT.
13. THRUST BLOCKS WILL NOT BE ALLOWED ON THE SYSTEM WITHOUT SPECIAL APPROVAL. JOINTS WILL BE RESTRAINED WITH RESTRAINING SYSTEMS APPROVED BY NBU AND RESTRAINT LENGTH SHALL BE SUBMITTED TO NBU AT THE TIME OF PLAN SUBMITTAL.
14. CONTRACTOR SHALL PLACE TRACER WIRE ON TOP OF THE WATER MAINS. TRACER WIRE SHOULD RUN FROM VALVE TO VALVE AND EXIT AT THE VALVE BOX. THE TRACER WIRE SHOULD BE ATTACHED TO THE TOP OF THE PIPE USING TAPE. EXCESS WIRE SHOULD BE LEFT WITHIN VALVE BOXES TO BE PLACED WITHIN LID OF COVER.

CITY OF NEW BRAUNFELS CONSTRUCTION NOTES REVISED 01/2015

IF CONSTRUCTION HAS NOT COMMENCED WITHIN ONE-YEAR OF CITY APPROVAL FOR CONSTRUCTION INSPECTION, THAT APPROVAL IS NO LONGER VALID.

THE MOST CURRENT EDITIONS OF THE CITY OF SAN ANTONIO STANDARD SPECIFICATIONS AND THE TEXAS DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR CONSTRUCTION OF HIGHWAYS, STREETS AND BRIDGES SHALL FOLLOWED FOR ALL CONSTRUCTION EXCEPT AS AMENDED BY THE CITY OF NEW BRAUNFELS STANDARD DETAILS.

ALL RESPONSIBILITY FOR THE ADEQUACY OF THESE PLANS REMAINS WITH THE ENGINEER OF RECORD. IN ACCEPTING THESE PLANS, THE CITY OF NEW BRAUNFELS MUST RELY UPON THE ADEQUACY OF THE WORK OF THE ENGINEER OF RECORD.

PRIOR TO THE START OF CONSTRUCTION THE CONTRACTOR SHALL CONTACT THE CITY OF NEW BRAUNFELS TO SET A PRE-CONSTRUCTION MEETING. A 48-HOUR ADVANCED NOTIFICATION IS REQUIRED FOR ALL INSPECTION AND MEETING REQUESTS.

- ALL INSPECTIONS ARE TO BE CALLED IN AT 830-221-4068 OR,
- FAXED IN AT 830-608-2117 OR,
- E-MAILED AT INSPECTIONS@NBTEXAS.ORG.

IT IS THE CONTRACTOR'S RESPONSIBILITY TO SEE THAT ALL TEMPORARY AND PERMANENT TRAFFIC CONTROL DEVICES ARE PROPERLY INSTALLED AND MAINTAINED IN ACCORDANCE WITH THE PLANS AND LATEST EDITION OF THE TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES. IF THE NEED ARISES, ADDITIONAL TEMPORARY TRAFFIC CONTROL DEVICES MAY BE ORDERED BY THE ENGINEERING REPRESENTATIVE AT THE CONTRACTOR'S EXPENSE.

A TXDOT TYPE II B-B BLUE REFLECTIVE RAISED PAVEMENT MARKER SHALL BE INSTALLED IN THE CENTER OF THE ROADWAY ADJACENT TO ALL FIRE HYDRANTS. IN LOCATIONS WHERE HYDRANTS ARE SITUATED ON CORNERS, BLUE REFLECTIVE RAISED PAVEMENT MARKERS SHALL BE INSTALLED ON BOTH APPROACHES WHICH FRONT THE HYDRANT. THE RAISED PAVEMENT MARKER SHALL MEET TXDOT MATERIAL, EPOXY AND ADHESIVE SPECIFICATIONS.

GROUNDWATER

IT SHALL BE THE RESPONSIBILITY OF THE DEVELOPER, CONTRACTOR, SUBCONTRACTORS, BUILDERS, GEO-TECHNICAL ENGINEER, AND PROJECT ENGINEER TO IMMEDIATELY NOTIFY THE OFFICE OF THE CITY ENGINEER AND PROJECT ENGINEER IF THE PRESENCE OF GROUNDWATER WITHIN THE SITE IS EVIDENT. UPON NOTIFICATION THE PROJECT ENGINEER SHALL RESPOND WITH PLAN REVISIONS FOR THE MITIGATION OF THE GROUNDWATER ISSUE. THE CITY ENGINEER SHALL RESPOND WITHIN TWO (2) BUSINESS DAYS UPON RECEIPT OF THE MITIGATION PLAN. ALL CONSTRUCTION ACTIVITY, IMPACTED BY THE DISCOVERY OF GROUNDWATER, SHALL BE SUSPENDED UNTIL THE CITY ENGINEER GRANTS A WRITTEN APPROVAL OF THE GROUNDWATER MITIGATION PLAN.

RECORD DRAWINGS

AS PER PLATTING ORDINANCE SECTION 118-38M.: WHEN ALL OF THE IMPROVEMENTS ARE FOUND TO BE CONSTRUCTED AND COMPLETED IN ACCORDANCE WITH THE APPROVED PLANS AND SPECIFICATIONS AND WITH THE CITY'S STANDARDS, AND UPON RECEIPT OF ONE SET OF "RECORD DRAWING"PLANS, AND A DIGITAL COPY OF ALL PLANS (AUTOCAD 2000 MINIMUM AND PDF) THE CITY ENGINEER SHALL ACCEPT SUCH IMPROVEMENTS FOR THE CITY OF NEW BRAUNFELS, SUBJECT TO THE GUARANTY OF MATERIAL AND WORKMANSHIP PROVISIONS IN THIS SECTION.

CONSTRUCTION NOTE

ENGINEER OF RECORD IS RESPONSIBLE TO INSURE THAT EROSION CONTROL MEASURES AND STORMWATER CONTROL SUFFICIENT TO MITIGATE OFF SITE IMPACTS ARE IN PLACE AT ALL STAGES OF CONSTRUCTION.

DRAINAGE NOTE

DRAINAGE IMPROVEMENTS SUFFICIENT TO MITIGATE THE IMPACT OF CONSTRUCTION SHALL BE INSTALLED PRIOR TO ADDING IMPERVIOUS COVER.

FINISHED FLOOR ELEVATIONS

THE ELEVATION OF THE LOWEST FLOOR SHALL BE AT LEAST 10 INCHES ABOVE THE FINISHED GRADE OF THE SURROUNDING GROUND, WHICH SHALL BE SLOPED IN A FASHION SO AS TO DIRECT STORMWATER AWAY FROM THE STRUCTURE. PROPERTIES ADJACENT TO STORMWATER CONVEYANCE STRUCTURES MUST HAVE FLOOR SLAB ELEVATION OR BOTTOM OF FLOOR JOISTS A MINIMUM OF ONE FOOT ABOVE THE 100-YEAR WATER FLOW ELEVATION IN THE STRUCTURE. DRIVEWAYS SERVING HOUSES ON THE DOWNHILL SIDE OF THE STREET SHALL HAVE A PROPERLY SIZED CROSS SWALE PREVENTING RUNOFF FROM ENTERING THE GARAGE.

SOILS TESTING

PROCTORS SHALL BE SAMPLED FROM ON SITE MATERIAL (ON SITE IS DEFINED AS LIMITS OF CONSTRUCTION FOR THIS PLAN SET) AND A COPY OF THE PROCTOR RESULTS SHALL BE DELIVERED TO THE CITY OF NEW BRAUNFELS STREET INSPECTOR PRIOR TO ANY DENSITY TESTS.

ROADWAY

ALL ROADWAY COMPACTION TESTS SHALL BE THE RESPONSIBILITY OF THE DEVELOPER'S GEO-TECHNICAL ENGINEER. FLEXIBLE BASE OR FILL MATERIAL SHALL BE PLACED IN UNIFORM LAYERS NOT TO EXCEED SIX-INCHES (6") COMPACTED. EACH LAYER OF MATERIAL, INCLUSIVE OF SUBGRADE, SHALL BE COMPACTED AS SPECIFIED AND TESTED FOR DENSITY AND MOISTURE IN ACCORDANCE WITH TEST METHODS TEX-113-E, TEX-114-E, TEX-115-E. THE NUMBER AND LOCATION OF REQUIRED TESTS SHALL BE DETERMINED BY THE GEO-TECHNICAL ENGINEER AND APPROVED BY THE CITY OF NEW BRAUNFELS STREET INSPECTOR. AT A MINIMUM, TESTS SHALL BE TAKEN EVERY 100LF FOR EACH LIFT. UPON COMPLETION OF TESTING THE GEO-TECHNICAL ENGINEER WILL PROVIDE THE CITY OF NEW BRAUNFELS STREET INSPECTOR WITH ALL TESTING DOCUMENTATION AND A CERTIFICATION STATING THAT THE PLACEMENT OF FLEXIBLE BASE, AND FILL MATERIAL, AND SUBGRADE, HAS BEEN COMPLETED IN ACCORDANCE WITH THE PLANS.

ITEM 340

ASPHALTIC CONCRETE PAVEMENT SHALL BE TYPE "D" HOT MIX ASPHALT AS DEFINED IN TXDOT'S STANDARD SPECIFICATIONS FOR TXDOT STANDARD SPECIFICATIONS FOR CONSTRUCTION OF HIGHWAYS, STREET AND BRIDGES, 2004.

THE CITY OF NEW BRAUNFELS WILL NOT ACCEPT THE USE OF RECYCLED ASPHALT PAVEMENT (RAP) OR RECYCLED ASPHALT SHINGLES (RAS) IN ASPHALT MIXTURES FOR NEW ROADWAYS. ANY DEBRIS INCLUSIONS WITHIN NEW ASPHALT PAVEMENTS WILL RESULT IN ASPHALT REMOVAL AND REPLACEMENT FROM CURB TO CURB FOR LIMITS TO BE DETERMINED BY THE CITY OF NEW BRAUNFELS.

THE ASPHALTIC CONCRETE SURFACE COURSE SHALL BE PLANT MIXED, HOT LAID TYPE "D" MEETING THE SPECIFICATION REQUIREMENTS OF 2004 TXDOT ITEM 340. THE MIX SHALL BE DESIGNED FOR A STABILITY OF AT LEAST 35 AND SHALL BE COMPACTED TO BETWEEN 91 AND 95 PERCENT OF THE MAXIMUM THEORETICAL DENSITY AS DETERMINED BY TXDOT TEST METHOD TEX-227-F. THE ASPHALT CEMENT CONTENT BY PERCENT OF TOTAL MIXTURE WEIGHT SHALL FALL WITHIN A TOLERANCE OF +0.5 PERCENT FROM A SPECIFIC MIX DESIGN.

UTILITY TRENCH COMPACTION (ADDED TO THE CONSTRUCTION PLANS ON ALL UTILITY PLAN SHEETS).

ALL UTILITY TRENCH COMPACTION TESTS WITHIN THE STREET PAVEMENT SECTION SHALL BE THE RESPONSIBILITY OF THE DEVELOPER'S GEO-TECHNICAL ENGINEER. FILL MATERIAL SHALL BE PLACED IN UNIFORM LAYERS NOT TO EXCEED TWELVE INCHES (12") LOOSE. EACH LAYER OF MATERIAL SHALL BE COMPACTED TO A MINIMUM 95% DENSITY AND TESTED FOR DENSITY AND MOISTURE IN ACCORDANCE WITH TE

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
ORGANIZED SEWAGE COLLECTION SYSTEM
GENERAL CONSTRUCTION NOTES

1. THIS ORGANIZED SEWAGE COLLECTION SYSTEM (SCS) MUST BE CONSTRUCTED IN ACCORDANCE WITH 30 TEXAS ADMINISTRATIVE CODE (TAC) §213.5(C), THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY'S (TCEQ) EDWARDS AQUIFER RULES AND ANY LOCAL GOVERNMENT STANDARD SPECIFICATIONS.

2. ALL CONTRACTORS CONDUCTING REGULATED ACTIVITIES ASSOCIATED WITH THIS PROPOSED REGULATED PROJECT MUST BE PROVIDED WITH COPIES OF THE SCS PLAN AND THE TCEQ LETTER INDICATING THE SPECIFIC CONDITIONS OF ITS APPROVAL. DURING THE COURSE OF THESE REGULATED ACTIVITIES, THE CONTRACTORS MUST BE REQUIRED TO KEEP ON-SITE COPIES OF THE PLAN AND THE APPROVAL LETTER.

3. A WRITTEN NOTICE OF CONSTRUCTION MUST BE SUBMITTED TO THE PRESIDING TCEQ REGIONAL OFFICE AT LEAST 48 HOURS PRIOR TO THE START OF ANY REGULATED ACTIVITIES. THIS NOTICE MUST INCLUDE:
- THE NAME OF THE APPROVED PROJECT;
- THE ACTIVITY START DATE; AND
- THE CONTACT INFORMATION OF THE PRIME CONTRACTOR.

4. ANY MODIFICATION TO THE ACTIVITIES DESCRIBED IN THE REFERENCED SCS APPLICATION FOLLOWING THE DATE OF APPROVAL MAY REQUIRE THE SUBMITTAL OF AN SCS APPLICATION TO MODIFY THIS APPROVAL, INCLUDING THE PAYMENT OF APPROPRIATE FEES AND ALL INFORMATION NECESSARY FOR ITS REVIEW AND APPROVAL.

5. PRIOR TO BEGINNING ANY CONSTRUCTION ACTIVITY, ALL TEMPORARY EROSION AND SEDIMENTATION (E&S) CONTROL MEASURES MUST BE PROPERLY INSTALLED AND MAINTAINED IN ACCORDANCE WITH THE MANUFACTURERS SPECIFICATIONS. THESE CONTROLS MUST REMAIN IN PLACE UNTIL THE DISTURBED AREAS HAVE BEEN PERMANENTLY STABILIZED.

6. IF ANY SENSITIVE FEATURES ARE DISCOVERED DURING THE WASTEWATER LINE TRENCHING ACTIVITIES, ALL REGULATED ACTIVITIES NEAR THE SENSITIVE FEATURE MUST BE SUSPENDED IMMEDIATELY. THE APPLICANT MUST IMMEDIATELY NOTIFY THE APPROPRIATE REGIONAL OFFICE OF THE TCEQ OF THE FEATURE DISCOVERED. A GEOLOGIST'S ASSESSMENT OF THE LOCATION AND EXTENT OF THE FEATURE DISCOVERED MUST BE REPORTED TO THAT REGIONAL OFFICE IN WRITING AND THE APPLICANT MUST SUBMIT A PLAN FOR ENSURING THE STRUCTURAL INTEGRITY OF THE SEWER LINE OR FOR MODIFYING THE PROPOSED COLLECTION SYSTEM ALIGNMENT AROUND THE FEATURE. THE REGULATED ACTIVITIES NEAR THE SENSITIVE FEATURE MAY NOT PROCEED UNTIL THE TCEQ-0596 (REV. JULY 15, 2015) PAGE 2 OF 6 EXECUTIVE DIRECTOR HAS REVIEWED AND APPROVED THE METHODS PROPOSED TO PROTECT THE SENSITIVE FEATURE AND THE EDWARDS AQUIFER FROM ANY POTENTIALLY ADVERSE IMPACTS TO WATER QUALITY WHILE MAINTAINING THE STRUCTURAL INTEGRITY OF THE LINE.

7. SEWER LINES LOCATED WITHIN OR CROSSING THE 5-YEAR FLOODPLAIN OF A DRAINAGE WAY WILL BE PROTECTED FROM INUNDATION AND STREAM VELOCITIES WHICH COULD CAUSE EROSION AND SCOURING OF BACKFILL. THE TRENCH MUST BE CAPPED WITH CONCRETE TO PREVENT SCOURING OF BACKFILL, OR THE SEWER LINES MUST BE ENCASED IN CONCRETE. ALL CONCRETE SHALL HAVE A MINIMUM THICKNESS OF 6 INCHES.

8. BLASTING PROCEDURES FOR PROTECTION OF EXISTING SEWER LINES AND OTHER UTILITIES WILL BE IN ACCORDANCE WITH THE NATIONAL FIRE PROTECTION ASSOCIATION CRITERIA. SAND IS NOT ALLOWED AS BEDDING OR BACKFILL IN TRENCHES THAT HAVE BEEN BLASTED. IF ANY EXISTING SEWER LINES ARE DAMAGED, THE LINES MUST BE REPAIRED AND RETESTED.

9. ALL MANHOLES CONSTRUCTED OR REHABILITATED ON THIS PROJECT MUST HAVE WATERTIGHT SIZE ON SIZE RESILIENT CONNECTORS ALLOWING FOR DIFFERENTIAL SETTLEMENT. IF MANHOLES ARE CONSTRUCTED WITHIN THE 100-YEAR FLOODPLAIN, THE COVER MUST HAVE A GASKET AND BE BOLTED TO THE RING. WHERE GASKETED MANHOLE COVERS ARE REQUIRED FOR MORE THAN THREE MANHOLES IN SEQUENCE OR FOR MORE THAN 1,500 FEET, ALTERNATE MEANS OF VENTING WILL BE PROVIDED. BRICKS ARE NOT AN ACCEPTABLE CONSTRUCTION MATERIAL FOR ANY PORTION OF THE MANHOLE.

THE DIAMETER OF THE MANHOLES MUST BE A MINIMUM OF FOUR FEET AND THE MANHOLE FOR ENTRY MUST HAVE A MINIMUM CLEAR OPENING DIAMETER OR 30 INCHES. THESE DIMENSIONS AND OTHER DETAILS SHOWING COMPLIANCE WITH THE COMMISSION'S RULES CONCERNING MANHOLES AND SEWER LINE/MANHOLE INVERTS DESCRIBED IN 30 TAC §217.55 ARE INCLUDED ON PLAN SHEET 57.

IT IS SUGGESTED THAT ENTRANCE INTO MANHOLES IN EXCESS OF FOUR FEET DEEP BE ACCOMPLISHED BY MEANS OF A PORTABLE LADDER. THE INCLUSION OF STEPS IN A MANHOLE IS PROHIBITED.

10. WHERE WATER LINES AND NEW SEWER LINES ARE INSTALLED WITH A SEPARATION DISTANCE CLOSER THAN NINE FEET (I.E., WATER LINES CROSSING WASTEWATER LINES, WATER LINES PARALLELING WASTEWATER LINES, OR WATER LINES NEXT TO MANHOLES) THE INSTALLATION MUST MEET THE REQUIREMENTS OF 30 TAC §217.53 (D) (PIPE DESIGN) OR 30 TAC §290.44(E) (WATER DISTRIBUTION).

11. WHERE SEWER LINES DEVIATE FROM STRAIGHT ALIGNMENT AND UNIFORM GRADE ALL CURVATURE OF SEWER PIPE MUST BE ACHIEVED BY THE FOLLOWING PROCEDURE WHICH IS RECOMMENDED BY THE PIPE MANUFACTURER:

THERE WILL BE NO DEVIATION FROM STRAIGHT ALIGNMENTS.

IF PIPE FLEXURE IS PROPOSED, THE FOLLOWING METHOD OF PREVENTING DEFLECTION OF THE JOINT MUST BE USED:

PIPE FLEXURE IS NOT PROPOSED.

SPECIFIC CARE MUST BE TAKEN TO ENSURE THAT THE JOINT IS PLACED IN THE CENTER OF THE TRENCH AND PROPERLY BEDDED IN ACCORDANCE WITH 30 TAC §217.54.

12. NEW SEWAGE COLLECTION SYSTEM LINES MUST BE CONSTRUCTED WITH STUB OUTS FOR THE CONNECTION OF ANTICIPATED EXTENSIONS. THE LOCATION OF SUCH STUB-OUTS MUST BE MARKED ON THE GROUND SUCH THAT THEIR LOCATION CAN BE EASILY DETERMINED AT THE TIME OF CONNECTION OF THE EXTENSIONS. SUCH STUB-OUTS MUST BE MANUFACTURED WYES OR TEES THAT ARE COMPATIBLE IN SIZE AND MATERIAL WITH BOTH THE SEWER LINE AND THE EXTENSION. AT THE TIME OF ORIGINAL CONSTRUCTION, NEW STUB-OUTS MUST BE CONSTRUCTED SUFFICIENTLY TO EXTEND BEYOND END OF THE STREET PAVEMENT. ALL STUB-OUTS MUST BE SEALED WITH A MANUFACTURED CAP TO PREVENT LEAKAGE. EXTENSIONS THAT WERE NOT ANTICIPATED AT THE TIME OF ORIGINAL CONSTRUCTION OR THAT ARE TO BE CONNECTED TO AN EXISTING SEWER LINE NOT FURNISHED WITH STUB-OUTS MUST BE CONNECTED USING A MANUFACTURED SADDLE AND IN ACCORDANCE WITH ACCEPTED PLUMBING TECHNIQUES.

IF NO STUB-OUT IS PRESENT AN ALTERNATE METHOD OF JOINING LATERALS IS SHOWN IN THE DETAIL ON PLAN SHEET 57. (FOR POTENTIAL FUTURE LATERALS).

THE PRIVATE SERVICE LATERAL STUB-OUTS MUST BE INSTALLED AS SHOWN ON THE PLAN AND PROFILE SHEETS ON PLAN SHEET 57 AND MARKED AFTER BACKFILLING AS SHOWN IN THE DETAIL ON PLAN SHEET 57.

13. TRENCHING, BEDDING AND BACKFILL MUST CONFORM 30 TAC §217.54. THE BEDDING AND BACKFILL FOR FLEXIBLE PIPE MUST COMPLY WITH THE STANDARDS OF ASTM D-2321, CLASSES IA, IB, II OR III. RIGID PIPE BEDDING MUST COMPLY WITH THE REQUIREMENTS OF ASTM C 12 (ANSI A 106.2) CLASSES A, B OR C.

14. SEWER LINES MUST BE TESTED FROM MANHOLE TO MANHOLE. WHEN A NEW SEWER LINE IS CONNECTED TO AN EXISTING STUB OR CLEAN-OUT, IT MUST BE TESTED FROM EXISTING MANHOLE TO NEW MANHOLE. IF A STUB OR CLEAN-OUT IS USED AT THE END OF THE PROPOSED SEWER LINE, NO PRIVATE SERVICE ATTACHMENTS MAY BE CONNECTED BETWEEN THE LAST MANHOLE AND THE CLEAN-OUT UNLESS IT CAN BE CERTIFIED AS CONFORMING WITH THE PROVISIONS OF 30 TAC §213.5(C)(3)(E).

15. ALL SEWER LINES MUST BE TESTED IN ACCORDANCE WITH 30 TAC §217.57. THE ENGINEER MUST RETAIN COPIES OF ALL TEST RESULTS WHICH MUST BE MADE AVAILABLE TO THE EXECUTIVE DIRECTOR UPON REQUEST. THE ENGINEER MUST CERTIFY IN WRITING THAT ALL WASTEWATER LINES HAVE PASSED ALL REQUIRED TESTING TO THE APPROPRIATE REGIONAL OFFICE WITHIN 30 DAYS OF TEST COMPLETION AND PRIOR TO USE OF THE NEW COLLECTION SYSTEM. TESTING METHOD WILL BE:

(a) FOR A COLLECTION SYSTEM PIPE THAT WILL TRANSPORT WASTEWATER BY GRAVITY FLOW, THE DESIGN MUST SPECIFY AN INFILTRATION AND EXFILTRATION TEST OR A LOW-PRESSURE AIR TEST. A TEST MUST CONFORM TO THE FOLLOWING REQUIREMENTS:

(1) LOW PRESSURE AIR TEST.

(A) A LOW PRESSURE AIR TEST MUST FOLLOW THE PROCEDURES DESCRIBED IN AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) C-828, ASTM C-924, ASTM F-1417 OR OTHER PROCEDURES APPROVED BY THE EXECUTIVE DIRECTOR, EXCEPT AS TO TESTING TIMES AS REQUIRED IN TABLE C.3 IN SUBPARAGRAPH (C) OF THIS PARAGRAPH OR EQUATION C.3 IN SUBPARAGRAPH (B)(ii) OF THIS PARAGRAPH.

(B) FOR SECTIONS OF COLLECTION SYSTEM PIPE LESS THAN 36 INCH AVERAGE INSIDE DIAMETER, THE FOLLOWING PROCEDURE MUST APPLY, UNLESS A PIPE IS TO BE TESTED AS REQUIRED BY PARAGRAPH (2) OF THIS SUBSECTION.

(i) A PIPE MUST BE PRESSURIZED TO 3.5 POUNDS PER SQUARE INCH (PSI) GREATER THAN THE PRESSURE EXERTED BY GROUND WATER ABOVE THE PIPE.

(ii) ONCE THE PRESSURE IS STABILIZED THE MINIMUM TIME ALLOWABLE FOR THE PRESSURE TO DROP FROM 3.5 PSI GAUGE TO 2.5 PSI GAUGE IS COMPUTED FROM THE FOLLOWING EQUATION:

EQUATION C.3

$$T = \frac{0.085 \times D \times K}{Q}$$

WHERE:

T = TIME FOR PRESSURE TO DROP 1.0 POUND PER SQUARE INCH GAUGE IN SECONDS
K = 0.000419 X D X L, BUT NOT LESS THAN 1.0
D = AVERAGE INSIDE PIPE DIAMETER IN INCHES
L = LENGTH OF LINE OF SAME SIZE BEING TESTED, IN FEET
Q = RATE OF LOSS, 0.0015 CUBIC FEET PER MINUTE PER SQUARE FOOT INTERNAL SURFACE WILL BE USED.

(C) SINCE A "K" VALUE OF LESS THAN 1.0 MAY NOT BE USED, THE MINIMUM TESTING TIME FOR EACH PIPE DIAMETER IS SHOWN IN THE FOLLOWING TABLE C.3:

PIPE DIAMETER (INCHES)	MINIMUM TIME (SECONDS)	LENGTH FOR MINIMUM (FEET)	TIME FOR LONGER LENGTH (SECONDS)
6	340	398	0.855
8	454	298	1.520
10	567	239	2.374
12	680	199	3.419
15	850	159	5.342
18	1020	133	7.693
21	1190	114	10.471
24	1360	100	13.676
27	1530	88	17.309
30	1700	80	21.369
33	1870	72	25.856

(D) AN OWNER MAY STOP A TEST IF NO PRESSURE LOSS HAS OCCURRED DURING THE FIRST 25% OF THE CALCULATED TESTING TIME.

(E) IF ANY PRESSURE LOSS OR LEAKAGE HAS OCCURRED DURING THE FIRST 25% OF A TESTING PERIOD, THEN THE TEST MUST CONTINUE FOR THE ENTIRE TEST DURATION AS OUTLINED ABOVE OR UNTIL FAILURE.

(F) WASTEWATER COLLECTION SYSTEM PIPES WITH A 27 INCH OR LARGER AVERAGE INSIDE DIAMETER MAY BE AIR TESTED AT EACH JOINT INSTEAD OF FOLLOWING THE PROCEDURE OUTLINED IN THIS SECTION.

(G) A TESTING PROCEDURE FOR PIPE WITH AN INSIDE DIAMETER GREATER THAN 33 INCHES MUST BE APPROVED BY THE EXECUTIVE DIRECTOR.

(2) INFILTRATION/EXFILTRATION TEST.

(A) THE TOTAL EXFILTRATION, AS DETERMINED BY A HYDROSTATIC HEAD TEST, MUST NOT EXCEED 50 GALLONS PER INCH OF DIAMETER PER MILE OF PIPE PER 24 HOURS AT A MINIMUM TEST HEAD OF 2.0 FEET ABOVE THE CROWN OF A PIPE AT AN UPSTREAM MANHOLE.

(B) AN OWNER SHALL USE AN INFILTRATION TEST IN LIEU OF AN EXFILTRATION TEST WHEN PIPES ARE INSTALLED BELOW THE GROUNDWATER LEVEL.

(C) THE TOTAL EXFILTRATION, AS DETERMINED BY A HYDROSTATIC HEAD TEST, MUST NOT EXCEED 50 GALLONS PER INCH DIAMETER PER MILE OF PIPE PER 24 HOURS AT A MINIMUM TEST HEAD OF TWO FEET ABOVE THE CROWN OF A PIPE AT AN UPSTREAM MANHOLE, OR AT LEAST TWO FEET ABOVE EXISTING GROUNDWATER LEVEL, WHICHEVER IS GREATER.

(D) FOR CONSTRUCTION WITHIN A 25-YEAR FLOOD PLAIN, THE INFILTRATION OR EXFILTRATION MUST NOT EXCEED 10 GALLONS PER INCH DIAMETER PER MILE OF PIPE PER 24 HOURS AT THE SAME MINIMUM TEST HEAD AS IN SUBPARAGRAPH (C) OF THIS PARAGRAPH.

(E) IF THE QUANTITY OF INFILTRATION OR EXFILTRATION EXCEEDS THE MAXIMUM QUANTITY SPECIFIED, AN OWNER SHALL UNDERTAKE REMEDIAL ACTION IN ORDER TO REDUCE THE INFILTRATION OR EXFILTRATION TO AN AMOUNT WITHIN THE LIMITS SPECIFIED. AN OWNER SHALL RETEST A PIPE FOLLOWING A REMEDIATION ACTION.

(b) IF A GRAVITY COLLECTION PIPE IS COMPOSED OF FLEXIBLE PIPE, DEFLECTION TESTING IS ALSO REQUIRED. THE FOLLOWING PROCEDURES MUST BE FOLLOWED:

(1) FOR A COLLECTION PIPE WITH INSIDE DIAMETER LESS THAN 27 INCHES, DEFLECTION MEASUREMENT REQUIRES A RIGID MANDREL.

(A) MANDREL SIZING.
(i) A RIGID MANDREL MUST HAVE AN OUTSIDE DIAMETER (OD) NOT LESS THAN 95% OF THE BASE INSIDE DIAMETER (ID) OR AVERAGE ID OF A PIPE, AS SPECIFIED IN THE APPROPRIATE STANDARD BY THE ASTMs, AMERICAN WATER WORKS ASSOCIATION, UNI-BELL, OR AMERICAN NATIONAL STANDARDS INSTITUTE, OR ANY RELATED APPENDIX.
(ii) IF A MANDREL SIZING DIAMETER IS NOT SPECIFIED IN THE APPROPRIATE STANDARD, THE MANDREL MUST HAVE AN OD EQUAL TO 95% OF THE ID OF A PIPE. IN THIS CASE, THE ID OF THE PIPE, FOR THE PURPOSE OF DETERMINING THE OD OF THE MANDREL, MUST EQUAL THE AVERAGE OUTSIDE DIAMETER MINUS TWO MINIMUM WALL THICKNESSES FOR OD CONTROLLED PIPE AND THE AVERAGE INSIDE DIAMETER FOR ID CONTROLLED PIPE.
(iii) ALL DIMENSIONS MUST MEET THE APPROPRIATE STANDARD.

(B) MANDREL DESIGN.
(i) A RIGID MANDREL MUST BE CONSTRUCTED OF A METAL OR A RIGID PLASTIC MATERIAL THAT CAN WITHSTAND 200 PSI WITHOUT BEING DEFORMED.
(ii) A MANDREL MUST HAVE NINE OR MORE ODD NUMBER OF RUNNERS OR LEGS.
(iii) A BARREL SECTION LENGTH MUST EQUAL AT LEAST 75% OF THE INSIDE DIAMETER OF A PIPE.
(iv) EACH SIZE MANDREL MUST USE A SEPARATE PROVING RING.

(C) METHOD OPTIONS.
(i) AN ADJUSTABLE OR FLEXIBLE MANDREL IS PROHIBITED.
(ii) A TEST MAY NOT USE TELEVISION INSPECTION AS A SUBSTITUTE FOR A DEFLECTION TEST.
(iii) IF REQUESTED, THE EXECUTIVE DIRECTOR MAY APPROVE THE USE OF A DEFLECTOMETER OR A MANDREL WITH REMOVABLE LEGS OR RUNNERS ON A CASE-BY-CASE BASIS.

(2) FOR A GRAVITY COLLECTION SYSTEM PIPE WITH AN INSIDE DIAMETER 27 INCHES AND GREATER, OTHER TEST METHODS MAY BE USED TO DETERMINE VERTICAL DEFLECTION.
(3) A DEFLECTION TEST METHOD MUST BE ACCURATE TO WITHIN PLUS OR MINUS 0.2% DEFLECTION.
(4) AN OWNER SHALL NOT CONDUCT A DEFLECTION TEST UNTIL AT LEAST 30 DAYS AFTER THE FINAL BACKFILL.
(5) GRAVITY COLLECTION SYSTEM PIPE DEFLECTION MUST NOT EXCEED FIVE PERCENT (5%).
(6) IF A PIPE SECTION FAILS A DEFLECTION TEST, AN OWNER SHALL CORRECT THE PROBLEM AND CONDUCT A SECOND TEST AFTER THE FINAL BACKFILL HAS BEEN IN PLACE AT LEAST 30 DAYS.

16. ALL MANHOLES MUST BE TESTED TO MEET OR EXCEED THE REQUIREMENTS OF 30 TAC §217.58.
(a) ALL MANHOLES MUST PASS A LEAKAGE TEST.
(b) AN OWNER SHALL TEST EACH MANHOLE (AFTER ASSEMBLY AND BACKFILLING) FOR LEAKAGE, SEPARATE AND INDEPENDENT OF THE COLLECTION SYSTEM PIPES, BY HYDROSTATIC EXFILTRATION TESTING, VACUUM TESTING, OR OTHER METHOD APPROVED BY THE EXECUTIVE DIRECTOR.
(1) HYDROSTATIC TESTING.
(A) THE MAXIMUM LEAKAGE FOR HYDROSTATIC TESTING OR ANY ALTERNATIVE TEST METHODS IS 0.025 GALLONS PER FOOT DIAMETER PER FOOT OF MANHOLE DEPTH PER HOUR.
(B) TO PERFORM A HYDROSTATIC EXFILTRATION TEST, AN OWNER SHALL SEAL ALL WASTEWATER PIPES COMING INTO A MANHOLE WITH AN INTERNAL PIPE PLUG, FILL THE MANHOLE WITH WATER, AND MAINTAIN THE TEST FOR AT LEAST ONE HOUR.
(C) A TEST FOR CONCRETE MANHOLES MAY USE A 24-HOUR WETTING PERIOD BEFORE TESTING TO ALLOW SATURATION OF THE CONCRETE.
(2) VACUUM TESTING.
(A) TO PERFORM A VACUUM TEST, AN OWNER SHALL PLUG ALL LIFT HOLES AND EXTERIOR JOINTS WITH A NON-SHRINK GROUT AND PLUG ALL PIPES ENTERING A MANHOLE.
(B) NO GROUT MUST BE PLACED IN HORIZONTAL JOINTS BEFORE TESTING.
(C) STUB-OUTS, MANHOLE BOOTS, AND PIPE PLUGS MUST BE SECURED TO PREVENT MOVEMENT WHILE A VACUUM IS DRAWN.
(D) AN OWNER SHALL USE A MINIMUM 60 INCH/LB TORQUE WRENCH TO TIGHTEN THE EXTERNAL CLAMPS THAT SECURE A TEST COVER TO THE TOP OF A MANHOLE.
(E) A TEST HEAD MUST BE PLACED AT THE INSIDE OF THE TOP OF A CONE SECTION AND THE SEAL INFLATED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.
(F) THERE MUST BE A VACUUM OF 10 INCHES OF MERCURY INSIDE A MANHOLE TO PERFORM A VALID TEST.
(G) A TEST DOES NOT BEGIN UNTIL AFTER THE VACUUM PUMP IS OFF.
(H) A MANHOLE PASSES THE TEST IF AFTER 2.0 MINUTES AND WITH ALL VALVES CLOSED, THE VACUUM IS AT LEAST 9.0 INCHES OF MERCURY.

17. ALL PRIVATE SERVICE LATERALS MUST BE INSPECTED AND CERTIFIED IN ACCORDANCE WITH 30 TAC §213.5(c)(3)(i). AFTER INSTALLATION OF AND, PRIOR TO COVERING AND CONNECTING A PRIVATE SERVICE LATERAL TO AN EXISTING ORGANIZED SEWAGE COLLECTION SYSTEM, A TEXAS LICENSED PROFESSIONAL ENGINEER, TEXAS REGISTERED SANITARIAN, OR APPROPRIATE CITY INSPECTOR MUST VISUALLY INSPECT THE PRIVATE SERVICE LATERAL AND THE CONNECTION TO THE SEWAGE COLLECTION SYSTEM, AND CERTIFY THAT IT IS CONSTRUCTED IN CONFORMITY WITH THE APPLICABLE PROVISIONS OF THIS SECTION. THE OWNER OF THE COLLECTION SYSTEM MUST MAINTAIN SUCH CERTIFICATIONS FOR FIVE YEARS AND FORWARD COPIES TO THE APPROPRIATE REGIONAL OFFICE UPON REQUEST. CONNECTIONS MAY ONLY BE MADE TO AN APPROVED SEWAGE COLLECTION SYSTEM.

AUSTIN REGIONAL OFFICE 2800 S. IH 35, SUITE 100 AUSTIN, TX 78704-5712 PHONE(512) 339-2929 FAX (512) 339-3795	SAN ANTONIO REGIONAL OFFICE 14250 JUDSON ROAD SAN ANTONIO, TEXAS 78233-4480 PHONE (210) 490-3096 FAX (210) 545-4329

TCEQ-0596 (REV. JULY 15, 2015)

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
WATER POLLUTION ABATEMENT PLAN
GENERAL CONSTRUCTION NOTES

1. A WRITTEN NOTICE OF CONSTRUCTION MUST BE SUBMITTED TO THE TCEQ REGIONAL OFFICE AT LEAST 48 HOURS PRIOR TO THE START OF ANY REGULATED ACTIVITIES. THIS NOTICE MUST INCLUDE:
- THE NAME OF THE APPROVED PROJECT;
- THE ACTIVITY START DATE; AND
- THE CONTACT INFORMATION OF THE PRIME CONTRACTOR.

2. ALL CONTRACTORS CONDUCTING REGULATED ACTIVITIES ASSOCIATED WITH THIS PROJECT MUST BE PROVIDED WITH COMPLETE COPIES OF THE APPROVED WATER POLLUTION ABATEMENT PLAN (WPAP) AND THE TCEQ LETTER INDICATING THE SPECIFIC CONDITIONS OF ITS APPROVAL. DURING THE COURSE OF THESE REGULATED ACTIVITIES, THE CONTRACTORS ARE REQUIRED TO KEEP ON-SITE COPIES OF THE APPROVED PLAN AND APPROVAL LETTER.

3. IF ANY SENSITIVE FEATURE(S) (CAVES, SOLUTION CAVITY, SINK HOLE, ETC.) IS DISCOVERED DURING CONSTRUCTION, ALL REGULATED ACTIVITIES NEAR THE SENSITIVE FEATURE MUST BE SUSPENDED IMMEDIATELY. THE APPROPRIATE TCEQ REGIONAL OFFICE MUST BE IMMEDIATELY NOTIFIED OF ANY SENSITIVE FEATURES ENCOUNTERED DURING CONSTRUCTION. CONSTRUCTION ACTIVITIES NOT BE RESUMED UNTIL THE TCEQ HAS REVIEWED AND APPROVED THE APPROPRIATE PROTECTIVE MEASURES IN ORDER TO PROTECT ANY SENSITIVE FEATURE AND THE EDWARDS AQUIFER FROM POTENTIALLY ADVERSE IMPACTS TO WATER QUALITY.

4. NO TEMPORARY OR PERMANENT HAZARDOUS SUBSTANCE STORAGE TANK SHALL BE INSTALLED WITHIN 150 FEET OF A WATER SUPPLY SOURCE, DISTRIBUTION SYSTEM, WELL, OR SENSITIVE FEATURE.

5. PRIOR TO BEGINNING ANY CONSTRUCTION ACTIVITY, ALL TEMPORARY EROSION AND SEDIMENTATIONS (E&S) CONTROL MEASURES MUST BE PROPERLY INSTALLED AND MAINTAINED IN ACCORDANCE WITH THE APPROVED PLANS AND MANUFACTURERS SPECIFICATIONS. IF INSPECTIONS INDICATE A CONTROL HAS BEEN USED INAPPROPRIATELY, OR INCORRECTLY, THE APPLICANT MUST REPLACE OR MODIFY THE CONTROL FOR SITE SITUATIONS. THESE CONTROLS MUST REMAIN IN PLACE UNTIL THE DISTURBED AREAS HAVE BEEN PERMANENTLY STABILIZED.

6. ANY SEDIMENT THAT ESCAPES THE CONSTRUCTION SITE MUST BE COLLECTED AND PROPERLY DISPOSED OF BEFORE THE NEXT RAIN EVENT TO ENSURE IT IS NOT WASHED INTO SURFACE STEAMS, SENSITIVE FEATURES, ETC.

7. SEDIMENT MUST BE REMOVED FROM THE SEDIMENT TRAPS OR SEDIMENTATION BASINS NOT LATER THAN WHEN IT OCCUPIES 50% OF THE BASIN'S DESIGN CAPACITY.

8. LITTER, CONSTRUCTION DEBRIS, AND CONSTRUCTION CHEMICALS EXPOSED TO STORMWATER SHALL BE PREVENTED FROM BEING DISCHARGED OFFSITE.

9. ALL SPOILS (EXCAVATED MATERIAL) GENERATED FROM THE PROJECT SITE MUST BE STORED ON-SITE WITH PROPER E&S CONTROLS. FOR STORAGE OR DISPOSAL OF SPOILS AT ANOTHER SITE ON THE EDWARD AQUIFER RECHARGE ZONE, THE OWNER OF THE SITE MUST RECEIVE APPROVAL OF A WATER POLLUTION ABATEMENT PLAN FOR THE PLACEMENT OF FILL MATERIAL OR MASS GRADING PRIOR TO THE PLACEMENT OF SPOILS AT THE SITE.

10. IF PORTIONS OF THE SITE WILL HAVE A TEMPORARY OR PERMANENT CEASE IN CONSTRUCTION ACTIVITY LASTING LONGER THAN 14 DAYS, SOIL STABILIZATION IN THOSE AREAS SHALL BE INITIATED AS SOON AS POSSIBLE PRIOR TO THE 14TH DAY OF INACTIVITY. IF ACTIVITY WILL RESUME PRIOR TO THE 21ST DAY, STABILIZATION MEASURES ARE NOT REQUIRED. IF DROUGHT CONDITIONS OR INCLEMENT WEATHER PREVENT ACTION BY THE 14TH DAY, STABILIZATION MEASURES SHALL BE INITIATED AS SOON AS POSSIBLE.

11. THE FOLLOWING RECORDS SHALL BE MAINTAINED AND MADE AVAILABLE TO THE TCEQ UPON REQUEST:
- THE DATES WHEN MAJOR GRADING ACTIVITIES OCCUR
- THE DATES WHEN CONSTRUCTION ACTIVITIES TEMPORARILY OR PERMANENTLY CEASE ON A PORTION OF THE SITE; AND
- THE DATES WHEN STABILIZATION MEASURES ARE INITIATED.

12. THE HOLDER OF ANY APPROVED EDWARD AQUIFER PROTECTION PLAN MUST NOTIFY THE APPROPRIATE REGIONAL OFFICE IN WRITING AND OBTAIN APPROVAL FROM THE EXECUTIVE DIRECTOR PRIOR TO INITIATING ANY OF THE FOLLOWING:

A. ANY PHYSICAL OR OPERATIONAL MODIFICATION OF ANY WATER POLLUTION ABATEMENT STRUCTURE(S), INCLUDING BUT NOT LIMITED TO PONDS, DAMS, BERMS, SEWAGE TREATMENT PLATS, AND DIVERSIONARY STRUCTURES;

B. ANY CHANGE IN NATURE OR CHARACTER OF THE REGULATED ACTIVITY FROM THAT WHICH WAS ORIGINALLY APPROVED OR A CHANGE IN WHICH WOULD SIGNIFICANTLY IMPACT THE ABILITY OF THE PLAN TO PREVENT POLLUTION OF THE EDWARDS AQUIFER;

C. ANY DEVELOPMENT OF LAND PREVIOUSLY IDENTIFIED AS UNDEVELOPED IN THE ORIGINAL WATER POLLUTION ABATEMENT PLAN.

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11/1/16

TCEQ GENERAL NOTES
CIVIL SITE CONSTRUCTION PLANS

MANOR CREEK, UNIT 4
CIVIL SITE CONSTRUCTION PLANS

DR HORTON
210 W. HUTCHISON STREET
SAN MARCOS, TEXAS 78666

DATE: MAY 2016
DRAWN BY: KRK
DESIGNED BY: GJM
CHECKED BY: CVH
REVIEWED BY: SWH & SCH
PROJECT NO.: 031.023.106

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"TXDOT CONSTRUCTION GENERAL NOTES"

1. "THE DESIGN AND CONSTRUCTION WILL PROVIDE FOR PRESERVING ALL EXISTING FEATURES IN OR NEAR THE STATE RIGHT OF WAY BEING AFFECTED BY THE WIDENING. THIS INCLUDES BUT IS NOT LIMITED TO, EXISTING DRIVEWAY GATE SET-BACKS, RELOCATION OF ELECTRONIC PRIVATE PROPERTY GATES, MAILBOX TURNOUTS, MAIL BOXES AND SUPPORTS, CATTLE GUARDS, ROADWAY SIGNING, EXISTING RIP-RAP OR OTHER PERMANENT EROSION CONTROL FEATURES, DIVERSIONARY BERMS, SWALES, DITCHES, AMOUNT AND CONFIGURATION OF DRIVEWAY FLARES AND DRIVEWAY CENTERLINE PROFILE, METAL BEAM GUARD FENCE AND END TREATMENTS, ETC. EXISTING DRIVEWAY CULVERTS AND SAFETY END TREATMENTS IF EFFECTED BY ROADWAY WIDENING WILL BE RECONSTRUCTED TO PRESERVE EXISTING FRONT SLOPE RATES. THE COORDINATION OF ITEMS THAT EFFECT EXISTING PRIVATE PROPERTY ACCESS, MAIL DELIVERY, ETC. IS THE RESPONSIBILITY OF THE DEVELOPER. THE WRITTEN CONCURRENCE OF ANY EFFECTED PROPERTY OWNERS FOR CONSTRUCTION EFFECTING THEIR DRIVEWAYS OR MAILBOX TURNOUTS MUST BE OBTAINED AND PROVIDED TXDOT PRIOR TO TXDOT DRIVEWAY PERMITS BEING ISSUED."

2. "FOR WORK IN STATE RIGHT OF WAY, THE DEVELOPER IS RESPONSIBLE FOR COORDINATION OF, OBTAINING PERMITS FOR, AND COMPLYING WITH ANY AND ALL STATE AND FEDERAL REGULATORY AGENCIES AND ALL APPLICABLE LAWS, RULES AND REGULATIONS PERTAINING TO THE REGULATION OF DRAINAGE, PRESERVATION OF CULTURAL RESOURCES, NATURAL RESOURCES AND THE ENVIRONMENT. THE DEVELOPER IS RESPONSIBLE FOR DETERMINING IF THE PROJECT IS IN AN ENVIRONMENTALLY SENSITIVE AREA SUCH AS WITHIN THE RECHARGE OR CONTRIBUTING ZONE OF PROTECTED AQUIFERS, AND ACT IN ACCORDANCE WITH ALL RESOURCE AGENCY REGULATIONS."

IF TXDOT HAS A CZP OR WPAP ON FILE WITH TCEQ, THE DEVELOPER IS RESPONSIBLE FOR AMENDING TXDOT'S PERMIT, OBTAINING TCEQ APPROVAL AND PROVIDING TXDOT WITH THE APPROVED AMENDED PERMIT. THE AMENDED PERMIT WILL ADDRESS THE RELOCATION OF ANY TXDOT PERMANENT BMP'S INCLUDING VEGETATIVE FILTER STRIPS THAT MAY BE IMPACTED BY WORK DONE WITHIN TXDOT ROW. "

IF TXDOT DOES NOT HAVE A CZP OR WPAP ON FILE WITH TCEQ, ANY PERMANENT BMP'S INCLUDING VEGETATIVE FILTER STRIPS, THAT MAY BE REQUIRED IN ORDER TO TREAT ADDITIONAL IMPERVIOUS COVER PLACED IN TXDOT ROW WILL BE LOCATED IN PRIVATE PROPERTY AND THE DEVELOPER WILL PROVIDE TXDOT WITH EVIDENCE OF TCEQ APPROVAL OF THE ADDITIONAL IMPERVIOUS COVER."

THE DEVELOPER MAY NOT OPERATE UNDER RESOURCE AGENCY ENVIRONMENTAL CLEARANCE OF A PREVIOUS OR ONGOING TXDOT PROJECT, BUT WILL BE REQUIRED TO OBTAIN SEPARATE RESOURCE/ENVIRONMENTAL AGENCY CLEARANCE."

3. "IF WASTE AREAS OR MATERIAL SOURCE AREAS RESULT FROM THIS PROJECT, THE CONTRACTOR IS REMINDED TO FOLLOW THE REQUIREMENTS OF THE TEXAS AGGREGATE QUARRY AND PIT SAFETY ACT. IN ADDITION, IT IS REQUESTED THAT THESE AREAS NOT BE VISIBLE FROM ANY HIGHWAY ON THE STATE SYSTEM."

4. "ANY TREES EXISTING WITHIN STATE RIGHT OF WAY ARE THE NATURAL RESOURCES OF THE STATE AND WILL BE PROTECTED. IN THE EVENT THAT TREES MUST BE REMOVED, TXDOT WRITTEN PERMISSION WILL BE RECEIVED IN ADVANCE AND WILL IDENTIFY THE SPECIFIC TREES BY SPECIES, DIAMETER AND LOCATION TO BE REMOVED. THE DEVELOPER WILL BE FINED FOR ANY UNPERMITTED REMOVAL OF TREES."

5. "THE DEVELOPER WILL MAINTAIN AT THE PROJECT SITE, AND MAKE AVAILABLE UPON REQUEST, COPIES OF ALL APPROVED ENVIRONMENTAL PLANS AND PERMITS RELATING TO WORK IN STATE RIGHT OF WAY."

6. "PRIOR TO BEGINNING GRADING ACTIVITY THE CONTRACTOR WILL SET AND MAINTAIN ROADWAY STATIONING, CONTROL POINTS, MARKS, STAKES TO ESTABLISH LINES, SLOPES, GRADES AND CENTERLINES."

7. "ANY SLOPES IN STATE RIGHT OF WAY WHICH BECOME STEEPER THAN 3:1 AS A RESULT OF THE WORK WILL BE TREATED WITH 4" THICK REINFORCED CONCRETE RIPRAP AND BE TREATED WITH METAL BEAM GUARD FENCE. THIS MAY ENTAIL ADDITIONAL RIP-RAP BEYOND THAT SHOWN IN THE PLANS."

8. "JAMES BROWNE (830) 609-0707 NEW BRAUNFELS, BRENT RAINOSEK (830) 303-0130 SEGUIN, CHAD LUX (830) 816-2430 BOERNE, TIMOTHY LOWAK (830) 393-3144 FLORESVILLE, TXDOT MAINTENANCE OFFICE WILL BE CONTACTED BY THE CONTRACTOR 48 HOURS PRIOR TO WORK OCCURRING IN STATE RIGHT OF WAY."

9. "STATE RIGHT OF WAY WILL NOT BE USED AS AN AREA FOR CONTRACTOR PARKING OR FOR STAGING THE RECEIPT OF MATERIALS OR EQUIPMENT."

10. "TRAFFIC CONTROL AND CONSTRUCTION BARRICADES WILL MEET THE REQUIREMENTS OF THE TEXAS MUTCD."

11. "AT NO TIME WILL THE ROADWAY TRAVEL WAY BE BLOCKED"

12. "LANE CLOSURES WILL ONLY BE PERMITTED WITH 48 HOUR PRIOR APPROVAL OF THE TXDOT MAINTENANCE SUPERVISOR. LANE CLOSURES WILL BE PERMITTED ONLY BETWEEN 9:00 A.M. AND 4:00 P.M. MONDAY THROUGH FRIDAY."

13. "A MINIMUM 3:1 (H:V) TEMPORARY SAFETY SLOPE OF STABLE COMPACTED MATERIAL WILL BE REQUIRED ADJACENT TO THE STATE HIGHWAY EDGE OF PAVEMENT AT ALL TIMES DURING NON WORKING HOURS."

14. "ONLY ONE SIDE OF THE ROADWAY WILL BE OPEN TO CONSTRUCTION AT A TIME. WORK WILL BE COMPLETED AND PAVEMENT EDGES BACKFILLED ON ONE SIDE OF THE ROAD BEFORE WORK WILL BEGIN ON THE OPPOSITE SIDE OF THE ROADWAY.

15. "ANY PAVEMENT EDGE DROP-OFFS BETWEEN 1 AND 2 INCHES IN HEIGHT WILL HAVE CW 8-11 WARNING SIGNS. ANY PAVEMENT EDGE DROP-OFF 2 INCHES OR GREATER WILL HAVE A 3:1 COMPACTED SAFETY SLOPE AND CW 8-9A OR CW 8-11 SIGNS PLUS CHANNELIZING DEVICES. PAVEMENT EDGES WILL BE SHOULDERED UP WITH COMPACTED EMBANKMENT MATERIAL AND 4 INCHES OF TOPSOIL AS SOON AS POSSIBLE AFTER PAVING IS COMPLETED ON THE SIDE OF THE ROAD BEING WIDENED."

16. "PROOF ROLLING OF SUBGRADE IS REQUIRED AND SHALL BE WITNESSED BY TXDOT PRIOR TO PLACEMENT OF PAVEMENT STRUCTURE UNLESS OTHERWISE APPROVED BY THE TXDOT MAINTENANCE SUPERVISOR."

17. "ALL FLEXIBLE BASE WILL HAVE A MINIMUM PLASTICITY INDEX OF 4."

18. "ALL COURSES OF ASPHALTIC CONCRETE PAVEMENT (REGARDLESS OF TYPE) WILL BE PLACED WITH A ASPHALT PAVING EQUIPMENT MEETING THE REQUIREMENTS OF TXDOT ITEM 320, "EQUIPMENT FOR ASPHALT CONCRETE PAVEMENT", UNLESS OTHERWISE APPROVED BY THE MAINTENANCE SUPERVISOR."

19. "ALL SURFACE AGGREGATES WILL MEET THE REQUIREMENTS OF TXDOT FRICTION CLASSIFICATION "B" AND WILL MEET PG BINDER GRADE 70-22."

20. "ALL SURFACE ASPHALT CONCRETE PAVEMENT WILL BE UNDER-SEALED WITH A ONE COURSE SURFACE TREATMENT."

21. "ALL ASPHALTIC CONCRETE PAVEMENT USED IN BASE COURSES WILL BE TYPE "A" OR "B" AND WILL MEET PG BINDER GRADE 64-22."

22. "ALL PAVEMENT WIDENING INCLUDING SHOULDERS WILL MATCH THE EXISTING PAVEMENT CROSS SLOPE."

23. "ALL PAVEMENT MARKINGS WILL BE TYPE I THERMOPLASTIC (100 MIL) WITH UNDER-SEAL MEETING THE REQUIREMENTS OF TXDOT ITEM 666, REFLECTORIZED PAVEMENT MARKINGS. THE CONTRACTOR WILL PLACE GUIDE MARKS IN ACCORDANCE WITH ITEM 666 AND WILL MAKE ARRANGEMENTS FOR TXDOT INSPECTION OF THE PAVEMENT MARKING LAYOUT PRIOR TO PLACEMENT OF STRIPING. EQUIPMENT USED FOR THE PLACEMENT OF STRIPING WILL MEET THE PRODUCTION REQUIREMENTS OF ITEM 666 UNLESS OTHERWISE APPROVED IN ADVANCE BY THE TXDOT MAINTENANCE SUPERVISOR."

23.1. "EXISTING PAVEMENT MARKINGS THAT CONFLICT WITH PROPOSED PAVEMENT MARKINGS WILL BE LIGHTLY GROUND IN A MANNER THAT DOES NOT DAMAGE THE PAVEMENT SURFACE, TO REMOVE ANY PAVEMENT MARKING ACCUMULATION, AND WILL BE COVERED WITH A STRIP SEAL OF 18" MINIMUM WIDTH, CONSISTING OF PRECOATED GRADE 5, FRICTION CLASS B AGGREGATE."

24. "ALL MATERIALS AND CONSTRUCTION METHODS USED IN STATE RIGHT OF WAY WILL MEET TXDOT SPECIFICATIONS. THIS SUPERSEDES ALL OTHER SPECIFICATIONS IN THE PLANS."

25. "ALL TURN LANE CONCRETE PAVEMENT IN STATE ROW WILL MEET THE REQUIREMENTS OF TXDOT ITEM 360 CLASS P CONCRETE AND WILL BE BATCHED AT CONCRETE PLANTS HAVING A CURRENT APPROVED MIX DESIGN. CLASS P CONCRETE SHALL HAVE 7 AND 28 DAY COMPRESSIVE STRENGTH OF 3200 PSI AND 4400 PSI RESPECTIVELY."

26. "WHEN WIDENING EXISTING CONCRETE PAVEMENTS, JOINTS IN THE NEW PAVEMENT WILL MATCH JOINTS IN EXISTING PAVEMENT AND CURB."

27. "THE CONTRACTOR IS RESPONSIBLE FOR ENSURING THAT TXDOT APPROVED MATERIALS, MIX DESIGNS, APPROVED SOURCES AND PRODUCTS ARE USED FOR ALL WORK IN STATE ROW. THE CONTRACTOR WILL ARRANGE FOR THE SERVICES OF A QUALIFIED TESTING LABORATORY FOR ALL ITEMS REQUIRING TESTING AND WILL NOTIFY TXDOT OF ANY DISCREPANCIES BETWEEN TEST RESULTS AND TXDOT SPECS IN A TIMELY MANNER. THE CONTRACTOR WILL PROVIDE TO TXDOT INVOICES AND TESTING RESULTS AS SOON THEY ARE AVAILABLE. FAILURE TO DO THIS WILL RESULT IN REJECTION OF THE WORK."

28. "SAWING OF CONTRACTION/CONSTRUCTION JOINTS IN CONCRETE PAVEMENT WILL BE ACCOMPLISHED AS SOON AS PERSONNEL CAN WALK ON THE CONCRETE WITHOUT DAMAGING THE SURFACE REGARDLESS OF TIME OF DAY OR WEATHER CONDITIONS. STAND-BY POWER DRIVEN CONCRETE SAWS WILL BE PROVIDED DURING THE SAWING OPERATION. CURING COMPOUND WILL BE RE-APPLIED TO THE SAWED JOINT IMMEDIATELY UPON SAWING THE JOINT."

29. "ANY CONCRETE CURB TO BE REMOVED WILL BE SAW-CUT AT THE LIMITS OF REMOVAL AND BE REMOVED ENTIRELY. SLICING THE TOP PORTION OF THE CURB OFF AND LEAVING REMAINING PORTION OF CURB IN PLACE IS UNACCEPTABLE. "

30. "ANY DAMAGE TO TXDOT FACILITIES WILL BE REPAIRED AT NO EXPENSE TO THE STATE, TO TXDOT'S SATISFACTION."

31. "SIDEWALKS PLACED IN THE HIGHWAY RIGHT-OF-WAY WILL BE A MINIMUM WIDTH OF FIVE FEET OR COMPLY WITH THE MORE STRINGENT WIDTH AS REQUIRED BY CITY ORDINANCE AND WILL MEET ALL OTHER REQUIREMENTS OF THE AMERICANS WITH DISABILITIES ACT. PEDESTRIAN RAMPS WILL BE PROVIDED AT STREET AND DRIVEWAY INTERSECTIONS AS SHOWN ON THE CURRENT STATE STANDARD FOR PEDESTRIAN FACILITIES. COLOR CONTRAST AND TEXTURING OF PEDESTRIAN RAMPS WILL BE PLACE AT STREET INTERSECTION RAMPS ONLY AS SHOWN ON THE CURRENT STATE STANDARD FOR PEDESTRIAN FACILITIES. PEDESTRIAN RAMPS AT DRIVEWAY INTERSECTIONS WILL NOT RECEIVE ANY COLOR CONTRAST OR TEXTURING."

32. "THE CONTRACTOR WILL USE BEST MANAGEMENT PRACTICES (BMP'S) TO MINIMIZE EROSION AND SEDIMENTATION IN THE STATE RIGHT OF WAY RESULTING FROM THE PROPOSED CONSTRUCTION. RE-VEGETATION OF DISTURBED AREAS WILL BE COMPLETED IN ACCORDANCE WITH TXDOT STANDARD SPECIFICATIONS. PERMANENT VEGETATIVE COVER MUST ACHIEVE 70% COVERAGE PRIOR TO PROJECT ACCEPTANCE. SOIL RETENTION BLANKETS MAY BE REQUIRED TO PREVENT EROSION OF TOPSOIL PRIOR TO VEGETATION RE-ESTABLISHMENT"

33. "PRIOR TO SEEDING OR RE-VEGETATION THE FRONT SLOPES WILL BE SHOULDERED UP WITH TOPSOIL TO ELIMINATE ANY PAVEMENT EDGE DROP-OFF."

34. "MUD TRACKED ONTO THE ROADWAY FROM THE SITE WILL BE IMMEDIATELY REMOVED TO THE SATISFACTION OF TXDOT."

35. "IT WILL BE THE DEVELOPER/OWNER'S RESPONSIBILITY TO CLEAN OUT, TO THE STATE'S SATISFACTION, ANY DRAINAGE STRUCTURE OR STORM SEWER SYSTEM THAT BECOMES SILTED AS A RESULT OF THEIR OPERATIONS."

36. "THE ADJUSTMENT OF ANY UTILITIES IN STATE RIGHT OF WAY OR ADJACENT PRIVATE EASEMENT WILL BE THE RESPONSIBILITY OF THE DEVELOPER/OWNER'S."

37. "THE CONTRACTOR IS RESPONSIBLE FOR PLACING AND MAINTAINING EXISTING SIGNS ON TXDOT APPROVED TEMPORARY MOUNTS UNTIL PERMANENT SIGNS ARE PLACED."

38. "THE FINAL PLACEMENT OF PERMANENT SIGNS WILL BE COORDINATED PRIOR TO PLACEMENT WITH THE LOCAL TXDOT MAINTENANCE SUPERVISOR."

39 "FOR WORK WITHIN THE STATE RIGHT OF WAY WHERE REMOVAL OF MATERIALS OR DEBRIS WITHIN THE CONSTRUCTION LIMITS AND NOT INCORPORATED IN THE FINISHED ROADWAY SECTION OF RIGHT OF WAY, WILL BE DISPOSED OF IN A MANNER ACCEPTABLE TO THE MAINTENANCE SUPERVISOR AT NO EXPENSE TO THE STATE. MATERIALS THAT ARE NOT DETERMINED TO BE SALVAGEABLE BY THE MAINTENANCE SUPERVISOR BECOME THE PROPERTY OF THE CONTRACTOR FOR PROPER DISPOSAL AT THEIR EXPENSE. MATERIALS DETERMINED TO BE SALVAGEABLE WILL BE RETURNED TO THE STATE AND DELIVERED TO THE LOCATION AS DETERMINED BY THE MAINTENANCE SUPERVISOR."

40. "REGARDLESS OF ERRORS AND OMISSIONS IN INFORMATION PROVIDED IN THE PLANS OR CROSS-SECTIONS THE PERMITEE IS RESPONSIBLE FOR PROVIDING FOR POSITIVE DRAINAGE OUTFALLS WITHIN AND OFF THE LIMITS OF THE PROJECT."

41. "ALL TRAFFIC SIGNALS ON THE STATE HIGHWAY SYSTEM WITHIN THE NEW BRAUNFELS CITY LIMITS, WITH THE EXCEPTION OF SIGNALS ON IH 35, ARE THE RESPONSIBILITY OF THE CITY OF NEW BRAUNFELS AND THE CITY OF NEW BRAUNFELS WILL PERFORM CONSTRUCTION INSPECTION. CONTACT GARRY FORD, P.E. AT (830) 221-4645, 48 HOURS PRIOR TO THE NEED FOR ANY INSPECTIONS. ALSO WHEN NON-TRAFFIC SIGNAL WORK IS BEING PERFORMED WITHIN 400 FEET OF AN EXISTING SIGNALIZED INTERSECTION, FLASHING BEACON OR SCHOOL ZONE FLASHER OR OTHER TYPE OF SIGNAL; IF WITHIN THE CITY OF NEW BRAUNFELS AREA OF RESPONSIBILITY CONTACT GARRY FORD, P.E. TO DETERMINE/VERIFY THE LOCATION OF LOOP DETECTORS, CONDUIT, GROUND-BOXES, ETC. FOR ALL OTHER LOCATIONS, CONTACT TXDOT REPRESENTATIVE, CRAIG WILLIAMS, AT (210) 615-6213, E-MAIL IS CRAIG.WILLIAMS@TXDOT.GOV. THE CONTRACTOR IS RESPONSIBLE FOR REPAIR OR REPLACEMENT OF ANY SIGNAL EQUIPMENT DAMAGED BY CONSTRUCTION OPERATIONS. THE METHOD OF REPAIR OR REPLACEMENT SHALL BE PRE-APPROVED AND INSPECTED, DEPENDING ON THE TYPE AND EXTENT OF THE DAMAGE, THE ENGINEER RESERVES THE RIGHT TO PERFORM THE REPAIR OR REPLACEMENT WORK AND THE CONTRACTOR WILL BE BILLED FOR THIS WORK. WHEN WORKING NEAR AERIAL ELECTRICAL LINES OR UTILITY POLES, COMPLY WITH FEDERAL, STATE AND LOCAL REGULATIONS."

PROJECT CLEAR ZONE BASIS

Table 2-12: Clear Zones

Location	Functional Classification	Design Speed (mph)	Avg. Daily Traffic	Clear Zone Width (ft)[3,4,5]	
-	-	-	-	Minimum	Desirable
Rural	Freeways	All	All	30 (16 for ramps)	
Rural	Arterial	All	0 - 750 750 - 1500 >1500	10 16 30	16 30 --
Rural	Collector	≥ 50	All	Use above rural arterial criteria.	
Rural	Collector	≤ 45	All	10	--
Rural	Local	All	All	10	--
Suburban	All	All	<8,000	10[6]	10[6]
Suburban	All	All	8,000 - 12,000	10[6]	20[6]
Suburban	All	All	12,000 - 16,000	10[6]	25[6]
Suburban	All	All	>16,000	20[6]	30[6]
Urban	Freeways	All	All	30 (16 for ramps)	
Urban	All (Curbed)	≥ 50	All	Use above suburban criteria insofar as available border width permits.	
Urban	All (Curbed)	≤ 45	All	4 from curb face	6
Urban	All (Uncurbed)	≥ 50	All	Use above suburban criteria.	
Urban	All (Uncurbed)	≤ 45	All	10	--

[1] Because of the need for specific placement to assist traffic operations, devices such as traffic signal supports, railroad signal/warning device supports, and controller cabinets are excluded from clear zone requirements. However, these devices should be located as far from the travel lanes as practical. Other non-breakaway devices should be located outside the prescribed clear zone or these devices should be protected with barrier.
[2] Average ADT over project life, i.e., 0.5 (present ADT plus future ADT). Use total ADT on two-way roadways and directional ADT on one-way roadways.
[3] Without barrier or other safety treatment of appurtenances.
[4] Measured from edge of travel lane for all cut sections and for all fill sections where side slopes are 1V:4H or flatter. Where fill slopes are steeper than 1V:4H it is desirable to provide a 10 ft area free of obstacles beyond the toe of slope.
[5] Desirable, rather than minimum, values should be used where feasible.
[6] Purchase of 5 ft or less of additional right-of-way strictly for satisfying clear zone provisions is not required.

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TXDOT GENERAL NOTES

CIVIL SITE CONSTRUCTION PLANS

MANOR CREEK, UNIT 4
CIVIL SITE CONSTRUCTION PLANS

DR HORTON
210 W. HUTCHISON STREET
SAN MARCOS, TEXAS 78666

DATE: MAY 2016
DRAWN BY: TECH
DESIGNED BY: ENGINEER
CHECKED BY: ENGINEER
REVIEWED BY: ENGINEER
PROJECT NO.: 031.023.106

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Table 1 - Manor Creek Unit 4 Existing Conditions Hydrology Calculations

Point of Concentration	Area	Area	"C" Value	Tc	I2	I10	I25	I100	K2	K10	K25	K100	Q2	Q10	Q25	Q100
EX A	DA EX 1	28.22	0.47	22	3.37	5.18	6.25	8.19	1.00	1.00	1.10	1.25	44.65	68.53	91.02	135.50
SCS METHOD																
EX B	DA EX 2 & DA EX 3 (BC 010 of HMS Model)	194.82											217.00	571.00	751.20	996.10

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EXISTING DRAINAGE AREA MAP

MANOR CREEK, UNIT 4
CIVIL SITE CONSTRUCTION PLANS

DR HORTON
210 W. HUTCHISON STREET
SAN MARCOS, TEXAS 78666

CIVIL SITE CONSTRUCTION PLANS

DATE: MAY 2016
DRAWN BY: KRK
DESIGNED BY: GJM
CHECKED BY: CVH
REVIEWED BY: SWH
PROJECT NO.: 031.023.106

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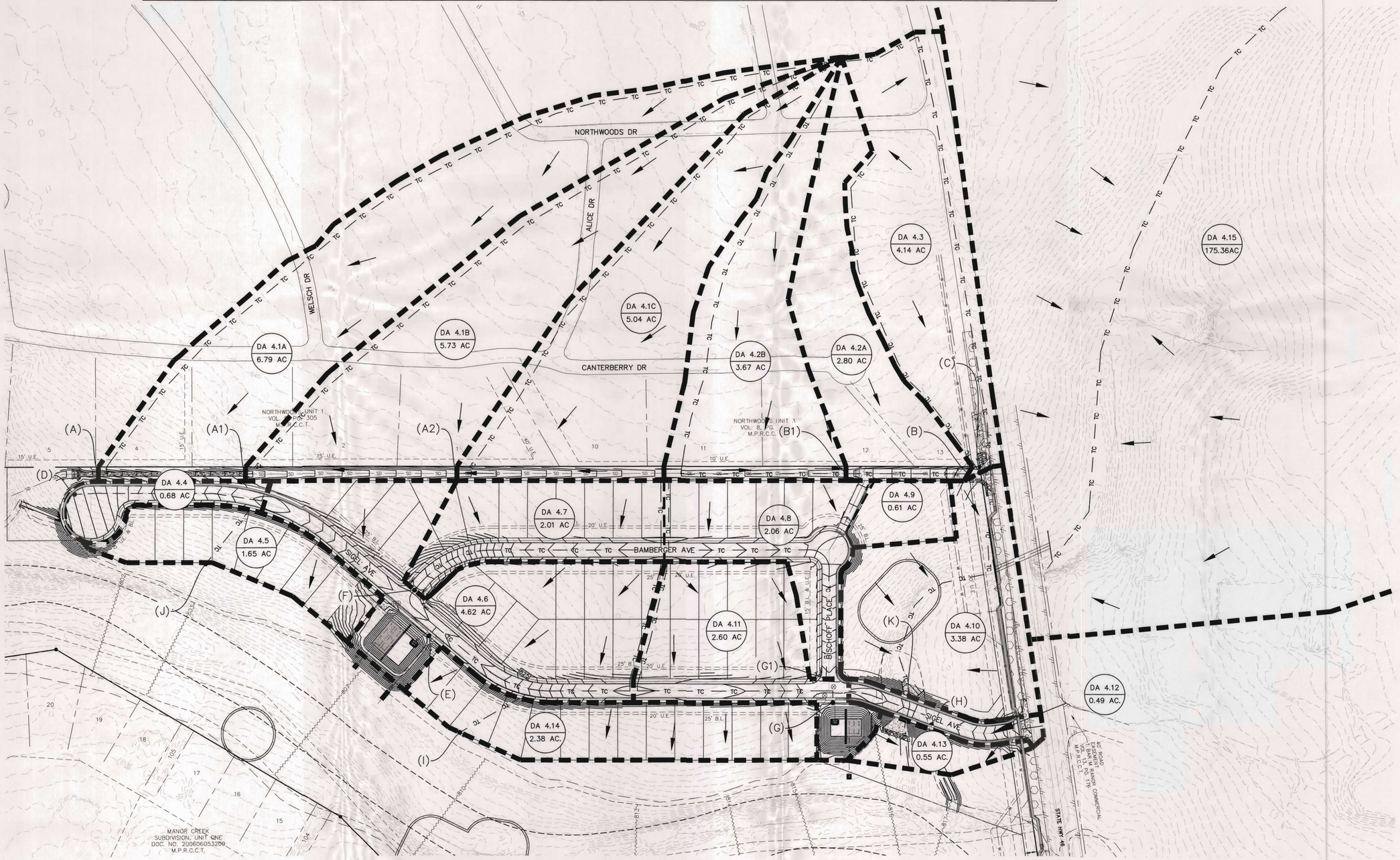
Table 2 - Manor Creek Unit 4 Proposed Conditions Hydrology Calculations

Point of Concentration	Area	Area	"C" Value	Tc	I2	I10	I25	I100	K2	K10	K25	K100	Q2	Q10	Q25	Q100
A	DA 4.1A, DA 4.1B DA 4.1C	17.56	0.53	26	3.09	4.76	5.76	7.54	1.00	1.00	1.10	1.25	28.73	44.28	58.93	87.75
A1	DA 4.1A & DA 4.1B	10.77	0.53	23	3.33	5.12	6.18	8.10	1.00	1.00	1.10	1.25	19.03	29.23	38.83	57.80
A2	DA 4.1C	5.04	0.53	19	3.67	5.62	6.77	8.87	1.00	1.00	1.10	1.25	9.80	15.00	19.89	29.62
B	DA 4.2A & DA 4.2B	6.47	0.53	19	3.66	5.60	6.75	8.84	1.00	1.00	1.10	1.25	12.54	19.20	25.46	37.90
C	DA 4.2A +DA 4.2B+4.3	10.61	0.53	19	3.66	5.60	6.75	8.84	1.00	1.00	1.10	1.25	20.56	31.48	41.75	62.16
C (Culvert)	DA 4.3	4.14	0.53	15	4.08	6.24	7.51	9.85	1.00	1.00	1.10	1.25	8.96	13.70	18.13	27.02
D	DA 4.4	0.68	0.53	15	4.13	6.32	7.60	9.97	1.00	1.00	1.10	1.25	1.49	2.28	3.01	4.49
E	DA 4.6+4.7	6.61	0.53	15	4.13	6.32	7.60	9.97	1.00	1.00	1.10	1.25	14.47	22.13	29.28	43.64
F	DA 4.7	2.01	0.53	15	4.13	6.32	7.60	9.97	1.00	1.00	1.10	1.25	4.40	6.73	8.90	13.27
G	DA 4.8+4.11	4.64	0.53	15	4.13	6.32	7.60	9.97	1.00	1.00	1.10	1.25	10.16	15.53	20.55	30.64
G1	DA 4.8	2.04	0.53	15	4.13	6.32	7.60	9.97	1.00	1.00	1.10	1.25	4.47	6.83	9.04	13.47
H	DA 4.12	0.49	0.53	15	4.13	6.32	7.60	9.97	1.00	1.00	1.10	1.25	1.07	1.64	2.17	3.24
I	DA 4.14	2.38	0.53	15	4.13	6.32	7.60	9.97	1.00	1.00	1.10	1.25	5.21	7.97	10.54	15.71
J	DA 4.5	1.65	0.53	15	4.13	6.32	7.60	9.97	1.00	1.00	1.10	1.25	3.61	5.52	7.31	10.89
SCS METHOD																
K	DA 4.2+4.3+4.9+4.10+4.12+4.13+DA 4.15	189.98											244.40	631.60	829.30	1098.20



0 50 100 200
HORIZONTAL SCALE: 1:100

LEGEND

- EXISTING CONTOURS
- PROPOSED CONTOURS
- B.L. BUILDING SETBACK LINE
- U.E. UTILITY EASEMENT
- D.E. DRAINAGE EASEMENT
- DRAINAGE AREA
- TC — TC TIME OF CONCENTRATION
- (A) POINT OF CONCENTRATION
- DRAINAGE FLOW DIRECTION
- DA / ACRES DRAINAGE AREA LABEL

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Chris Van Heerde, P.E.

5/13/16

PROPOSED DRAINAGE AREA MAP

MANOR CREEK, UNIT 4
CIVIL SITE CONSTRUCTION PLANS

DR HORTON
210 W. HUTCHISON STREET
SAN MARCOS, TEXAS 78666

CIVIL SITE CONSTRUCTION PLANS

DATE: MAY 2016
DRAWN BY: KRK
DESIGNED BY: GJM
CHECKED BY: CVH
REVIEWED BY: SWH & SCH
PROJECT NO.: 031.023.106

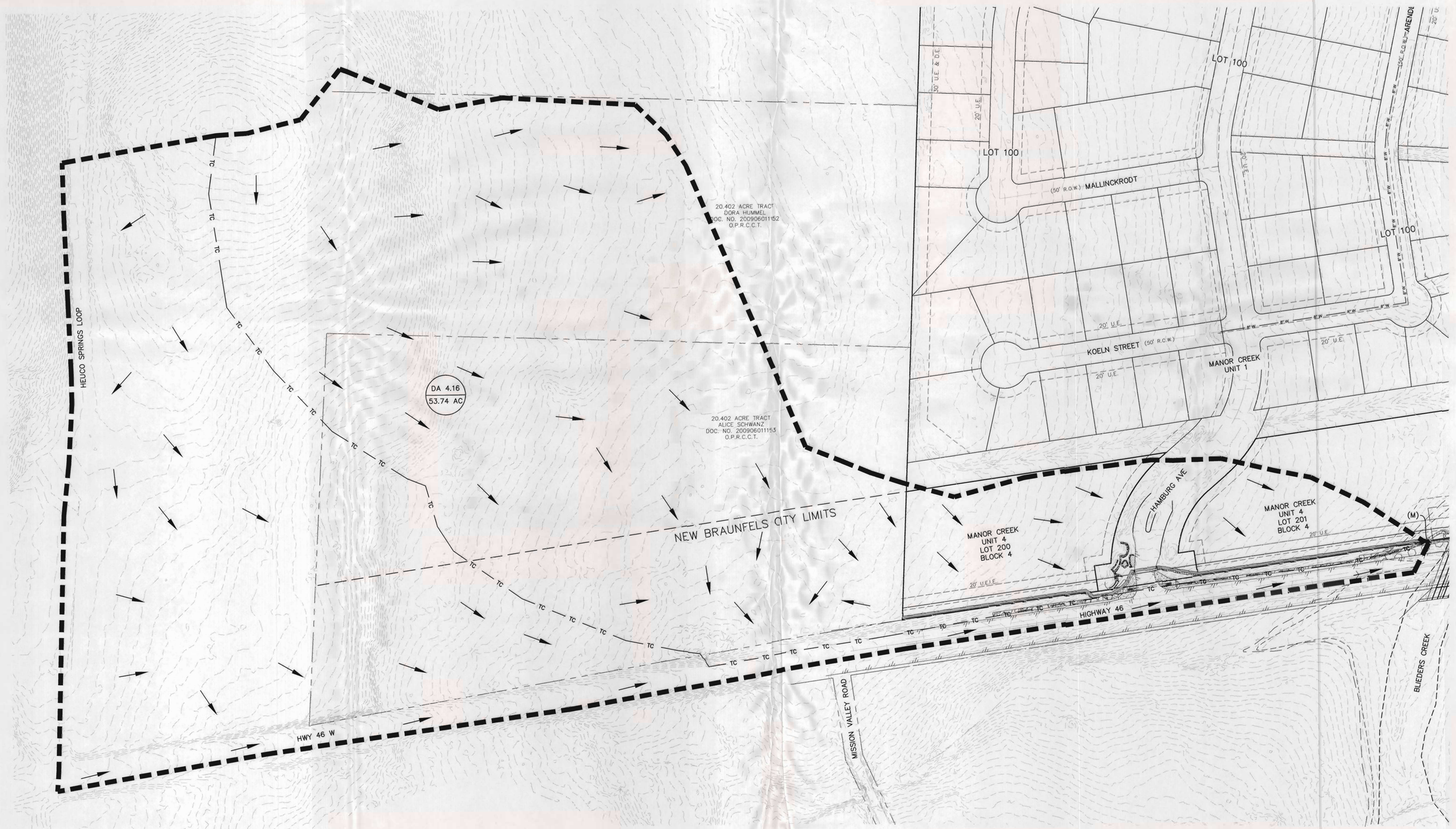
SHEET 11

Drawing Name: N:_Projects\031 - DR Horton\031.023 - Manor Creek Unit 4\031.023.106 - Construction Documents\031.023.106-DPAC.dwg User: gonrattm May 13, 2016 - 11:36am

Table 1 - Manor Creek Unit 4 Sidewalk Bridge Ultimate Conditions Hydrology Calculations-TxDOT METHOD												
Point of Concentration	Area	Area	"C" Value	Tc	I2	I10	I25	I100	Q2	Q10	Q25	Q100
M	DA 4.16	53.74	0.44	47.37	2.12	3.28	3.28	5.16	50.07	77.46	77.46	122.08

0 50 100 200
HORIZONTAL SCALE: 1:100

LEGEND
- 700 — EXISTING CONTOURS
- 700 — PROPOSED CONTOURS
- B.L. BUILDING SETBACK LINE
- U.E. UTILITY EASEMENT
- D.E. DRAINAGE EASEMENT
- DRAINAGE AREA
- TC — TC — TIME OF CONCENTRATION
- (A) POINT OF CONCENTRATION
- DRAINAGE FLOW DIRECTION
- DA / ACRES DRAINAGE AREA LABEL



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PROPOSED SIDEWALK BOX DRAINAGE AREA MAP

CIVIL SITE CONSTRUCTION PLANS

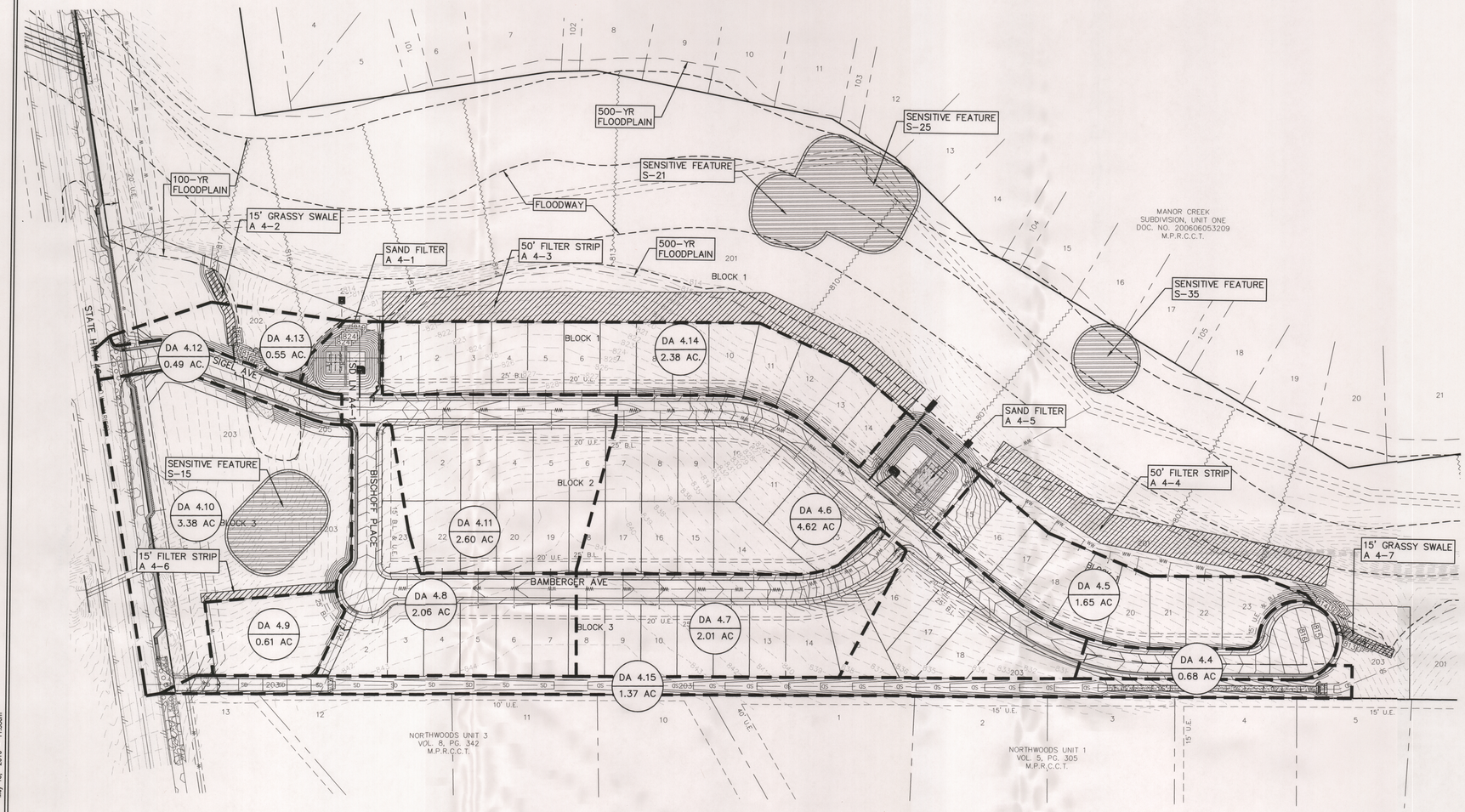
MANOR CREEK, UNIT 4
CIVIL SITE CONSTRUCTION PLANS

DR HORTON
210 W. HUTCHISON STREET
SAN MARCOS, TEXAS 78666

DATE:	MAY 2016
DRAWN BY:	TECH
DESIGNED BY:	ENGINEER
CHECKED BY:	ENGINEER
REVIEWED BY:	ENGINEER
PROJECT NO.:	031.023.106

SHEET
12

Drawing Name: N:_Projects\031 - DR Horton\031.023 - Manor Creek Unit 4\031.023.106 - Construction Documents\031.023.106-DRNG.dwg User: pprrettm May 13, 2016 - 11:56am



0 50 100
SCALE: 1" = 100'

LEGEND

- EXISTING CONTOURS
- PROPOSED CONTOURS
- B.L. BUILDING SETBACK LINE
- U.E. UTILITY EASEMENT
- D.E. DRAINAGE EASEMENT
- DRAINAGE AREA
- TC TIME OF CONCENTRATION
- DRAINAGE FLOW DIRECTION
- (A) POINT OF CONCENTRATION
- C-7 / 5.4 ac DRAINAGE AREA LABEL
- VEGETATED FILTER STRIP
- SAND FILTER BASIN
- DRAINAGE AND BUFFER AREA FOR SENSITIVE FEATURES

SENSITIVE FEATURE PROTECTION NOTES:

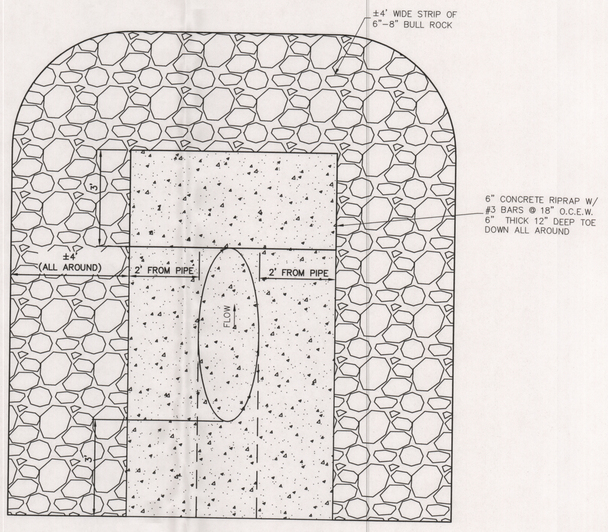
CONTRACTOR SHALL ENSURE THAT THE FOLLOWING ITEMS ASSOCIATED WITH THE SENSITIVE FEATURE PRIOR TO COMMENCING ANY CONSTRUCTION ACTIVITIES ARE IN GOOD WORKING ORDER. IF THEY ARE NOT IN ACCEPTABLE CONDITION IN THE OWNERS ESTIMATION, CONTRACTOR SHALL REPLACE OR REPAIR THESE ITEMS AS NECESSARY (AT NO ADDITIONAL EXPENSE TO OWNER):

- HIGH PERFORMANCE ROCK BERM IN LOT 203

Manor Creek Unit 4 Permanent BMP Summary Table

Subbasin Data	Area Treated	Treatment Method	Total Area (acres)	Acreage Treated	Impervious Area (acres)	Imp %	LR (lbs)	LM (lbs)	LM (lbs) Desired
A 4-1	DA 4.8+DA 4.11	Sand Filter	4.67	4.67	2.38	50.9%	2,453	2,134	2,202
A 4-2	DA 4.12	Grassy Swale	0.49	0.49	0.36	73.3%	289	322	289
A 4-3	DA 4.14	Vegetated Filter Strips	2.38	2.38	1.06	44.6%	988	952	952
A 4-4	DA 4.5	Vegetated Filter Strips	1.65	1.64	0.68	41.3%	636	612	612
A 4-5	DA 4.6+ DA 4.7	Sand Filter	6.63	6.63	3.06	46.1%	3,166	2,744	3,020
A 4-6	DA 4.9	Vegetated Filter Strips	0.61	0.61	0.08	12.4%	77	68	68
A 4-7	DA 4.4	Grassy Swale	0.68	0.68	0.55	81.1%	437	495	437
A 4-15	DA 4.15	Untreated Release	1.37	1.37	0.24	17.7%	-	217	-
Total			**18.48**	**17.10**	**8.41**	**50.0%**	**8,046**	**7,544**	**7,580**
								Required TSS Removal	7,544

NOTE: AREAS DA 4.10 AND DA 4.13 DO NOT REQUIRE PERMANENT BMPs.



PVC SPLASH PAD DETAIL

NOT-TO-SCALE

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WATER QUALITY TREATMENT

CIVIL SITE CONSTRUCTION PLANS

MANOR CREEK, UNIT 4
CIVIL SITE CONSTRUCTION PLANS

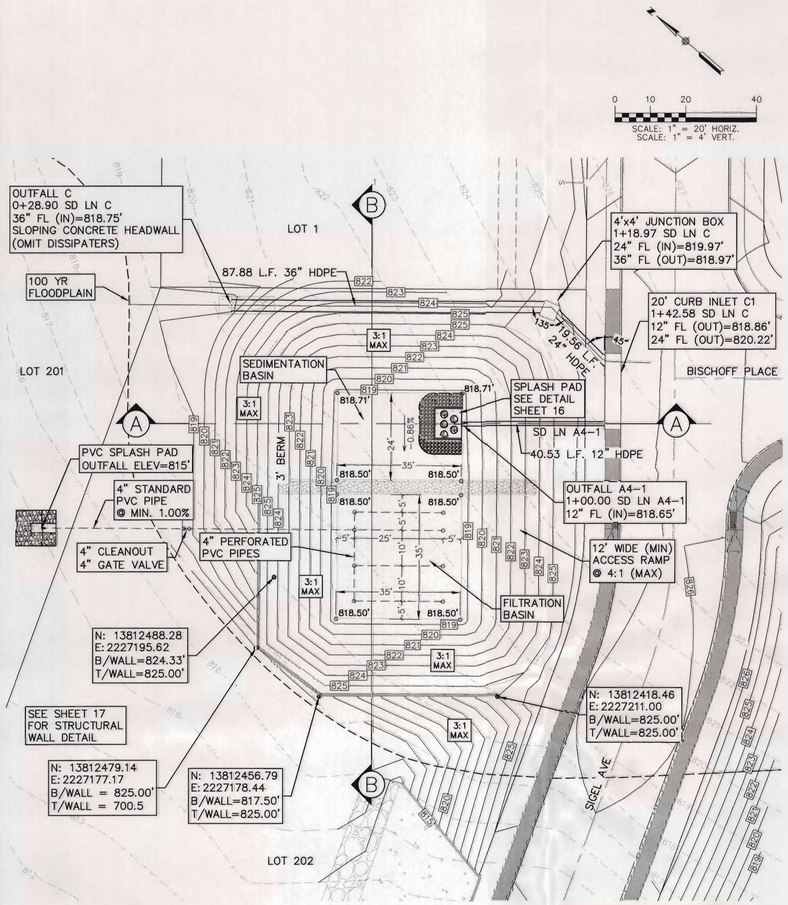
DR HORTON
210 W. HUTCHISON STREET
SAN MARCOS, TEXAS 78666

DATE: MAY 2016
DRAWN BY: KRK
DESIGNED BY: GJM
CHECKED BY: CVH
REVIEWED BY: SWH & SCH
PROJECT NO.: 031.023.106

SHEET 13

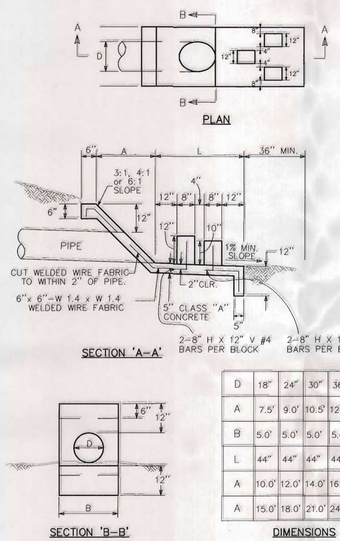
Drawing Name: N:_Projects\031 - DR Horton\031-023 - Manor Creek Unit 4\031.023.106 - Construction Documents\031.023.106-WQTY.dwg User: gonnellm May 13, 2016 - 11:58am

WATER QUALITY BASIN A4-1 DETAILS	
ITEM	QUANTITY
WQ VOLUME REQUIRED	13,585 CF
WQ VOLUME PROVIDED	20,432 CF
SEDIMENTATION AREA REQUIRED	283 SF
SEDIMENTATION AREA PROVIDED	840 SF
FILTER AREA REQUIRED	1,132 SF
FILTER AREA PROVIDED	1,225 SF
WQ STORAGE DEPTH	5.06 FEET
TSS REMOVED	2,681 LBS



1 SAND FILTER BASIN A4-1 PLAN

SCALE: Horz. 1:20 Vert. 1:4

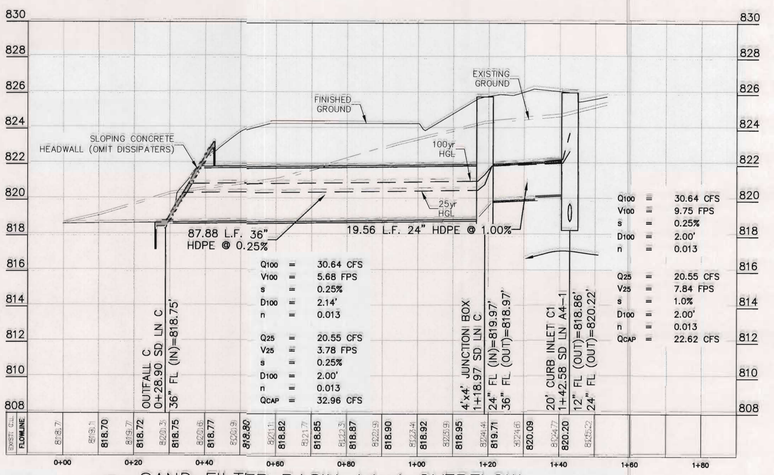


D	18"	24"	30"	36"	42"	for 3:1
A	7.5'	9.0'	10.5'	12.0'	13.5'	
B	5.0'	5.0'	5.0'	5.0'	5.0'	
L	44"	44"	44"	44"	44"	
A	10.0'	12.0'	14.0'	16.0'	18.0'	for 4:1
A	15.0'	18.0'	21.0'	24.0'	27.0'	for 6:1

DIMENSIONS

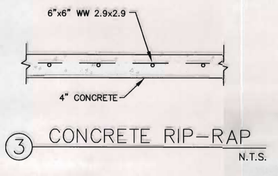
2 SLOPING CONCRETE HEADWALL

N.T.S.



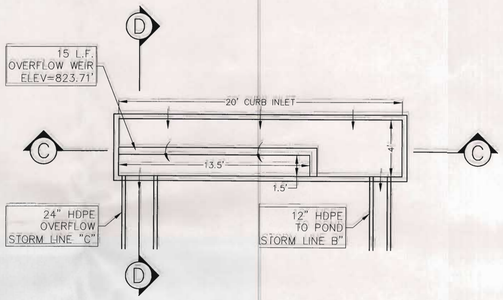
5 SAND FILTER BASIN A4-1 OVERFLOW

SCALE: Horz. 1:20 Vert. 1:4



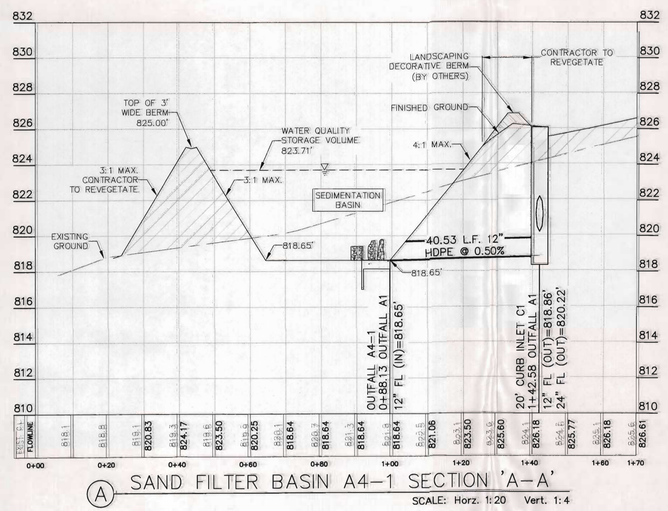
3 CONCRETE RIP-RAP

N.T.S.



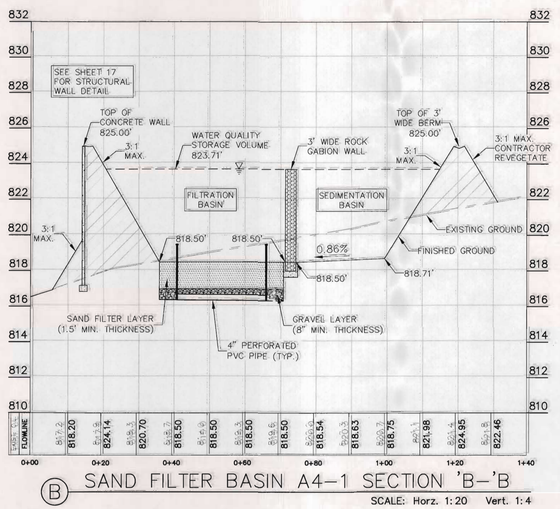
4 OVERFLOW WEIR PLAN

SCALE: 1:5



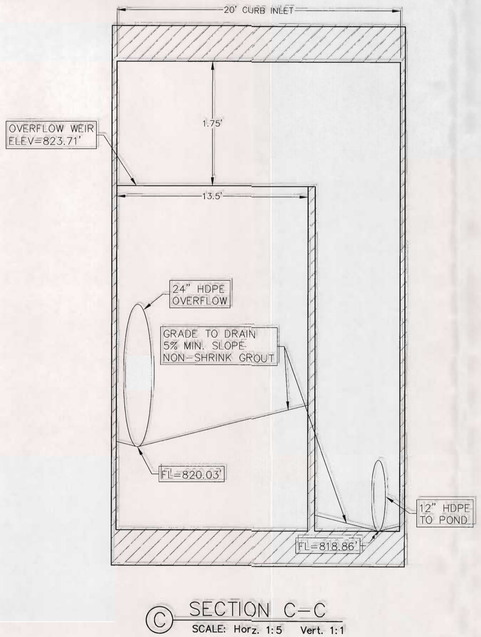
A SAND FILTER BASIN A4-1 SECTION 'A-A'

SCALE: Horz. 1:20 Vert. 1:4



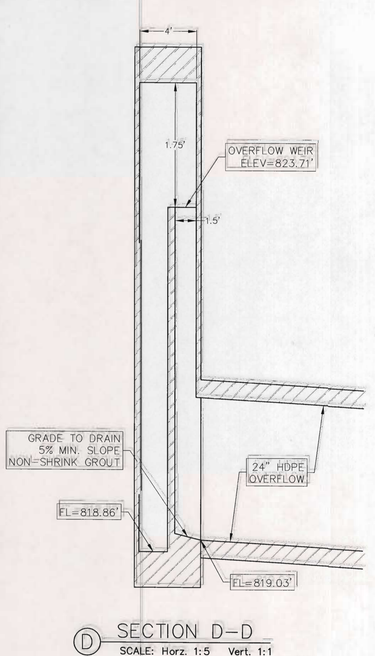
B SAND FILTER BASIN A4-1 SECTION 'B-B'

SCALE: Horz. 1:20 Vert. 1:4



C SECTION C-C

SCALE: Horz. 1:5 Vert. 1:1



D SECTION D-D

SCALE: Horz. 1:5 Vert. 1:1

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SAND FILTER BASIN A4-1 CIVIL SITE CONSTRUCTION PLANS

MANOR CREEK, UNIT 4
CIVIL SITE CONSTRUCTION PLANS

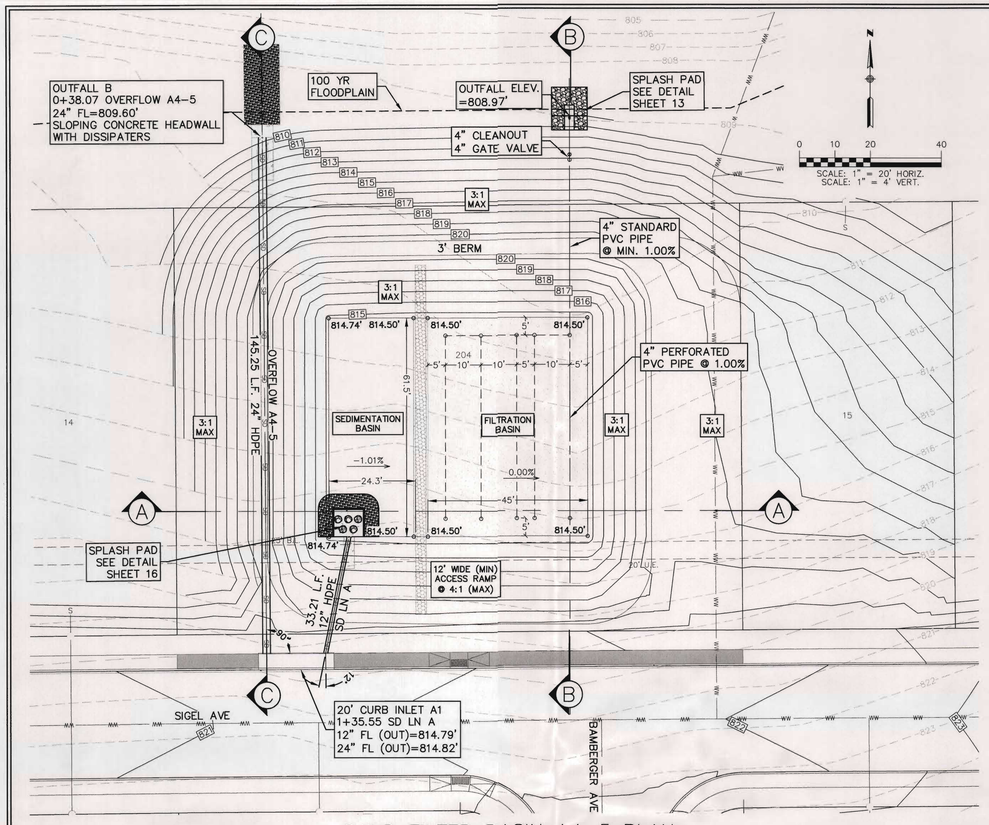
DR HORTON
210 W. HUTCHISON STREET
SAN MARCOS, TEXAS 78666

DATE:	MAY 2016
DRAWN BY:	TJB
DESIGNED BY:	CJM
CHECKED BY:	CVH
REVIEWED BY:	SWH & SCH
PROJECT NO.:	031.023.106

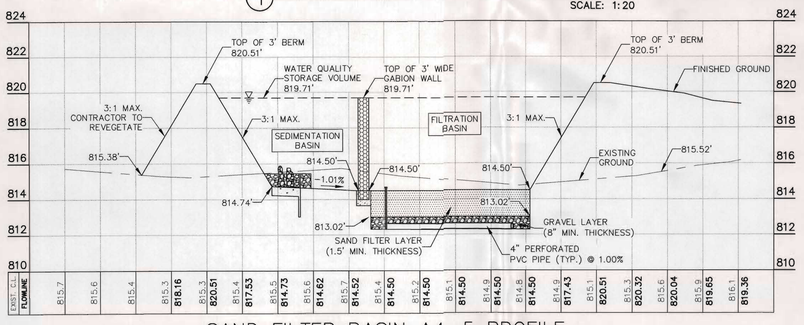
SHEET 14

Drawing Name: N:_Projects\031 - BH Horton\031.023 - Manor Creek Unit 4\031.023.106 - Construction Documents\031.023.106-WQTY.dwg User: cathymm Nov 18, 2016 - 11:08am

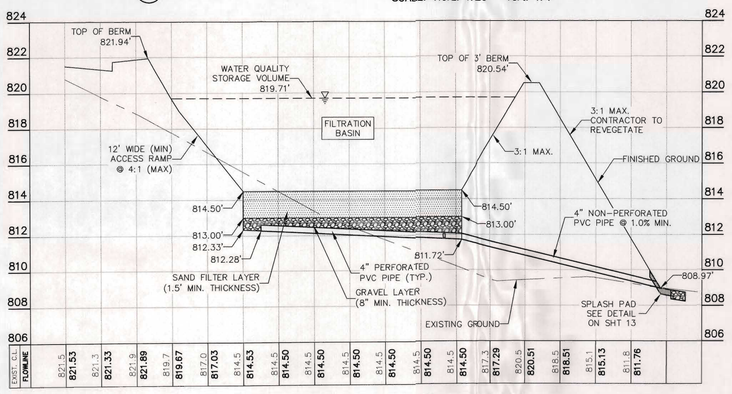
WATER QUALITY BASIN A4-5 DETAILS	
ITEM	QUANTITY
WQ VOLUME REQUIRED	32,805 CF
WQ VOLUME PROVIDED	34,286 CF
SEDIMENTATION AREA REQUIRED	683 SF
SEDIMENTATION AREA PROVIDED	1,494 SF
FILTER AREA REQUIRED	2,734 SF
FILTER AREA PROVIDED	2,767 SF
WQ STORAGE DEPTH	5.21 FEET
TSS REMOVED	3,946 LBS



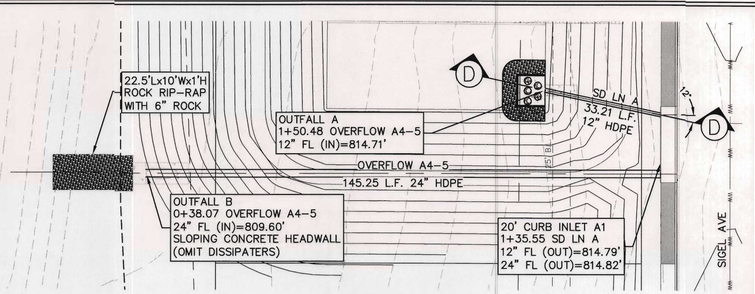
1 SAND FILTER BASIN A4-5 PLAN
SCALE: 1:20

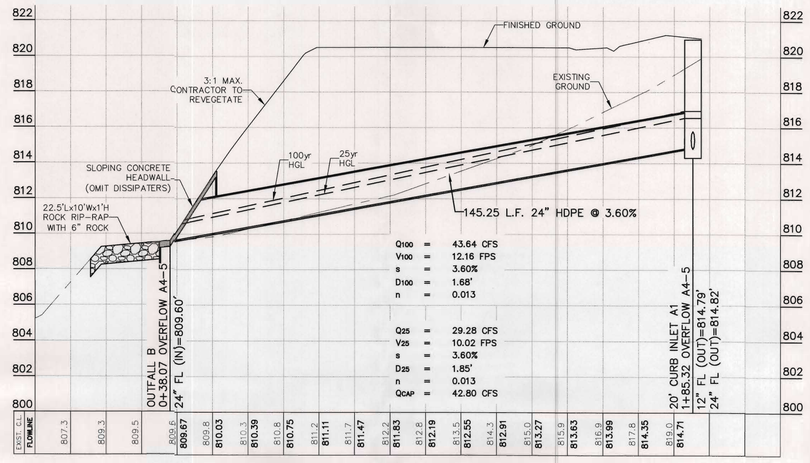


A SAND FILTER BASIN A4-5 PROFILE
SCALE: Horz. 1:20 Vert. 1:4

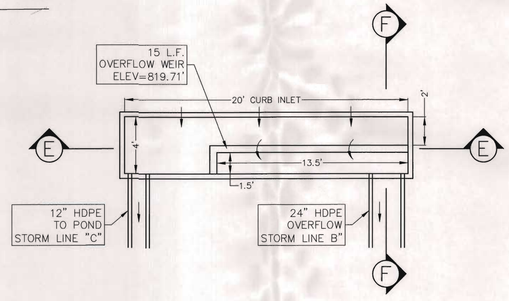


B SAND FILTER BASIN A4-5 PROFILE
SCALE: Horz. 1:20 Vert. 1:4

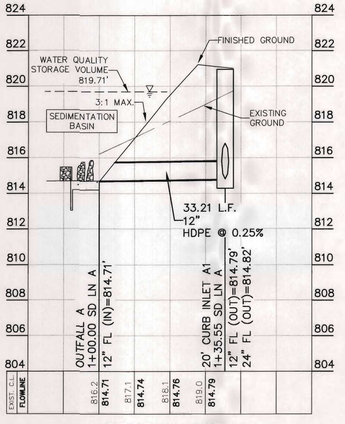




C STORM LINE B
SCALE: Horz. 1:20 Vert. 1:4



2 OVERFLOW WEIR PLAN
SCALE: 1:5



D STORM LINE A
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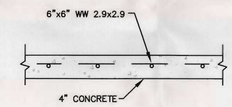
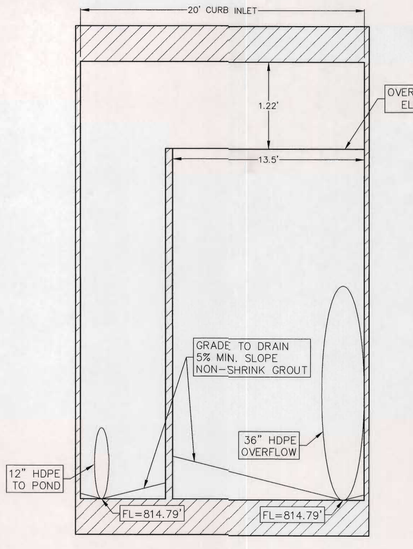
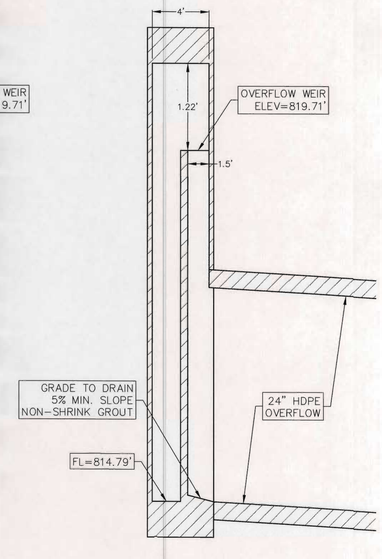


3 CONCRETE RIP-RAP
N.T.S.



E SECTION E-E
SCALE: Horz. 1:5 Vert. 1:1



F SECTION F-F
SCALE: Horz. 1:5 Vert. 1:1

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SAND FILTER BASIN A4-5

CIVIL SITE CONSTRUCTION PLANS

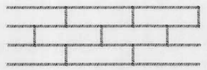
MANOR CREEK, UNIT 4
CIVIL SITE CONSTRUCTION PLANS

DR HORTON
210 W. HUTCHISON STREET
SAN MARCOS, TEXAS 78666

DATE: MAY 2016
DRAWN BY: TJB
DESIGNED BY: GJM
CHECKED BY: CVH
REVIEWED BY: SWH & SCH
PROJECT NO.: 031.023.106

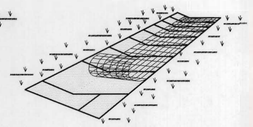
SHEET 15

Drawing Name: N:_Projects\031 - DR Horton\031.023 - Manor Creek Unit 4\031.023.106 - Construction Documents\031.023.106-WDT.dwg User: cathynm Nov 18, 2016 - 11:08am

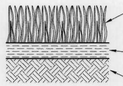


LAY SOD IN A STAGGERED PATTERN. BUTT THE STRIPS TIGHTLY AGAINST EACH OTHER. DO NOT LEAVE SPACES AND DO NOT OVERLAP. A SHARPENED MASON'S TROWEL IS A HANDY TOOL FOR TUCKING DOWN THE ENDS AND TRIMMING PIECES.

BUTTING – ANGLED ENDS CAUSED BY THE AUTOMATIC SOD CUTTER MUST BE MATCHED CORRECTLY.



IN CRITICAL AREAS, SECURE SOD WITH NETTING. USE STAPLES.

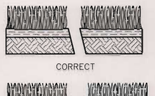


APPEARANCE OF GOOD SOD

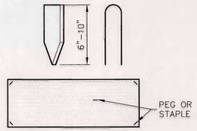
NOTES:
1. ROLL SOD IMMEDIATELY TO ACHIEVE FIRM CONTACT WITH THE SOIL.

2. WATER TO A DEPTH OF 4" AS NEEDED. WATER WELL AS SOON AS THE SOD IS LAID.

3. MOW WHEN THE SOD IS ESTABLISHED – IN 2–3 WEEKS. SET THE MOWER HIGH (2"–3").



SOD INSTALLATION



USE PEGS OR STAPLES TO FASTEN SOD FIRMLY – AT THE ENDS OF STRIPS AND IN THE CENTER, OR EVERY 3–4 FEET IF THE STRIPS ARE LONG. WHEN READY TO MOW, DRIVE PEGS OR STAPLES FLUSH WITH THE GROUND.

MATERIALS

1. SOD SHOULD BE MACHINE CUT AT A UNIFORM SOIL THICKNESS OF 3/4" INCH (± 1/4" INCH) AT THE TIME OF CUTTING. THIS THICKNESS SHOULD EXCLUDE SHOOT GROWTH AND THATCH.

2. PIECES OF SOD SHOULD BE CUT TO THE SUPPLIER'S STANDARD WIDTH AND LENGTH, WITH A MAXIMUM ALLOWABLE DEVIATION IN ANY DIMENSION OF 5%. TORN OR UNEVEN PADS SHOULD NOT BE ACCEPTABLE.

3. STANDARD SIZE SECTIONS OF SOD SHOULD BE STRONG ENOUGH TO SUPPORT THEIR OWN WEIGHT AND RETAIN THEIR SIZE AND SHAPE WHEN SUSPENDED FROM A FIRM GRASP ON ONE END OF THE SECTION.

4. SOD SHOULD BE HARVESTED, DELIVERED, AND INSTALLED WITHIN A PERIOD OF 36 HOURS.

SITE PREPARATION

1. PRIOR TO SOIL PREPARATION, AREAS TO BE SODDED SHOULD BE BROUGHT TO FINAL GRADE IN ACCORDANCE WITH THE APPROVED PLAN.

2. THE SURFACE SHOULD BE CLEARED OF ALL TRASH, DEBRIS AND OF ALL ROOTS, BRUSH, WIRE, GRADE STAKES AND OTHER OBJECTS THAT WOULD INTERFERE WITH PLANTING, FERTILIZING OR MAINTENANCE OPERATIONS.

3. FERTIRLIZE ACCORDING TO SOIL TESTS. FERTILIZER NEEDS CAN BE DETERMINED BY A SOIL TESTING LABORATORY OR REGIONAL RECOMMENDATIONS CAN BE MADE BY COUNTY AGRICULTURAL EXTENSION AGENTS. FERTILIZER SHOULD BE WORKED INTO THE SOIL TO A DEPTH OF 3 INCHES WITH A DISC, SPRINGTOOTH HARROW OR OTHER SUITABLE EQUIPMENT. ON SLOPING LAND, THE FINAL HARROWING OR DISCING OPERATION SHOULD BE ON THE CONTOUR.

INSTALLATION IN CHANNELS

1. SOD STRIPS IN WATERWAYS SHOULD BE LAID PERPENDICULAR TO THE DIRECTION OF FLOW. CARE SHOULD BE TAKEN TO BUTT ENDS OF STRIPS TIGHTLY (SEE FIGURE ABOVE).

2. AFTER ROLLING OR TAMPING, SOD SHOULD BE PEGGED OR STAPLED TO RESIST WASHOUT DURING THE ESTABLISHMENT PERIOD. MESH OR OTHER NETTING MAY BE PEGGED OVER THE SOD FOR EXTRA PROTECTION IN CRITICAL AREAS.

GENERAL INSTALLATION (VA. DEPT. OF CONSERVATION, 1992)

1. SOD SHOULD NOT BE CUT OR LAID IN EXCESSIVELY WET OR DRY WEATHER. SOD ALSO SHOULD NOT BE LAID ON SOIL SURFACES THAT ARE FROZEN.

2. DURING PERIODS OF HIGH TEMPERATURE, THE SOIL SHOULD BE LIGHTLY IRRIGATED IMMEDIATELY PRIOR TO LAYING THE SOD, TO COOL THE SOIL AND REDUCE ROOT BURNING AND DIEBACK.

3. THE FIRST ROW OF SOD SHOULD BE LAID IN A STRAIGHT LINE WITH SUBSEQUENT ROWS PLACED PARALLEL TO AND BUTTING TIGHTLY AGAINST EACH OTHER. LATERAL JOINTS SHOULD BE STAGGERED TO PROMOTE MORE UNIFORM GROWTH AND STRENGTH. CARE SHOULD BE EXCERCISED TO ENSURE THAT SOD IS NOT STRETCHED OR OVERLAPPED AND THAT ALL JOINTS ARE BUTTED TIGHT IN ORDER TO PREVENT VOIDS WHICH WOULD CAUSE DRYING OF THE ROOTS (SEE FIGURE ABOVE).

4. ON SLOPES 3:1 OR GREATER, OR WHEREVER EROSION MAY BE A PROBLEM, SOD SHOULD BE LAID WITH STAGGERED JOINTS AND SECURED BY STAPLING OR OTHER APPROVED METHODS. SOD SHOULD BE INSTALLED WITH THE LENGTH PERPENDICULAR TO THE SLOPE (ON CONTOUR).

5. AS SODDING OF CLEARLY DEFINED AREAS IS COMPLETED, SOD SHOULD BE ROLLED OR TAMPED TO PROVIDE FIRM CONTACT BETWEEN ROOTS AND SOIL.

6. AFTER ROLLING, SOD SHOULD BE IRRIGATED TO A DEPTH SUFFICIENT THAT THE UNDERSIDE OF THE SOD PAD AND THE SOIL 4 INCHES BELOW THE SOD IS THOROUGLY WET.

7. UNTIL SUCH TIME A GOOD ROOT SYSTEM BECOMES DEVELOPED, IN THE ABSENCE OF ADEQUATE RAINFALL, WATERING SHOULD BE PERFORMED AS OFTEN AS NECESSARY TO MAINTAIN MOIST SOIL TO A DEPTH OF AT LEAST 4 INCHES.

8. THE FIRST MOWING SHOULD NOT BE ATTEMPTED UNTIL THE SOD IS FIRMLY ROOTED, USUALLY 2–3 WEEKS. NOT MORE THAN ONE THIRD OF THE GRASS LEAF SHOULD BE REMOVED AT ANY ONE CUTTING.

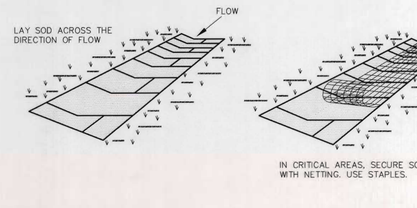
INSPECTION AND MAINTENANCE GUIDELINES

1. SOD SHOULD BE INSPECTED WEEKLY AND AFTER EACH RAIN EVENT TO LOCATE AND REPAIR ANY DAMAGE.

2. DAMAGE FROM STORMS OR NORMAL CONSTRUCTION ACTIVITIES SUCH AS TIRE RUTS OR DISTURBANCE OF SWALE STABILIZATION SHOULD BE REPAIRED AS SOON AS PRACTICAL.

SOD INSTALLATION DETAIL

NOT–TO–SCALE

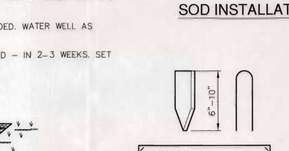


NOTES:
1. VALVE WILL BE SET **PARTIALLY CLOSED** SO AS TO PROVIDE A MINIMUM DRAWDOWN TIME OF 24 HOURS.

2. CONTRACTOR SHALL PROVIDE OWNER WITH VALVE OPERATING KEY/ROD PRIOR TO PROJECT COMPLETION.

4" GATE & FLAPPER VALVE DETAIL

NOT–TO–SCALE



NOTES:
1. LINER AND PROTECTIVE GEOTEXTILE FABRIC, ARE TO BE INSTALLED PER MANUFACTURER'S SPECIFICATIONS.

2. GEOMEMBRANE LINER SHALL HAVE A MINIMUM THICKNESS OF FORTY–FIVE (45) MILS.

3. SELECTION OF FINAL LINER WILL BE IDENTIFIED IN CERTIFICATION LETTER TO TCEQ AFTER COMPLETION OF BASIN CONSTRUCTION.

LINER DETAIL

NOT–TO–SCALE

GEOMEMBRANE POLY LINER

– ULTRAVIOLET RESISTANT

– THICKNESS = 45 MILS MINIMUM

– JOINTS SHALL BE WATER TIGHT AT SEAMS

– ANCHOR TO WALLS

– WATERTIGHT SEAL BETWEEN POLY LINER AND TRANSITION SURFACES

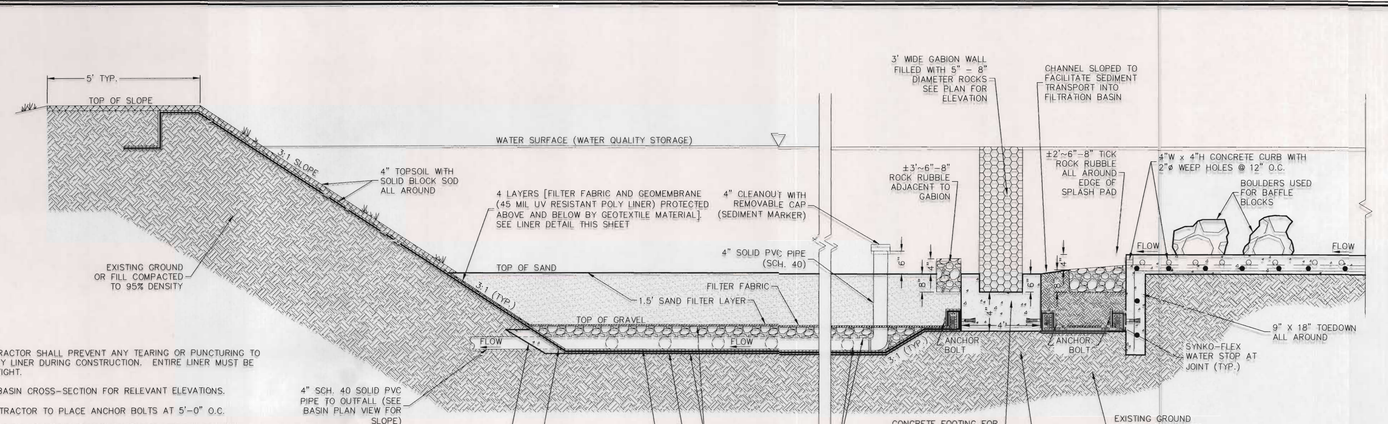
– BEDDING MATERIAL SHALL BE SUITABLY COMPACTED MATERIAL (NOT SAND) IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS

– PROTECTIVE GEOTEXTILE FABRIC TO BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS

CLAY LINER SPECIFICATIONS (ALTERNATE FOR GEOMEMBRANE POLY LINER)

PROPERTY	TEST METHOD	SPECIFICATION
CLAY COMPACTION (%)	ASTM D 2434	
PLASTICITY INDEX OF CLAY (%)	ASTM D 423/D 424	NOT LESS THAN 15
PERMEABILITY (CM/SEC)	ASTM D 2216	NOT LESS THAN 30
CLAY PARTICLES PASSING (%)	ASTM D 422	NOT LESS THAN 30
LIQUID LIMIT OF CLAY (%)	ASTM D 2216	95% OF STANDARD PROCTOR DENSITY

NOTES:
1. THE CLAY LINER SHALL HAVE A MINIMUM THICKNESS OF TWELVE (12) INCHES.



NOTES:
1. CONTRACTOR SHALL PREVENT ANY TEARING OR PUNCTURING TO THE POLY LINER DURING CONSTRUCTION. ENTIRE LINER MUST BE WATER TIGHT.

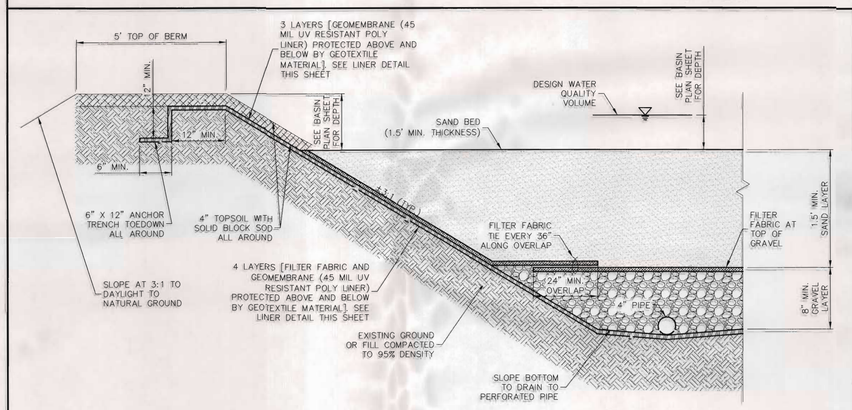
2. SEE BASIN CROSS–SECTION FOR RELEVANT ELEVATIONS.

3. CONTRACTOR TO PLACE ANCHOR BOLTS AT 5'–0" O.C.

4. IN ORDER TO SECURE FILTER FABRIC TO SIDEWALLS WITH GEOMEMBRANE/GEOTEXTILE LAYERS, IT IS RECOMMENDED THAT THE CONTRACTOR INSTALL A LENGTH OF FILTER FABRIC WITH THE OTHER LAYERS SUCH THAT SUBSEQUENT LAYERS CAN BE OVERLAPPED AND TIED TO THE EXPOSED FILTER FABRIC. THIS WILL PROVIDE FOR EASIER MAINTENANCE IN THE FUTURE WITHOUT DESTROYING CONCRETE OR WATER TIGHT LINER.

CROSS–SECTION DETAIL

NOT–TO–SCALE



GEOTEXTILE FABRIC SPECIFICATIONS (COA, 2004)

PROPERTY	TEST METHOD	UNIT	SPECIFICATION (MIN.)
UNIT WEIGHT	ASTM D–5261	oz/yd²	8
FILTRATION RATE	ASTM D–4491	in/sec	0.08
PUNCTURE STRENGTH	ASTM D–751*	lbs.	125
MULLEN BURST STRENGTH	ASTM D–3786	psi	400
TENSILE STRENGTH	ASTM D–4632	lbs.	200
EQUIV. OPENING SIZE	US STANDARD SIEVE	No.	80

*MODIFIED

NOTES:
1. THE GEOMEMBRANE LINER SHALL HAVE A MINIMUM THICKNESS OF 30 MILS (40 MILS, RECOMMENDED) AND BE ULTRAVIOLET RESISTANT.

2. INSTALLATION METHODS FOR GEOMEMBRANE LINERS VARY ACCORDING TO THE SITE REQUIREMENTS. INSTALLATION SHALL BE IN ACCORDANCE WITH MANUFACTURERS SPECIFICATIONS.

SAND FILTER CROSS SECTION

NOT–TO–SCALE

SAND & GRAVEL SPECIFICATIONS

SAND FILTER MATERIAL SHALL BE ASTM C33 0.0165 IN (#40 SIEVE) TO 0.0469 IN (#16 SIEVE) WASHED SAND.

ROCK FOR GRAVEL LAYER SHALL BE 1/2" TO 1" DIAMETER WASHED GRAVEL.

NOTES TO CONTRACTOR (EACH PHASE OF BASIN CONSTRUCTION)

1. CONTRACTOR IS ADVISED THAT TCEQ DOES NOT ALLOW CHANGES TO PERMANENT POLLUTION ABATEMENT MEASURES WITHOUT THEIR PRIOR APPROVAL.

2. CONTRACTOR SHALL NOTIFY CERTIFYING ENGINEER WHEN BASIN CONSTRUCTION HAS PROGRESSED TO THE FOLLOWING MILESTONES:

a.) REINFORCING STEEL FOR BASIN WALL OR RIPRAP LINER HAS BEEN SET, CONCRETE HAS NOT BEEN PLACED AND DRAIN PIPE IS IN PLACE WHERE EPDM LINER IS USED, CONTRACTOR SHALL PROVIDE ENGINEER WITH SURVEY DATA WHICH DEMONSTRATES THE LINER HAS BEEN SET AT PROPER ELEVATION AND GRADE.

b.) CONCRETE RIPRAP OR EPDM LINER IS IN PLACE AND UNDER–DRAIN SYSTEM IS IN PLACE WITHOUT GRAVEL.

c.) GRAVEL AROUND UNDER–DRAIN SYSTEM IS IN PLACE AND FILTER FABRIC IS INSTALLED AND ATTACHED TO WALLS OR RIPRAP.

d.) SAND FILTER MEDIA HAS BEEN PLACED & BASIN HAS BEEN COMPLETELY FINISHED INCLUDING SOD OR SEED PLACEMENT ON SIDE SLOPES (WHERE APPLICABLE).

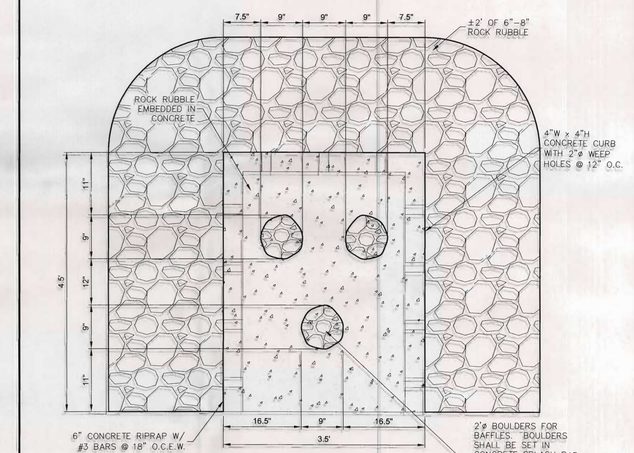
3. WORK SHALL NOT CONTINUE ON THE BASIN UNTIL THE ENGINEER HAS HAD AN OPPORTUNITY TO OBSERVE THE STATUS OF CONSTRUCTION AT EACH STAGE. CONTRACTOR SHALL PROVIDE ENGINEER A MINIMUM OF 24 HOURS ADVANCE NOTICE PRIOR TO TIME THE BASIN WILL BE AT THE REQUIRED STAGE.

4. UPON SUBSTANTIAL COMPLETION, OR AS REQUESTED BY ENGINEER, CONTRACTOR TO PROVIDE CERTIFYING ENGINEER WITH FIELD SHOTS VERIFYING ELEVATIONS OF THE FOLLOWING:

– TOP OF BANK/WALL AT EACH CORNER OF BASIN
– TOE OF SLOPE AT EACH CORNER OF BASIN (INSIDE BASIN TOE)
– SPLASH PAD/INLET PIPES
– OVERFLOW WEIRS

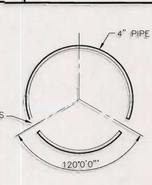
5. BEFORE FINAL ACCEPTANCE OF CONSTRUCTION BY THE OWNER, THE CONTRACTOR WILL REMOVE ALL TRASH, DEBRIS, AND ACCUMULATED SILT FROM THE BASINS AND REESTABLISH THEM TO THE PROPER OPERATING CONDITION.

6. THE MINIMUM DRAIN TIME FOR A FULL BASIN IS 24 HOURS. THE CONTRACTOR SHALL RESTRICT THE FLOW THROUGH THE BASIN BY ADJUSTING THE GATE VALVE ON THE DISCHARGE PIPE SO AS TO PROVIDE THE MINIMUM 24 HOUR DRAW–DOWN TIME.



SPLASH PAD DETAIL

NOT–TO–SCALE



NOTES:
1. MINIMUM DIAMETER = 4 INCHES; SCHEDULE 40 PVC, UNLESS NOTED OTHERWISE.

2. THE MAXIMUM SPACING BETWEEN ROWS OF PERFORATIONS SHOULD NOT EXCEED 6".

3. SET PERFORATIONS IN THE BOTTOM 1/3 OF PIPE.

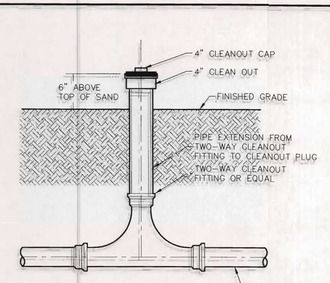
4. PERFORATIONS SHOULD BE LESS THAN A 1/2".

5. PIPES SHOULD LIE FLAT ON LINER BOTTOM WHICH HAS BEEN GRADED TO DRAIN AS SHOWN ON PLAN VIEW.

6. ALL CLEANOUTS SHALL BE SOLID PIPE AND SHALL BE AT THE END OF EACH LINE.

4" PERFORATED PIPE DETAIL

NOT–TO–SCALE



(DUAL DIRECTION)

CLEANOUT DETAIL

NOT–TO–SCALE

410 N. SEGUIN AVE.
NEW BRAUNFELS,
TEXAS 78130
PH.:(830)625–8555
FAX.:(830)625–8556
www.HMTNB.com
TBPE FIRM F–10961

HMT ENGINEERING & SURVEYING

STATE OF TEXAS
CHRISTOPHER P. VAN HEERDE
93047
LICENSED
PROFESSIONAL ENGINEER

5/13/16

WATER QUALITY TREATMENT DETAILS (1 OF 2)

CIVIL SITE CONSTRUCTION PLANS

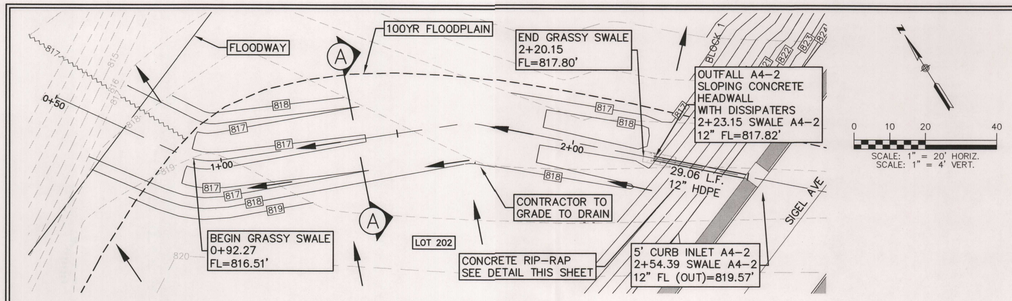
MANOR CREEK, UNIT 4
CIVIL SITE CONSTRUCTION PLANS

DR HORTON
210 W. HUTCHISON STREET
SAN MARCOS, TEXAS 78666

DATE: MAY 2016
DRAWN BY: TJB
DESIGNED BY: GJM
CHECKED BY: CVH
REVIEWED BY: SWH & SCH
PROJECT NO.: 031.023.106

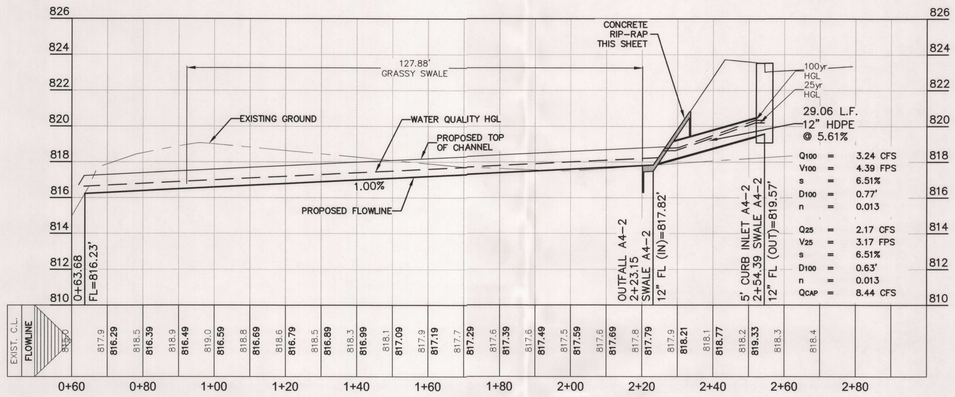
SHEET 16

Drawing Name: N:\...Projects\031 - DR Horton\031.023 - Manor Creek Unit 4\031.023.106 - Construction Documents\031.023.106-WQTY.dwg User: gonsitnm May 13, 2016 - 11:58am

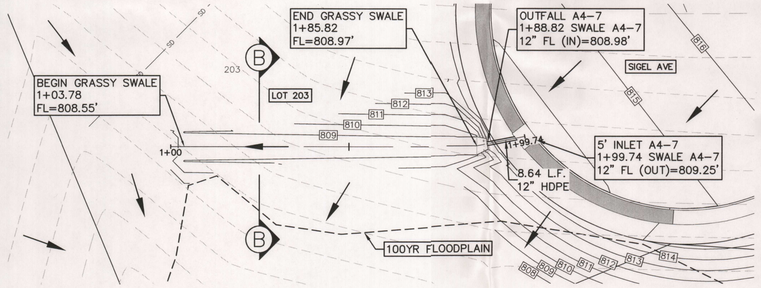


0 10 20 40
SCALE: 1" = 20' HORIZ.
SCALE: 1" = 4' VERT.

1 GRASSY SWALE A4-2 PLAN
SCALE: Horz. 1:20 Vert. 1:4

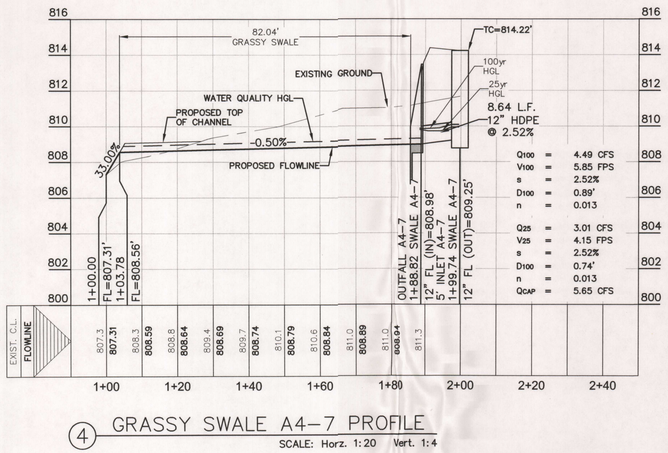


2 GRASSY SWALE A4-2 PROFILE
SCALE: Horz. 1:20 Vert. 1:4



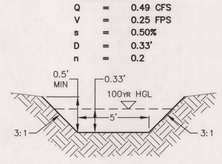
0 10 20 40
SCALE: 1" = 20' HORIZ.
SCALE: 1" = 4' VERT.

3 GRASSY SWALE A4-7 PLAN
SCALE: Horz. 1:20 Vert. 1:4



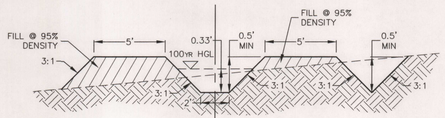
4 GRASSY SWALE A4-7 PROFILE
SCALE: Horz. 1:20 Vert. 1:4

WATER QUALITY
Q = 0.49 CFS
V = 0.25 FPS
s = 0.50%
D = 0.33'
n = 0.2



B SECTION 'B-B'
N.T.S.

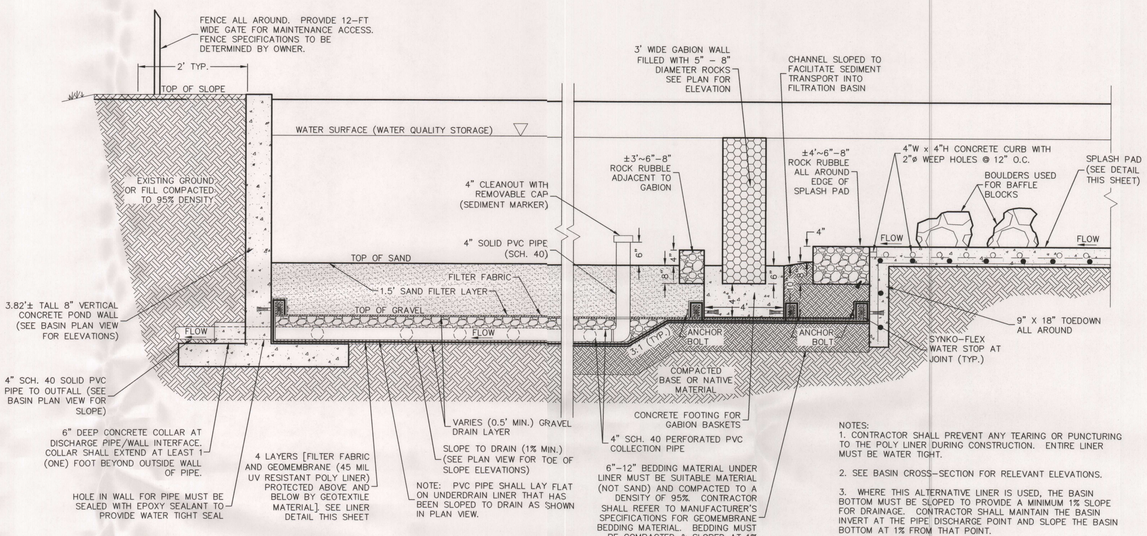
WATER QUALITY
Q = 0.34 CFS
V = 0.36 FPS
s = 1.00%
D = 0.33'
n = 0.2



A SECTION 'A-A'
N.T.S.

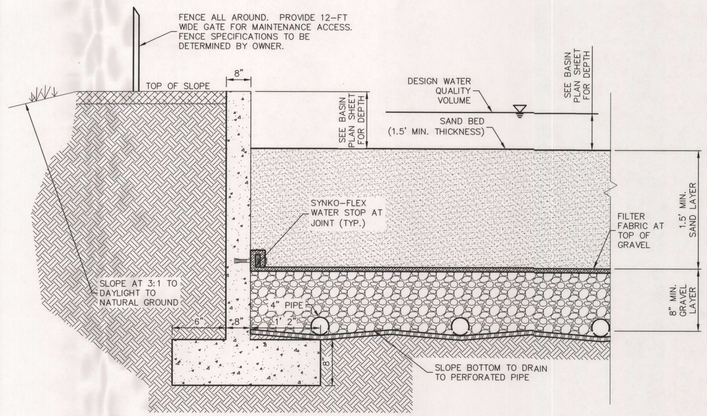
GRASSY SWALE A4-2				
	BOTTOM WIDTH	LENGTH	DEPTH	GRADE
REQUIRED	2'	107.24'	0.5'	1.0%
PROVIDED	2'	127.88'	0.5'	1.0%

GRASSY SWALE A4-7				
	BOTTOM WIDTH	LENGTH	DEPTH	GRADE
REQUIRED	5'	75.83'	0.5'	0.5%
PROVIDED	5'	82.04'	0.5'	0.5%



CROSS-SECTION DETAIL
NOT-TO-SCALE

NOTES:
1. CONTRACTOR SHALL PREVENT ANY TEARING OR PUNCTURING TO THE POLY LINER DURING CONSTRUCTION. ENTIRE LINER MUST BE WATER TIGHT.
2. SEE BASIN CROSS-SECTION FOR RELEVANT ELEVATIONS.
3. WHERE THIS ALTERNATIVE LINER IS USED, THE BASIN BOTTOM MUST BE SLOPED TO PROVIDE A MINIMUM 1% SLOPE FOR DRAINAGE. CONTRACTOR SHALL MAINTAIN THE BASIN INVERT AT THE PIPE DISCHARGE POINT AND SLOPE THE BASIN BOTTOM AT 1% FROM THAT POINT.
4. SELECTION OF FINAL LINER WILL BE IDENTIFIED IN CERTIFICATION LETTER TO TCEQ AFTER COMPLETION OF BASIN CONSTRUCTION.
5. CONTRACTOR TO PLACE ANCHOR BOLTS AT 5'-0" O.C.
6. IN ORDER TO SECURE FILTER FABRIC TO SIDEWALLS WITH GEOMEMBRANE/GEOTEXTILE LAYERS, IT IS RECOMMENDED THAT THE CONTRACTOR INSTALL A LENGTH OF FILTER FABRIC WITH THE OTHER LAYERS SUCH THAT SUBSEQUENT LAYERS CAN BE OVERLAPPED AND TIED TO THE EXPOSED FILTER FABRIC. THIS WILL PROVIDE FOR EASIER MAINTENANCE IN THE FUTURE WITHOUT DESTROYING CONCRETE OR WATER TIGHT LINER.



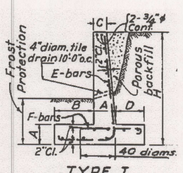
GEOTEXTILE FABRIC SPECIFICATIONS (COA, 2004)

PROPERTY	TEST METHOD	UNIT	SPECIFICATION (MIN.)
UNIT WEIGHT	ASTM D-5261	oz/yd²	8
FILTRATION RATE	ASTM D-4491	in/sec	0.08
PUNCTURE STRENGTH	ASTM D-751*	lbs.	125
MULLEN BURST STRENGTH	ASTM D-3786	psi	400
TENSILE STRENGTH	ASTM D-4632	lbs.	200
EQUIV. OPENING SIZE	US STANDARD SIEVE	No.	80

*MODIFIED

NOTES:
1. THE GEOMEMBRANE LINER SHALL HAVE A MINIMUM THICKNESS OF 30 MILS (40 MILS, RECOMMENDED) AND BE ULTRAVIOLET RESISTANT.
2. INSTALLATION METHODS FOR GEOMEMBRANE LINERS VARY ACCORDING TO THE SITE REQUIREMENTS. INSTALLATION SHALL BE IN ACCORDANCE WITH MANUFACTURERS SPECIFICATIONS.

SAND FILTER CROSS SECTION
NOT-TO-SCALE



TYPE I

TYPE I							
H (ft.-in.)	A (in.)	B (ft.-in.)	D (ft.-in.)	C (in.)	Toe Pressure p.s.f.	E-Bars (in.)	F-Bars (in.)
5-0	8	1-2	0-6	8	765	#3 - 12 o.c.	#3 - 18 o.c.
6-0	8	1-5	0-8	8	865	#3 - 12 o.c.	#3 - 18 o.c.
7-0	8	1-8	0-10	8	930	#3 - 9 o.c.	#3 - 18 o.c.
8-0	12	1-11	0-9	8	1125	#3 - 11½ o.c.	#3 - 18 o.c.
9-0	12	2-2	1-0	8	1230	#3 - 7½ o.c.	#3 - 18 o.c.
10-0	12	2-5	1-2	8	1315	#4 - 10 o.c.	#3 - 12 o.c.
11-0	12	2-8	1-5	8	1420	#5 - 10½ o.c.	#3 - 12 o.c.
12-0	12	2-11	1-8	8	1515	#6 - 12 o.c.	#4 - 14 o.c.
13-0	12	3-2	1-11	10	1630	#7 - 12 o.c.	#4 - 12 o.c.
14-0	12	3-5	2-2	10	1735	#8 - 12½ o.c.	#4 - 10 o.c.
15-0	14	3-8	2-3	12	1895	#8 - 12½ o.c.	#4 - 12 o.c.
16-0	15	3-11	2-4	12	2010	#8 - 11½ o.c.	#4 - 10 o.c.
17-0	16	4-2	2-6	12	2130	#9 - 13 o.c.	#4 - 9½ o.c.
18-0	17	4-4	2-7	12	2260	#9 - 11½ o.c.	#4 - 9½ o.c.
20-0	19	4-10	2-11	12	2510	#9 - 10 o.c.	#5 - 10½ o.c.
22-0	21	5-4	3-3	12	2750	#9 - 8 o.c.	#6 - 11½ o.c.
24-0	24	5-10	3-5	12	3020	#9 - 7½ o.c.	#6 - 11½ o.c.
26-0	26	6-4	3-8	12	3240	#9 - 6 o.c.	#6 - 11 o.c.
28-0	28	6-10	4-0	12	3500	#9 - 5½ o.c.	#6 - 9 o.c.
30-0	31	7-3	4-2	12	3780	#9 - 5 o.c.	#6 - 9 o.c.

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5/13/16

WATER QUALITY TREATMENT DETAILS (2 OF 2)

CIVIL SITE CONSTRUCTION PLANS

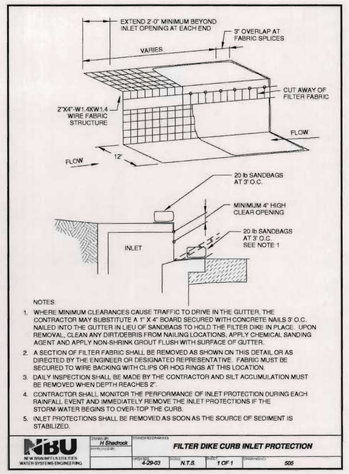
MANOR CREEK, UNIT 4
CIVIL SITE CONSTRUCTION PLANS

DR HORTON
210 W. HUTCHISON STREET
SAN MARCOS, TEXAS 78666

DATE: MAY 2016
DRAWN BY: TJB
DESIGNED BY: GJM
CHECKED BY: CVH
REVIEWED BY: SWH & SCH
PROJECT NO.: 031.023.106

SHEET 17

Drawing Name: N:_Projects\031 - DR Horton\031.023 - Manor Creek Unit 4\031.023.106 - Construction Documents\031.023.106-WQTT.dwg User: ggrattim May 13, 2016 - 11:56am



NOTES:

1. WHERE MINIMUM CLEARANCES CAUSE TRAFFIC TO DRIVE IN THE GUTTER, THE CONTRACTOR MAY SUBSTITUTE A 1"X 4" BOARD SECURED WITH CONCRETE NAILS 5' O.C. NAILED INTO THE GUTTER IN LIEU OF SANDBAGS TO HOLD THE FILTER DIKE IN PLACE. UPON REMOVAL, CLEAN ANY DIRT/DEBRIS FROM NAILING LOCATIONS. APPLY CHEMICAL SANDING AGENT AND APPLY NON-SHRINK GROUT FLUSH WITH SURFACE OF GUTTER.
2. A SECTION OF FILTER FABRIC SHALL BE REMOVED AS SHOWN ON THIS DETAIL OR AS DIRECTED BY THE ENGINEER OR DESIGNATED REPRESENTATIVE. FABRIC MUST BE SECURED TO WIRE BACKING WITH CLIPS OR HOG RINGS AT THIS LOCATION.
3. DAILY INSPECTION SHALL BE MADE BY THE CONTRACTOR AND SILT ACCUMULATION MUST BE REMOVED WHEN DEPTH REACHES 2".
4. CONTRACTOR SHALL MONITOR THE PERFORMANCE OF INLET PROTECTION DURING EACH RAINFALL EVENT AND IMMEDIATELY REMOVE THE INLET PROTECTIONS IF THE STORM WATER BEGINS TO OVER-TOP THE CURB.
5. INLET PROTECTIONS SHALL BE REMOVED AS SOON AS THE SOURCE OF SEDIMENT IS STABILIZED.

NBU ENGINEERING & SURVEYING	DESIGNED BY: N Shedrock	DRAWN BY:	FILTER DIKE CURB INLET PROTECTION
	DATE: 4-29-03	SCALE: N.T.S.	SHEET: 1 OF 1

CONCRETE WASHOUT AREAS

THE PURPOSE OF CONCRETE WASHOUT AREAS IS TO PREVENT OR REDUCE THE DISCHARGE OF POLLUTANTS TO STORMWATER FROM CONCRETE WASTE BY CONDUCTING WASHOUT OFFSITE, PERFORMING ONSITE WASHOUT IN A DESIGNATED AREA, AND TRAINING EMPLOYEES AND SUBCONTRACTORS.

THE FOLLOWING STEPS WILL HELP REDUCE STORMWATER POLLUTION FROM CONCRETE WASTES:

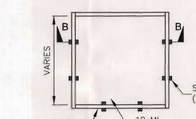
- INCORPORATE REQUIREMENTS FOR CONCRETE WASTE MANAGEMENT INTO MATERIAL SUPPLIER AND SUBCONTRACTOR AGREEMENTS.
- AVOID MIXING EXCESS AMOUNTS OF FRESH CONCRETE.
- PERFORM WASHOUT OF CONCRETE TRUCKS IN DESIGNATED AREAS ONLY.
- DO NOT WASH OUT CONCRETE TRUCKS INTO STORM DRAINS, OPEN DITCHES, STREETS, OR STREAMS.
- DO NOT ALLOW EXCESS CONCRETE TO BE DUMPED ONSITE, EXCEPT IN DESIGNATED AREAS.

FOR ONSITE WASHOUT:

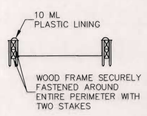
- LOCATE WASHOUT AREA AT LEAST 50 FEET FROM SENSITIVE FEATURES, STORM DRAINS, OPEN DITCHES, OR WATER BODIES. DO NOT ALLOW RUNOFF FROM THIS AREA BY CONSTRUCTING A
- TEMPORARY PIT OR BERMED AREA LARGE ENOUGH FOR LIQUID AND SOLID WASTE.
- WASH OUT WASTES INTO THE TEMPORARY PIT WHERE THE CONCRETE CAN SET, BE BROKEN UP, AND THEN DISPOSED PROPERLY.

BELOW GRADE CONCRETE WASHOUT FACILITIES ARE TYPICAL. THESE CONSIST OF A LINED EXCAVATION SUFFICIENTLY LARGE TO HOLD EXPECTED VOLUME OF WASHOUT MATERIAL. ABOVE GRADE FACILITIES ARE USED IF EXCAVATION IS NOT PRACTICAL. TEMPORARY CONCRETE WASHOUT FACILITY (TYPE ABOVE GRADE) SHOULD BE CONSTRUCTED AS SHOWN ON THE DETAILS AT THE END OF THIS SECTION, WITH SUFFICIENT QUANTITY AND VOLUME TO CONTAIN ALL LIQUID AND CONCRETE WASTE GENERATED BY WASHOUT OPERATIONS. PLASTIC LINING MATERIAL SHOULD BE A MINIMUM OF 10 MIL IN POLYETHYLENE SHEETING AND SHOULD BE FREE OF HOLES, TEARS, OR OTHER DEFECTS THAT COMPROMISE THE IMPERMEABILITY OF THE MATERIAL.

WHEN TEMPORARY CONCRETE WASHOUT FACILITIES ARE NO LONGER REQUIRED FOR THE WORK, THE HARDENED CONCRETE SHOULD BE REMOVED AND DISPOSED OF. MATERIALS USED TO CONSTRUCT TEMPORARY CONCRETE WASHOUT FACILITIES SHOULD BE REMOVED FROM THE SITE OF THE WORK AND DISPOSED OF. HOLES, DEPRESSIONS OR OTHER GROUND DISTURBANCE CAUSED BY THE REMOVAL OF THE TEMPORARY CONCRETE WASHOUT FACILITIES SHOULD BE BACKFILLED AND REPAIRED.



PLAN
NOT TO SCALE
TYPE "ABOVE GRADE"



NOTES

1. ACTUAL LAYOUT DETERMINED IN FIELD.

SECTION B–B
NOT TO SCALE

STABILIZED CONSTRUCTION ENTRANCE / EXIT

MATERIALS:

(1) THE AGGREGATE SHOULD CONSIST OF 3 TO 5 INCH WASHED STONE OVER A STABLE FOUNDATION AS SPECIFIED IN THE PLAN.
(2) THE AGGREGATE SHOULD BE PLACED WITH A MINIMUM THICKNESS OF 8 INCHES.
(3) THE GEOTEXTILE FABRIC SHOULD BE DESIGNED SPECIFICALLY FOR USE AS A SOIL FILTRATION MEDIA WITH AN APPROXIMATE WEIGHT OF 6 OZ/YD2, A MULLEN BURST RATING OF 140 LB/IN2, AND AN EQUIVALENT OPENING SIZE GREATER THAN A NUMBER 50 SIEVE.
(4) IF A WASHING FACILITY IS REQUIRED, A LEVEL AREA WITH A MINIMUM OF 4 INCH DIAMETER WASHED STONE OR COMMERCIAL RACK SHOULD BE INCLUDED IN THE PLANS. DIVERT WASTEWATER TO A SEDIMENT TRAP OR BASIN.

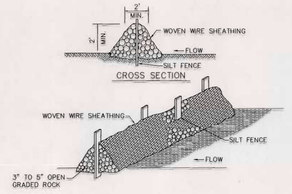
INSTALLATION:

(1) AVOID CURVES ON PUBLIC ROADS AND STEEP SLOPES. REMOVE VEGETATION AND OTHER OBJECTIONABLE MATERIAL FROM THE FOUNDATION AREA. GRADE CROWN FOUNDATION FOR POSITIVE DRAINAGE.
(2) THE MINIMUM WIDTH OF THE ENTRANCE/EXIT SHOULD BE 12 FEET OR THE FULL WIDTH OF EXIT ROADWAY, WHICHEVER IS GREATER.
(3) THE CONSTRUCTION ENTRANCE SHOULD BE AT LEAST 50 FEET LONG.
(4) IF THE SLOPE TOWARD THE ROAD EXCEEDS 2%, CONSTRUCT A RIDGE, 6 TO 8 INCHES HIGH WITH 3:1 (H:V) SIDE SLOPES, ACROSS THE FOUNDATION APPROXIMATELY 15 FEET FROM THE ENTRANCE TO DIVERT RUNOFF AWAY FROM THE PUBLIC ROAD.
(5) PLACE GEOTEXTILE FABRIC AND GRADE FOUNDATION TO IMPROVE STABILITY, ESPECIALLY WHERE WET CONDITIONS ARE ANTICIPATED.
(6) PLACE STONE TO DIMENSIONS AND GRADE SHOWN ON PLANS. LEAVE SURFACE SMOOTH AND SLOPE FOR DRAINAGE.
(7) DIVERT ALL SURFACE RUNOFF AND DRAINAGE FROM THE STONE PAD TO A SEDIMENT TRAP OR BASIN.
(8) INSTALL PIPE UNDER PAD AS NEEDED TO MAINTAIN PROPER PUBLIC ROAD DRAINAGE.

INSPECTION AND MAINTENANCE GUIDELINES:

(1) THE ENTRANCE SHOULD BE MAINTAINED IN A CONDITION, WHICH WILL PREVENT TRACKING OR LOWING OF SEDIMENT ONTO PUBLIC RIGHTS-OF-WAY. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE AS CONDITIONS DEMAND AND REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT.
(2) ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED ONTO PUBLIC RIGHTS-OF-WAY SHOULD BE REMOVED IMMEDIATELY BY CONTRACTOR.
(3) WHEN NECESSARY, WHEELS SHOULD BE CLEANED TO REMOVE SEDIMENT PRIOR TO ENTRANCE ONTO PUBLIC RIGHT-OF-WAY.
(4) WHEN WASHING IS REQUIRED, IT SHOULD BE DONE ON AN AREA STABILIZED WITH CRUSHED STONE THAT DRAINS INTO AN APPROVED SEDIMENT TRAP OR SEDIMENT BASIN.
(5) ALL SEDIMENT SHOULD BE PREVENTED FROM ENTERING ANY STORM DRAIN, DITCH OR WATER COURSE BY USING APPROVED METHODS.

ROCK BERM
NOT-TO-SCALE



HIGH SERVICE ROCK BERM
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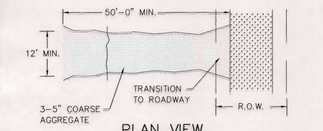

PLAN VIEW
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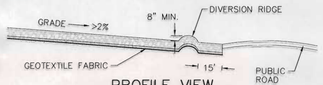


PROFILE VIEW
NOT TO SCALE

NOTES:

1. USE ONLY OPEN GRADED ROCK 3–5" DIAMETER.
2. THE ROCK BERM SHALL BE SECURED WITH A WOVEN WIRE SHEATHING HAVING MAXIMUM 1" OPENINGS AND MINIMUM WIRE DIAMETER OF 20 GAUGE.
3. THE ROCK BERM SHALL BE INSPECTED WEEKLY OR AFTER EACH RAIN, AND THE STONE AND/OR FABRIC CORE–WOVEN WIRE SHEATHING SHALL BE REPLACED WHEN THE STRUCTURE CEASES TO FUNCTION AS INTENDED, DUE TO SILT ACCUMULATION AMONG THE ROCKS, WASHOUT CONSTRUCTION TRAFFIC DAMAGE, ETC.
4. WHEN SILT REACHES A DEPTH EQUAL TO 6", THE SILT WILL BE REMOVED AND DISPOSED OF IN AN APPROVED SITE AND IN SUCH A MANNER AS TO NOT CREATE A SILTATION PROBLEM.
5. DAILY INSPECTION SHALL BE MADE ON SEVERE SERVICE ROCK BERMS.
6. WHEN THE SITE IS COMPLETELY STABILIZED, THE BERM AND ACCUMULATED SILT SHALL BE REMOVED AND DISPOSED OF IN AN APPROVED MANNER.

HIGH SERVICE ROCK BERM

MATERIALS:

1. SILT FENCE MATERIAL SHOULD BE POLYPROPYLENE, POLYETHYLENE OR POLYAMIDE WOVEN OR NONWOVEN FABRIC. THE FABRIC WIDTH SHOULD BE 36 INCHES, WITH A MINIMUM UNIT WEIGHT OF 4.5 OZ/YD, MULLEN BURST STRENGTH EXCEEDING 190 LB/IN², ULTRAVIOLET STABILITY EXCEEDING 70%, AND MINIMUM APPARENT OPENING SIZE OF U.S. SIEVE NO. 30.
2. FENCE POSTS SHOULD BE MADE OF HOT ROLLED STEEL, AT LEAST 4 FEET LONG WITH TEE OR Y–BAR CROSS SECTION, SURFACE PAINTED OR GALVANIZED, MINIMUM NOMINAL WEIGHT 1.25 LB/FT², AND BRINDELL HARDNESS EXCEEDING 140. REBAR (EITHER #5 OR #6) MAY ALSO BE USED TO ANCHOR THE BERM.
3. WOVEN WIRE BACKING TO SUPPORT THE FABRIC SHOULD BE GALVANIZED 2" X4" WELDED WIRE, 12 GAUGE MINIMUM.
4. THE BERM STRUCTURE SHOULD BE SECURED WITH A WOVEN WIRE SHEATHING HAVING MAXIMUM OPENING OF 1 INCH AND A MINIMUM WIRE DIAMETER OF 20 GAUGE GALVANIZED AND SHOULD BE SECURED WITH SHOAT RINGS.
5. CLEAN, OPEN GRADED 3 TO 5–INCH DIAMETER ROCK SHOULD BE USED, EXCEPT IN AREAS WHERE HIGH VELOCITIES OR LARGE VOLUMES OF FLOW ARE EXPECTED, WHERE 5 TO 8–INCH DIAMETER ROCKS MAY BE USED.

INSTALLATION:

1. LAY OUT THE WOVEN WIRE SHEATHING PERPENDICULAR TO THE FLOW LINE. THE SHEATHING SHOULD BE 20 GAUGE WOVEN WIRE MESH WITH 1–INCH OPENINGS.
2. INSTALL THE SILT FENCE ALONG THE CENTER OF THE PROPOSED BERM PLACEMENT, AS WITH A NORMAL SILT FENCE DESCRIBED IN SECTION 2.4.3.
3. PLACE THE ROCK ALONG THE SHEATHING ON BOTH SIDES OF THE SILT FENCE AS SHOWN IN THE DIAGRAM (FIGURE 1.30), TO A HEIGHT NOT LESS THAN 24 INCHES. CLEAN, OPEN GRADED 3–5" DIAMETER ROCK SHOULD BE USED, EXCEPT IN AREAS WHERE HIGH VELOCITIES OR LARGE VOLUMES OF FLOW ARE EXPECTED, WHERE 5– TO 8–INCH DIAMETER ROCK MAY BE USED.
4. WRAP WIRE SHEATHING AROUND THE ROCK AND SECURE WITH TIE WIRE SO THAT THE ENDS OF THE SHEATHING OVERLAP AT LEAST 2 INCHES, AND THE BERM RETAINS ITS SHAPE WHEN WALKED UPON.
5. THE HIGH SERVICE ROCK BERM SHOULD BE REMOVED WHEN THE SITE IS REVEGETATED OR OTHERWISE STABILIZED OR IT MAY REMAIN IN PLACE AS A PERMANENT BMP IF DRAINAGE IS ADEQUATE.

LEGEND

700	EXISTING CONTOURS
700	PROPOSED CONTOURS
B.L.	BUILDING SETBACK LINE
U.E.	UTILITY EASEMENT
D.E.	DRAINAGE EASEMENT
	DRAINAGE FLOW DIRECTION
SF	SILT FENCE
LOC	LIMIT OF CONSTRUCTION
	STABILIZED CONSTRUCTION ENTRANCE
	FILTER DIKE

SEQUENCE OF CONSTRUCTION

1. INSTALL EROSION CONTROLS PER APPROVED PLAN.
2. TEMPORARY CONTROLS TO BE INSPECTED AND MAINTAINED WEEKLY AND PRIOR TO ANTICIPATED RAINFALL EVENTS, AND AFTER RAINFALL EVENTS, AS NEEDED. CONTRACTOR/OWNER SHALL PROVIDE A CONTACT NAME AND NUMBER FOR EROSION CONTROL ISSUES.
3. CONDUCT DEMOLITION ACTIVITIES, IF APPLICABLE.
4. CONSTRUCT DRAINAGE IMPROVEMENTS, IF APPLICABLE.
5. CONSTRUCT CURB INLET PROTECTION AT THE TIME OF CURB INLET INSTALLATION.
6. CONSTRUCT DEVELOPMENT PER APPROVED PLANS.
7. INSTALL STREETSCAPE AND/OR LANDSCAPING IMPROVEMENTS.
8. CONTRACTOR TO VEGETATE ANY DISTURBED AREAS ONCE FINAL GRADING IS COMPLETE, AND ESTABLISH A MIN OF 80% VEGETATION PRIOR TO COMPLETION
9. REMOVE ALL TEMPORARY EROSION CONTROL MEASURES.

SILT FENCE

MATERIALS:

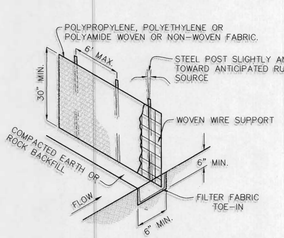
(1) SILT FENCE MATERIAL SHOULD BE POLYPROPYLENE, POLYETHYLENE OR POLYAMIDE WOVEN OR NONWOVEN FABRIC. THE FABRIC WIDTH SHOULD BE 36 INCHES, WITH A MINIMUM UNIT WEIGHT OF 4.5 OZ/YD, MULLEN BURST STRENGTH EXCEEDING 190 LB/IN2, ULTRAVIOLET STABILITY EXCEEDING 70%, AND MINIMUM APPARENT OPENING SIZE OF U.S. SIEVE NO. 30.
(2) FENCE POSTS SHOULD BE MADE OF HOT ROLLED STEEL, AT LEAST 4 FEET LONG WITH TEE OR YBAR CROSS SECTION, SURFACE PAINTED OR GALVANIZED, MINIMUM NOMINAL WEIGHT 1.25 LB/FT2, AND BRINDELL HARDNESS EXCEEDING 140.
(3) WOVEN WIRE BACKING TO SUPPORT THE FABRIC SHOULD BE GALVANIZED 2" X 4" WELDED WIRE, 12 GAUGE MINIMUM.

INSTALLATION:

(1) STEEL POSTS, WHICH SUPPORT THE SILT FENCE, SHOULD BE INSTALLED ON A SLIGHT ANGLE TOWARD THE ANTICIPATED RUNOFF SOURCE. POST MUST BE EMBEDDED A MINIMUM OF 1– FOOT DEEP AND SPACED NOT MORE THAN 8 FEET ON CENTER. WHERE WATER CONCENTRATES, THE MAXIMUM SPACING SHOULD BE 6 FEET.
(2) LAY OUT FENCING DOWN–SLOPE OF DISTURBED AREA, FOLLOWING THE CONTOUR AS CLOSELY AS POSSIBLE. THE FENCE SHOULD BE SITED SO THAT THE MAXIMUM DRAINAGE AREA IS ¼ ACRE/100 FEET OF FENCE.
(3) THE TOE OF THE SILT FENCE SHOULD BE TRENCHED IN WITH A SPADE OR MECHANICAL TRENCHER, SO THAT THE DOWN–SLOPE FACE OF THE TRENCH IS FLAT AND PERPENDICULAR TO THE LINE OF FLOW. WHERE FENCE CANNOT BE TRENCHED IN (E.G., PAVEMENT OR ROCK OUTCROP), WEIGHT FABRIC FLAP WITH 3 INCHES OF PEA GRAVEL ON UPHILL SIDE TO PREVENT FLOW FROM SEEPING UNDER FENCE.
(4) THE TRENCH MUST BE A MINIMUM OF 6 INCHES DEEP AND 6 INCHES WIDE TO ALLOW FOR THE SILT FENCE FABRIC TO BE LAID IN THE GROUND AND BACKFILLED WITH COMPACTED MATERIAL.
(5) SILT FENCE SHOULD BE SECURELY FASTENED TO EACH STEEL SUPPORT POST OR TO WOVEN WIRE, WHICH IS IN TURN ATTACHED TO THE STEEL FENCE POST. THERE SHOULD BE A 3–FOOT OVERLAP, SECURELY FASTENED WHERE ENDS OF FABRIC MEET.
(6) SILT FENCE SHOULD BE REMOVED WHEN THE SITE IS COMPLETELY STABILIZED SO AS NOT TO BLOCK OR IMPEDE STORM FLOW OR DRAINAGE.

INSPECTION AND MAINTENANCE GUIDELINES:

(1) INSPECT ALL FENCING WEEKLY, AND AFTER ANY RAINFALL.
(2) REMOVE SEDIMENT WHEN BUILDUP REACHES 6 INCHES.
(3) REPLACE ANY TORN FABRIC OR INSTALL A SECOND LINE OF FENCING PARALLEL TO THE TORN SECTION.
(4) REPLACE OR REPAIR ANY SECTIONS CRUSHED OR COLLAPSED IN THE COURSE OF CONSTRUCTION ACTIVITY. IF A SECTION OF FENCE IS OBSTRUCTING VEHICULAR ACCESS, CONSIDER RELOCATING IT TO A SPOT WHERE IT WILL PROVIDE EQUAL PROTECTION, BUT WILL NOT OBSTRUCT VEHICLES. A TRIANGULAR FILTER DIKE MAY BE PREFERABLE TO A SILT FENCE AT COMMON VEHICLE ACCESS POINTS.
(5) WHEN CONSTRUCTION IS COMPLETE, THE SEDIMENT SHOULD BE DISPOSED OF IN A MANNER THAT WILL NOT CAUSE ADDITIONAL SILTATION AND THE PRIOR LOCATION OF THE SILT FENCE SHOULD BE REVEGETATED. THE FENCE ITSELF SHOULD BE DISPOSED OF IN AN APPROVED LANDFILL.



PERSPECTIVE VIEW
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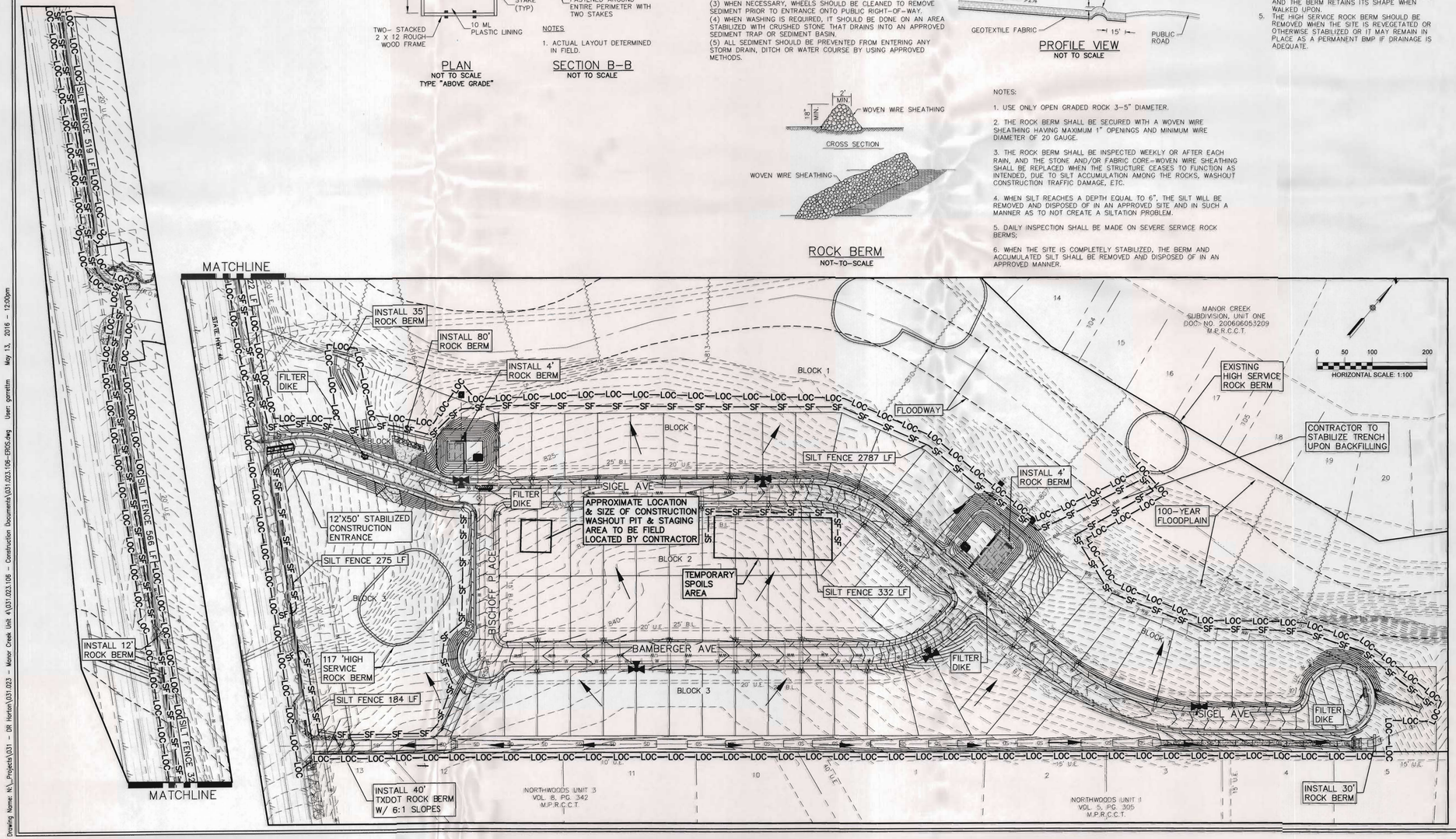

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THE LOCATION OF ALL EXISTING UNDERGROUND UTILITIES ARE SHOWN IN APPROXIMATE LOCATIONS ONLY. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK. THE CONTRACTOR WILL AGREE TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE INCURRED BY THEIR FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES, STRUCTURES OR FACILITIES. CONTRACTOR SHALL NOTIFY ENGINEER OF ANY DISCREPANCIES 24–HOURS PRIOR TO COMMENCING CONSTRUCTION.

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CHRISTOPHER P. VAN HEERDE
93047
LICENSED PROFESSIONAL ENGINEER

5/13/16

EROSION CONTROL PLAN

CIVIL SITE CONSTRUCTION PLANS

MANOR CREEK, UNIT 4
CIVIL SITE CONSTRUCTION PLANS

DR HORTON
210 W. HUTCHISON STREET
SAN MARCOS, TEXAS 78666

DATE: MAY 2016	DRAWN BY: KRK	DESIGNED BY: CJM	CHECKED BY: CVH	REVIEWED BY: SWH & SCH	PROJECT NO.: 031.023.106

SHEET
18

Drawing Name: N:_Projects\031 - DR Horton\031.023 - Manor Creek Unit 4\031.023.106 - Construction Documents\031.023.106-ESC05.dwg User: gsmeltzer May 13, 2016 - 12:00pm

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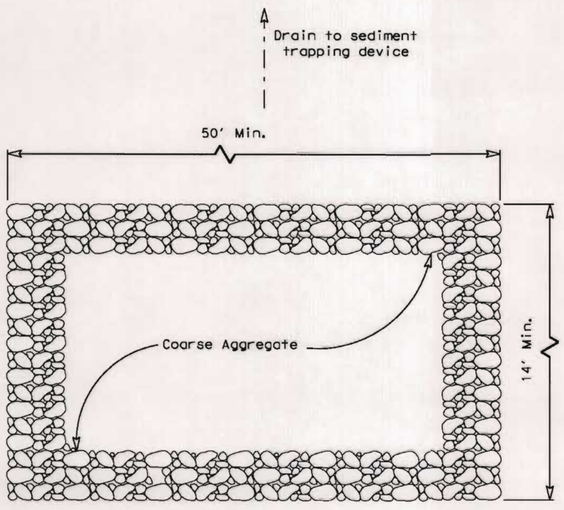
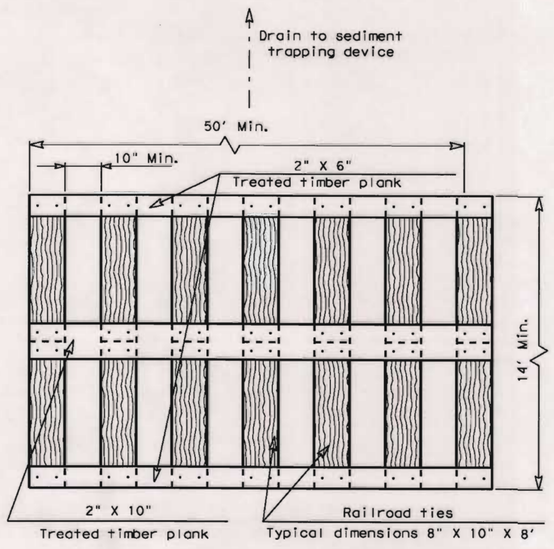


PLAN



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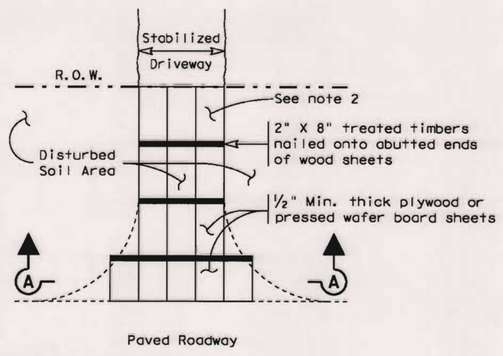
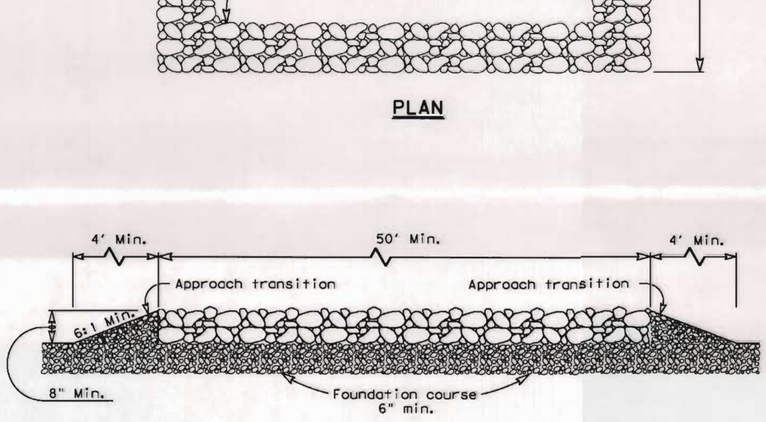


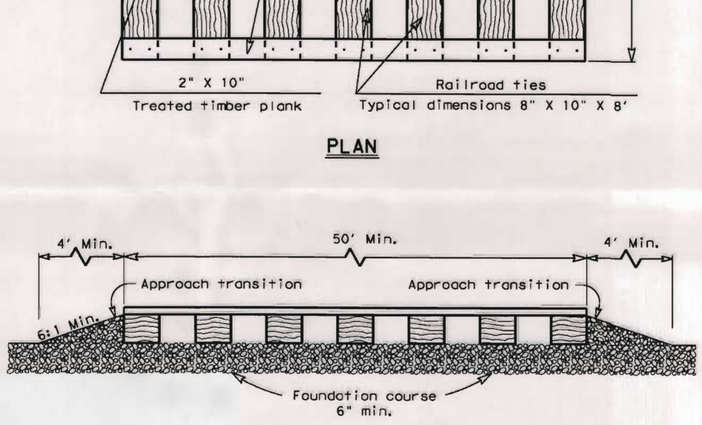
Paved Roadway

PLAN



PROFILE

CONSTRUCTION EXIT (TYPE 1)



PROFILE

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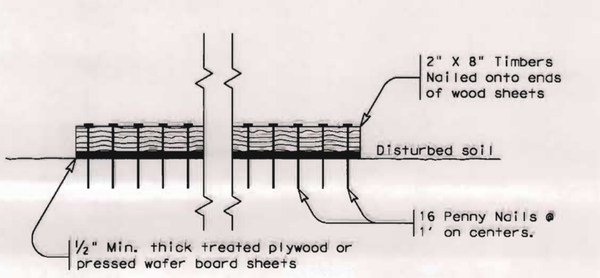

SECTION A-A

CONSTRUCTION EXIT (TYPE 3)

GENERAL NOTES

1. The length of the type 1 construction exit shall be as indicated on the plans, but not less than 50'.
2. The coarse aggregate should be open graded with a size of 4" to 8".
3. The approach transitions should be no steeper than 6:1 and constructed as directed by the Engineer.
4. The construction exit foundation course shall be flexible base, bituminous concrete, portland cement concrete or other material as approved by the Engineer.
5. The construction exit shall be graded to allow drainage to a sediment trapping device.
6. The guidelines shown hereon are suggestions only and may be modified by the Engineer.

GENERAL NOTES

1. The length of the type 2 construction exit shall be as indicated on the plans, but not less than 50'.
2. The treated timber planks shall be attached to the railroad ties with ½"x 6" min. lag bolts. Other fasteners may be used as approved by the Engineer.
3. The treated timber planks shall be #2 grade min., and should be free from large and loose knots.
4. The approach transitions shall be no steeper than 6:1 and constructed as directed by the Engineer.
5. The construction exit foundation course shall be flexible base, bituminous concrete, portland cement concrete or other material as approved by the Engineer.
6. The construction exit should be graded to allow drainage to a sediment trapping device.
7. The guidelines shown hereon are suggestions only and may be modified by the Engineer.

GENERAL NOTES

1. The length of the type 3 construction exit shall be as shown on the plans, or as directed by the Engineer.
2. The type 3 construction exit may be constructed from open graded crushed stone with a size of two to four inches spread a min. of 4" thick to the limits shown on the plans.
3. The treated timber planks shall be #2 grade min., and should be free from large and loose knots.
4. The guidelines shown hereon are suggestions only and may be modified by the Engineer.

Texas Department of Transportation — Design Division Standard

TEMPORARY EROSION, SEDIMENT AND WATER POLLUTION CONTROL MEASURES

CONSTRUCTION EXITS

EC(3)-93

FILE: ec393.dgn	DN: TxDOT	CK: HEJ	DW: BD	CK:
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REVISIONS	DIST	COUNTY		SHEET NO.

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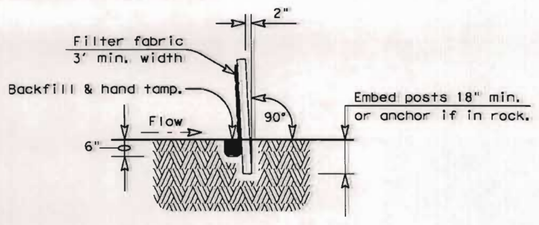


SECTION A-A

GENERAL NOTES

1. The guidelines shown hereon are suggestions only and may be modified by the Engineer.

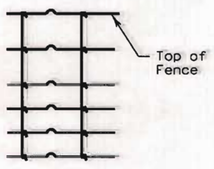
PLAN SHEET LEGEND

Sediment Control Fence — SCF

SEDIMENT CONTROL FENCE USAGE GUIDELINES

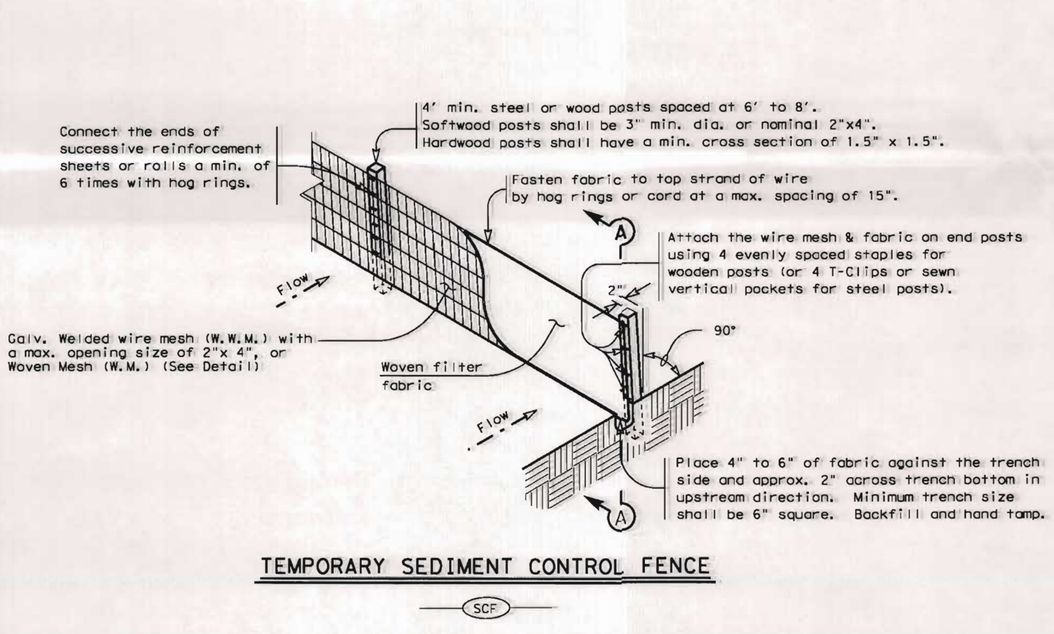
A sediment control fence may be constructed near the downstream perimeter of a disturbed area along a contour to intercept sediment from overland runoff. A 2 year storm frequency may be used to calculate the flow rate to be filtered.

Sediment control fence should be sized to filter a max. flow through rate of 100 GPM/FT^2. Sediment control fence is not recommended to control erosion from a drainage area larger than 2 acres.



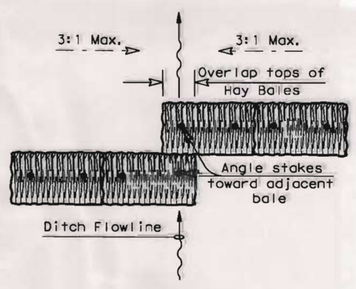
Galv. Hinge joint knot woven mesh (12.5 Ga. Min.) requires a minimum of five horizontal wires spaced at a max. 12 inches apart and all vertical wires spaced at a max. 12 inches apart.

Hinge Joint Knot Woven Mesh (Option)

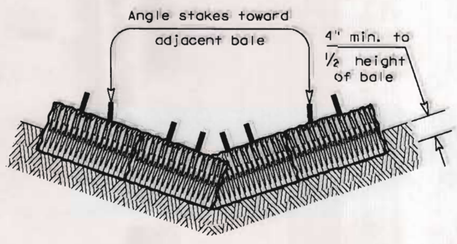


TEMPORARY SEDIMENT CONTROL FENCE

SCF



PLAN VIEW



PROFILE VIEW

PLANS SHEET LEGEND

Baled Hay — BH

BALED HAY USAGE GUIDELINES

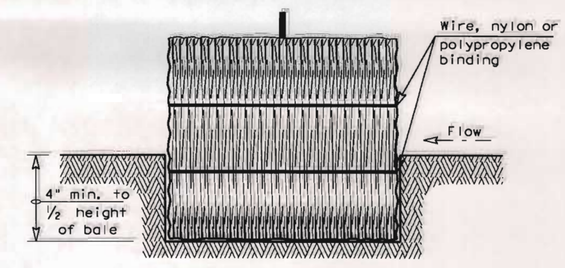
A Baled Hay installation may be constructed near the downstream perimeter of a disturbed area along a contour to intercept sediment from overland runoff. A two year storm frequency may be used to calculate the flow rate to be filtered. The installation should be sized to filter a maximum flow thru rate of 5 GPM/FT^2 of cross sectional area. Baled hay may be used at the following locations:

1. Where the runoff approaching the baled hay flows over disturbed soil for less than 100'. If the slope of the disturbed soil exceeds 10%, the length of slope upstream the baled hay should be less than 50'.
2. Where the installation will be required for less than 3 months.
3. Where the contributing drainage area is less than ½ acre.

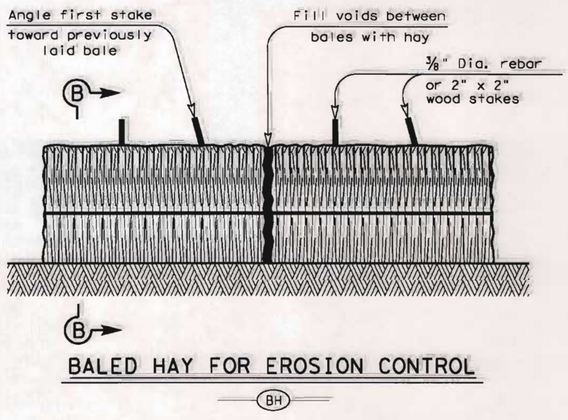
For Baled Hay installations in small ditches, the additional following considerations apply:

1. The ditch sideslopes should be graded as flat as possible to maximize the drainage flowrate thru the hay.
2. The ditch should be graded large enough to contain the overtopping drainage when sediment has filled to the top of the baled hay.

Bales should be replaced usually every 2 months or more often during wet weather when loss of structural integrity is accelerated.



SECTION B-B



BALED HAY FOR EROSION CONTROL

BH

GENERAL NOTES

1. Hay bales shall be a minimum of 30" in length and weigh a minimum of 50 Lbs.
2. Hay bales shall be bound by either wire or nylon or polypropylene string. The bales shall be composed entirely of vegetative matter.
3. Hay bales shall be embedded in the soil a minimum of 4" and where possible ½ the height of the bale.
4. Hay bales shall be placed in a row with ends tightly abutting the adjacent bales. The bales shall be placed with bindings parallel to the ground.
5. Hay bales shall be securely anchored in place with ⅜" Dia. rebar or 2" x 2" wood stakes, driven through the bales. The first stake shall be angled towards the previously laid bale to force the bales together.
6. The guidelines shown hereon are suggestions only and may be modified by the Engineer.

Texas Department of Transportation — Design Division Standard

TEMPORARY EROSION, SEDIMENT AND WATER POLLUTION CONTROL MEASURES

FENCE & BALED HAY

EC(1)-09

FILE: ec109.dgn	DN: TxDOT	CK: AM	DW: TV	CK: BD
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SHEET 19

DATE:	MAY 2016
DRAWN BY:	TJB
DESIGNED BY:	GJM
CHECKED BY:	SWH
REVIEWED BY:	CVH
PROJECT NO.:	031.023.106

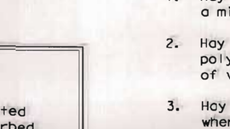
MANOR CREEK, UNIT 4
CIVIL SITE CONSTRUCTION PLANS

DR HORTON
210 W. HUTCHISON STREET
SAN MARCOS, TEXAS 78666

TXDOT EROSION CONTROL DETAILS (1 OF 2)

CIVIL SITE CONSTRUCTION PLANS

5/13/16



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ITEM 459

GABIONS AND GABION MATTRESSES

459.1. Description. Furnish and install gabions and gabion mattresses.

459.2. Materials. This Item uses the following terms:

- Gabion. A wire fabric or mesh container, filled with stone, with a height of 1 ft. or greater.
- Gabion Mattress. A wire fabric or mesh container filled with stone and with a height of 6, 9, or 12 in. Referred to as "revet mattress" in ASTM A 975.

Furnish welded wire gabions and gabion mattresses in accordance with ASTM A 974. Furnish Style 1 or 2 when galvanized wire coating is specified or Style 5 when PVC wire coating is specified.

Furnish twisted wire gabions and gabion mattresses in accordance with ASTM A 975. Furnish Style 1 when galvanized wire coating is specified or Style 3 when PVC wire coating is specified.

Furnish producer or supplier certification that wire baskets, stiffeners, lacing wire, and spiral connectors conform to the applicable ASTM specification.

If alternative wire fasteners are proposed, furnish producer or supplier certification that the fasteners conform to the strength requirements in Table 1 when tested in accordance with the applicable ASTM specification. Submit certification for approval before beginning work.

Table 1
Minimum Panel-to-Panel Connection Strength

Application	Strength (lb/ft)
Gabions, galvanized	1,400
Gabions, PVC-coated	1,200
Gabion mattress, galvanized and PVC-coated	700

Provide filler stone consisting of clean, hard, durable stone that does not contain shale, caliche, or other soft particles. Stone appearing to contain such particles will be tested for soundness. Stone with 5-cycle magnesium sulfate soundness of more than 18% when tested in accordance with Tex-411-A will be rejected. Use stones that are between 4 and 8 in. in their least dimension for gabions and between 3 and 6 in. for gabion mattresses. Prevent contamination when storing and handling stone.

Provide Type 2 filter fabric when required in accordance with DMS-6200, "Filter Fabric."

Provide filter material when required consisting of hard, durable, clean sand or gravel with a maximum particle size of 3/8 in.

459.3. Construction. At the start of construction, the gabion and gabion mattress manufacturer must have a qualified representative available for consultation as needed throughout the gabion and gabion mattress construction.

A. **Foundation Preparation.** Excavate the foundation to the extent shown on the plans or as directed. Remove all loose or otherwise unsuitable materials. Carefully backfill all depressions to grade with suitable materials from adjacent required excavation or another approved source, and compact the backfill to a density at least equal to that of the adjacent foundation. Remove any buried debris protruding from the foundation that will impede the proper installation and final appearance of the gabion or gabion mattress, and carefully backfill and compact voids as specified above. Immediately before gabion placement, have the Engineer inspect the prepared foundation surface.

B. **Filter Placement.** When filter material is required, spread it uniformly on the prepared foundation surface to the slopes, lines, and grades indicated on the plans. Do not place filter material by methods that tend to segregate particle sizes. Repair all damage to the foundation surface that occurs during filter placement before proceeding with the work. Compaction of the filter material is not required, but finish the material to present a reasonably even surface, without mounds or windrows.

C. **Filter Fabric Placement.** When filter fabric is required, place it as shown on the plans. Any defects, rips, holes, flaws, or damage to the material may be cause for rejection. Place the material with the long axis parallel to the centerline of the structure, highway, or dam. Place securing pins in the lapped longitudinal joints, spaced on approximately 10-ft. centers. Keep the fabric material free of tension, stress, folds, wrinkles, or creases. Lap the material at least 3 ft. along the longitudinal joint of material, or lap the joints 1 ft. and sew them. Lap the ends of rolls at joints by at least 3 ft. Repair torn or punctured fabric by placing a layer of fabric over the damaged area, overlapping at least 3 ft. beyond the damaged area in all directions.

Place securing pins through both strips of material at lapped joints at approximately the midpoint of the overlap. Place additional securing pins as necessary to hold filter fabric in position. Store filter fabric out of direct sunlight. After placing filter fabric, cover as soon as possible but within 3 days.

D. **Assembly and Installation.** If PVC wire coating is specified, do not place PVC-coated materials unless the ambient temperature and the temperature of the coated wire are at least 15°F above the brittleness temperature of the PVC.

Assemble empty gabion or gabion mattress units individually, and place them on the approved surface to the lines and grades shown on the plans with the sides, ends, and diaphragms erected to ensure that all creases are in the correct position, the tops of all sides are level, and all sides that are to remain exposed are straight and plumb. Fill the basket units after transporting them to their final position in the work.

Place the front row of gabion or gabion mattress units first, and successively construct units toward the top of the slope or the back of the structure. Place the initial line of basket units on the prepared surface, and partially fill them to provide anchorage against deformation and displacement during subsequent filling operations. Stretch and hold empty basket units as necessary to remove kinks and provide a uniform alignment. Before filling, connect all adjoining empty gabion or gabion mattress units with lacing, wire spiral binders, or approved fasteners along the perimeter of their contact surface to obtain a monolithic structure. If lacing wire is used, provide continuous stitching with alternating single and double loops at intervals of no more than 5 in. Securely fasten all lacing wire terminals.

Provide connections meeting the joint strength requirements of Article 459.2, "Materials." These requirements apply to all connections including attachment of end panels, diaphragms, and lids.

Join twisted wire baskets through selvage-to-selvage or selvage-to-edge wire connection; do not use mesh-to-mesh or selvage-to-mesh wire connection except where baskets are offset or stacked, in which case join each mesh opening where mesh wire meets selvage or edge wire.

Carefully fill the basket units with stone, using hand placement to avoid damaging wire coating, to ensure as few voids as possible between the stones and to maintain alignment. Machine placement of stone will be allowed if approved by the Engineer. Correct excessive deformation and bulging of the mesh before further filling. To avoid localized deformation, fill the basket units in a row in stages consisting of maximum 12-in. courses; do not at any time fill a cell to a depth exceeding 1 ft. more than its adjoining cell. Do not drop stones into the basket units from a height greater than 36 in.

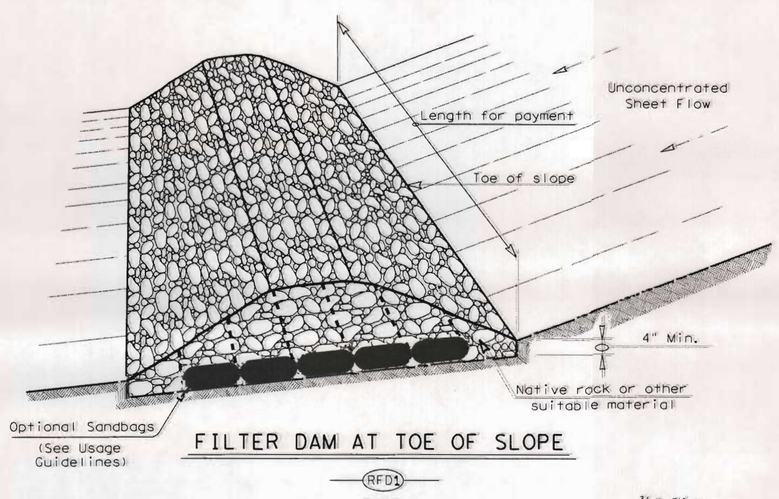
For gabion units more than 2 ft. high, place 2 uniformly spaced internal connecting wires between each stone layer in all front and side gabion units, connecting the back and the front faces of the compartments. Loop connecting wires or preformed stiffeners around 2 twisted wire-mesh openings or a welded wire joint at each basket face, and securely twist the wire terminals to prevent loosening.

Along all exposed faces, carefully place the outer layer of stone and arrange it by hand to ensure a neat and compact appearance. Overfill the last layer of stone uniformly by 1 to 2 in. for gabions and 1 in. for gabion mattresses to compensate for future settlement in rock while still allowing for the proper closing of the lid and providing an even surface with a uniform appearance. Make final adjustments for compaction and surface tolerance by hand. Stretch lids tight over the stone fill, using an approved lid-closing tool, until the lid meets the perimeter edges of the front and end panels. Do not use crowbars or other single-point leverage bars for lid closing. Close the lid tightly along all edges, ends, and internal-cell diaphragms with spiral binders or lacing wire or with other wire fasteners if approved. Ensure that all projections or wire ends are turned into the baskets. Where shown on the plans or directed or where a complete gabion or gabion mattress unit cannot be installed because of space limitations, cut the basket unit and fold and wire it together to suit site conditions. Fold the mesh back and neatly wire it to an adjacent basket face. Complete the assembling, installation, filling, lid closing, and lacing of the reshaped gabion or gabion mattress units in accordance with this Section.

459.4. Measurement. Gabions will be measured in place by the cubic yard of stone-filled gabions. Gabion mattresses will be measured in place by the square yard of surface area or by the cubic yard.

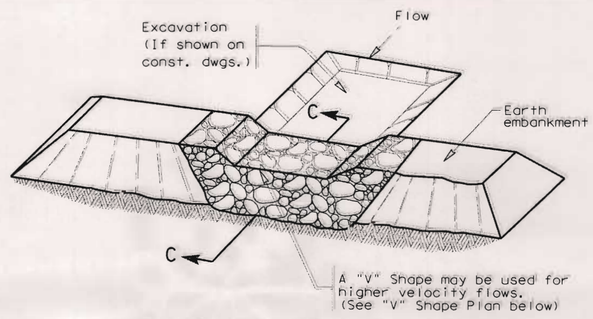
459.5. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Gabions" of the basket-wire coating specified, and per square yard of "Gabion Mattresses" of the thickness and basket-wire coating specified or per cubic yard of "Gabion Mattresses" of the basket-wire coating specified.

The price bid is full compensation for wire baskets, stone fill, lacing and fasteners, filter fabric, filter material, excavation, grading and backfill, materials, tools, equipment, labor, and incidentals. Filter fabric and filter material, if used, will not be paid for directly but will be considered subsidiary to this Item.



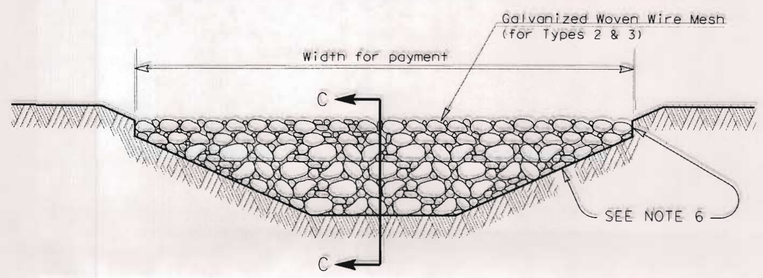
FILTER DAM AT TOE OF SLOPE

RFD1
TYPE 1



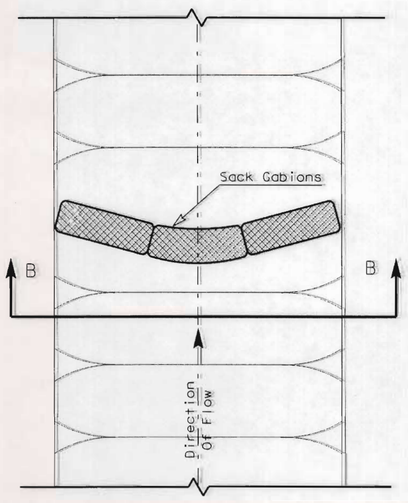
FILTER DAM AT SEDIMENT TRAP

RFD1 OR RFD2
TYPE 1 OR TYPE 2

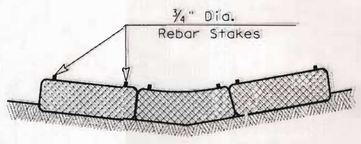


FILTER DAM AT CHANNEL SECTIONS

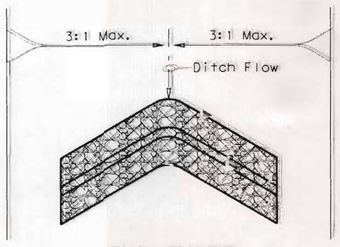
RFD1 OR RFD2 OR RFD3
TYPE 1 OR TYPE 2



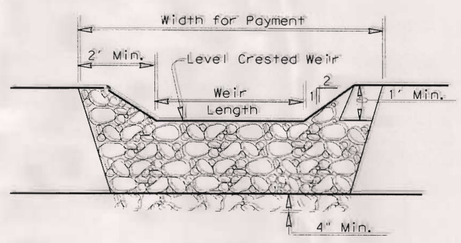
PLAN VIEW



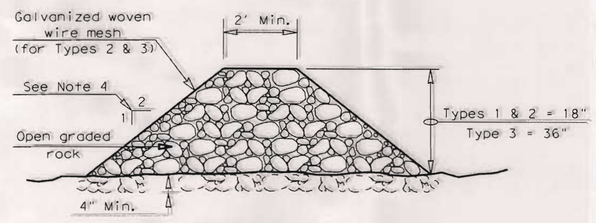
SECTION B-B



"V" SHAPE
(Plan View)



PROFILE



SECTION C-C

PLANS SHEET LEGEND

Type 1 Rock Filter Dam — RFD1
Type 2 Rock Filter Dam — RFD2
Type 3 Rock Filter Dam — RFD3

ROCK FILTER DAM USAGE GUIDELINES

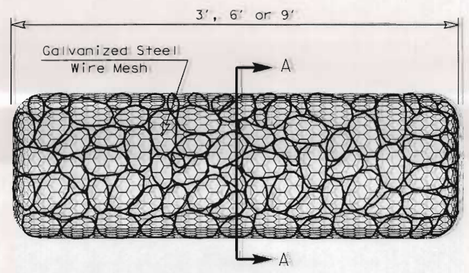
Rock Filter Dams should be constructed downstream from disturbed areas to intercept sediment from overland runoff and/or concentrated flow. The dams should be sized to filter a maximum flow through rate of 60 GPM/FT^2 of cross sectional area. A 2 year storm frequency may be used to calculate the flow rate.

Type 1 (18" high with no wire mesh): Type 1 may be used at the toe of slopes, around inlets, in small ditches, and at dike or swale outlets. This type of dam is recommended to control erosion from a drainage area of 5 acres or less. Type 1 may not be used in concentrated high velocity flows (approx. 8 Ft/Sec or more) in which aggregate wash out may occur. Sandbags may be used at the embedded foundation (4" deep min.) for better filtering efficiency of low flows if called for on the plans or directed by the Engineer.

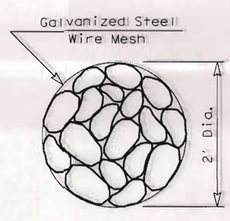
Type 2 (18" high with wire mesh): Type 2 may be used in ditches and at dike or swale outlets.

Type 3 (36" high with wire mesh): Type 3 may be used in stream flow and should be secured to the stream bed.

Type 4 (Sack gabions): Type 4 May be used in ditches and smaller channels to form an erosion control dam.



TYPE 4 (SACK GABIONS)



SECTION A-A

GENERAL NOTES

1. If shown on the plans or directed by the Engineer, filter dams should be placed near the toe of slopes where erosion is anticipated, upstream and/or downstream at drainage structures, and in roadway ditches and channels to collect sediment.
2. Materials (aggregate, wire mesh, sandbags, etc.) shall be as indicated by the specification for "Rock Filter Dams for Erosion and Sedimentation Control".
3. The rock filter dam dimensions shall be as indicated on the SW3P plans.
4. Side slopes should be 2:1 or flatter. Dams within the safety zone shall have sideslopes of 6:1 or flatter.
5. Maintain a minimum of 1' between top of rock filter dam weir and top of embankment for filter dams at sediment traps.
6. Filter dams should be embedded a minimum of 4" into existing ground.
7. The sediment trap for ponding of sediment laden runoff shall be of the dimensions shown on the plans.
8. Rock filter dam types 2 & 3 shall be secured with 20 gauge galvanized woven wire mesh with 1" diameter hexagonal openings. The aggregate shall be placed on the mesh to the height & slopes specified. The mesh shall be folded at the upstream side over the aggregate and tightly secured to itself on the downstream side using wire ties or hog rings. In stream use the mesh should be secured or staked to the stream bed prior to aggregate placement.
9. Sack Gabions should be staked down with ¾" dia. rebar stakes.
10. Flow outlet should be onto a stabilized area (vegetation, rock, etc.).
11. The guidelines shown hereon are suggestions only and may be modified by the Engineer.

Texas Department of Transportation
Design Division (Roadway)

TEMPORARY EROSION, SEDIMENT AND WATER POLLUTION CONTROL MEASURES

ROCK FILTER DAMS

EC(2)-93

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MANOR CREEK, UNIT 4
CIVIL SITE CONSTRUCTION PLANS

DR HORTON
210 W. HUTCHISON STREET
SAN MARCOS, TEXAS 78666

TXDOT EROSION CONTROL DETAILS (2 OF 2)

CIVIL SITE CONSTRUCTION PLANS

5/13/16

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