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

RECEIVED

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

JAN 1 9 2016

COUNTY ENGINEER

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

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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, <u>Complying with the Edwards Aquifer Rules: Technical Guidance on Best Management Practices (2005)</u>, 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	ВМР	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			

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5-4A	Untreated release	0.28	0.17	152	ac
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		

<u>GEOLOGY</u>

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,

Lýnn 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

 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



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December 14, 2015

JAN 04 2016

COUNTY ENGINEER

Edwards Aquifer Protection Program Texas Commission on Environmental Quality 14250 Judson Road San Antonio, TX 78233

RE: Edwards Aquifer, Comal County Manor Creek Subdivision, Units 4-6; Located on Hamburg Avenue, New Braunfels, Texas Plan Type: Request for the Water Pollution Abatement Plan (WPAP); 30 Texas Administrative Code (TAC)Chapter 213 EAPP File No. 13-15061001

To Whom it May Concern:

Please find our response to comments made by the Texas Commission of Environmental Quality in regard to the project mentioned above.

- 1) Upon re-review of the permanent BMP data, additional discrepancies were noted.
 - We acknowledge that additional discrepancies may be noted.
- 2) Unit 4
 - a. For A 4-1, please resolve $A_1 = 2.32$ versus 2.62 acres of impervious cover.
 - The 0.30 acre difference you reference is from impervious cover areas that are not proposed to be treated. Upon a closer examination of the grades for the Emergency Access Road, there are 0.06 acres that goes to the Sand Filter Basin A 4-1. Therefore, we have updated the calculations for that basin and construction plan sheets. Additionally, we have added drainage area A 4-15 to include the remainder (0.24 acres) of the untreated impervious cover areas as a separate item on the summary table. The corresponding change of the attached hard copies is to update the backup calculations and summary tables.
 - b. For A 4-2, please resolve $A_1 = 0.40$ versus 0.36 acres of impervious cover.
 - The 0.40 acre number was a typo. It has been changed to be 0.36 acres on the updated summary table.
 - c. In addition, overcompensation for under sizing is totally permissible within the same drainage basin.
 - We acknowledge that overcompensation is permissible.
- 3) Unit 5
 - a. For A 5-3, only L_M (80%) can be used for a Vegetative Filter Strip; 64 pounds is the maximum TSS removal for a flow-through VFS.
 - We have revised the calculations to show 64 pounds removed through the VFS. To achieve the 80% TSS removal, we have increased the volume of Sand Basin A 5-1 and shifted the gabion wall within the basin by 3.89 feet.
 - b. For A 5-6, please resolve $A_1 = 6.81$ versus 6.87 acres impervious cover.

• The 0.06 acres difference you reference is from impervious cover areas that were not proposed to treated. We have added drainage area A 5-12 to include the untreated impervious cover as a separate item on the Summary Table.

NOTE: While reviewing the calculations, we found that Drainage Area A 5-2 included untreated impervious cover that you did not comment on. Therefore, the impervious cover for this drainage area was reduced from 0.85 acres to 0.68 acres and Drainage Area A 5-4 was added to represent the 0.17 acres that is exiting the site without treatment.

Similarly, the previous calculations included the 0.20 acres of impervious area in Drainage Area A 5-6. Therefore, the impervious cover for Drainage Area A 5-6 was reduced from 6.87 acres to 6.66 acres. The 0.20 acres of impervious area in Drainage Area A 5-12 was added to represent that it is exiting the site without treatment on the summary table.

- 4) Unit 6
 - a. For A 6-1, please resolve $A_1 = 6.69$ versus 7.04 acres impervious cover.
 - The 0.05 acres difference is from impervious cover areas that is proposed to released without treatment. While reviewing the calculations, we found that Drainage Area A 6-1 included untreated impervious cover for Hildeshieim that connects to Manor Creek Unit 5B and the stub street on the east side of the development. The impervious cover for these areas is 0.35 acres. Therefore, the impervious cover for Drainage Area A 6-1 was reduced from 7.04 acres to 6.695 acres and Drainage Areas A 6-8 and A 6-12 were added to represent the 0.35 acres that is exiting the site without treatment.

We believe that everything here is in order, and if you have any further questions or comments, please contact me at (830) 625-8555.

Sincerely,

Had PE

Chris Van Heerde, CFM, PE Sr. Project Manager

	Manor Creek Unit 4 Permanent BMP Summary Table								
Subbasin Data	Area Treated	Treatment Method	Total Area (acres)	Acreage Treated	Impervious Area (acres)	lmp %	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	2.38	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
						R	equired TS	S Removal	7,544

P 1111 CHRISTOPHER P. VAN HEERDE ENGINE 93047 93047 CENSED VICENSED V

TCE0 R-13 2015 DEC 23 1553

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Permanent BMP Summary Table								
TSS Removal Calculations 04-20-2009				Project N Date Prep	lame: ared:	Manor Creek U 6/1/2015	nit 4	
Additional information is provided for cells with a red Text shown in blue indicate location of instructions in the T Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields	triangle in echnical G . Changes	the upper auidance Ma s to these	r <mark>right cor</mark> anual - RG fields will	ner. Place the -348. remove the eq	curs uatio	or over the cell	spreads	neet.
1. The Required Load Reduction for the total project:	(Calculations f	rom RG-348			Pages 3-27 to 3-30)	
Page 3-29 Equation	n 3.3: L _M = 2	27.2(A _N x P)						
where: L _{M TOT}	$AL PROJECT = F$ $A_N = N$ $P = F$	Required TSS Net increase Average annu	6 removal re in imperviou ial precipitat	sulting from the pro s area for the projection, inches	posed ct	development = 80°	% of increa	sed load
Site Data: Determine Required Load Removal Based on the En	tire Project County = in plan 3 =	Comal	acres			Streets		
Predevelopment impervious area within the limits of Total post-development impervious area within the limits of	he plan • ≠ the plan ˆ =	0.00	acres acres	Lots		SF/Lot	141,913	3.26
I otal post-development impervious cover	P =	0.36 33	inches		64	U Channel	3,787	4.85
L _{MTOT} * The values entered in these fields should be for the total projection	AL PROJECT =	7544	lbs.			Fire Access	9222	2 0.21
Number of drainage basins / outfalls areas leaving the	plan area =	8					6819	8.41
2. Drainage Basin Parameters (This information should be provid	led for each	basin):						
Drainage Basin/Outfall	Area No. =	A 4-1						
Total drainage basin/or Predevelopment impervious area within drainage basin/or Post-development impervious area within drainage basin/or Post-development impervious fraction within drainage basin/or L	utfall area = utfall area = utfall area = utfall area = arthis basin =	4.67 0.00 2.38 0.51 2134	acres acres acres Ibs.	# of Lots	17	SF/Lot 3,300 44,977 2403	1.29 1 00 0.06	acres of IC for lots acres of street acres of Fire Access
3. Indicate the proposed BMP Code for this basin.								
Propo Removal	sed BMP = efficiency =	Sand Filter 89	percent					
4. Calculate Maximum TSS Load Removed (L ₂) for this Drainage	Basin by th	e selected B	MP Type.			Aqualogic Cartridg Bioretention Contech StormFilt Constructed Wetk Extended Detentio Grassy Swale Retention / Irrigati Sand Filter Stormceptor Vegetated Filter S Vortechs Wet Basin Wet Vault	ge Filter er and on on trips	
RG-348 Page 3-33 Equation	m 3.7. L _R =	(BMP efficier	icy) x P x (A	x 34.6 + Ap x 0.54))			
where:	$A_{C} = A_{I} = A_{P} = L_{R} = A_{C} = A_{C$	Total On-Site Impervious a Pervious are TSS Load re 4.67	e drainage a rea propose a remaining moved from acres acres	ea in the BMP catch d in the BMP catch in the BMP catchm this catchment area # of Lots	chmen ment a ent ar a by th	t area area ea e proposed BMP SE/Lot		
	A _P = L _R =	2.29 2453	acres lbs	# 01 LUIS	17	44,977 2403	1.2 1.0 0.0	9 acres of IC for lots 3 acres of street 6 acres of Fire Access

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

	2202	lbs						
F :	= 0.90							
6. Calculate Capture Volume required by the BMP Type for this drainage ba	asin / outfall ar	ea.	Calculations from RG	3-348 F	ages 3-34 to	3-36		
Rainfall Depth : Post Development Runoff Coefficient =	= 1.70 0.36	inches						
On-site Water Quality Volume	= 10452	cubic feet						
	Calculations f	rom 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						
Off-site Runoff Coefficient	= 0 = 0.00							
Off-site Water Quality Volume	= 0	cubic feet						
Storage for Sediment	= 2090							
Total Capture Volume (required water quality volume(s) x 1.20)	= 12542	cubic feet						
The following sections are used to calculate the required water quality vol The values for BMP Types not selected in cell C45 will show NA	ume(s) for the	selected BMP						
7. Retention/Irrigation System	Designed as I	Required in RC	3-348	Pages 3-42 to :	3-46			
Required Water Quality Volume for retention basin	= NA	cubic feet						
Irrigation Area Calculations								
		11 A 11						
Soil infiltration/permeability rate	= 0.1 = NA	in/hr square feet	Enter determined p	ermeability rate	or assumed	value of 0	1.1	
	NA	acres						
4 Estanded Detection Resis Custom	Decised as	Dogwood in D/	2 2 49	Pages 2 46 to	2 61			
8. Extended Detention Basin System	Designed as	Required in Ho	3-340	Pages 3-40 to	3-21			
Required Water Quality Volume for extended detention basin	= NA	cubic feet						
9. Filter area for Sand Filters	Designed as	Required in RC	3-348	Pages 3-58 to	3-63			
9A. Full Sedimentation and Filtration System								
Water Quality Volume for sedimentation basin	= 12542	cubic feet						
Minimum filter basin area	= 581	square feet						
Maximum sedimentation basin area Minimum sedimentation basin area	= 5226 = 1306	square feet square feet	For minimum water For maximum water	r depth of 2 feet r depth of 8 feet				
9B. Partial Sedimentation and Filtration System								20
Water Quality Volume for combined basins	= 12542	cubic feet	SF @ Given Depth 2,508.31	7	Given Depth	Width 5	95 1	ength 26.40
Minimum filter basın area	= 1045	square feet					95	11.00161
Maximum sedimentation basin area	= 4181	square feet	For minimum water	r depth of 2 feet			95	44.00644
Minimum sedimentation basin area	1045 = 261	square feet square feet	For Given water de For maximum wate	pth r depth of 8 feet			95 95	11.00161 2 750402
10. Bioretention System	Designed as	Required in R	G-348	Pages 3-63 to	3-65			
Required Water Quality Volume for Bioretention Basin	= NA	cubic feet						
11. Wet Basins	Designed as	Required in R	G-348	Pages 3-66 to	3-71			
Required capacity of Permanent Pool	= NA	cubic feet	Permanent Pool Ca	apacity is 1.20 ti	mes the WQ	1		
Bequired capacity at WOV Elevation	= NA	cubic feet	Total Capacity sho	uld be the Perm V.	anent Pool C	apacity		
	Designed	Description	0.040	Danas a Tal	5 70			
12. Constructed Wetlands	Designed as	Required in R	G-348	Pages 3-71 to	3-73			
12. Constructed Wetlands Required Water Quality Volume for Constructed Wetlands	Designed as	Required in Re cubic feet	G-348	Pages 3-71 to	3-73			

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 REMOVAL	S ARE BASE	D UPON FLOW R	ATES - NOT CALC	ULATED WATER QUALITY VOLUMES
15. Grassy Swales D	esigned as R	equired in RG-348	Pa	ages 3-51 to 3-54
Design parameters for the swale:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfall intensity = i = Swale Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	0.00 0.00 1.1 0.0205 3 0.33 #DIV/0!	acres acres in/hr t/ft t		
Acs = cross-sectional area of flow in Swate =	#DIV/0!	sf		
P _w = Wetted Perimeter =	#DIV/0!	feet		
R _H = hydraulic radius of flow cross-section = A _{CS} /P _W = n = Manning's roughness coefficient ≠	#DIV/0! 0 2	feet		
15A. Using the Method Described in the RG-348				
Manning's Equation: $Q = 1.49 A_{CS} R_{H}^{23} S^{0.5}$ n				
$b = \frac{0.134 \times Q}{y^{167}} - zy =$	#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/01	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 s	set forth in R	G-348, the design p	parameters must be	modified and the solver rerun.
		-		
15B. Alternative Method using Excel Solver				
Design O = CiA =	#DIV/0	cfs		
Manning's Equation Q =	2.3	8 cfs	Error 1 =	#DIV/0!
Swale Width=	13.6	1 ft		
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	#DIV/0! #DIV/0!	ft∕s ft		
Instructions are provided to the right (blue comments).				
Design Width = Design Discharge = Design Depth = Flow Velocity = Minimum Length =	1 2.7 0.3 0.4 146.6	6 ft 4 cfs 3 ft 9 cfs 9 ft	Error 2 =	#DIV/0!

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 F	Required in AG	-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 = C1A			
C = runoff coefficient for the drainage area =	0.3	1	C = Runoff Coefficient = 0.546 (IC) ² + 0.328 (IC) + 0.03
i = design raintall intensity = A = drainage area in acres =	1.	acres	
Q = flow rate in cubic feet per second =	0.3	7 cubic feet/se	c
RG-348 Page 3-31 Equation 3.5: V _{OR} = Q/A			
Q = Runoff rate calculated above = A = Water surface area in the wet vault =	0.3 15	7 cubic feet/se) square feet	c
V _{OR} = Overflow Rate =	0.0) feet/sec	
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	5	3 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 = Efficiency Reduction for Actual Rainfall Intensity =	0.7 0.8	5 percent 3 percent	
Resultant TSS Load removed by Wet Vault =	#VALUE!	lbs	
18. Permeable Concrete	Designed as I	Required in RC	G-348 Pages 3-79 to 3-83
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZO	ME		
19. BMPs Installed in a Series	Designed as I	Required in R	3-348 Pages 3-32
Michael E. Barrett, Ph.D., P.E. recommended that the coeffic	cient for E ₂ be	changed from	n 0.5 to 0.65 on May 3, 2006
$E_{TOT} = [1 \cdot ((1 \cdot E_1) \times (1 \cdot 0.65E_2) \times (1 \cdot 0.25E_3))] \times 100 =$	94.0	1 percent	NET EFFICIENCY OF THE BMPS IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 =	89.0	0 percent	
EFFICIENCY OF THE SECOND BMP IN THE SERIES = $\mathrm{E_2}$ =	70.0	0 percent	
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 =	0.0	0 percent	
THEREFORE, THE NET LOAD REMOVAL WOULD BE: (A, AND A, VALUES ARE FROM SECTION 3 ABOVE)			
L _R = E _{TOT} X P X (A _I X 34.6 X A _P X0 54) =	2591 2	5 lbs	
20. Stormceptor			
Required TSS Removal in BMP Drainage Area= Impervious Cover Overtreatment=	NA 0.0000	lbs ac	
TSS Removal for Uncaptured Area =	0.00	lbs	
Effective Area ≂	NA	EA	
Calculated Model Size(s) = Actual Model Size (if multiple values provided in Calculatec Model Size or if you are choosing a larger model size) =	#N/A	Model Size	
Curless Ares-	. #NI/A	# ²	
Overflow Rate =	#VALUE	Var	
Rounded Overflow Rate =	#VALUE!	Va	
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				
<u>zi. vonoen</u>		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	
	Ļ	Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
		Surface Area =	7.10	ft²
		Overflow Rate =	#VALUE!	Var
		Rounded Overflow Rate =	#VALUE!	Var
		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!	

TSS Removal Calculations 04-20-2009				Proje	ct Name:	Manor Creek Un	it 4	
				Date P	repared:	6/1/2015		
Additional information is provided for cells with a red triang Text shown in blue indicate location of instructions in the Technic Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Cha	le in th cal Guid	ne upper dance Ma o these f	right corr anual - RG fields will	ner. Place t -348. remove the	he curs equatio	or over the cell. ons used in the s	preadshe	et.
1. The Required Load Reduction for the total project:	Cal	culations f	rom RG-348			Pages 3-27 to 3-30		
Page 3-29 Equation 3.3: L	- _M = 27.2	2(A _N x P)						
utore:	- Por	wired TCC	romoval roc	ulting from the		dovelopment - 80°	of increased	load
	w = Net	increase i	n impervious	s area for the p	roiect		Unificieased	lioau
	P = Ave	arage annu	al precipitati	ion, inches				
Site Data: Determine Required Load Removal Based on the Entire Pro Coun	ject tv =	Comal				82288.79		1.889091
Total project area included in plan	* =	23.60	acres			Streets		
Predevelopment impervious area within the limits of the plan Total post-development impervious area within the limits of the plan	"= 	0.00	acres	Lots		SE/L of	141,913	3.26
Total post-development impervious area within the limits of the plat Total post-development impervious cover fraction	• =	0.36	acres	LOIS	64	3,300	211,200	4.85
	P =	33	inches			U Channel		
		7544	16-2				3,787	0.09
* The values entered is these fields should be for the total project area	CT =	/544	IDS.			Fire Access	0222	0.21
The values entered in mese news should be for the total project area.							9222	0.21
Number of drainage basins / outfalls areas leaving the plan are	ea =	8						8.41
2. Drainage Basin Parameters [This information should be provided for Drainage Basin/Outfall Area N Total drainage basin/outfall are Predevelopment impervious area within drainage basin/outfall are Post-development impervious fraction within drainage basin/outfall are Post-development impervious fraction within drainage basin/outfall are L _{M THIS BAR}	each ba o. = ea = ea = ea = ea = ea = ea =	A 4-2 0.49 0.00 0.36 0.73 322	acres acres acres Ibs.	# of Lots	0	SF/Lot 3300 15635	0.36	acres of IC acres of str
3. Indicate the proposed BMP Code for this basin.								
Proposed BN Removal efficien	nP = Gra cv =	155y Swal 70	e percent					
4. Calculate Maximum TSS I and Demound (II.) (or this Desirance Posin		alaotad P				Aqualogic Cartridge Bioretention Contech StormFilter Constructed Wellam Extended Detention Grassy Swale Retention / Irrigation Sand Filter Stormceptor Vegetated Filter Stri Vortechs Wet Basin Wet Vault	Filter d ps	
4. Laiculate Maximum 155 Load Removed [L _R) for this Drainage Basin	by the s	elected B	MP Type.					
RG-348 Page 3-33 Equation 3.7:	L _R = (BN	MP efficien	cy) x P x (A _i	x 34.6 + A _P x 0	.54)			
where	$A_c = Tot$ $A_i = Imp$ $A_p = Pe$ $L_R = TS$	tal On-Site pervious al rvious area S Load rer	e drainage are rea proposed a remaining i moved from t	ea in the BMP d in the BMP ca in the BMP cate this catchment :	catchmen Itchment a chment are area by th	t area area ea ne proposed BMP		
3	A _C =	0.49	acres					
	A ₁ =	0.36	acres	# of Lots		SF/Lot		
	А _Р =	0.13	acres		(3287		acres of IC
	Lg≃	289	lbs			15817	0.36	acres of str

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

Permanent BMP Summary Table

Desired L _{M THIS BASIN} =	289	lbs.	
F =	1.00		
6. Calculate Capture Volume required by the BMP Type for this drainage bar	sin / outfall ar	ea.	Calculations from RG-348 Pages 3-34 to 3-36
Bainfall Danh -	4.00	inches	
Post Development Runoff Coefficient = On-site Water Quality Volume =	0.54	cubic feet	
	Calculations	from RG-348	Pages 3-36 to 3-37
Off-site area draining to BMP = Off-site Impervious cover draining to BMP =	0.00	acres acres	
Impervious fraction of off-site area = Off-site Runoff Coefficient =	0 0.00		
Off-site Water Quality Volume =	0	cubic feet	
<pre>Storage for Sediment = Total Capture Volume (required water quality volume(s) x 1.20) =</pre>	772 4631	cubic feet	
The following sections are used to calculate the required water quality volu The values for BMP Types not selected in cell C45 will show NA.	me(s) for the	selected BMP	
7. Retention/Irrigation System	Designed as	Required in RC	3-348 Pages 3-42 to 3-46
Required Water Quality Volume for retention basin =	NA	cubic feet	
Irrigation Area Calculations:			
Soil infiltration/permeability rate = Irrigation area =	0.1 NA NA	in/hr square feet acres	Enter determined permeability rate or assumed value of 0.1
8. Extended Detention Basin System	Designed as	Required in RC	3-348 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 R(3-348 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 = Minimum sedimentation basin area =	NA NA	square feet square feet	For minimum water depth of 2 feet For maximum water depth of 8 feet
9B. Partial Sedimentation and Filtration System			
Water Quality Volume for combined basins =	= NA	cubic feet	SF @ Given Depth Given Depth Width #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
Minimum sedimentation basin area =	= NA	square feet	For maximum water depth of 8 feet 60
10. Bioretention System	Designed as	Required in R	G-348 Pages 3-63 to 3-65
Required Water Quality Volume for Bioretention Basin =	= NA	cubic feet	-
11. Wet Basins	Designed as	Required in R	G-348 Pages 3-66 to 3-71
Required capacity of Permanent Pool = Required capacity at WQV Elevation =	NA NA	cubic feet cubic feet	Permanent Pool Capacity is 1.20 times the WQV Total Capacity should be the Permanent Pool Capacity plus a second WQV.
12. Constructed Wetlands	Designed as	Required in R	G-348 Pages 3-71 to 3-73
Required Water Quality Volume for Constructed Wetlands =	= NA	cubic feet	
13. AguaLogic [™] Cantridge System	Designed as	Required in R	G-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 ni.

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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	S ARE BAS	ED UPON FLOW BATI	ES - NOT CALCULA	ATED WATER QUALITY VOLUMES
15. Grassy Swales De	signed as I	Required in RG-348	Page	s 3-51 to 3-54
Design parameters for the swale:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfall intensity = i = Swale Slope = Side Slope (z) = Design Water Depth = y = Weichted Bund Count (Counts of the States)	0.4 0.3 1. 0.0	9 acres 6 acres 1 in/hr 1 ft/ft 3 ft		
	0.0	3		
A _{CS} = cross-sectional area of flow in Swale = P _w = Wetted Perimeter = R _H = hydraulic radius of flow cross-section ≈ A _{CS} /P _w ≈ n = Manning's roughness coefficient =	0.9 3.9 0.2 0.	5 sf 6 feet 4 feet 2		
15A. Using the Method Described in the RG-348				
Manning's Equation. $Q = 1.49 A_{CS} R_{H}^{2/3} S^{0.5}$ n				
$b = \frac{0.134 \times Q}{S^{0.5}} - zy$	1 8	6 feet		
Q = CiA =	0.3	4 cfs		
To calculate the flow velocity in the swale:				
V (Velocity of Flow in the swale) = Q/A_{CS} =	0.3	6 ft/sec		
To calculate the resulting swale length:				
L = Minimum Swale Length = V (ft/sec) * 300 (sec) =	107.2	4 feet		
If any of the resulting values do not meet the design requirement s	et forth in F	G-348, the design para	meters must be more	dified and the solver rerun.
15B. Alternative Method using Excel Solver				
Design Q = CiA =	0.3	34 cfs		
Manning's Equation Q ⇒ Swale Width=	0.5 6.0	76 cfs 00 ft	Error 1 =	-0.42
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	0.: 107.:	36 ft/s 24 ft		
Instructions are provided to the right (blue comments).				
Design Width = Design Discharge = Design Depth = Flow Velocity = Minimum Length =	0. 0. 0. 97.	6 ft 76 cts 33 ft 32 cts 48 ft	Error 2 =	-0.42

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	Des	signed as R	equired in RG	-348	Pages 3-30 to 3-32 & 3-79
Required Load Removal Based upo	on Equation 3.3 =	NA	ibs		
First calculate the load removal at 1.1 in/hour					
RG-348 Page 3-30 Equa	tion 3 4. Q = CiA				
C = runoff coefficient for the i = design r A = drainag	e drainage area = rainfall intensity = re area in acres =	0.56 1.1	in/hour acres	C = Runoff Coefficie	nt = 0.548 (IC) ² + 0.328 (IC) + 0.03
Q = flow rate in cubic	eet per second =	0.62	cubic feet/se	с	
RG-348 Page 3-31 Equatio	n 3.5 [.] V _{OR} = Q/A				
Q = Runoff rate ca A = Water surface area	alculated above = in the wet vault =	0.62	cubic feet/se square feet	c	
V _{OR} =	Overflow Rate =	0.00	feet/sec		
Percent TSS Removal from Figure 3-1 (RG-	348 Page 3-31) =	53	percent		
Load remove	ed by Wet Vault ≠	#VALUE!	lbs		
If a bypass occurs at a rainfall intensity of less than 1.1 in/h Calculate the efficiency reduction for the actual rainfall inte	nsity rate				
Actual Rainfall Intensity at which Wet Vault	bypass Occurs =	05	in/hour		
Fraction of rainfall treated from Figure 3-2 RG Efficiency Reduction for Actual F	-348 Page 3-32 = Rainfall Intensity =	0.75	percent percent		
Resultant TSS Load remove	ed by Wet Vault ≂	#VALUE!	lbs		
18. Permeable Concrete	De	signed as P	equired in RG	9-348	Pages 3-79 to 3-83
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CO	INTRIBUTING ZONE				
19. BMPs Installed in a Series	De	signed as P	lequired in RC	à-348	Pages 3-32
Michael E. Barrett, Ph.D., P.E. recommende	d that the coefficien	t for E ₂ be	changed from	n 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 =	94.0	percent	NET EFFICIENCY O	F THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN TH	IE SERIES = E1 =	89.00	percent		
EFFICIENCY OF THE SECOND BMP IN TH	$E SERIES = E_2 =$	70.00	percent		
EFFICIENCY OF THE THIRD BMP IN TH	IE SERIES = E3 =	0.00	percent		
THEREFORE, THE NET LOAD REMOVAL W (A, AND A $_{\rm P}$ VALUES ARE FROM SECTION 3	OULD BE: ABOVE)				
$L_{R} = E_{TOT} X P X (A; X 3)$	4.6 X A _P X0.54) =	388.58	3 lbs		
20. Stormceptor					
Required TSS Removal in BM Impervious Cove	P Drainage Area= er Overtreatment=	0 0000	lbs ac		
TSS Removal for L BMP Sizing	Incaptured Area =	0.00	lbs		
 The state of the s	Effective Area =	NA	EA		
Calculate Actual Model Size (if multiple values prov	d Model Size(s) = ided in Calculated	#N/A			
Model Size or if you are choosing a la	rger model size) =	0	Model Size		
	Surface Area =	#N/A	ft ²		
	Overflow Rate =	#VALUE!	Var		
Rounde	d Overflow Rate =	#VALUE	Vor		
В	MP 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 Vortaab				
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	A SHORE CHARACTER STOCKED IN CONCERNMENT STOCKED IN CONCERNMENT		
		Effective Area =	NA	EA
		Calculated Model Size(s) =	#N/A	
	А	ctual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
		Surface Area =	7.10	ft ²
		Overflow Bate =	#VALUE!	Va
		Bounded Overflow Pate -	#VALUEI	V
		BMB Efficiency % -	#VALUE	* Or 0/
			#VALUE:	/0
			#VALUE:	lbs
		TSS Load Credit ≃	#VALUE!	lbs
	Is Sufficient	Treatment Available? (TSS Credit \geq TSS Uncapt)	#VALUE!	
		TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

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Permanent BMP Summary Table						
TSS Removal Calculations 04-20-2009			Project Name Date Prepared	Manor Creek U 6/1/2015	Jnit 4	
Additional information is provided for cells with a red triangle Text shown in blue indicate location of instructions in the Technical Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Change	in the uppe I Guidance M ges to these	er right corn Manual - RG- fields will r	er. Place the curr 348. emove the equati	sor over the cell ons used in the	spreadsh	leet.
1. The Required Load Reduction for the total project:	Calculations	from RG-348		Pages 3-27 to 3-30	0	
Page 3-29 Equation 3.3 L.	= 27 2(A., x P)					
where: L _M total project A _N P	= Required TS = Net increase = Average ann	S removal resu in impervious inal precipitatio	Iting from the propose area for the project n, inches	d development = 80'	% of increas	ed toad
Site Data: Determine Required Load Removal Based on the Entire Projec County Total project area included in plan * Predevelopment impervious area within the limits of the plan* Total post-development impervious area within the limits of the plan* Total post-development impervious cover fraction *	cl = Comal = 23.60 = 0.00 = 8.41 = 0.36 = 33	acres acres acres inches	Lots 64	Streets SF/Lot 3,300 U Channel	141,913 211,200	3.26 4.85
LM TOTAL PROJECT	= 7544	lbs.		Fire Access	3,787	0.09
* The values entered in these fields should be for the total project area.					9222	0.21
Number of drainage basins / outfalts areas leaving the plan area	= 8					8 41
2. Drainage Basin Parameters (This information should be provided for ea	ich basin):					
Drainage Basin/Outfall Area No.	= A 4-3					
Total drainage basin/outfalt area Predevelopment impervious area within drainage basin/outfall area Post-development impervious area within drainage basin/outfall area Post-development impervious fraction within drainage basin/outfall area L _{M THIS BASIN}	= 2.38 = 0.00 = 1.06 = 0.45 = 952	acres acres acres Ibs	# of Lots 1	SF/Lot 4 3300	1.06 a - a	cres of IC for lots cres of street
3. Indicate the proposed BMP code for this basin.						
Removal efficiency	= vegetated	percent		Aquałogic Cartrido Bioretention Contech StormFilt Constructed Wetta Extended Detentio Grassy Swale Retention / Irrigati Stormceptor Vegetated Filter S Vortechs Wet Basin Wet Vault	ge Filter er and on on	
4. Calculate Maximum TSS Load Removed (L_a) for this Drainage Basin by	the selected l	ВМР Түре.		in all radii		
RG-348 Page 3-33 Equation 3.7. L _R	= (BMP efficie	ency) x P x (A, x	34.6 + A _P x 0.54)			
where: A _c A _i A _P L _R	= Total On-Sit = Impervious are = Pervious are = TSS Load re	le drainage are area proposed ea remaining in emoved from th	a in the BMP catchmen in the BMP catchment the BMP catchment a is catchment area by t	nt area area rea he proposed BMP		
Ac	= 2.38	acres				
A,	= 1.06	acres	# of Lots	SF/Lot		avec all O to 1
	= 1.32 ≓ 988	acres Ibs	1	4 3300	1.06 a 0 a	cres of IC for lots cres of street

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

Desired L _{M THIS BASIN} =	952	lbs.		
F =	0.96			
6. Calculate Capture Volume required by the BMP Type for this drainage bas	sin / outfall a	irea.	Calculations from RG-348 Pages 3-34 to	0 3-36
Rainfall Depth =	2.80	inches		
Post Development Runoff Coefficient = On-site Water Quality Volume =	0.33 7962	cubic feet		
	Calculations	from BG-348	Panes 3, 36 to 3, 37	
Officite area draining to BMP -	0 00	20105	rages 3-30 10 3-37	
Off-site Impervious cover draining to BMP =	0.00	acres		
Off-site Runoff Coefficient =	0.00			
Off-site Water Quality Volume =	0	cubic feet		
Storage for Sediment =	1592			
Total Capture Volume (required water quality volume(s) x 1.20) = The following sections are used to calculate the required water quality volu	9554 me(s) for the	cubic feet		
The values for BMP Types not selected in cell C45 will show NA.	Decigored an	Required to DC	248 Doors 2.42 to 2.46	
<u>7. Retention/initiation System</u>	Designed as	nequired in ho	-340 Fages 3*42 (0.3*40	
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	t value of 0.1
irrigation area =	NA	square teet acres		
8. Extended Detention Basin System	Designed as	Required in RC	-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 RO	i-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 = Minimum sedimentation basin area =	NA NA	square feet square feet	For minimum water depth of 2 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 =		square feet	For minimum water depth of 2 feet	
		Square leer	For maximum water depth of a teet	
10. Bioretention System	Designed as	s Required in RO	3-348 Pages 3-63 to 3-65	
Required Water Quality Volume for Bioretention Basin =	= NA	cubic feet		
11. Wet Basins	Designed a:	s Required in R	G-348 Pages 3-66 to 3-71	
Required canacity of Permanent Pool =	NA	cubic feet	Permanent Pool Capacity is 1.20 times the WO	N.
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the Permanent Pool plus a second WQV.	Capacity
12. Constructed Wetlands	Designed at	s Required in R	3-348 Pages 3-71 to 3-73	
Required Water Quality Volume for Constructed Wetlands =	= NA	cubic feet		
<u>13. AquaLoqic[™] Cartridqe System</u>	Designed a	s Required in R	3-348 Pages 3-74 to 3-78	

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RiA _F) =	NA NA NA	cubic feet cartridges square feet	1	
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 REMOVA	LS ARE BAS	ED UPON FI	OW RATES - NOT CALCI	JLATED WATER QUALITY VOLUMES
15. Grassy Swales	Designed as	Required in F	RG-348 Pa	ges 3-51 to 3-54
Design parameters for the swale:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfall intensity = i = Swale Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	0.0 1 0.0 #DIV/0!	0 acres 0 acres 1 in/hr 1 tt/ft 3 3 ft		
A_{CS} = cross-sectional area of flow in Swale = P_{W} = Wetted Perimeter = R_{H} = hydraulic radius of flow cross-section = A_{CS}/P_{W} = n = Manning's roughness coefficient = 154. Using the Method Described in the RG-348.	#DIV/01 #DIV/01 #DIV/01 0	sf feet feet 2		
13A. Using the Method Described in the Hd-346				
Manning's Equation: $Q = 1.49 A_{CS} R_{H}^{23} S^{0.5}$ n				
$b = \frac{0.134 \text{ x Q}}{\text{y}^{157}} \text{ s}^{05}$	#DIV/01	feet		
Q = CiA =	#DIV/0'	cfs		
To calculate the flow velocity in the swale				
V (Velocity of Flow in the swale) = Q/A_{CS} =	#D1V/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	t set forth in F	G-348, the d	esign parameters must be r	nodified and the solver rerun.
15B. Alternative Method using Excel Solver				
Design Q = CiA =	#DIV/0!	cfs		
Manning's Equation Q = Swale Width=	0. 6.	76 cfs 00 ft	Error 1 =	#DIV/0!

Instructions are provided to the right (green comments).

Flow Velocity Minimum Length ≕	#DIV/0! #DIV/0!	ft/s ft		
Instructions are provided to the right (blue comments).				
Design Width =		6 ft		
Design Discharge =	0.7	76 cfs	Error 2 =	#DIV/0!
Design Depth =	0.3	33 ft		
Flow Velocity =	0.3	32 cfs		
Minimum Length =	97.4	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 swala 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	Design	ned as R	equired in RG	-348	Pages 3-30 to 3-32 & 3-79
Required Load Removat Based upon Equation 3.	3 = 1	NA lbs			
First calculate the load removal at 1.1 in/hour					
RG-348 Page 3-30 Equation 3.4 $^{\circ}$ Q = C	CiA				
C = runoff coefficient for the drainage area i = design rainfall intensity A = drainage area in acres	a = y = s =	0.28 1.1	in/hour acres	C = Runoff Coefficie	$tent = 0.546 (IC)^2 + 0.328 (IC) + 0.03$
Q = flow rate in cubic feet per second	= t	0.31	cubic feet/se	C	
RG-348 Page 3-31 Equation 3.5: V _{OR} = C)/A				
Q = Runoff rate calculated above A = Water surface area in the wet vaul	9 = t =	0 31	cubic feet/se square feet	ec	
V _{OR} = Overflow Rate	e =	0.00	feet/sec		
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	53	percent		
Load removed by Wet Vaul	lt= #V.	ALUE?	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 Occur	S =	0.5	in/hour		
Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-3 Efficiency Reduction for Actual Rainfall Intensit	2 = y =	0.75	percent		
Resultant TSS Load removed by Wet Vau	lt = #∨	ALUE	ibs		
18. Permeable Concrete	Desig	ned as R	lequired in R(3-348	Pages 3-79 to 3-83
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING	ZONE				
19. BMPs Installed in a Series	Desig	ned as F	lequired in RC	3-348	Pages 3-32
Michael E. Barrett, Ph.D., P.E. recommended that the coe	fficient fo	or E ₂ be	changed from	n 0.5 to 0.65 on May	3, 2006
$E_{TOT} = \{1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))\} \times 10^{-1}$	0 =	94.01	percent	NET EFFICIENCY O	F THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E	I, =	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	E ₃ =	0.00	percent		
THEREFORE, THE NET LOAD REMOVAL WOULD BE: (A; AND A $_{\rm P}$ VALUES ARE FROM SECTION 3 ABOVE)					
L _R = E _{TOT} X P X (A, X 34.6 X A _P X0.54	ŧ) =	1160.50) Ibs		
20. Stormceptor Required TSS Removal in BMP Drainage Are Impervious Cover Overtreatme TSS Removal for Uncaptured Are BMP Sizing Effective Are Calculated Model Size(Actual Model Size (if multiple values provided in Calcula Model Size or if you are choosing a larger model size	ea= ent= 0 ea = s) = i tted e) =	NA 0000 0.00 NA #N/A 0	lbs ac Ibs EA Model Size		
Surface Are Overflow Rat Rounded Overflow Rat BMP Efficiency L _R Valu	ea = te = #V te = #V % = #V te = #V	#N/A 'ALUE! 'ALUE! 'ALUE! 'ALUE!	tt² Vαr % Ibs		

		TSS Load Credit =	#VALUE!	lbs
	Is Sufficient	Treatment Available? (TSS Credit \geq 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
	母随户 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!	Va
		Rounded Overflow Rate =	#VALUE!	Va
		8MP Efficiency % =	#VALUE!	%
		Lo Value =	#VALUE!	lhe
		-n		105
		TSS Load Credit =	#VALUE ¹	lbs
	Is Sufficient	Treatment Avaitable? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
		TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Permanent BMP Summary Table								
TSS Removal Calculations 04-20-2009				Project Date Pre	Name: Mane pared: 6/1	or Creek Un /2015	it 4	
Additional information is provided for cells with a red Text shown in blue indicate location of instructions in the T Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields	triangle in echnical Gu	the uppe uidance M to these	r right con Ianual - RG fields will	ner. Place the -348. remove the e	e cursor ov quations u	er the cell. sed in the s	preadsheet.	
1. The Required Load Reduction for the total project:	C	alculations	from RG-348		Pages	3-27 to 3-30		
Page 3-29 Equation	n 3.3: L _M = 27	7 2(A _N x P)						
where: L _{M TOT}	$A_{N} = N$ $P = A^{1}$	equired TS et increase verage ann	S removal res in impervious ual precipitati	sulting from the pr s area for the proj ion, inches	oposed devel ect	opment = 80%	of increased load	
Site Data: Determine Required Load Removal Based on the Er	tire Project County =	Comal	actes		Street	5		
Predevelopment impervious area within the limits of Total post-development impervious area within the limits of Total post-development impervious cover	the plan = the plan = fraction =	0.00 8.41 0.36	acres	Lots	SF/Lo 64	14 3,300 21	1,913 3.26 1,200 4.85	
Lu tot		33 7544	linches		U Cha Fire A	nnel	3.787 0 09	
* The values entered in these fields should be for the total proje	ct area.						9222 0.21	
Number of drainage basins / outfalls areas leaving the	plan area =	8					8 41	
2. Drainage Basin Parameters (This information should be provide	led for each l	bas <u>in):</u>						
Drainage Basin/Outfall	Area No. =	A 4-4						
Total drainage basin/o Predevelopment impervious area within drainage basin/o Post-development impervious area within drainage basin/o Post-development impervious fraction within drainage basin/o L	utfall area = utfall area = utfall area = utfall area = m THIS BASIN =	1.65 0.00 0.68 0.41 612	acres acres acres Ibs.	# of Lots	SF/Lc 9	1 3300	0.68 acres of IC fo - acres of stree	or lots et
3. Indicate the proposed BMP Code for this basin.								
Prop. Removal	osed BMP = V efficiency =	egetated F 80	ilter Strips percent					
•	Basin by the	selected F	MP Type.		Aqua Biore Conte Exten Grass Reter Sand Storm Vege Vorte Wet f	ogic Cartridge ention ch StormFilter ructed Wetlan ded Detention y Swale tion / Irrigatior Filter ceptor ated Filter Stri chs iasin 'ault	Filter	
RG-348 Page 3-33 Equation	on 3.7 L _B = (1	BMP efficie	ncy) x P x (A ₁	x 34,6 + A _P x 0.5	4)			
where:	$A_{C} = T$ $A_{i} = Ir$ $A_{P} = F$ $L_{R} = T$ $A_{C} =$	otal On-Sit npervious are Pervious are SS Load re	e drainage ar area proposed a remaining emoved from t acres	ea in the BMP ca d in the BMP catc in the BMP catchi this catchment are	tchment area hment area nent area ea by the prop	osed BMP		
	A, = A _P = La =	0.68 0.96 636	acres acres Ibs	# of Lots	SF/Lo 9	3300	0.68 acres of IC f	or lots
	-0							199

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

Desired L _{M THIS BASIN} =	612	lbs			
F =	0.96				
6. Calculate Capture Volume required by the BMP Type for this drainage bas	sin / outfall :	area.	Calculations from RG	-348 Page	s 3-34 to 3-36
Painfall Daath -	2.80	inchos			
Post Development Runoff Coefficient =	0.31	incres			
On-site Water Quality Volume =	5242	cubic feet			
	Calculations	from RG-348	Pages 3-36 to 3-37		
Off-site area draining to BMP	0.00	acres			
Impervious fraction of off-site area ≈	0.00	acres			
Off-site Runoff Coefficient = Off-site Water Quality Volume =	0.00 0	cubic feet			
Storage for Sediment =	1048				
Total Capture Volume (required water quality volume(s) x 1.20) =	6290	cubic feet			
The following sections are used to calculate the required water quality volu The values for BMP Types not selected in cell C45 will show NA.	me(s) for th	e selected BMP	*		
7. Retention/Irrigation System	Designed a	s Required in RG	3-348	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 pe	irmeability rate or a	issumed value of 0.1
Irrigation area =	NA	square feet acres			
8. Extended Detention Basin System	Designed a	s Required in RG	3-348	Pages 3-46 to 3-51	
Required Water Quality Volume for extended detention basin =	NA	cubic feet			
9. Filter area for Sand Filters	Designed a	s Required in RC	3-348	Pages 3-58 to 3-63	í.
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 filler 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 leet	
10. Bioretention System	Designed a	s Required in RO	3-348	Pages 3-63 to 3-65	5
Required Water Quality Volume for Bioretention Basin	NA	cubic feet			
	-				
11. Wet Basins	Designed a	is Required in Ho	3-348	Pages 3-66 to 3-71	
Required capacity of Permanent Pool = Required capacity at WQV Elevation =	NA NA	cubic feet cubic feet	Permanent Pool Ca Total Capacity shou plus a second WQV	pacity is 1.20 times uld be the Permane	the WQV nt Pool Capacity
12. Constructed Wetlands	Designed a	is Required in R	G-348	Pages 3-71 to 3-72	3
Required Water Outline Values for Constructed Westerder		aubia laat			
nequired water quality volume for constructed wetlands =		cubic reet			
<u>13. AquaLogic[™] Cartridge System</u>	Designed a	is Required in R	G-348	Pages 3-74 to 3-76	3

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

Required Sedimentation chamber capacity	= NA	cubic feet			
Filter basin area (RIA _F)	= NA = 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 REMO	VALS ARE BAS	ED UPON FLOW RA	TES - NOT CALC	JLATED WATER QUALITY VOL	UMES
15. Grassy Swales	Designed as F	Required in RG-348	Pa	ges 3-51 to 3-54	
Design parameters for the swale					
Drainage Area to be Treated by the Swale \neq A	= 0.0	acres			
Impervious Cover in Drainage Area	= 0.0	0 acres			
Rainfall intensity = r	= 1.	1 in/hr			
Side Slope (z)	= 0.0	3			
Design Water Depth = y	= 0.3	3 ft			
Weighted Runoff Coefficient = C	= #DIV/0!				
Acs = cross-sectional area of flow in Swale	= #DIV/01	sf			
Pw = Wetted Perimeter	= #DIV/0!	feet			
$R_{H} \approx hydraulic radius of flow cross-section = A_{CS}/P_{W}$	= #DIV/0!	feet			
n = Manning's roughness coefficient	= 0.	2			
15A. Using the Method Described in the RG-348					
Manning's Equation $Q \approx 1.49 A_{CS} R_{H}^{23} S'$	0.5				
n					
$b = \frac{0.134 \times Q}{2} - zy$	= #DIV/0!	feet			
y ¹⁶⁷ S ⁰⁵					
Q = CiA	= #DIV/01	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/01	feet			
If any of the resulting values do not meet the design requirement	ent set forth in R	G-348, the design pa	rameters must be r	nodified and the solver rerun.	
15B. Alternative Method using Excel Solver					
Design Q = CiA	a = #DIV/0!	cts			
Manning's Equation Q Swale Width)= 07 h= 6.0	'6 cfs 10 ft	Error 1 =	#DIV/01	
Instructions are provided to the right (green comments).					
Flow Veloc	ity #DIV/0!	ft/s			
Instructions are provided to the right (blue as month)		K.			
instructions are provided to the right (blue comments).					
Design Width	1 =	6 ft	0.14		
Design Discharge	e 0.7	rocts 33 ft	Error $2 =$	#UIV/0!	
Flow Velocity	/= 0.3	12 cfs			
Minimum Length	n = 97.4	18 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 F	lequired in RG	2-348 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 = runolf coefficient for the drainage area = i = design rainfall intensity = A = drainage area in acres =	0.20	3 I in/hour I acres	C = Runoff Coefficient = 0.546 $(IC)^2 + 0.328 (IC) + 0.03$
Q = flow rate in cubic feet per second =	0.2	3 cubic feet/se	ec
RG-348 Page 3-31 Equation 3.5: $V_{OR} \approx Q/A$			
Q = Runoff rate calculated above = A = Water surface area in the wet vault =	0.2	3 cubic feet/se 3 square feet	20
V _{OR} = Overflow Rate =	0.0) feet/sec	
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	5	3 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 = Efficiency Reduction for Actual Rainfall Intensity =	0.7	5 percent 3 percent	
Resultant TSS Load removed by Wet Vault =	#VALUE!	lbs	
18. Permeable Concrete	Designed as I	Required in RC	G-348 Pages 3-79 to 3-83
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZO	ONE		
19. BMPs Installed in a Series	Designed as I	Required in RC	G-348 Pages 3-32
Michael E. Barrett, Ph.D., P.E. recommended that the coeffic	cient for E ₂ be	changed from	m 0.5 to 0.65 on May 3. 2005
$E_{\text{TOT}} = [1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100 =$	94.0	1 percent	NET EFFICIENCY OF THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = $E_1 = E_2$	89.0	0 percent	
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 =	70.0	0 percent	
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 :	0.0	0 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 _P X0.54) =	= 747.8	8 lbs	
20. Stormceptor Required TSS Removal in BMP Drainage Area Impervious Cover Overtreatment TSS Removal for Uncaptured Area BMP Sizing	= NA = 0.0000 = 0.00	lbs ac lbs	
Effective Area	= NA = #N/A	EA	
Actual Model Size (if multiple values provided in Calculate) Model Size or if you are choosing a larger model size) :	d = 0	Model Size	
Surface Area	= #N/A	ft ²	
Overflow Rate	= #VALUE!	Var	
Rounded Overflow Rate	#VALUE	Var	
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				
zi. voneen		Required TSS Removal in BMP Drainage Area=	NA	lbs
		Impervious Cover Overtreatment=	0 0000	ac
		TSS Removal for Uncaptured Area =	0.00	lbs
	8MP 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!	Va
		Rounded Overflow Rate =	#VALUE!	Var
		BMP Efficiency % =	#VALUE!	%
		L _R Value =	#VALUE!	Ibs
		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 Na Date Prepa	me: Mane red: 6/1	/2015	Unit 4	
Additional information is provided for cells wit Text shown in blue indicate location of instructions Characters shown in red are data entry fields. Characters shown in black (Bold) are calculate	h a red triangle in in the Technical G d fields. Changes	the upper uidance Ma s to these f	right corr Inual - RG- fields will	ner. Place the c -348. remove the equ	ations u	er the ce sed in th	II. e spreads	heet.
1. The Required Load Reduction for the total project:	C	Calculations fr	om RG-348		Pages	3-27 to 3-	30	
Page 3-29	9 Equation 3.3: L _M = 2	27.2(A _N x P)						
where:	$L_{\rm M} {\rm total PROJECT} = F$ $A_{\rm N} = N$ $P = F$	Required TSS Net increase in Average annu	removal res n impervious al precipitatio	ulting from the prop area for the project on, inches	osed devel	opment = 8	0% of increa	ised load
Site Data: Determine Required Load Removal Based	on the Entire Project							
Total project area Predevelopment impervious area within the Total post-development impervious area within the Total post-development impervious	County = included in plan * = limits of the plan * = e limits of the plan * =	Comal 23.60 0.00 8.41	acres acres acres	Lots	Street SF/Lo	s t 3 300	141,913	3.26
	P = [33	inches		U Cha	innel	3,787	0.09
* The values entered in these fields should be for the to	L _{M TOTAL PROJECT} =	7544	lbs.		Fire A	ccess	9222	0.21
Number of drainage basins / outfalls areas lea	aving the plan area =	8						8.41
		havin).						
2. Drainage Basin Parameters This mormation should		Dasin):						
Drainage Basi Total drainag Predevelopment impervious area within drainag Post-development impervious area within drainag Post-development impervious fraction within drainag	e basin/outfall area = e basin/outfall area = e basin/outfall area = e basin/outfall area = L _{M THIS} BASIN =	6.63 0.00 3.06 0.46 2744	acres acres acres (bs	# of Lots	SF/Lc 23	4 3300 57265	1.74 1.31	acres of IC for lots acres of street
3. Indicate the proposed BMP Code for this basin.								
	Proposed BMP = Removal efficiency =	Sand Filter 89	percent		Aqua Biore Conte Cons Exter Grass Reter Sand Storm Vege Vorte Wet B	ogic Cartrii tention sch StormF tructed We ded Deten ded Deten y Swale tilon / Irriga Filter ceptor tated Filter chs 3asin Jault	dge Filter ilter tland tion ation Strips	
4. Calculate Maximum TSS Load Removed (L _B) for this	Drainage Basin by the	e selected B	МР Түре.					
RG-348 Page 3-3	33 Equation 3.7: L _B =	(BMP efficien	cy) x P x (A;	x 34.6 + A _P x 0.54)				
where:	$A_{C} = \\ A_{I} = \\ A_{P} = \\ L_{B} = $	Total On-Site Impervious al Pervious area TSS Load rer	drainage are rea proposed a remaining a noved from th	ea in the BMP catch I in the BMP catchm n the BMP catchme his catchment area	iment area lent area nt area by the prop	osed BMP		
	$A_{C} = A_{1} = A_{2} = A_{2$	6.63 3.06 3.57 3166	acres acres acres lbs	# of Lots	SF/Lo 23	ot 3300 57399	1.74 1.32	acres of IC for lots acres of street

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

Desired L _{M THIS BASIN} =	3020	lbs					
F =	0.95						
6. Calculate Capture Volume required by the BMP Type for this drainage ba	sin / outfall a	rea.	Calculations from RG-	348	Pages 3-34 to 3-36		
Rainfall Depth = Post Development Runoff Coefficient ⇒ On-site Water Quality Volume =	2.60 0.34 21097	inches cubic feet					
	Calculations	from RG-348	Pages 3-36 to 3-37				
Off-site area draining to BMP = Off-site Impervious cover draining to BMP = Impervious fraction of off-site area = Off-site Runoff Coefficient =	0.00 0.00 0 0.00	acres acres					
Off-site Water Quality Volume =	. 0	cubic feet					
Storage for Sediment = Total Capture Volume (required water quality volume(s) x 1.20) = The following sections are used to calculate the required water quality volu The values for BMP Types not selected in cell C45 will show NA.	4219 25317 me(s) for the	cubic feet selected BMP					
7. Retention/Irrigation System	Designed as	Hequired in Hu	3-348	Pages 3-42 to	3-40		
Required Water Quality Volume for retention basin a	= NA	cubic feet					
rrigation Area Calculations. Soil infiltration/permeability rate = Irrigation area =	0.1 NA NA	in/hr square feet acres	Enter determined pe	rmeability rate	e or assumed value o	10.1	
8. Extended Detention Basin System	Designed as	Required in RC	3-348	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 RC	3-348	Pages 3-58 to	3-63		
9A. Full Sedimentation and Filtration System							
Water Quality Volume for sedimentation basin	25317	cubic feet					
Minimum filter basin area =	= 1172	square feet					
Maximum sedimentation basin area = Minimum sedimentation basin area =	= 10549 = 2637	square feet square feet	For minimum water For maximum water	depth of 2 fee depth of 8 fee	t IT.		
9B. Partial Sedimentation and Filtration System							
Water Quality Volume for combined basins	= 25317	cubic feet	SF @ Given Depth 5.063.39		Given Depth Width 5	90 90	ength 56.26
Minimum filter basin area :	= 2110	square feet				90	23.4416
Maximum sedimentation basin area	= 8439 2110	square feet square feet	For minimum water For Given water dep	depth of 2 fee	c.	90 90	93.76641 23.4416
Minimum sedimentation basin area	= 527	square feet	For maximum water	depth of 8 fee	t	90	5.860401
10. Bioretention System	Designed as	Required in R	G-348	Pages 3-63 to	3-65		
Required Water Quality Volume for Bioretention Basin	= NA	cubic feet					
11. Wet Basins	Designed as	Required in R	G-348	Pages 3-66 to	3-71		
Required capacity of Permanent Pool = Required capacity at WQV Elevation =	NA NA	cubic feet cubic feet	Permanent Pool Cap Total Capacity shou plus a second WQV	pacity is 1.20 t Ild be the Perm	imes the WQV nanent Pool Capacity	I.	
12. Constructed Wetlands	Designed as	Required in R	G-348	Pages 3-71 to	3-73		
Required Water Quality Volume for Constructed Wetlands							
	= NA	cubic feet					

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA	cubic feet cartridges 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 REMOVA	ALS ARE BAS	ED UPON FLOW	RATES - NOT CALC	ULATED WATER QUALITY VOLUMES
15. Grassy Swales	Designed as I	Required in RG-3	48 Pa	ages 3-51 to 3-54
Design parameters for the swale;				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfall intensity = i = Swale Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	0,00 0,0 1, 0,02 0,3 #DIV/01	acres 0 acres 1 in/hr 5 ft/ft 3 ft		
A_{CS} = cross-sectional area of flow in Swale = P_w = Wetted Perimeter = R_H = hydraulic radius of flow cross-section = A_{CS}/P_w = n ~ Manning's roughness coefficient =	#DIV/0! #DIV/0! #DIV/01 0.	sf feet feet 2		
15A. Using the Method Described in the RG-348				
Manning's Equation $Q = \frac{1.49}{n} A_{CS} R_{H}^{2.3} S^{0.5}$				
$b = \frac{0.134 \times Q}{y^{167} S^{0.5}} - zy =$	#DIV/01	feet		
Q = CiA =	#DIV/01	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 requiremen	nt set forth in R	G-348, the desig	n parameters must be	modified and the solver rerun.
15B. Alternative Method using Excel Solver				
Design Q = CiA =	#DIV/0!	cfs		
Manning's Equation Q = Swale Width=	1.2 6.0	20 cfs 00 ft	Error 1 =	#DIV/0!
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	/ #DIV/01 = #DIV/01	ft/s ft		
Instructions are provided to the right (blue comments).				
Design Width Design Discharge Design Depth Flow Velocity	= 12 = 0.3 = 0.5	6 ft 20 cfs 33 ft 51 cfs	Error 2 =	#DIV/01

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.

Minimum Length =

16. Vegetated Filter Strips

Designed as Required in RG-348

0.51 cfs 154.12 ft

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 F	lequired in RG	-348 F	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	λ.			
C = runoff coefficient for the drainage area = i = design rainfall intensity = A = drainage area in acres =	= 0.3(= 1,1) in/hour acres	C = Runoff Coefficient	t = 0.546 (IC) ² + 0.328 (IC) + 0.03
Q = flow rate in cubic feet per second :	= 0.33	3 cubic feet/se	c	
RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$	4			
$Q \approx Runoff$ rate calculated above = A = Water surface area in the wet vault =	= 0.33 = 150	3 cubic feet/se 3 square feet	c	
V _{OR} = Overflow Rate :	= 0.00) feet/sec		
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31)	5	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		5 in/hour		
Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 Efficiency Reduction for Actual Rainfall Intensity	= 0.7 = 0.8	5 percent 3 percent		
Resultant TSS Load removed by Wet Vault	= #VALUE!	lbs		
18. Permeable Concrete	Designed as I	Required in RC	-348	Pages 3-79 to 3-83
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING Z	ONE			
19. BMPs Installed in a Series	Designed as I	Required in RC	-348	Pages 3-32
Michael E. Barrett, Ph.D., P.E. recommended that the coeff	icient for E ₂ be	changed from	0.5 to 0.65 on May 3,	2006
$E_{TOT} = [1 \cdot ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100$	= 94.0	1 percent	NET EFFICIENCY OF	THE BMPS IN THE SERIES
EFFICIENCY OF FIRST 8MP IN THE SERIES = E,	89.0	o percent		
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_Z	70.0	0 percent		
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3	- 0.0	o percent		
THEREFORE, THE NET LOAD REMOVAL WOULD BE: (A, AND $A_{\rm P}$ VALUES ARE FROM SECTION 3 ABOVE)				
L _R = E _{TOT} X P X (A _I X 34.6 X A _P X0.54)	= 3344.3	8 lbs		
20. Stormceptor Required TSS Removal in BMP Drainage Area Impervious Cover Overtreatment TSS Removal for Uncaptured Area BMP Sizing Effective Area Calculated Model Size(s) Actual Model Size (if multiple values provided in Calculate Model Size or if you are choosing a larger model size) Surface Area Overflow Rate Bounded Overflow Bate	= NA = 0.0000 = 0.00 = NA d = 0 = #N/A = #VALUE! = #VALUE!	lbs ac lbs EA Model Size ft ² V _{cr}		
BMP Efficiency % L _R Value	= #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. voneen		Required TSS Removal in BMP Drainage Area= Impervious Cover Overtreatment=	NA 0 0000	lbs ac					
		TSS Removal for Uncaptured Area =	0.00	lbs					
BMP Sizing		Effective Area = Calculated Model Size(s) =	NA #N/A	EA					
	Vx1000	Pick Model Size							
		Surface Area =	7.10	ft²					
		Overflow Rate =	#VALUE!	Va					
		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!						
Permanent BMP Summary Table									
--	--	---	---	--	--	--	--	---	---
TSS Removal Calculations 04-20-2009				Project Date Pre	Name: pared:	Manor 6/1/2	Creek I	Unit 4	
Additional information is provided for cells with a red triar Text shown in blue indicate location of instructions in the Techr Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Ch	igle in f nical Gu nanges	the upper lidance Ma to these f	right corr anual - RG- fields will	ner. Place the 348. remove the e	e curs quatio	or over	the cel	l. e spread	sheet.
1. The Required Load Reduction for the total project:	Ca	alculations fr	rom RG-348			Pages 3	-27 to 3-3	30	
Page 3-29 Equation 3.3:	L _M = 27	7.2(A _N x P)							
where: L _{M TOTAL PRO}	_{JECT} = Re A _N = Ne P ≃ Av	equired TSS et increase i verage annu	removal res n impervious al precipitatio	ulting from the pi area for the proj on, inches	roposec ect	l develop	ment = 8()% of incre	ased load
Site Data: Determine Required Load Removal Based on the Entire P	roject								
Co Total project area included in pla	unty = an ' =	Comal 23.60	acres			Streets			
Predevelopment impervious area within the limits of the pi Total post-development impervious area within the limits of the p	an = an =	8.41	acres	Lots	~ ~	SF/Lot		141,913	3.26
i otal post-development impervious cover fracti	P =	33	inches		64	U Chan	nel	211,200	4.85
LM YOTAL PRO	NECT =	7544	lbs			Fire Acc	ess	3,787	0.09
* The values entered in these fields should be for the total project are	a .							9222	0.21
Number of drainage basins / outfalls areas leaving the plan a	area =	8							8.41
2. Drainage Basin Parameters (This information should be provided for	or each t	oasin):							
Drainage Basin/Outfall Area	No. =	A 4-6							
Total drainage basin/outfall Predevelopment impervious area within drainage basin/outfall Post-development impervious area within drainage basin/outfall Post-development impervious fraction within drainage basin/outfall	area = area = area = area =	0.61 0.00 0.08 0.12	acres acres acres	# of Lots	t	SF/Lot	3300	0 08	acres of IC for lots acres of street
LM THIS	BASIN =	68	lbs						
3. Indicate the proposed BMP Code for this basin.									
Proposed 8 Removal efficie	BMP = Vi ency =	egetated Fil 80	percent						
						Aqualog Bioreter Contect Construc Extended Grassy Retention Stormce Vegetat Vortech Wet Ba Wet Va	gic Cartric ntion In StormFil cted Wet ed Detenti Swale on / Irrigat Iter eptor ed Filter S sin ult	Ige Filter Iand ion tion Strips	
4. Calculate Maximum TSS Load Removed (L _B) for this Drainage Basi	n by the	selected BI	MP Type.						
RG-348 Page 3-33 Equation 3.7	: L _A ≃ (E	BMP efficient	cy) x P x (A;)	x 34.6 + A _P x 0.5	4)				
where:	$A_{C} = T_{I}$ $A_{I} = In$ $A_{P} = P_{I}$ $L_{R} = T_{I}$	otal On-Site npervious ar ervious area SS Load ren	drainage are rea proposed a remaining ir noved from th	ea in the BMP ca in the BMP catc n the BMP catching nis catchment are	tchmen hment a ment ar ea by th	t area area ea e propos	ed BMP		
	A _C ≖ A –	0.61	acres	# of Lata		SE#			
	-∩₁ = Α _ρ = L _β ≂	0.53 77	acres lbs		η	SF/LOI	3300	0.08 0	acres of IC for lots acres of street

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

Desired L _{M THIS} BASIN =	68	lbs.		
F =	0.89			
6. Calculate Capture Volume required by the BMP Type for this drainage bas	sin / outf <u>all a</u>	rea.	Calculations from RG-	348 Pages 3-34 to 3-36
Rainfall Depth =	1.60	inches		
Post Development Runoff Coefficient = On-site Water Quality Volume =	0.15 516	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		
Off-site Runoff Coefficient =	0.00			
Off-site Water Quality Volume =	0	cubic feet		
Storage for Sediment =	103			
Total Capture Volume (required water quality volume(s) x 1.20) =	619 me(s) for the	cubic feet		
The values for BMP Types not selected in cell C45 will show NA.				D 0.404- 0.40
7. Retention/Irrigation System	Designed as	Hequired in HC	-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 pe	rmeability rate or assumed value of 0.1
Irrigation area =	NA	square feet		
	14	acres		
8. Extended Detention Basin System	Designed as	Required in RC	3-348	Pages 3-46 to 3-51
Bequired Water Quality Volume for extended detention basin =	NA	cubic feet		
Required water Quality volume for extended detention basis =	NA			
9. Filter area for Sand Filters	Designed as	Required in RC	3-348	Pages 3-58 to 3-63
9A. Full Sedimentation and Filtration System				
Water Quality Volume for sedimentation basin =	NA	cubic feet		
Minimum filter basın area =	NA	square feet		
Maximum sedimentation basin area = Minimum sedimentation basin area =	NA NA	square feet square feet	For minimum water For maximum water	depth of 2 feet 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 Disententian Contem	Designed	Description D	2.210	Dense 1 02 in 2 05
10. Bioretention System	Designed as	Hequired in Hi	a-348	Pages 3-63 to 3-65
Required Water Ouality Volume for Bioretention Basin =	NA	cubic feet		
11. Wet Basins	Designed a	Required in R	G-348	Pages 3-66 to 3-71
Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Ca	pacity is 1.20 times the WQV
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity shou	ald be the Permanent Pool Capacity
			provid pocond reav	
12. Constructed Wetlands	Designed a	s Hequired in Ri	G-348	Pages 3-71 to 3-73
Required Water Quality Volume for Constructed Wetlands =	= NA	cubic feet		
12 Aqual agis TM Castridge Sustem	Designed	Boguirad in D	0.249	Pages 3.74 to 3.78

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges square feet		
14. Stormwater Management StormFilter® by CONTECH				
Required Water Quality Volume for Contech StormFilter System =	NA NA	cubic feet		
THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOV	ALS ARE BASE	D UPON FLOW RATES - N	OT CALCULATED WATER QUALITY VOLUMI	S
15. Grassy Swales	Designed as R	equired in RG-348	Pages 3-51 to 3-54	
Design parameters for the swale:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfalf intensity = i = Swale Slope Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	= 0.00 = 0.00 = 1.1 = 3 = 0.33 = #DIV/0!	acres acres in/hr tt/tt		
$A_{rs} = cross-sectional area of flow in Swale =$	= #DIV/01	st		
P _w = Watted Perimeter =	= #DIV/0!	feet		
R_{H} = hydraulic radius of flow cross-section = A_{GS}/P_{W} =	= #DIV/01	leet		
in - Maining's roughness coefficient -	- 0.2			
TSA. Using the Method Described in the HG-348				
Manning's Equation: $Q = 1.49 A_{CS} R_{H}^{23} S^{0}$ n	s			
b = <u>0.134 x Q</u> - zy = y ¹⁸⁷ S ^{o s}	= #DIV/01	feet		
Q = CiA :	= #DIV/01	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:				
I = M(n)m(n) S(n) I = I (f(n)) + 200 (n)	- #DIV/01	fact		
L = Minimum Swale Langin = V (1/Sec) - 500 (Sec) -	= #DIV/0			
If any of the resulting values do not meet the design requireme	nt set forth in HC	i-348, the design parameter:	s must be modified and the solver rerun.	
15B. Alternative Method using Excel Solver				
Design Q = CiA	= #DIV/0!	cfs		
Manning's Equation Q Swale Width:	= 0.7€ ≃ 6.00	Bicts E Dift	Error 1 = #D!V/01	
Instructions are provided to the right (green comments).				
Flow Velocit Minimum Length	y #DIV/0' = #DIV/0!	ft/s ft		
Instructions are provided to the right (blue comments).				

Design Width =	6 ft		
Design Discharge =	0.76 cts	Error 2 =	#DIV/01
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

17. Wet Vaults		Designed	as R	equired in RG	-348	Pages 3-30 to 3-32 & 3-79
	Required Load Removal Based upon Equation 3.3 =	NA		lbs		
First calculate th	te 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 Coefficie	nt = 0.546 (IC) ² + 0.328 (IC) + 0.03
	i = design räinfall intensity = A = drainage area in acres =		1.1	acres		
	Q = flow rate in cubic feet per second =		0.09	cubic feet/se	5	
	RG-348 Page 3-31 Equation 3.5: V _{OR} = Q/A					
	Q = Runoff rate calculated above = A = Water surface area in the wet vault =		0.09	cubic feet/se square feet	c	
	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 =	#VALL	JE'	lbs		
If a bypass occu Calculate the eff	irs at a rainfall intensity of less than 1.1 in/hours liciency reduction for the actual rainfall intensity rate					
	Actual Rainfall Intensity at which Wet Vault bypass Occurs =		05	in/hour		
	Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = Efficiency Reduction for Actual Rainfall Intensity =		0.75	percent percent		
	Resultant TSS Load removed by Wet Vault =	#VALL	JEI	lbs		
18. Permeable (Concrete	Designed	tas A	lequired in RG	-348	Pages 3-79 to 3-83
PERMEABLE CO	DINCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZO	NE				
19. BMPs Instal	led in a Series	Designed	as R	lequired in RG	-348	Pages 3-32
	Michael E. Barrett, Ph.D., P.E. recommended that the coeffic	ient for E	, be a	changed from	0.5 to 0.65 on May (1, 2006
	E _{TOT} = [1 - ((1 - E ₁) X (1 - 0.65E ₂) x (1 - 0.25E ₃))] X 100 =		94.01	percent	NET EFFICIENCY O	F 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: $(A_t \text{ AND } A_p \text{ VALUES ARE FROM SECTION 3 ABOVE})$					
	L _R = E _{TOT} X P X (A, X 34.6 X A _P X0.54) =		90.26	6 lbs		
20. Stormcepto						
	Hequired 155 Hemoval in BMP Drainage Area= Impervious Cover Overtreatment=	0.000	00	ac		
	TSS Removal for Uncaptured Area =	0.00	D	lbs		
	Effective Area =	NA		EA		
	Calculated Model Size(s) = Actual Model Size (if multiple values provided in Calculated	: #N/,	4			
	Model Size or if you are choosing a larger model size) =	0		Model Size		
	Surface Area =	#N/.	A	ft²		
	Overflow Rate =	#VAL	JE!	Va		
	Rounded Overflow Rate =	#VAL	JE!	Va		
	BMP Efficiency % =	#VAL	JE	%		
	L _R Value =	#VAL	JE!	lbs		

	TSS Load Credit =	#VALUE!	lbs
	Is Sufficient Treatment Available? (TSS Credit \geq TSS Uncapt.	#VALUE!	
	TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	
21. Vortech			
	Required TSS Removal in BMP Drainage Areas	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 farger model size) =	Vx1000	Pick Model Size
	Surface Area =	7.10	ft ²
	Overflow Rate =	#VALUE!	Va
	Rounded Overflow Rate	#VALUE	Var
	BMP Efficiency %	#VALUE!	%
	L _R Value :	* #VALUE!	lbs
	TSS Load Credit :	#VALUE!	lbs
	Is Sufficient Treatment Available? (TSS Credit \geq TSS Uncapt.) #VALUE	
	TSS Treatment by BMP (LM + TSS Uncapt.) +	#VALUE!	

,,								
TSS Removal Calculations 04-20-2009				Pro Date	ject Name: Prepared:	Manor Creek Ur 6/1/2015	nit 4	
Additional information is provided for cells with a red triangl Text shown in blue indicate location of instructions in the Technic Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Char	le in the al Guid nges to	e upper ance Ma these f	right cor nual - RG ields will	ner. Place i-348. remove th	the curs	or over the cell.	spreadshe	et.
1. The Required Load Reduction for the total project:	Calc	ulations fro	om RG-348			Pages 3-27 to 3-30		
Page 3-29 Equation 3.3: L	_M = 27.2((A _N x P)						
Landification and the	- 0.00	ined TCC		e dian faan d				flood
WILETE. LM TOTAL PROJEC	ir - nequ	ncrease in		s area for the	nroiect	development = ao.a	s of micreased	Illiau
	P = Aver	age annua	I precipitati	ion, inches	p. 9,001			
Site Data: Determine Required Load Removal Based on the Entire Proj	ect							
Count Total project area included in plan	(y = (* =	23.60	acres			Streets		
Predevelopment impervious area within the limits of the plan	*=	0.00	acres			1200F220012200124	141,913	3.26
Total post-development impervious area within the limits of the plan Total post-development impervious cover fraction	1'=	8.41	acres	Lots	64	SF/Lot	211 200	4.85
	P =	33	inches		04	U Channel	211,200	4.00
							3,787	0.09
LM TOTAL PROJEC	or =	7544	lbs			Fire Access		
 The values entered in these helds should be for the total project area. 							9222	021
Number of drainage basins / outfalls areas leaving the plan are	ea =	8						8.41
2. Drainage Basin Parameters (This information should be provided for o Drainage Basin/Outfall Area No Total drainage basin/Outfall are Predevelopment impervious area within drainage basin/outfall are Post-development impervious fraction within drainage basin/outfall are Post-development impervious fraction within drainage basin/outfall are LMTTHIS BAS 3. Indicate the proposed BMP Code for this basin.	each bas 0. = 0a = 0a = 0a = 0a = 0a = 0a =	a 4-7 0.68 0.00 0.55 0.81 495	acres acres acres lbs	# of Lots	C	SF/Lot) 3300 24037	0.55	acres of IC acres of str
Proposed BM	P = Gras	ssy Swale						
Removal efficienc	cy =	70	percent			Aqualogic Cartridge Bioretention Contech StormFilte Constructed Wetlar Extended Detention Grassy Swale Retention / Irrigatio Sand Filter Stormceptor Vegetated Filter Str Vortechs Wet Basin Wet Vault	e Filter nd n rips	
4. Calculate Maximum TSS Load Removed (L _R) for this Drainage Basin b	by the se	lected BN	Р Түре.					
RG-348 Page 3-33 Equation 3.7: L	L _R = (8M	P efficienc	y) x P x (A,	x 34.6 + A _P ;	(054)			
where A	$A_c = Tota$ $A_1 = Impe$ $A_P = Pen$ $L_R = TSS$ $A_c =$ $A_1 =$	al On-Site ervious area /ious area 5 Load rem 0.68 0.54	drainage ar ea proposed remaining i loved from i acres acres	rea in the BM d in the BMP in the BMP c this catchmen # of Lots	P catchmen catchment a atchment ar nt area by th	nt area area ea e proposed BMP SF/Lot		
,	А _Р =	0.14	acres		(0 3300		acres of IC
l	L _A =	437	lbs			23698.2	0 54	acres of str

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

Permanent BMP Summary Table

Desired L _{M THIS BASIN} =	437	lbs.					
۶ =	1.00						
6. Calculate Capture Volume required by the BMP Type for this drainage bas	sin / outfall ar	ea.	Calculations from RG-	348 P	ages 3-34 to 3	-36	
Rainfall Depth = Post Development Runoff Coefficient =	4.00 0.62	inches					
On-site Water Quality Volume =	6160	cubic feet					
	Calculations I	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 = Off-site Runoff Coefficient =	0.00						
Off-site Water Quality Volume =	0	cubic feet					
Storage for Sediment =	1232						
Total Capture Volume (required water quality volume(s) x 1.20) =	7392	cubic feet					
The values for BMP Types not selected in cell C45 will show NA.	ma(s) for the	Selected DMP					
7. Retention/Irrigation System	Designed as	Required in RG	i-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 per	meability rate	or assumed v	alue of 0.	1
Irrigation area =	NA	square feet					
8. Extended Detention Basin System	Designed as	Required in RC	3-348	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 RC	3-348	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 o	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	SF @ Given Depth #VALUE!	C	iven Depth	Width 5	60
Minimum filter basin area =	NA	square feet					60
Maximum sedimentation basin area =	a NA	square feet	For minimum water	depth of 2 feet			60
Minimum sedimentation basin area =	NA NA	square feet square feet	For Given water dep For maximum water	th depth of 8 feet			60 60
10. Bioretention System	Designed as	Required in R(3-348	Pages 3-63 to 3	3-65		
Required Water Quality Volume for Bioretention Basin =	= NA	cubic feet					
11. Wet Basins	Designed as	Required in R	G-348	Pages 3-66 to :	3-71		
	NA	cubic feet	Permanent Pool Can	acity is 1 20 tio	oes the WOV		
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity shou plus a second WQV.	Id be the Perma	ment Pool Ca	pacity	
12. Constructed Wetlands	Designed as	Required in R	G-348	Pages 3-71 to	3-73		
Required Water Quality Volume for Constructed Wetlands =	= NA	cubic feet					
<u>13. AquaLogic[™] Cartridge System</u>	Designed as	Required in R	G-348	Pages 3-74 to :	3-78		

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 REMOVAL	S ARE BASE	D UPON FLOW RATE	S - NOT CALCULA	ATED WATER QUALITY VOLUMES
15. Grassy Swales De	esigned as R	equired in RG-348	Page	s 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 =	0.54	acres		
Swale Slope =	0.005	i ft/ft		
Side Slope (z) =	1			
Design Water Depth = y =	0.33	h ft		
weighted Runon Coemclent = C =	0.60	,		
Acs = cross-sectional area of flow in Swale =	1.95	i sf		
P _w = Wetted Perimeter =	6.95	i feet		
R_{H} = hydraulic radius of flow cross-section = A_{CS}/P_{W} =	0.28	8 feet		
n = Manning's roughness coefficient =	0.2	2		
15A. Using the Method Described in the RG-348				
Manning's Equation. $Q = 1.49 A_{CS} R_{H}^{2.3} S^{0.5}$				
Π				
$b = \frac{0.134 \times Q}{y^{1.67}} - zy = y^{1.67} S^{0.5}$	4.84	feet		
Q = CiA =	0.49	ets		
To calculate the flow velocity in the swale:				
V (Velocity of Flow in the swate) = Q/A _{CS} =	0.2	5 ft/sec		
To calculate the resulting swale length:				
L = Minimum Swale Length = V (ft/sec) * 300 (sec) =	75 8	3 feet		
If any of the resulting values do not meet the design requirement s	set forth in R	G-348, the design parar	neters must be mod	lified and the solver rerun.
15B. Alternative Method using Excel Solver				
Design Q = CiA =	0.4	9 cfs		
Manning's Equation Q = Swale Width=	0.5 6.0	4 cfs D ft	Error 1 =	-0.04
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	0 2 75.8	5 ft/s 3 ft		
Instructions are provided to the right (blue comments).				
Docise Midth -		ē (†		
Design Widin = Design Discharge =	0.5	4 cfs	Error 2 =	-0 04
Design Depth =	03	3 ft	n e o managementantes	and the second sec
Flow Velocity =	0.2	3 cts 3 ft		
Ministrati Cengur -	00.5			

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

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17. Wet Vaults	Designed as F	lequired in AC	3-348	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 ⇒ i = design rainfall intensity = A = drainage area in acres =	0.6 1.	6 1 in/hour 1 acres	C = Runoff Coefficie	nt = 0.548 (IC) ² + 0.328 (IC) + 0.03
Q = flow rate in cubic feet per second =	0.7	2 cubic feet/se	ec	
RG-348 Page 3-31 Equation 3.5 V _{OR} = Q/A				
Q = Runoff rate calculated above = A = Water surface area in the wet vault =	0.7	2 cubic feet/se 3 square feet	ec	
V _{OR} = Overflow Rate =	0.0	0 feet/sec		
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	5	3 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 = Efficiency Reduction for Actual Rainfall Intensity =	0.7	5 percent 3 percent		
Resultant TSS Load removed by Wet Vault =	#VALUE ¹	lbs		
18. Permeable Concrete	Designed as I	Required in R	G-348	Pages 3-79 to 3-83
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZO	DNE			
19. BMPs Installed in a Series	Designed as	Required in R	G-348	Pages 3-32
Michael E. Barrett, Ph.D., P.E. recommended that the coeffic	tient for E2 be	changed from	m 0.5 to 0.65 on May 3	3, 2006
$E_{TOT} = [1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100 \approx$	94.0	1 percent	NET EFFICIENCY O	F THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E, =	89 0	o percent		
EFFICIENCY OF THE SECOND BMP IN THE SERIES = ${\rm E_2}$ =	70.0	0 percent		
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 =	0.0	o percent		
THEREFORE, THE NET LOAD REMOVAL WOULD BE: (A, AND A, VALUES ARE FROM SECTION 3 ABOVE)				
L _R = E _{TOT} X P X (A, X 34.6 X A _P X0.54) =	586.2	2 tbs		
20. Stormceptor				
Required TSS Removat in BMP Drainage Area≂ Impervious Cover Overtreatment=	NA 0.0000	lbs ac		
TSS Removal for Uncaptured Area =	0.00	lbs		
Effective Area =	= NA	EA		
Calculated Model Size() Actual Model Size (if multiple values provided in Calculated	= #N/A			
Model Size or if you are choosing a larger model size) =	0	Model Size		
Surface Area =	= #N/A	ft ²		
Overflow Rate =	#VALUE	V _α		
Rounded Overflow Rate =	#VALUE!	Var		
BMP Efficiency % =	= #VALUE!	%		

		L _R Value ≂	#VALUE!	lbs
		TSS Load Credit =	#VALUE!	lbs
	Is Sufficient	Treatment Available? (TSS Credit \geq TSS Uncapt.)	#VALUE!	
		TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE ¹	
11 Vortaab				
zi. vonecii		Required TSS Removal in 8MP 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	
	F	ctual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
		Surface Area =	7.10	ft ²
		Overflow Rate =	#VALUE!	Var
		Rounded Overflow Rate =	#VALUE!	Var
		8MP 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: Date Prepared:	Manor Creek Un 6/1/2015	it 4	
Additional information is provided for cells with a red triangl Text shown in blue indicate location of instructions in the Technic Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Char	le in the u al Guidan nges to th	opper ce Mai nese fi	right corner nual - RG-34 elds will ren	Place the curs 8. nove the equation	or over the cell.	preadsheet.	
1. The Required Load Reduction for the total project:	Calcula	tions fro	om RG-348		Pages 3-27 to 3-30		
Page 3-29 Equation 3.3: L	_M = 27.2(A _N	x P)					
where. L _{M TOTAL} PROJEC Aj	r = Require n = Net incr P = Average	ed TSS i rease in e annua	removal resultir impervious are I precipitation, i	ng from the proposed a for the project inches	d development = 80%	of increased loa	ad
Site Data: Determine Required Load Removal Based on the Entire Proje Count Total project area included in plan Predevelopment impervious area within the limits of the plan	ect y = Col = 23 *= 0.	mal .60	acres acres		Streets	141,913	3 26
Total post-development impervious area within the limits of the plan Total post-development impervious cover fraction	1 = <u>8.</u> * = 0.	36	acres L	ots 64	3,300	211,200	4.85
1	P =3	3	jinches		U Channel	3,787	0.09
- LM TOTAL PROJEC * The values entered in these fields should be for the total project area.	cτ = 75	44	lbs.		Fire Access	9222	0.21
Number of drainage basins / outfails areas leaving the plan are	a =	8					841
	u –						0.77
2. Drainage Basin Parameters (This information should be provided for e	each basin)	<u>):</u>					
Drainage Basin/Outfall Area No	D. = A 4	-15					
Total drainage basin/outfall are Predevelopment impervious area within drainage basin/outfall are Post-development impervious area within drainage basin/outfall are Post-development impervious fraction within drainage basin/outfall are L _{M THIS BASI}	a = 1, a = 0, a = 0, a = 0, m = 2	37 00 24 18 17	acres acres acres Ibs.		6819 3,787	0.15 0.09 0.24	
3. Indicate the proposed BMP Code for this basin.							
Proposed BM Removal efficienc	Y = None Y =	0	percent		Aqualogic Cartridge Bioretention Contech StormFilter Constructed Wetland Extended Detention Grassy Swale	Filter	
			D 7		Sand Filter Stormceptor Vegetated Filter Strip Vortechs Wet Basin Wet Vault	ps	
Calculate Maximum TSS Load Hemoved (L _a) for this Drainage Basin b Control of the Cont			IP Type.	6 A 2054)			
nororo raye oros equatori s.r.	-q - (Divir e	entorento	y) x (x (A x 34	1.0 + Ap X 0.34)			
where:	A _c = Total C A _t ≈ Imperv A _P = Perviou -8 = TSS Lo)n-Site (ious are us area bad rem	drainage area in the proposed in the remaining in the oved from this o	h the BMP catchmen the BMP catchment a e BMP catchment ar catchment area by th	it area area ea ne proposed BMP		
р 	$A_{c} = 1$ $A_{s} \approx 0$ $A_{p} = 1$ $L_{H} = 1$.37 .25 .12 0	acres acres acres Ibs				

Desired L _{M THIS} BASIN =	0	lbs.					
F =	0.00						
6. Calculate Capture Volume required by the BMP Type for this drainage bas	sin / outfall a	area.	Calculations from RG-3	48 Pag	es 3-34 to 3	1-36	
Rainfall Depth =	#N/A	inches					
Post Development Runoff Coefficient = On-site Water Quality Volume =	0.19 #N/A	cubic feet					
	Calculations	from RG-348	Pages 3-36 to 3-37				
Off-site area draining to BMP = Off-site Impervious cover draining to BMP ≂	0.00	acres					
Impervious fraction of off-site area =	0						
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) = The following sections are used to calculate the required water quality volu	#N/A me(s) for th	cubic feet	6				
The values for BMP Types not selected in cell C45 will show NA. 7. Retention/Irrination System	Designed as	s Bequired in BC	-348 F	Pages 3-42 to 3-4	3		
Bequired Water Quality Volume for retention basin -	NA	cubic feet		1900 0 4E 10 0 4			
Irrination Area Calculations:	10						
		infor	Enter determined new	atombility onto an	no cump of u	nium of 0	
Soli infitration/permeability rate = Irrigation area =	NA	square feet	Enter determined per	neadinty rate or	assumed v	alue or u.	1
	NA	acres					
8. Extended Detention Basin System	Designed a	s Required in RC	3-348 F	Pages 3-46 to 3-5	1		
Required Water Ouality Volume for extended detention basin =	NA	cubic feet					
9. Filter area for Sand Filters	Designed a	s Required in RC	3-348 F	ages 3-58 to 3-6	3		
9A. Full Sedimentation and Filtration System							
Water Quality Volume for sedimentation basin =	NA	cubic feet					
Minimum filler basın area =	NA	square feet					
Maximum sedimentation basin area = Minimum sedimentation basin area =	NA NA	square feet square feet	For minimum water de For maximum water d	epth of 2 feet lepth of 8 feet			
9B. Partial Sedimentation and Filtration System							
Water Quality Volume for combined basins =	NA	cubic feet	SF @ Given Depth #VALUE!	Giv	en Depth	Width 5	60
Minimum filter basın area =	NA	square feet					60
Maximum sedimentation basin area =	NA NA	square feet	For minimum water d	epth of 2 feet			60
Minimum sedimentation basin area =	NA NA	square feet	For maximum water d	lepth of 8 feet			60
10. Bioretention System	Designed a	s Required in Ro	G-348	Pages 3-63 to 3-6	5		
Required Water Quality Volume for Bioretention Basin =	NA	cubic feet					
11. Wet Basins	Designed a	is Required in R	G-348	Pages 3-66 to 3-7	1		
Required capacity of Permanent Pool = Required capacity at WQV Elevation =	NA NA	cubic feet cubic feet	Permanent Pool Capa Total Capacity should plus a second WQV	icity is 1.20 time t be the Perman	s the WQV ant Pool Ca	apacity	
12. Constructed Wetlands	Designed a	s Required in Ri	G-348	Pages 3-71 to 3-7	3		
Required Water Quality Volume for Constructed Wetlands =	= NA	cubic feet					
<u>13. AquaLogic[™] Cartridge System</u>	Designed a	as Required in R	G-348	Pages 3-74 to 3-7	8		

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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	S ARE BAS	ED UPON FLOW RAT	ES - NOT CALCUL	ATED WATER QUALITY VOLUMES
15. Grassy Swales De	asigned as F	Required in RG-348	Page	s 3-51 to 3-54
Design parameters for the swale.				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfall intensity = i = Swale Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	1.3 0.2 1. 0.00 0.3 0.4	7 acres 5 acres 1 in/tr 5 ft/ft 3 ft 0		
A_{cs} = cross-sectional area of flow in Swale = P_w = Wetted Perimeter = R_H = hydraulic radius of flow cross-section = A_{cs}/P_w = n = Manning's roughness coefficient =	2.4 8.3 0.2 0.	1 sf 5 feet 9 feet 2		
15A. Using the Method Described in the RG-348				
Manning's Equation: Q = <u>1.49</u> A _{CS} R _H ²³ S ⁰⁵ n				
$b = \frac{0.134 \times Q}{y^{1.67}} - zy =$	6 2	4 feet		
Q = CiA =	0.6	1 cfs		
To calculate the flow velocity in the swale:				
V (Velocity of Flow in the swale) = Q/A_{CS} =	0.2	5 ft/sec		
To calculate the resulting swale length:				
L = Minimum Swale Length = V (ft/sec) * 300 (sec) =	75 8	3 feet		
If any of the resulting values do not meet the design requirement s	et forth in R	G-348, the design para	ameters must be mod	dified and the solver rerun.
15B. Alternative Method using Excel Solver				
Design Q = CiA =	0.6	i1 cfs		
Manning's Equation Q = Swale Width=	0.5 6.0	64 cfs 00 ft	Error 1 =	0.07
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	0.2 75.8	25 ft/s 33 ft		
Instructions are provided to the right (blue comments).				
Design Width ≕ Design Discharge = Design Depth = Flow Velocity = Minimum Length ≅	0.5 0.3 0.2 68.9	6 ft 54 cfs 33 ft 23 cfs 93 ft	Error 2 ≏	0.07

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 nerun. 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

17. Wet Vaults	Designed as P	lequired in RC	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 = CrA						
C = runoff coefficient for the drainage area =	0.10)	C = Runoff Coefficien	$t = 0.546 (IC)^2 + 0.328 (IC) + 0.03$		
i = design rainfall intensity ≃	1.	1 in/hour				
A = drainage area in acres =		l acres				
Q = flow rate in cubic feet per second =	0 1:	2 cubic feet/se	c			
RG-348 Page 3-31 Equation 3.5. $V_{CR} = Q/A$						
Q = Runoff rate calculated above = A = Water surface area in the wet vault =	0.13 15	2 cubic feet/se square feet	C			
V _{OR} = Overflow Rate =	0.0) feet/sec				
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	5	3 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 rainfalt treated from Figure 3-2 RG-348 Page 3-32 = Efficiency Reduction for Actual Rainfall Intensity =	07	5 percent 3 percent				
Resultant TSS Load removed by Wet Vault =	#VALUE!	Ibs				
18. Permeable Concrete	Designed as f	Required in R	3-348	Pages 3-79 to 3-83		
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZO	NE					
19. BMPs Installed in a Series	Designed as I	Required in R	3-348	Pages 3-32		
Michael E. Barrett, Ph.D., P.E. recommended that the coeffic	tient for E ₂ be	changed from	n 0.5 to 0.65 on May 3.	2006		
$E_{TOT} = \{1 \cdot ((1 \cdot E_1) \times (1 \cdot 0.65E_2) \times (1 \cdot 0.25E_3))\} \times 100 =$	94.0	1 percent	NET EFFICIENCY OF	THE BMPs IN THE SERIES		
EFFICIENCY OF FIRST BMP IN THE SERIES = E, =	89.0	o percent				
EFFICIENCY OF THE SECOND BMP IN THE SERIES = $E_2 =$	70.0	0 percent				
EFFICIENCY OF THE THIRD BMP IN THE SERIES = $E_{\mathfrak{g}}$ =	0.0	0 percent				
THEREFORE, THE NET LOAD REMOVAL WOULD BE: (A, AND A₂ VALUES ARE FROM SECTION 3 ABOVE)						
L _R = E _{TOT} X P X (A, X 34.6 X A _P X0.54) =	287.1	0 ibs				
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				
Effective Area =	NA	EA				
Calculated Model Size(s) =	#N/A	- CT00 - 19				
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 -	#NI/A	ft ²				
Overflow Rate =	#VALUE	Va				
Rounded Overflow Rate =	#VALUE!	Va				
BMP Efficiency % =	#VALUE	%				

		L _R Value =	#VALUE!	lbs
		TSS Load Credit =	#VALUE	lbs
	Is Sufficient	Trealment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
		TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE ¹	
21 Vortech				
KIT FORCOM		Required TSS Removal in BMP Drainage Area=	NA	lbs
		Impervious Cover Overtreatment=	0.0000	ac
		TSS Removal for Uncaptured Area =	0.00	lbs
	8MP 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	ħ²
		Overflow Rate =	#VALUE	Va
		Rounded Overflow Rate =	#VALUE!	V _α
		BMP Efficiency % =	#VALUE!	%
		L _R Value =	#VALUE!	ibs
		TSS Load Credit =	#VALUE!	lbs
	Is Sufficien	t 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 (Ibs)	
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									
					Impervious					
			Total Area	Acreage	Area				Desired	
Subbasin Data	Area Treated	Treatment Method	(acres)	Treated	(acres)	Imp %	L _R (lbs)	L _M (lbs)	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	

TCE0 R-13 2015 DEC 23 1553

Required TSS Removal ************ CHRISTOPHER P. VAN HEERDE Nor Hende PE 12/22/15 lini

7036

Texas Commission on Environmental Quality								
TSS Removal Calculations 04-20-2009				Proje Date F	ect Name: Prepared:	Manor Creek U 3/10/2015	nit 5	
Additional information is provided for cells with a red triang Text shown in blue indicate location of instructions in the Technic Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Characters	le in th al Guid nges t	ne upper dance Ma o these f	right corn anual - RG- fields will a	ner. Place 1 348. remove the	the curso e equatio	or over the cell.	spreadshe	eet.
1. The Required Load Reduction for the total project:	Cal	culations fr	om RG-348			Pages 3-27 to 3-30	0	
Page 3-29 Equation 3.3.	_M = 27.2	2(A _N x P)						
where: L _{M TOTAL PROJEC}	n = Rec w = Net P = Ave	quired TS S increase in arage annu	removal resi n impervious al precipitatio	ulting from the area for the p on, inches	e proposed project	development = 80°	% of increase	d load
Site Data: Determine Required Load Removal Based on the Entire Proj Count Total project area included in plan Predevelopment impervious area within the limits of the plan Total post-development impervious area within the limits of the plan Total post-development impervious cover fraction	lect = = 1° = P =	Comal 45.67 0.00 17.14 0.38 33	acres acres acres inches	Lots	82	Streets SF/Lot 6,225	236,065 510,450	5 419 11.718 17.14
LM TOTAL PROJECT * The values entered in these fields should be for the total project area.	ot =	15383	lbs.					
Number of drainage basins / outfalls areas leaving the plan are	a =	9						
2. Drainage Basin Parameters (This information should be provided for	each ba	isin):						
Drainage Basin/Outfall Area No	0. =	A 5-1						
Total drainage basin/outfall are Predevelopment impervious area within drainage basin/outfall are Post-development impervious area within drainage basin/outfall are Post-development impervious fraction within drainage basin/outfall are Lathis bas	ea = ea = ea = ea = ea =	12.56 0.00 5.77 0.46 5183	acres acres acres Ibs	# of Lots	25	SF/Lot 6225 95920	3.57 2,20 5.77	acres of IC for lots acres of street Total IC (acres)
3. Indicate the proposed BMP Code for this basin.								
Proposed BM Removal efficient	IP = <mark>Sa</mark> r Cy =	nd Filter 89	percent			Aqualogic Cartridg Bioretention Contech StormFilth Constructed Wetla Extended Detentio Grassy Swale Retention / Irrigatis Sand Filter Stormceptor Vegetated Filter S Vortechs Wet Basin Wet Vault	e Filter er ind n on trips	
4. Calculate Maximum TSS Load Removed (L _B) for this Drainage Basin b	by the s	elected Bl	MP Type.					
RG-348 Page 3-33 Equation 3.7:	L _R = (B)	VP efficien	cy) x P x (A;)	x 34.6 + A _P x (0.54)			
where:	$A_c = Tol$ $A_i = Imp$ $A_p = Pe$ $L_H = TS$	tal On-Site pervious ar rvious area S Load ren	drainage are rea proposed a remaining ir noved from th	ea in the BMP in the BMP cat in the BMP cat his catchment	catchment atchment a chment are area by th	t area irea ea e proposed BMP		
	A _c =	12.56	acres	ward tracks		05%		

 A₁ =
 5.77
 acres
 # of Lots
 SF/Lot

 A_P =
 6.79
 acres
 25
 6225
 3.57 acres of IC for lots

 L_R =
 5976
 Ibs
 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 bas	sin / outfall ar	ea.	Calculations from RG-3	48 Pages 3	-34 to 3-36		
Rainfall Deoth =	1.80	inches					
Post Development Runoff Coefficient =	0.34	aubic feet					
On-site water quality volume =	27595	cubic leet					
	Calculations I	rom RG-348	Pages 3-36 to 3-37				
Off-site area draining to BMP =	0.00	acres					
Un-site impervious cover draining to BMP =	0.00	acres					
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 volu	me(s) for the	selected BMP	2				
The values for BMP Types not selected in cell C45 will show NA. 7. Retention/Irrigation System	Designed as	Required in BC	-348 F	Panes 3-42 to 3-46			
7. Retention find atton system	Designed as	nequired in ne	1-340	agas 3-42 to 3-40			
Required Water Quality Volume for retention basin =	NA	cubic feet					
Irrigation Area Calculations:							
Soil infiltration/permeability rate =	0.1	in/hr	Enter determined perr	meability rate or asso	umed value of 0	3.1	
Irrigation area =	NA	square feet					
	NA	acres					
8. Extended Detention Basin System	Designed as	Required in RG	3-348 F	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 RC	3-348 F	² ages 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 = Minimum sedimentation basin area =	= 13797 = 3449	square feet square feet	For minimum water de For maximum water d	epth of 2 feet lepth of 8 feet			
9B. Partial Sedimentation and Filtration System			SF @ Given Depth	Given D	eoth Width	ι	_enath
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 2205	square feet	For minimum water depth	epth of 2 feet		90	122.6437
Minimum sedimentation basin area =	= 690	square feet	For maximum water d	lepth of 8 feet		90	7.665231
10 Binatation Suptam	Decidend as	Paguired in R	2.949	Pages 3 62 to 3 65			
<u></u>	a congrieu da	- sequenced in the					
Required Water Quality Volume for Bioretention Basin =	= NA	cubic feet					
11. Wet Basins	Designed as	Required in R	G-348	Pages 3-66 to 3-71			
Required capacity of Permanent Pool ≃	NA	cubic feet	Permanent Pool Capa	city is 1.20 times the	WQV		
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should plus a second WQV.	t be the Permanent F	ool Capacity		
12. Constructed Wetlands	Designed as	Required in R	G-348	Pages 3-71 to 3-73			
Required Water Quality Volume for Constructed Wetlands =	= NA	cubic feet					
<u>13. AquaLogic[™] Cartridge System</u>	Designed as	Required in R	G-348	Pages 3-74 to 3-78			

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 REMOVAL	SARE BAS	ED UPON FLOW BATE	S-NOT CALC	ULATED WATER QUALITY VOLUMES
15. Grassy Swales	Designed as	Required in RG-348	P	ages 3-51 to 3-54
Design parameters for the swale:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfail intensity = i = Swale Slope Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	0.0 0.0 1 0.0 #DIV/0!	0 acres 0 acres 1 in/hr 1 ft/ft 3 5 ft		
A _{CS} = cross-sectional area of flow in Swale =	#DIV/01	sf		
P _w = Wetted Perimeter =	#DIV/0!	feet		
R_{H} = hydraulic radius of flow cross-section = A_{CS}/P_{W} = n = Manning's roughness coefficient =	#DIV/0! 0	feet .2		
15A. Using the Method Described in the RG-348				
Manning's Equation: $Q = 1.49 A_{cs} R_{H}^{23} S^{0.5}$ n				
$b = \frac{0.134 \times Q}{5^{167}} - zy = y^{167} S^{05}$	#DIV/0!	feet		
Q = CiA =	#D!V/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/01	feet		
If any of the resulting values do not meet the design requirement	set forth in F	G-348, the design parar	meters must be	modified and the solver rerun.
15B. Alternative Method using Excel Solver				
Design Q = CiA =	#DIV/0!	cts		
Manning's Equation Q = Swale Width=	2. 36.9	74 cfs 91 ft	Error 1 =	5.82
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	#DIV/0! #DIV/0!	ft/s ft		
Instructions are provided to the right (blue comments).				
Design Width = Design Discharge = Design Depth = Flo w Velocity = Minimum Length ≠	0. 0. 0. 97.	6 ft 76 cfs 33 ft 32 cfs 48 ft	Error 2 =	#DIV/01
If any of the resulting values do not meet the design requirement set forth in If any of the resulting values still do not meet the design requirement set for	RG-348, the th in RG-348	a design parameters ma 5, widening the swale b	ay be modified ottom value m	f and the solver rerun. ay not be possible.

16. Vegetated Filter Strips

Designed as Required in RG-348 Pages 3-55 to 3-57

17. Wet Vaults	Designed as	Required in RC	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/s	ec.			
RG-348 Page 3-31 Equation 3.5: V _{OR} = Q/A						
Q = Runoff rate calculated above = A = Water surface area in the wet vault =	0. 1	33 cubic feet/si 50 square feet	ec			
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 Wer 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 = Efficiency Reduction for Actual Rainfail Intensity =	0	75 percent 83 percent				
Resultant TSS Load removed by Wet Vault =	#VALUE!	lbs				
18. Permeable Concrete	Designed as	Required in R	5-348 Page	s 3-79 to 3-83		
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZO	ONE					
19. BMPs Installed in a Series	Designed as	Required in R	3-348 Page	s 3-32		
Michael E. Barrett, Ph.D., P.E. recommended that the coeffic	cient for E ₂ b	e changed fro	n 0.5 to 0.65 on May 3, 2006	5		
$E_{TOT} = [1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100 =$	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 \approx E2 \approx	70	00 percent				
EFFICIENCY OF THE THIRD BMP IN THE SERIES = $\mathrm{E_3}$ =	0	00 percent				
THEREFORE, THE NET LOAD REMOVAL WOULD BE: (A, AND A, VALUES ARE FROM SECTION 3 ABOVE)						
L _R = E _{TOT} X P X (A _i X 34.6 X A _P X0.54) =	6311	.91 /bs				
30 Stormontor						
Required TSS Removal in BMP Drainage Area=	NA	lbs				
Impervious Cover Overtreatment=	0.0000	ac				
TSS Removal for Uncaptured Area = BMP Sizing	0.00	IDS				
Effective Area =	= NA	EA				
Calculated Model Size (if multiple values provided in Calculates	= #N/A					
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				
ZT. VOILECH		Required TSS Removal in BMP Drainage Area=	NΔ	lbs
		Impervious Cover Overtreatment=	0 0000	ac
		TSS Removal for Uncaptured Area =	0.00	lbs
	BMP Sizing	1		
	-	Effective Area =	NA	EA
		Calculated Model Size(s) =	#N/A	
	Ļ	Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
		Surface Area =	7 10	ft ²
		Overflow Rate =	#VALUE!	V _{or}
		Rounded Overflow Rate =	#VALUE!	V _α
		BMP Efficiency % =	#VALUE!	%
		L _R Value =	#VALUE	lbs
		TSS Load Credit =	#VALUE1	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 Nam Date Prepare	e: Man d: 3/1	or Creek Unit 5 0/2015		
Additional information is provided for cells with a red triang Text shown in blue indicate location of instructions in the Techni Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Cha	gle in th ical Guid anges to	n <mark>e upper</mark> dance Ma o these fi	right corn nual - RG-3 ields will r	er. Place the cur 348. emove the equa	tions u	ver the cell. used in the sprea	adsheet.	
1. The Required Load Reduction for the total project:	Cal	culations fro	om RG-348		Page	s 3-27 to 3-30		
Page 3-29 Equation 3.3:	L _M = 27.2	2(A _N x P)						
where: L _{M TOTAL PROJ}	_{ECT} = Rec A _N = Net P = Ave	quired T S S increase in rage annua	removal resu nimpervious a al precipitation	lting from the propos area for the project n, inches	ed deve	lopment = 80% of in	creased lo	ad
Site Data: Determine Required Load Removal Based on the Entire Pr Cou Total project area included in plar Predevelopment impervious area within the limits of the pla Total post-development impervious area within the limits of the pla Total post-development impervious cover fraction	oject nty = n = n = an = P =	Comal 45.67 0.00 17.14 0.38 33	acres acres acres inches	Lots 8	Stree SF/L	ets ot 6,225 510	,065 ,450	5.419 1.718 17.14
* The values entered in these fields should be for the total project area	ест =	15383	lbs.					
Number of drainage basins / outfalls areas leaving the plan a	rea =	9						
2. Drainage Basin Parameters (This information should be provided for	r each ba	isin):						
Drainage Basin/Outfall Area I	No. =	A 5-2						
Total drainage basin/outfall a Predevelopment impervious area within drainage basin/outfall a Post-development impervious area within drainage basin/outfall a Post-development impervious fraction within drainage basin/outfall a L _{M THIS} B.	rea = rea = rea = rea = ASIN =	1.02 0.00 0.68 0.67 610	acres acres acres Ibs.	# of Lots	SF/L 3.5 78	ot 6225 325.4103	0.50 acre 0.18 acre 0.68 Tota	es of IC for lots es of street al IC (acres)
3. Indicate the proposed BMP Code for this basin.								
Proposed B Removal efficie	MP = Gra ncy =	ro Swale	percent					
4 Columbia Naviana TSS and Removed // .) (or this Draining Resi		alastad B1	40 Tupo		Aqua Biore Cont Con: Exte Gras Rete Sand Storr Vege Vort Wet	alogic Cartridge Filte atention lech StormFilter structed Wetland nded Detention ssy Swale inition / Irrigation d Filter meeptor etated Filter Strips echs Basin Vault	r	
BG-348 Page 3-33 Emistion 3.7	l = (B)	AP efficience	w) x P x (A, x	34.6 + A ₂ x () 54)				
where:	$A_{c} = Tot$ $A_{t} = Imp$ $A_{p} = Pe$ $L_{R} = TS$	at On-Site pervious are rvious area S Load rem	drainage area ea proposed remaining in noved from th	a in the BMP catchm in the BMP catchmer the BMP catchment is catchment area by	ent area nt area area r the pro	posed BMP		
	$A_{t} =$	0.47	acres	# of Lots	SF/L	_ot		
	Α _Ρ = L _R =	0.39 377	acres Ibs		2	6225 7825.4	0.29 acr 0.18 acr 0.47 Tot	es of IC for lots es of street al 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 ba	<u>sin / o</u> utfall a <u>r</u> e	a.	Calculations from RG-	348 P	ages 3-34 to 3-36	F.	
	4.00						
Post Development Runoff Coefficient =	0.38	inches					
On-site Water Quality Volume =	4762	cubic feet					
	Calculations fr	om 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 Water Quality Volume =	0.00	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 volu. The values for BMP Tunes not selected in call C45 will show NA	me(s) for the s	elected BMP					
7. Retention/Irrigation System	Designed as F	leduired in RC	5-348	Pages 3-42 to 3	-46		
				ages a rest a	- 25		
Required Water Quality Volume for retention basin =	NA	cubic feet					
Irrigation Area Calculations:							
Soil infiltration/permeability rate =	0.1	in/hr	Enter determined pe	rmeability rate	or assumed valu	e of 0.1	
Irrigation area =	NA	square feet					
	NA	acres					
8. Extended Detention Basin System	Designed as F	Required in RC	6-348	Pages 3-46 to 3	3-51		
Required Water Quality Volume for extended detention basin =	NA	cubic feet					
9. Filter area for Sand Filters	Designed as F	Required in RC	3-348	Pages 3-58 to 3	1-63		
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 = Minimum sedimentation basin area =	NA NA	square feet square feet	For minimum water For maximum water	depth of 2 feet depth of 8 feet			
9B. Partial Sedimentation and Filtration System			SF @ Given Depth	C	Siven Depth M	/idth I	enoth
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 NA	square feet	For minimum water	depth of 2 feet		90	#VALUE!
Minimum sedimentation basin area =	⊧ NA	square feet	For maximum water	depth of 8 feet		90	#VALUE!
10 Bioretention System	Designed as I	Bequired in B(3-348	Pages 3-63 10	3-65		
To. Diotetention System	pengred as i	inganou in m		1 4965 5 55 10 10 1	100		
Required Water Quality Volume for Bioretention Basin =	= NA	cubic feet					
11. Wet Basins	Designed as I	Required in R	G-348	Pages 3-66 to	3-71		
Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Cap	pacity is 1.20 tir	nes the WQV	city	
Hequired capacity at wow Elevation =	NA	CODIC IEEE	plus a second WQV	ing we use mering	mant root capat		
12. Constructed Wetlands	Designed as I	Required in R	G-348	Pages 3-71 to	3-73		
Required Water Quality Volume for Constructed Wetlands :	= NA	cubic feet					
<u>13. AquaLogic™ Cartridge System</u>	Designed as	Required in R	G-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^{TW}.

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 REMOVAL	LS ARE BASE	D UPON FLOW RATES	- NOT CALC	ULATED WATER QUALITY VOLUMES
15. Grassy Swales	Designed as R	equired in RG-348	Pa	ages 3-51 to 3-54
Design parameters for the swate:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfall intensity = i = Swale Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	1 02 #VALUE! 1.1 0 025 3 0.25 #VALUE!	acres in/hr tt/ft		
$A_{cs} = cross-sectional area of flow in Swale =$	#VALUE!	sf		
P _w = Wetted Perimeter =	#VALUE!	feet		
R _H = hydraulic radius of flow cross-section = A _{CS} /P _W = n = Manning's roughness coefficient =	#VALUE ^I 0.2	feet		
15A. Using the Method Described in the RG-348				
Manning's Equation: $Q = 1.49 A_{CS} R_{H}^{23} S^{0.5}$ n				
$b = \frac{0.134 \times Q}{y^{1.57}} - zy = y^{1.57} S^{0.5}$	#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	G-348, the design parame	ters must be	modified and the solver rerun.
158. Alternative Method using Excel Solver				
Design Q = CiA =	#VALUE!	cfs		
Manning's Equation Q = Swale Width=	4.34 36.91	4 cfs 1 ft	Error 1 =	5.82
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	#VALUE! #VALUE!	ft/s ft		
Instructions are provided to the right (blue comments).				
Desian Width =	6	6 ft		
Design Discharge =	1.20	0 cfs	Error 2 =	#VALUE ¹
Design Depth =	0.33	3 ft		
Flow Velocity = Minimum Length =	0.5	2 ft		
If any of the resulting values do not meet the design requirement set forth in If any of the resulting values still do not meet the design requirement set for	RG-348, the th in RG-348,	design parameters may widening the swale bot	be modified tom value m	and the solver rerun. ay not be possible.

16. Vegetated Filter Strips

Designed as Required in RG-348 Pages 3-55 to 3-57

17. Wet Vaults	Designed a	s Required in RC	3-348 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 =	C	.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 \Rightarrow	(1.54 cubic feet/se	ec
RG-348 Page 3-31 Equation 3.5: V _{OR} = Q/A			
Q = Runoff rate calculated above = A = Water surface area in the wet vault =	(1.54 cubic feet/se 150 square feet	20
V _{CR} ≈ 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	! Ibs	
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 = Efficiency Reduction for Actual Rainfall Intensity =		0.75 percent 0.83 percent	
Resultant TSS Load removed by Wet Vault ≈	#VALUE	l Ibs	
18. Permeable Concrete	Designed a	s Required in R	3-348 Pages 3-79 to 3-83
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZO)NE		
<u>19. BMPs Installed in a Series</u>	Designed a	s Required in R	G-348 Pages 3-32
Michael E. Barrett, Ph.D., P.E. recommended that the coeffic	tient for E ₂	be changed from	m 0.5 to 0.65 on May 3, 2006
$E_{TOT} = [1 \cdot ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100 =$	9	1.01 percent	NET EFFICIENCY OF THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E, =	8	9 00 percent	
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 =	7	0.00 percent	
EFFICIENCY OF THE THIRD BMP IN THE SERIES \approx E3 =		00 percent	
THEREFORE, THE NET LOAD REMOVAL WOULD BE: $(A_r AND A_p VALUES ARE FROM SECTION 3 ABOVE)$			
$L_{R} = E_{TOT} X P X (A; X 34.6 X A_{P} X 0.54) =$	50	6.21 ibs	
20. Stormcentor			
Required TSS Removal in BMP Drainage Area=	NA	lbs	
Impervious Cover Overtreatment=	0.0000	ac	
BMP Sizing	0.00	105	
Effective Area =	NA	EA	
Calculated Model Size(s) =	#N/A		
Actual model size (il 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 =	#VALU	I V _{or}	
Rounded Overflow Rate =	#VALU	E! V _{or}	
BMP Efficiency % =	= #VALU	=1 %	

		L _R Value =	#VALUE!	ľbs
		TSS Load Credit =	#VALUE!	lbs
	is Sufficient	Treatment Available? (TSS Credit > TSS Uncapt.)	#VALUE!	
		TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	
21. Vortech				
<u></u>		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 =	7.1Ŏ	ħ²
		Overflow Rate =	#VALUE!	V _{or}
		Rounded Overflow Rate =	#VALUE!	Vœ
		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.) \approx	#VALUE!	

Texas Commission on Environmental Quality						
TSS Removal Calculations 04-20-2009				Project Name Date Prepared	Manor Creek Unit	5
Additional information is provided for cells with a red trian Text shown in blue indicate location of instructions in the Techn Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Ch	gle in th ical Guid anges t	he upper dance Ma to these	right corr anual - RG fields will	ner. Place the cur -348. remove the equat	sor over the cell. ions used in the sp	readsheet.
1. The Required Load Reduction for the total project:	Cal	culations f	rom RG-348		Pages 3-27 to 3-30	
Page 3-29 Equation 3.3:	L _M = 27.1	2(A _N x P)				
where: L _{M TOTAL PRO}	u _{ECT} = Red A _N = Net P = Ave	quired TSS t increase t erage annu	s removal res in impervious ial precipitati	sulting from the proposi- s area for the project on, inches	ed development = 80% o	increased load
Site Data: Determine Required Load Removal Based on the Entire P Cou Total project area included in pla Predevelopment impervious area within the limits of the pla Total post-development impervious area within the limits of the pla Total post-development impervious cover fraction	roject unty = an " = lan" = Dn * = P =	Comal 45.67 0.00 17.14 0.38 33	acres acres acres inches	Lots 8	Streets SF/Lot 2 6,225 510	.065 5.419 .450 11.718 17.14
LA TOTAL PRO	јест = 8.	15383	lbs.			
Number of drainage basins / outfalls areas leaving the plan a	irea =	9				
2. Drainage Basin Parameters (This information should be provided for	er each ba	asin):				
Drainage Basin/Outfall Area	No. =	A 5-3				
Total drainage basin/outfall a Predevelopment impervious area within drainage basin/outfall a Post-development impervious area within drainage basin/outfall a Post-development impervious fraction within drainage basin/outfall a L _{M Thill} i	area = area = area = area = area =	0.28 0.00 0.07 0.26 64	acres acres acres Ibs.	# of Lots C	SF/Lot 5 6225	0.07 acres of IC for lots - acres of street
3. Indicate the proposed BMP Code for this basin.						
Proposed E Removal efficie	BMP = Ve ency =	getated Fi 80	Iter Strips			
					Aqualogic Cartridge F Bioretention Contech StormFriter Constructed Welland Extended Detention Grassy Swale Retention / Irrigatron Sand Filter Stormceptor Vegetated Filter Strip: Vortechs Wet Basin Wet Vault	ilter
4. Calculate Maximum TSS Load Removed (L _R) for this Drainage Basin	n by the s	selected B	МР Түре.			
RG-348 Page 3-33 Equation 3.7	: L _R = (Bl	MP efficier	icy) x P x (A _t	x 34.6 + A _P x 0.54)		
where:	$A_c = To$ $A_l = Im$ $A_p = Pe$ $L_R = TS$ $A_c =$ $A_r =$	ntal On-Site pervious a ervious are SS Load re 0.28 0.07	e drainage ar rea proposed a remaining i moved from t acres acres	ea in the BMP catchmen d in the BMP catchmen n the BMP catchment his catchment area by # of Lots	int area I area trea the proposed BMP SF/Lot	
	Α _ρ = L _R =	0.21 68	acres Ibs	(.5 6225	0.07 acres of IC for lots 0 acres of street

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

Desired L _{M THIS BASIN} =	64	ibs			
F =	0.94				
6. Calculate Capture Volume required by the BMP Type for this drainage bas	sin / outf <u>all are</u>	<u>a.</u>	Calculations from RG-	348 Pages 3-34 to 3-36	
Bainfall Deoth =	2.40	inches			
Post Development Runoff Coefficient =	0.23	aubio foot			
	5/1	cubic leet			
	Calculations fr	om RG-348	Pages 3-36 to 3-37		
Off-site area draining to BMP =	0.00	acres			
Impervious fraction of off-site area =	0.00	acres			
Off-site Runoff Coefficient =	0.00	cubic feet			
On-site Water Quality Volume =	U	cubic leet			
Storage for Sediment =	114				
Total Capture Volume (required water quality volume(s) x 1.20) = The following sections are used to calculate the required water quality volu The values for BMP Types not selected in cell C45 will show NA.	685 me(s) for the :	cubic feet			
7. Retention/Irrigation System	Designed as F	lequired in RC	3-348	Pages 3-42 to 3-46	
Required Water Quality Volume for retention basin =	NA	cubic feet			
Irrigation Area Calculations:					
Soil infiltration/permeability rate = Irrigation area =	0.1 NA NA	in/hr square feet acres	Enter determined pe	rmeability rate or assumed value of 0.1	
8. Extended Detention Basin System	Designed as F	lequired in R	3-348	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 F	Required in R	G-348	Pages 3-58 to 3-63	
94. Full Sedimentation and Filtration System					
water quality volume for sedimentation basin =	NA	cubic leet			
	NA	square feet	Eas minimum water	danih al 3 faat	
Minimum sedimentation basin area = 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 = Minimum sedimentation basin area =	NA NA	square feet square feet	For minimum water For maximum water	depth of 2 feet depth of 8 feet	
10. Bioretention System					
	Designed as I	Required in R	G-348	Pages 3-63 to 3-65	
Required Water Quality Volume for Bioretention Basin =	Designed as I	Required in R	G-348	Pages 3-63 to 3-65	
Required Water Quality Volume for Bioretention Basin =	Designed as i	Required in Ri	G-348	Pages 3-63 to 3-65	
Required Water Quality Volume for Bioretention Basin =	Designed as I NA Designed as	Required in Ri cubic feet Required in Ri	G-348 G-348	Pages 3-63 to 3-65 Pages 3-66 to 3-71	
Required Water Quality Volume for Bioretention Basin = <u>11. Wet Basins</u> Required capacity of Permanent Pool = Required capacity at WQV Elevation =	Designed as I NA Designed as I NA NA	Required in R cubic feet Required in R cubic feet cubic feet	G-348 G-348 Permanent Pool Cay Total Capacity shou plus a second WQV	Pages 3-63 to 3-65 Pages 3-66 to 3-71 pacity is 1.20 times the WQV Id be the Permanent Pool Capacity	
Required Water Quality Volume for Bioretention Basin = <u>11. Wet Basins</u> Required capacity of Permanent Pool = Required capacity at WQV Elevation = <u>12. Constructed Wetlands</u>	Designed as I NA Designed as I NA NA Designed as I	Required in R cubic feet Required in R cubic feet cubic feet Required in R	G-348 G-348 Permanent Pool Caj Total Capacity shou plus a second WQV G-348	Pages 3-63 to 3-65 Pages 3-66 to 3-71 pacity is 1.20 times the WQV Id be the Permanent Pool Capacity Pages 3-71 to 3-73	
Required Water Quality Volume for Bioretention Basin = 11. Wet Basins Required capacity of Permanent Pool = Required capacity at WQV Elevation = 12. Constructed Wetlands Required Water Quality Volume for Constructed Wetlands =	Designed as I Designed as I NA NA Designed as I Designed as I	Required in R cubic feet Required in R cubic feet Required in R cubic feet	G-348 G-348 Permanent Pool Caj Total Capacity shou plus a second WQV G-348	Pages 3-63 to 3-65 Pages 3-66 to 3-71 pacity is 1.20 times the WQV Id be the Permanent Pool Capacity Pages 3-71 to 3-73	

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

Required Sedimentation chamber capacity ≂ Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 BMPB / LOAD REMOVAL	S ARE BAS	ED UPON FLOW RA	TES - NOT CALC	ULATED WATER QUALITY VOLUMES
15. Grassy Swales Do	esigned as P	Required in RG-348	Pa	ages 3-51 to 3-54
Design parameters for the swale:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfall intensity = i = Swale Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	0.00 1.7 0.07 1.7 0.07 1.7 0.07 1.7 0.07 1.7 0.07 1.7 0.07 1.7 0.07 1.7 0.07 1.7 0.07 1.7 0.07 1.7 0.07 1.7 0.07 1.7 0.07 1.7 0.07 1.7 0.07 1.7 0.07 1.7 0.07 1.7 0.07 1.7 0.07 1.7 1.7 1.7 1.7 1.7 1.7 1.7 1.7 1.7 1.	acres acres 1 in/hr 1 ft/ft 3 ft		
A_{CS} = cross-sectional area of flow in Swale = P_{W} = Wetted Perimeter = R_{H} = hydraulic radius of flow cross-section = A_{CS}/P_{W} = n = Mannund's rouchness coefficient =	#DIV/0! #DIV/0' #DIV/0'	sf feet feet		
	0.2	-		
15A. Using the Method Described in the HG-348				
Manning's Equation: Q = <u>1.49</u> A _{CS} R _H ²³ S ⁰⁵ n				
$b = \frac{0.134 \times Q}{y^{1.87}} - zy = y^{1.87}$	#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 s	set forth in R	G-348, the design pa	arameters must be r	modified and the solver rerun.
15B. Alternative Method using Excel Solver				
Design Q = CiA =	#DIV/0!	cts		
Manning's Equation Q = Swale Width=	0.7 6.0	6 cfs 0 ft	Error 1 =	#DIV/0!
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	#DIV/0! #DIV/0!	tt∕s ft		
Instructions are provided to the right (blue comments).				
Design Width = Design Discharge = Design Depth = Flow Velocity = Minimum Length =	0.7 0.3 0.3 97.4	6 ft 6 cfs 33 ft 12 cfs 8 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 rerur 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

17. Wet Vaults	Designed as P	equired 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	5	C = Runoff Coefficie	nt = 0.546 (IC) ² + 0.328 (IC) + 0.03
i = design rainfall intensity = A = drainage area in acres =	1.1	in/hour acres		
Q = flow rate in cubic feet per second =	0.16	6 cubic feet/se	с	
RG-348 Page 3-31 Equation 3.5: V _{OR} = Q/A				
Q = Runoff rate calculated above = A = Water surface area in the wet vault =	0.16	5 cubic feet/se 9 square feet	c	
V _{OR} = Overflow Rate =	0.00) feet/sec		
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	5.	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.	in/hour		
Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = Efficiency Reduction for Actual Rainfall Intensity =	= 0.75 = 0.85	percent percent		
Resultant TSS Load removed by Wet Vault =	#VALUE!	lbs		
18. Permeable Concrete	Designed as F	Required in BC	1.948	Pages 3-79 to 3-83
PERMEARING CONCRETE MAY ONLY BE LISED ON THE CONTRIBUTING 7	THE	indanine in the		1 4903 0 10 10 0 000
19 RMPs Installed in a Series	Designed as F	Required in BC	3.348	Pages 3-32
Michael E Parrett Dh D. D.E. recommended that the coeffi	cient for F he	changed from	0.5 to 0.65 on May	3 2006
		enanges non		
$E_{TOT} = [1 - ((1 - E_1) \land (1 - 0.05E_2) \land (1 - 0.25E_3))] \land 100 =$	= 94.0	percent	NET EFFICIENCE O	F THE DIVIPS IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 :	89.0	percent		
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 :	70.0	0 percent		
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 :	0.0	percent		
THEREFORE, THE NET LOAD REMOVAL WOULD BE: (A, AND A, VALUES ARE FROM SECTION 3 ABOVE)				
L _R = E _{TOT} X P X (A, X 34.6 X A _P X0.54) :	= 80.1	9 lbs		
20. Stormceptor Required TSS Removal in BMP Drainage Area: Impervious Cover Overtreatment: TSS Removal for Uncaptured Area = BMP Sizing	= NA = 0.0000 = 0.00	łbs ac Ibs		
Effective Area Calculated Model Size(s)	= NA = #N/A	EA		
Actual Model Size (if multiple values provided in Calculate Model Size or if you are choosing a larger model size)	d = 0	Model Size		
Surface Area	= #N/A	ft²		
Overflow Rate	= #VALUE!	V _{or}		
Rounded Overflow Rate	= #VALUE!	V _{or}		
BMP Efficiency %	= #VALUE! = #VALUE!	% lbs		
		100		

		TSS Load Credit =	#VALUE!	lbs
	Is Sufficient	Treatment Available? (TSS Credit > TSS Uncapt.)	#VALUE!	
		TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	
21. Vortech				
<u></u>		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	
		and Martal Ciae (4 share) and a start size)		D: 1 11 1 10:
	β	ctual Model Size (il choosing larger model size) =	Vx1000	Pick Model Size
	μ	ctual Model Size (il choosing larger model size) = Surface Area =	7.10	fick Model Size
	م ب	ctual Model Size (if choosing larger model size) = Surface Area = Overflow Rate =	7.10 7.10 #VALUE!	h ² h ² V _{or}
	م بر	ctual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate =	7.10 #VALUE! #VALUE!	hick Model Size ft ² V _{or} V _{or}
	μ.	Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % =	7.10 #VALUE! #VALUE! #VALUE!	Pick Model Size ft ² V _α %
	Α	Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % = L _R Value =	7.10 #VALUE! #VALUE! #VALUE! #VALUE!	Pick Model Size ft ² V _{or} V _o Ibs
	μ	Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % = L _R Value = TSS Load Credit =	7.10 #VALUE! #VALUE! #VALUE! #VALUE! #VALUE!	Pick Model Size ft ² V _α V _α % Ibs
	P Is Sufficient	Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % = L _R Value = TSS Load Credit = Treatment Available? (TSS Credit <u>></u> TSS Uncapt.)	7.10 #VALUE! #VALUE! #VALUE! #VALUE! #VALUE!	Pick Model Size fr ² V _α V _α V _α Ibs

Texas Commission on Environmental Quality						
TSS Removal Calculations 04-20-2009				Project Name: Date Prepared:	Manor Creek Uni 3/10/2015	15
Additional information is provided for cells with a red triang Text shown in blue indicate location of instructions in the Technic Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Cha	gle in th cal Guid anges to	ne upper dance Ma o these f	right corr anual - RG- fields will	ner. Place the curs 348. remove the equation	or over the cell.	preadsheet.
1. The Required Load Reduction for the total project:	Cal	culations fr	om RG-348		Pages 3-27 to 3-30	
Page 3-29 Equation 3.3:	L _M = 27.2	2(A _N x P)				
where: L _M TOTAL PROJE	_{ict} = Rec A _N = Net P = Ave	uired TSS Increase i rage annu	removal res n impervious al precipitatio	ulting from the proposed area for the project on, inches	d development = 80% (f increased load
Site Data: Determine Required Load Removal Based on the Entire Pro Cour Total project area included in plan Predevelopment impervious area within the limits of the plan Total post-development impervious cover fraction Total post-development impervious cover fraction • The values entered in these fields should be for the total project area Number of drainage basins / outfalls areas leaving the plan ar 2. Drainage Basin Parameters (This information should be provided for	bject hty = h = h = P = ea = each ba	Comal 45.67 0.00 17.14 0.38 33 15383 9 9	acres acres acres inches Ibs.	Lois 82	Streets SF/Lot 6,225 510	3.065 5.419 9.450 11.718 17.14
Drainage Basin/Outfall Area N	lo. =	A 5-4				
Total drainage basin/outfall ar Predevelopment impervious area within drainage basin/outfall ar Post-development impervious area within drainage basin/outfall ar Post-development impervious fraction within drainage basin/outfall ar L _{M THES BA}	rea = rea = rea = rea = rea =	5.24 0.00 0.71 0.14 641	acres acres acres lbs.	# of Lots	SF/Lot 5 6225	0.71 acres of IC for lots - acres of street
3. Indicate the proposed BMP Code for this basin.						
Proposed Bi Removal efficier 4. Calculate Maximum TSS Load Removed (L _a) for this Drainage Basin RG-348 Page 3-33 Equation 3.7:	$by the s$ $L_{R} = (BN)$	elected Bi	MP Type. cy) x P x (A, :	x 34.6 + A _P x 0.54)	Aqualogic Cartridge Bioretention Contech StormFilter Constructed Wetlanc Extended Detention Grassy Swale Retention / Irrigation Sand Filter Stormceptor Vegetated Filter Strip Vortechs Wet Basin Wet Vault	Filter I
where:	A _c = Tot	al On-Site	drainage are	ea in the BMP catchmer	nt area	
	$A_p = Per L_R = TS$	rvious area S Load rer	a remaining in noved from the	n the BMP catchment ar his catchment area by th	rea ne proposed BMP	
	A _C =	5.24	acres		-	
	A ₁ = A _P = L _R =	0.71 4.53 717	acres acres Ibs	# of Lots	SF/Lot 5 6225	0.71 acres of IC for lots 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 ba	sin / outfall ar	rea.	Calculations from RG-	348 Pages 3-3	4 to 3-36
Rainfall Depth =	1.60	inches			
Post Development Runoff Coefficient = On-site Water Quality Volume =	0.16 4731	cubic feet			
	Calculations I	from RG-348	Pages 3-36 to 3-37		
Off-site area draining to BMP = Off-site Impervious cover draining to BMP =	0.00	acres acres			
Impervious fraction of off-site area = Off-site Runoff Coefficient =	0 0.00				
Off-site Water Quality Volume =	0	cubic feet			
Storage for Sediment =	946	2.12			
Total Capture Volume (required water quality volume(s) x 1.20) = The following sections are used to calculate the required water quality volu	5677 me(s) for the	cubic feet selected BMP			
The values for BMP Types not selected in cell C45 will show NA. 7. Retention/Irrigation System	Designed as	Required in RG	3-348	Pages 3-42 to 3-46	
Bequired Water Quality Volume for retention basin =	NA	cubic feet			
Irrination Area Calculations:					
ingalion Alea Galchalions.	-	1000			
Soil infiltration/permeability rate = Irrigation area =	0.1 NA	in/hr square feet	Enter determined pe	rmeability rate or assur	ned value of 0.1
	NA	acres			
8. Extended Detention Basin System	Designed as	Required in RG	3-348	Pages 3-46 to 3-51	
Required Water Quality Volume for extended detention basin =	NA	cubic feet			
	Designed	Deputyed in Of	2.040	Deces 2 52 to 2 62	
9. Filler area for Sand Fillers	Designed as	Required in Ro	3-348	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			
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area =	NA NA NA	square feet square feet square feet	For minimum water For maximum water	depth of 2 feet depth of 8 feet	
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 9B. Partial Sedimentation and Filtration System	NA NA NA	square feet square feet square feet	For minimum water For maximum water	depth of 2 feet depth of 8 feet	
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins =	NA NA NA	square feet square feet square feet cubic feet	For minimum water For maximum water #VALUE!	depth of 2 feet depth of 8 feet sf at 4' of depth	
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area =	NA NA NA NA	square feet square feet square feet cubic feet square feet	For minimum water For maximum water #VALUE!	depth of 2 feet depth of 8 feet sf at 4' of depth	
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area =	NA NA NA NA NA	square feet square feet square feet cubic feet square feet square feet	For minimum water For maximum water #VALUE! For minimum water	depth of 2 leet depth of 8 feet sf at 4' of depth depth of 2 feet	
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area =	NA NA NA NA NA	square feet square feet cubic feet square feet square feet square feet	For minimum water For maximum water #VALUE! For minimum water For maximum water	depth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 8 feet	
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area =	NA NA NA NA NA NA Designed as	square feet square feet cubic feet square feet square feet square feet square feet	For minimum water For maximum water #VALUE! For minimum water For maximum water 3-348	depth of 2 leet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3-65	
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 10. Bioretention System Required Water Quality Volume for Bioretenton Basin =	NA NA NA NA NA Designed as NA	square feet square feet cubic feet square feet square feet square feet Required in RC cubic feet	For minimum water For maximum water #VALUE! For minimum water For maximum water 3-348	depth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3-65	
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 10. Bioretention System Required Water Quality Volume for Bioretention Basin =	NA NA NA NA NA Designed as	square feet square feet square feet square feet square feet square feet Required in R(cubic feet	For minimum water For maximum water #VALUE! For minimum water For maximum water 3-348	depth of 2 leet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3-65	
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin ar	NA NA NA NA NA Designed as NA	square feet square feet cubic feet square feet square feet square feet Required in RC cubic feet	For minimum water For maximum water #VALUE! For minimum water For maximum water 3-348	depth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3-65 Pages 3-66 to 3-71	
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = Minimum filter basin area = Minimum sedimentation basin ar	NA NA NA NA NA Designed as NA Designed as NA	square feet square feet square feet square feet square feet square feet Required in R(cubic feet Required in R(For minimum water For maximum water #VALUE! For minimum water For maximum water 3-348 3-348 Permanent Pool Caj Total Capacity shou plus a second WQV	depth of 2 leet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 5 feet Pages 3-63 to 3-65 Pages 3-66 to 3-71 pacity is 1.20 times the ld be the Permanent Po	WOV Kol Capacity
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basins area = Minimum filter basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = Maximum sedimentation basin area = Minimum sedimentarea = Maximum sedime	NA NA NA NA NA Designed as NA Designed as NA NA Designed as	square feet square feet square feet square feet square feet square feet square feet cubic feet Required in RC cubic feet cubic feet square feet	For minimum water For maximum water #VALUE! For minimum water For maximum water 3-348 3-348 Permanent Pool Caj Total Capacity sho plus a second WQV 3-348	depth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3-65 Pages 3-66 to 3-71 pacity is 1.20 times the id be the Permanent Po Pages 3-71 to 3-73	WQV Iol Capacity
Minimum filter basin area = Maximum sedimentation basin area = BB. Partial Sedimentation and Filtration System Water Quality Volume for combined basins area = Minimum filter basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Minimum sedimentarea = Maximum sedime	NA NA NA NA NA Designed as NA Designed as NA	square feet square feet cubic feet square feet square feet square feet Required in RC cubic feet cubic feet Required in RC cubic feet cubic feet	For minimum water For maximum water #VALUE! For minimum water For maximum water 3-348 3-348 Permanent Pool Caj Total Capacity shou plus a second WQV 3-348	depth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 2 feet depth of 8 feet Pages 3-63 to 3-65 Pages 3-66 to 3-71 pacity is 1.20 times the id be the Permanent Po Pages 3-71 to 3-73	WQV Kol Capacity

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 REMOVAL	S ARE BASE	D UPON FLOW RATE	S - NOT CALC	ULATED WATER QUALITY VOLUMES
15. Grassy Swales D	esigned as R	equired in RG-348	Pa	ages 3-51 to 3-54
Design parameters for the swale:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfatl intensity = i = Swale Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	0.00 0.00 1.1 0.01 3 0.33 #DIV/0!	acres acres in/hr tt/ft		
$\label{eq:A_cs} \mbox{=} \mbox{cs-sectional area of flow in Swale =} \\ \mbox{P_w} = \mbox{Wetted Perimeter =} \\ \mbox{R_H} \mbox{=} \mbox{hydraulic radius of flow cross-section =} \mbox{A_{Cs}/P_w} \mbox{=} \\ \mbox{n} \mbox{=} \mbox{Manning's roughness coefficient =} \end{array}$	#DIV/0! #DIV/0! #DIV/0! 0.2	sf feet feet 2		
15A. Using the Method Described in the RG-348				
Manning's Equation: $Q = 1.49 A_{CS} R_{H}^{23} S^{05}$ n				
$b = \frac{0.134 \text{ x Q}}{\text{y}^{167} \text{ S}^{05}} - 2\text{y}^{-2}$	#DIV/01	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 s	set forth in R	G-348, the design para	meters must be	modified and the solver rerun.
15B. Alternative Method using Excel Solver				
Design Q = CiA ≃	#DIV/0!	cfs		
Manning's Equation Q = Swale Width=	0.7 6.0	6 cfs 0 ft	Error 1 =	#DIV/01
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	#DIV/0! #DIV/0!	ft/s ft		
Instructions are provided to the right (blue comments).				
Design Width = Design Discharge = Design Depth = Flow Velocity = Minimum Length =	0.7 0.3 0.3 97.4	6 ft 6 cfs 3 ft 2 cfs 8 ft	Error 2 =	#DIV/0!

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

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 RC	348 Pages	3-30 to 3-32 & 3-79
Required Load Removal Based upon Equation 3.3 \simeq	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 =	0.0	8	C = Runoff Coefficient = 0.5	46 (IC) ² + 0.328 (IC) + 0.03
i = design rainfall intensity = A = drainage area in acres =	1	1 in/hour 1 acres		
Q = flow rate in cubic feet per second =	0.0	9 cubic feet/se		
RG-348 Page 3-31 Equation 3 5: V _{OR} = Q/A				
Q = Runoff rate calculated above = A = Water surface area in the wet vault =	0.0 15	9 cubic feet/se 0 square feet	2	
V _{CR} = Overflow Rate =	0.0	0 feet/sec		
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	5	3 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 = Efficiency Reduction for Actual Rainfall Intensity =	0.0	5 percent 3 percent		
Resultant TSS Load removed by Wet Vault =	#VALUE!	lbs		
18. Permeable Concrete	Designed as	Required in R	-348 Pages	3-79 to 3-83
PERMEARING CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING 20	NE	induited in the	1000	0.010 0 000
19 BMDs Installed in a Series	Designed as	Required in Bt	.349 Panes	9-30
Michael E. Damati. Dk.D., D.E. managemented that the coefficient for E. he changed from 0.6 to 0.65 on May 2, 2005				
	atem for £2 be	eimigen not		
$E_{TOT} = [1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100 =$	94.	1 percent	NET EFFICIENCY OF THE E	MPS IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E, =	89.	0 percent		
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 =	70.	0 percent		
EFFICIENCY OF THE THIRD BMP IN THE SERIES = $E_3 \approx$	0.	0.00 percent		
THEREFORE, THE NET LOAD REMOVAL WOULD BE: $(A_t \text{ AND } A_P \text{ VALUES ARE FROM SECTION 3 ABOVE})$				
L _R = E _{TOT} X P X (A ₁ X 34.6 X A _P X0.54) =	842,	7 5 lbs		
20. Stormentor				
Required TSS Removal in BMP Drainage Area	NA	lbs		
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!	Vor		
Rounded Overflow Rate =	#VALUE!	Vor		
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			
and the second sec	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	
Å	Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
	Surface Area =	7.10	ft ²
	001100071100		
	Overflow Rate =	#VALUE!	Va
	Overflow Rate = Rounded Overflow Rate =	#VALUE! #VALUE!	V _a V _a
	Overflow Rate = Rounded Overflow Rate = BMP Efficiency % =	#VALUE! #VALUE! #VALUE!	V∝ V∝ %
	Overliow Rate = Rounded Overliow Rate = BMP Efficiency % = L _R Value =	#VALUE! #VALUE! #VALUE! #VALUE!	V∝ V∝ % Ibs
	Overflow Rate = Rounded Overflow Rate = BMP Efficiency % = L _R Value = TSS Load Credit =	#VALUE! #VALUE! #VALUE! #VALUE!	V _a V _a Ibs
ts Sufficient	Overflow Rate = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % = L _R Value = TSS Load Credit = Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE! #VALUE! #VALUE! #VALUE! #VALUE!	V _a V _a Ibs

Texas Commission on Environmental Quality									
TSS Removal Calculations 04-20-2009				Project Date Pre	Name: pared:	Manor 3/10/2	Creek U 015	nit 5	
Additional information is provided for cells with a red triang Text shown in blue indicate location of instructions in the Technic Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Cha	l <mark>e in th</mark> cal Guid inges to	le upper dance Ma o these f	right corr inual - RG- fields will	ner. Place the 348. remove the e	e curs quatio	or over	the cell. d in the	spread	sheet.
1. The Required Load Reduction for the total project:	Calc	culations fr	om RG-348			Pages 3	27 to 3-30		
Page 3-29 Equation 3.3: L	- _M = 27.2	2(A _N x P)							
where: LM TOTAL PROJE	_{ct} = Req A _N = Net P = Ave	uired TSS increase in rage annu	removal res n impervious al precipitatio	ulting from the pr area for the proje on, inches	oposec ect	l develop	ment = 80%	% of incre	ased load
Site Data: Determine Required Load Removal Based on the Entire Pro	iect								
Total post-development impervious area within the limits of the plan Total post-development impervious area within the limits of the plan Total post-development impervious area within the limits of the plan Total post-development impervious cover fraction	ity = * = ח* = ח* = P =	Comal 45.67 0.00 17.14 0.38 33	acres acres acres Inches	Lots	82	Streets SF/Lot 6	,225	236,065 510,450	5.419 11.718 17.14
LA TOTAL PROJE	-cr =	15383	lbs.						
* The values entered in these fields should be for the total project area.									
Number of drainage basins / outfalls areas leaving the plan are	ea =	9							
2. Drainage Basin Parameters (This information should be provided for	each ba	sin):							
Drainage Basin/Outfall Area N	lo. =	A 5-5							
Total drainage basin/outfall arr Predevelopment impervious area within drainage basin/outfall arr Post-development impervious area within drainage basin/outfall arr Post-development impervious fraction within drainage basin/outfall arr L м тніз ва	ea = ea = ea = ea = sin =	0.83 0.00 0.29 0.34 257	acres acres acres Ibs.	# of Lots	2	SF/Lot	6225	0.29	acres of IC for lots acres of street
3. Indicate the proposed BMP Code for this basin.									
Proposed BM Removal efficien 4. Calculate Maximum TSS Load Removed (L _B) for this Drainage Basin	ΛP = Veg cy ≕ by the se	elected Bi	MP Type.			Aqualog Bioreter Constru Extende Grassy Retentic Sand Fi Stormce Vegetat Vortech Wet Ba Wet Va	iic Cartridg Ition StormFiltt cted Wetla d Detentio Swale on / Irrigatio lter sptor ed Filter S s sin Jt	e Filter er und un on trips	
RG-348 Page 3-33 Equation 3.7:	L _A = (BN	/IP efficien	су) х Р х (А,	x 34.6 + A _P x 0.5	4)				
where:	$A_{c} = Tot$ $A_{i} = Imp$ $A_{p} = Per$ $L_{a} = TSS$ $A_{c} =$ $A_{i} =$	al On-Site pervious ar rvious area S Load ren 0.83 0.29	drainage are rea proposed a remaining in noved from ti acres acres	ea in the BMP cat I in the BMP catch In the BMP catchr his catchment are # of Lots	tchment hment a ment ar ea by th	t area area ea ne propos SF/Lot	ed BMP		
	A _P =	0.54 269	acres Ibs		1	2	6225	0.29	acres of IC for lots
	-8 -	209	105						acrea or street

Desired L _{M.THIS BASIN} =	257	lbs.			
F =	0.96				
6. Calculate Capture Volume required by the BMP Type for this drainage bas	sin / outfall ar	<u>ea.</u>	Calculations from RG-3	Page	es 3-34 to 3-36
Rainfall Depth = Post Development Runoff Coefficient = On-site Water Quality Volume =	2.80 0.28 2364	inches cubic feet			
	Calculations f	rom RG-348	Pages 3-36 to 3-37		
Off-site area draining to BMP = Off-site Impervious cover draining to BMP = Impervious fraction of off-site area = Off-site Runoff Coefficient = Off-site Water Quality Volume =	0.00 0.00 0.00 0	acres acres cubic feet			
Storage for Sediment ≈	473				
Total Capture Volume (required water quality volume(s) x 1.20) = The following sections are used to calculate the required water quality volu The values for BMP Types not selected in cell C45 will show NA.	2836 me(s) for the	cubic feet selected BMP.		D0.40.4-0.44	
7. Hetention/irrigation System	Designed as i	Hequired in HG	-348	Pages 3-42 (0 3-40	3
Required Water Quality Volume for retention basin =	NA	cubic feet			
Irrigation Area Calculations:					
Soil infiltration/permeability rate = Irrigation area =	0.1 NA NA	in/hr square feet acres	Enter determined per	meability rate or a	assumed value of 0.1
8. Extended Detention Basin System	Designed as	Required in RG	i-348	Pages 3-46 to 3-5	1
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 3-6	3
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System	Designed as	Required in RG	-348	Pages 3-58 to 3-6	3
<u>9. Filter area for Sand Filters</u> <u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basin =	Designed as	Required in RG	i-348	Pages 3-58 to 3-6	3
<u>9. Filter area for Sand Filters</u> <u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basin = Minimum filter basin area =	Designed as NA NA	Required in RG cubic feet square feet	i-348	Pages 3-58 to 3-6	3
<u>9. Filter area for Sand Filters</u> <u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basin = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area =	Designed as NA NA NA NA	Required in RG cubic feet square feet square feet square feet	5-348 For minimum water d For maximum water o	Pages 3-58 to 3-6 lepth of 2 feet depth of 8 feet	3
<u>9. Filter area for Sand Filters</u> <u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basin = Minimum filter basin area = Maximum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u>	Designed as NA NA NA NA	Required in RG cubic feet square feet square feet square feet	-348 For minimum water d For maximum water d	Pages 3-58 to 3-6 lepth of 2 feet depth of 8 feet	3
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basins =	Designed as NA NA NA NA	Required in RG cubic feet square feet square feet square feet cubic feet	i-348 For minimum water d For maximum water o #VALUE!	Pages 3-58 to 3-6 lepth of 2 feet depth of 8 feet sf at 4' of depth	3
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Image: System Water Quality Volume for sedimentation basin area Image: System Maximum sedimentation basin area Image: System 9B. Partial Sedimentation and Filtration System Image: System Water Quality Volume for combined basins Image: System Mater Quality Volume for combined basins Image: System	Designed as NA NA NA NA NA NA	Required in RG cubic feet square feet square feet square feet cubic feet square feet	5-348 For minimum water d For maximum water o #VALUE!	Pages 3-58 to 3-6 lepth of 2 feet depth of 8 feet sf at 4' of depth	3
 <u>9. Filter area for Sand Filters</u> <u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basin area = Minimum filter basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Minimum filter basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = 	Designed as NA NA NA NA NA NA NA NA	Required in RG cubic feet square feet square feet square feet cubic feet square feet square feet square feet	5348 For minimum water d For maximum water o #VALUE! For minimum water o For maximum water o	Pages 3-58 to 3-6 lepth of 2 feet depth of 8 feet si at 4' of depth lepth of 2 feet depth of 8 feet	3
 <u>9. Filter area for Sand Filters</u> <u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basin area = Minimum filter basin area = Maximum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Minimum filter basin area = 	Designed as NA NA NA NA NA NA NA Designed as	Required in RG cubic feet square feet square feet square feet cubic feet square feet square feet square feet square feet	5-348 For minimum water of For maximum water of #VALUE! For minimum water of For maximum water of 5-348	Pages 3-58 to 3-6 lepth of 2 feet depth of 8 feet sl at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3-6	3
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin area = Minimum filter basin area = Minimum sedimentation basin area = 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basins = Minimum filter basin area = Minimum sedimentation basin area =	Designed as NA NA NA NA NA NA NA NA NA NA	Required in RG cubic feet square feet square feet cubic feet square feet square feet square feet square feet square feet cubic feet	5-348 For minimum water of For maximum water of #VALUE! For minimum water of For maximum water of 3-348	Pages 3-58 to 3-6 lepth of 2 feet depth of 8 feet sl at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3-6	3
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Image: System Water Quality Volume for sedimentation basin area = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 9B. Partial Sedimentation and Filtration System Image: System Water Quality Volume for combined basins = Minimum filter basin area = Minimum filter basin area = Minimum filter basin area = Maximum sedimentation basin area = Minimum filter basin area = Maximum sedimentation basin area = Minimum filter basin area = Maximum sedimentation basin area = Minimum filter basin area = Minimum sedimentation basin area = Minimum filter basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = Minimum filter basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = Minimum se	Designed as NA NA NA NA NA NA NA Designed as NA	Required in RG cubic feet square feet square feet cubic feet square feet square feet square feet Required in RC cubic feet Required in RC	5-348 For minimum water of For maximum water of #VALUE! For minimum water of 5-348	Pages 3-58 to 3-6 lepth of 2 feet depth of 8 feet si at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3-6 Pages 3-66 to 3-7	3 5 1
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin area = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basins = Minimum filter basin area = Minimum sedimentation basin area =	Designed as NA NA NA NA NA NA Designed as NA Designed as NA	Required in RG cubic feet square feet square feet cubic feet square feet square feet square feet square feet Required in RC cubic feet cubic feet cubic feet	5-348 For minimum water of For maximum water of #VALUE! For minimum water of For maximum water of 5-348 3-348 Permanent Pool Cap Total Capacity shoul plus a second WQV.	Pages 3-58 to 3-6 lepth of 2 feet depth of 8 feet sl at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3-6 Pages 3-66 to 3-7 acity is 1.20 time d be the Permane	5 1 s the WQV ent Pool Capacity
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin area = Minimum filter basin area = Maximum sedimentation basin area = 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basins = Minimum filter basin area = 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Minimum filter basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = Maximum sedimentation basin area =	Designed as NA NA NA NA NA NA Designed as NA Designed as NA NA	Required in RG cubic feet square feet square feet square feet square feet square feet square feet cubic feet Required in RC cubic feet cubic feet cubic feet	5-348 For minimum water of For maximum water of #VALUE! For minimum water of 5-348 3-348 Permanent Pool Cap Total Capacity shout Total Capacity shout plus a second WQV. 3-348	Pages 3-58 to 3-6 lepth of 2 feet depth of 8 feet sf at 4' of depth depth of 8 feet Pages 3-63 to 3-6 Pages 3-66 to 3-7 acity is 1.20 times d be the Permana Pages 3-71 to 3-7	5 1 s the WQV tent Pool Capacity 3
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin area = Minimum filter basin area = Maximum sedimentation basin area = Minimum filter basin area = Minimum sedimentation basin area	Designed as NA NA NA NA NA Oesigned as NA Designed as NA Designed as	Required in RG cubic feet square feet square feet square feet cubic feet square feet square feet square feet square feet cubic feet Required in RC cubic feet Required in RC cubic feet cubic feet	5-348 For minimum water of For maximum water of #VALUE! For minimum water of For maximum water of 5-348 3-348 Permanent Pool Cap Total Capacity shoul plus a second WQV. 3-348	Pages 3-58 to 3-6 lepth of 2 feet depth of 8 feet si at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3-6 Pages 3-66 to 3-7 acity is 1.20 times d be the Permane Pages 3-71 to 3-7	5 1 s the WQV ent Pool Capacity 3

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

Required Sedimentation chamber capacity ≃ Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 REMOVAL	S ARE BASI	ED UPON FLOW RAT	ES - NOT CALC	ULATED WATER QUALITY VOLUMES
15. Grassy Swales	Designed as R	lequired in RG-348	P	ages 3-51 to 3-54
Design parameters for the swale:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfall intensity = i = Swale Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	0.00 0.00 1. 0.01 2 0.33 #DIV/01) acres) acres) in/hr it/it s it		
$\label{eq:Acs} \begin{array}{l} A_{cs} = cross\text{-sectional area of flow in Swale} = \\ P_{vi} = Wetted \; Perimeter = \\ R_{H} = hydraulic \; radius \; of \; flow \; cross\text{-section} = A_{cs}/P_w = \\ n = Manning's \; roughness \; coefficient = \\ \end{array}$	#DIV/0! #DIV/0! #DIV/0! 0.2	sf feet feet 2		
15A. Using the Method Described in the RG-348				
Manning's Equation: Q = <u>1.49</u> A _{CS} R _H ²³ S ⁶⁵ n				
b = <u>0.134 x 0</u> - zy ≑ y ¹⁶⁷ S ⁰⁵	#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/01	feet		
If any of the resulting values do not meet the design requirement	set forth in R	G-348, the design para	ameters must be	modified and the solver rerun
15B. Alternative Method using Excel Solver				
Design Q = CiA =	#DIV/0	cfs		
 Manning's Equation Q = Swale Width=	0.7 6.0	6 cfs 0 ft	Error 1 =	#DIV/0
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	#DIV/0' #DIV/0!	ft/s ft		
Instructions are provided to the right (blue comments).				
Design Width = Design Discharge = Design Depth = Flow Velocity = Minimum Length =	0.7 0.3 0.3 97.4	6 ft 6 cfs 3 ft 2 cfs 8 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

17. Wet Vaults	Designed as F	equired 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 =	0.2		C = Runoff Coefficient = 0.546 (IC) ² + 0.328 (IC) + 0.03
i = design rainfall intensity = A = drainage area in acres =	1.1	in/hour acres	
Q = flow rate in cubic feet per second =	0.23	8 cubic feet/se	c
RG-348 Page 3-31 Equation 3.5: V _{OR} = Q/A			
Q = Runoff rate calculated above = A = Water surface area in the wet vault =	0.23	3 cubic feet/se square feet	c
V _{OR} = Overflow Rate =	0.0) feet/sec	
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	5	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.	in/hour	
Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = Efficiency Reduction for Actual Rainfall Intensity =	0.7	percent percent	
Resultant TSS Load removed by Wet Vault =	#VALUE!	lbs	
18 Permeable Concrete	Designed as I	loguized in P(248 Pager 2,70 to 3,93
	Designed as r	ieduien in ric	r-340 Fages 3-73 10 3-63
10 DNDs lostelled is a Oxida	Decisional as I	and a D	Data Data 2.00
19. BMPS Installed in a Series	Designed as r	sequired in Hi	a-346 Pages 3-32
Michael E. Barrett, Ph.D., P.E. recommended that the coeffic	tent for E ₂ be	changed from	n 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 =	94.0	1 percent	NET EFFICIENCY OF THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E, =	89.0	percent	
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 =	70.0	percent	
EFFICIENCY OF THE THIRD BMP IN THE SERIES = $E_{\rm 3}$ =	0.0	0 percent	
THEREFORE, THE NET LOAD REMOVAL WOULD BE: $(A_{\rm f}$ AND $A_{\rm p}$ VALUES ARE FROM SECTION 3 ABOVE)			
L _R = E _{TOT} X P X (A ₁ X 34.6 X A _P X0.54) =	315.8	9 lbs	
20. Stormceptor Required TSS Removal in BMP Drainage Area≈	NA	lbs	
Impervious Cover Overtreatment= TSS Removal for Uncaptured Area =	0.0000	ac Ibs	
BMP Sizing		FA	
Effective Area = Calculated Model Size(s) =	= NA = #N/A	EA	
Actual Model Size (if multiple values provided in Calculated	0	Model Sizo	
woder Size of it you are choosing a larger model Size) =	v	wodet Size	
Surface Area =	#N/A	ft ²	
Overflow Rate =	#VALUE	V _{or}	
Hounded Overflow Hate =	#VALUE!	V or 9/	
	#VALUE!	lbs	

	TSS Load C	redit =	#VALUE!	lbs
	Is Sufficient Treatment Available? (TSS Credit > TSS Ur	ncapt.)	#VALUE ¹	
	TSS Treatment by BMP (LM + TSS Unc	apt.) =	#VALUE!	
21. Vortech				
	Required TSS Removal in BMP Drainage	Area=	NA	lbs
	Impervious Cover Overtreat	iment=	0.0000	ac
	TSS Removal for Uncaptured	Area =	0.00	lbs
	BMP Sizing Effective Calculated Model Siz	Area = ze(s) =	NA #N/A	EA
	Actual Model Size (if choosing larger model :	size) =	Vx1000	Pick Model Size
	Surface .	Area =	7 10	ft ²
	Overflow	Rate =	#VALUE!	V _{or}
	Rounded Overflow	Rate =	#VALUE!	Var
	BMP Efficient	cy % =	#VALUE!	%
	L _H V	/alue =	#VALUE!	lbs
	TSS Load C	Credit =	#VALUE!	lbs
	Is Sufficient Treatment Available? (TSS Credit \geq TSS Ur	ncapt.)	#VALUE!	
	TSS Treatment by BMP (LM + TSS Unc	apt.) =	#VALUE!	

Texas Commission on Environmental Quality								
TSS Removal Calculations 04-20-2009				Projec Date Pr	t Name: epared:	Manor Creek 3/10/2015	Unit 5 &	6
Additional information is provided for cells with a red trian. Text shown in blue indicate location of instructions in the Techn Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Ch	gle in t ical Gu anges	he upper idance Ma to these	right corr anual - RG- fields will	ner. Place th 348. remove the	e cursi	or over the ce ons used in th	ell. ne spread	sheet.
1. The Required Load Reduction for the total project:	Ca	Iculations (rom RG-348			Pages 3-27 to 3	-30	
Page 3-29 Equation 3.3:	L _M = 27	2(A _N x P)						
where: Ly total proj	ect = Re A _N = Ne P = Av	equired TSS et increase i erage annu	removal res n impervious al precipitatio	ulting from the p area for the pro on, inches	proposed bject	development =	80% of incre	ased load
Site Data: Determine Required Load Removal Based on the Entire Pr	oject							
Cou Total project area included in pla Predevelopment impervious area within the limits of the pla Total post-development impervious area within the limits of the pla	nty = n = un = an =	Comal 45.67 0.00 17.14	acres acres acres	Lots	00	Streets SF/Lot	236,)65 5.419
rotar post-development impervious cover nacio	P =	33	inches		02	0,223	510,	17.14
LM TOTAL PRO. * The values entered in these fields should be for the total project area	ECT = 3.	15383	lbs.					
Number of drainage basins / outfalls areas leaving the plan a	rea =	9						
2. Drainage Basin Parameters (This information should be provided fo	r each b	asin):						
Drainage Basin/Outfall Area	No. =	A 5-6						
Total drainage basin/outfall a Predevelopment impervious area within drainage basin/outfall a Post-development impervious area within drainage basin/outfall a Post-development impervious fraction within drainage basin/outfall a الس This e	rea = rea = rea = rea = ASIN =	14.39 0.00 6.66 0.46 5982	acres acres acres Ibs.	# of Lots	28	SF/Lot 6225 116018		4.00 acres of IC 2.66 acres of str 6.66 Total IC (a
3. Indicate the proposed BMP Code for this basin.								
Proposed B Removal efficie	MP = Sa ncy =	and Filter 89	percent					
4. Calculate Maximum TSS Load Removed (L_) for this Drainage Basir	hy the	selected B	MP Type			Aqualogic Cartr Bioretention Contech Stormf Constructed We Extended Deter Grassy Swale Retention / Irrig Sand Filter Stormceptor Vegetated Filte Vortechs Wet Basin Wet Vault	ridge Filter Filter etland htion ration	
BG-348 Page 3-33 Equation 3.7	L = (F	MP efficier		x 34.6 + A ₀ x 0	54)			
where:	$A_{c} = T_{c}$ $A_{i} = I_{n}$ $A_{p} = P_{c}$ $L_{R} = T_{c}$	otal On-Site npervious a ervious are SS Load re	e drainage are rea proposed a remaining i moved from ti	ea in the BMP c I in the BMP cat In the BMP catcl his catchment a	atchment chment a nment are rea by th	t area area ea e proposed BMP	9	
	A _C = A _I = A _P = L _R =	14.09 6.81 7.28 7033	acres acres acres Ibs	# of Lots	29	SF/Lot 9 6225 116018		4.14 acres of IC 2.66 acres of str 6.81 Total IC (a

Desired L _{M THIS BASIN} =	6294	lbs.			
F =	0.89				
6. Calculate Capture Volume required by the BMP Type for this drainage bas	sin / outfall are	<u>ea.</u>	Calculations from RG-34	B Pages 3-34 to 3	1-36
Rainfall Depth = Post Development Runoff Coefficient = On-site Water Quality Volume =	1.60 0.35 28511	inches cubic feet			
	Calculations fi	om RG-348	Pages 3-36 to 3-37		
Off-site area draining to BMP = Off-site Impervious cover draining to BMP = Impervious fraction of off-site area = Off-site Runoff Coefficient =	0.00 0.00 0.00	acres acres			
Off-site Water Quality Volume =	0	cubic feet			
Storage for Sediment = Total Capture Volume (required water quality volume(s) x 1.20) = The following sections are used to calculate the required water quality volu The values for BMP Types not selected in cell C45 will show NA. 7. Betention/Irrigation System	5702 34214 me(s) for the s	cubic feet selected BMP		ces 3-42 to 3-46	
Bequired Water Quality Volume for retention basin =	NA	cubic feet			
Irrination Area Calculations:	06				
Soil infiltration/permeability rate = Irrigation area =	0.1 NA NA	in/hr square feet acres	Enter determined perm	eability rate or assumed v	alue of 0.1
8. Extended Detention Basin System	Designed as I	Required in RC	3-348 Pa	ages 3-46 to 3-51	
Required Water Quality Volume for extended detention basin =	NA	cubic feet			
9. Filter area for Sand Filters	Designed as I	Required in RC	3-348 Pa	ages 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 = Minimum sedimentation basin area =	14256 3564	square feet square feet	For minimum water dep For maximum water de	oth of 2 leet pth of 8 feet	
9B. Partial Sedimentation and Filtration System			SE @ Given Denth	Given Depth	Width
Water Quality Volume for combined basins =	34214	cubic feet	6,842.72		5 60
Minimum filter basın area =	2851	square feet			60
Maximum sedimentation basin area =	11405	square feet	For minimum water dep	pth of 2 feet	60
Minimum sedimentation basin area =	713	square feet	For maximum water de	pth of 8 feet	60
10. Bioretention System	Designed as	Required in RO	3-348 Pi	ages 3-63 to 3-65	
Required Water Quality Volume for Bioretention Basin =	NA	cubic feet			
11. Wet Basins	Designed as	Required in R	3-348 Pi	ages 3-66 to 3-71	
Required capacity of Permanent Pool = Required capacity at WQV Elevation =	NA NA	cubic feet cubic feet	Permanent Pool Capac Total Capacity should plus a second WQV.	ity is 1.20 times the WQV be the Permanent Pool Ca	apacity
12. Constructed Wetlands	Designed as	Required in R	3-348 Pi	ages 3-71 to 3-73	
Required Water Quality Volume for Constructed Wetlands =	NA	cubic feet			
13. AquaLogic [™] Cartridge System	Designed as	Required in R	3-348 P	ages 3-74 to 3-78	

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RiA _F) =	NA NA NA	cubic feet cartridges 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 REMOVAL	S ARE BASE	D UPON FLOW RATE	S - NOT CALCU	ILATED WATER QUALITY VOLUMES
15. Grassy Swales	Designed as R	equired in RG-348	Pa	ges 3-51 to 3-54
Design parameters for the swale:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfall intensity = i = Swale Stope = Side Stope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	0.00 0.00 1.1 3 0.33 #DIV/0'	acres acres in/hr ft/lt ft		
Acs = 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/01	feet		
15A. Using the Method Described in the RG-348	0.2			
Manning's Equation: Q = <u>1.49</u> A _{CS} R _H ^{2.3} S ^{0.5} n				
$b = \frac{0.134 \times Q}{y^{167}} - zy =$	#DIV/0!	feet		
Q = CiA =	#DIV/01	cts		
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 R(3-348, the design paran	neters must be r	nodified and the solver rerun.
15B. Alternative Method using Excel Solver				
Design Q = CiA =	#DIV/0!	cfs		
Manning's Equation Q = Swale Width=	0.76	6 cfs 0 ft	Error 1 =	#DIV/0!
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	#DIV/0! #DIV/01	ft/s ft		
Instructions are provided to the right (blue comments).				
Design Width =		5 ft	F	1D11/01
Design Discharge = Design Depth =	0.70	o cis 3 ft	Error 2 =	#UTV/0!
Flow Velocity =	0.3	2 cfs		
Minimum Length =	97.4	8 ft		
If any of the resulting values do not meet the design requirement set forth in If any of the resulting values still do not meet the design requirement set for	RG-348, the th in RG-348,	design parameters ma widening the swale b	ty be modified ottom value ma	and the solver rerun. ay not be possible.

16. Vegetated Filter Strips

ā.

Designed as Required in RG-348

17. Wet Vaults	Designed as	Required in RC	3-348 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 = i = design rainfall intensity = A = drainage area in acres ≠	0.	30 1.1 in/hour 1 acres	C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$
Q = flow rate in cubic feet per second =	0	33 cubic feet/se	PC
RG-348 Page 3-31 Equation 3.5: V _{OR} = Q/A			
Q = Runoff rate calculated above = A = Water surface area in the wet vault =	0.	33 cubic feet/se 50 square feet	ec
V _{DR} = 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!	!bs	
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 = Efficiency Reduction for Actual Rainfall Intensity ⇒	0	75 percent 83 percent	
Resultant TSS Load removed by Wet Vault =	#VALUE	lbs	
18. Permeable Concrete	Designed as	Required in R	G-348 Pages 3-79 to 3-83
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZO	DNE		
19. BMPs Installed in a Series	Designed as	s Required in R	3-348 Pages 3-32
Michael E. Barrett, Ph.D., P.E. recommended that the coeffic	cient for E ₂ b	e changed from	n 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 = ${\rm E_2}$ =	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, VALUES ARE FROM SECTION 3 ABOVE)			
L _R = E _{TOT} X P X (A ₁ X 34.6 X A _P X0.54) =	7429	.02 lbs	
20. Stormceptor			
Required TSS Removal in BMP Drainage Area=	NA	lbs	
Impervious Cover Overtreatment= TSS Removal for Uncaptured Area =	= 0.000	ac Ibs	
BMP Sizing	N A	EA	
Effective Area = Calculated Model Size(s) =	= INA = #N/A	EA	
Actual Model Size (if multiple values provided in Calculate: Model Size or if you are choosing a larger model size) =	0 =	Model Size	
Surface Area =	= #N/A	ft ²	
Overflow Rate =	#VALUE	Vor	
Rounded Overflow Rate	= #VALUE	!V _{or} I∾∠	
Bivir Enticlency % =	- "VALUE	: /0	

		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				
ZI. VOITBCII		Beouired 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!	Var
		Rounded Overflow Rate =	#VALUE!	Var
		BMP Efficiency % =	#VALUE!	%
		L _B Value =	#VALUE!	1bs
		TSS Load Credit =	#VALUE!	lbs
	Is Sufficient	Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE1	
		TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality									
TSS Removal Calculations 04-20-2009				Project N Date Prepa	ame: ared:	Manor 3/10/2	Creek L	Jnit 5	
Additional information is provided for cells with a red triang Text shown in blue indicate location of instructions in the Technic Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Cha	le in the cal Guid	e upper ance Ma o these f	right corr inual - RG- fields will	er. Place the 348. remove the equ	curso uation	r over ns use	the cell d in the	spread	sheet.
1. The Required Load Reduction for the total project:	Calc	ulations fr	om RG-348		F	bages 3-	27 to 3-3	0	
Page 3-29 Equation 3.3: 1	-M = 27.2	(A _N x P)							
where:	Requ	ured TSS	removal res	ulting from the prov	hosod	develop	mont - 80	% of incre	asad load
	A _N = Net r P = Aver	ncrease ir age annu	n impervious al precipitatio	area for the projection, inches	ot	iereiop.			
Site Data: Determine Required Load Removal Based on the Entire Pro	ject								
Coun Total project area included in plan Predevelopment impervious area within the limits of the plar Total post-development impervious area within the limits of the pla Total post-development impervious cover fraction	ity = (* = n* = n* = P =	Comal 45.67 0.00 17.14 0.38 33	acres acres acres inches	Lots	82	Streets SF/Lot 6	.225	236,065 510,450	5.419 11.718 17.14
Lastoral PROLe	cr =	15383	lbs.						
The values entered in these neids should be for the total project area.									
Number of drainage basins / outfalls areas leaving the plan are	ea =	9							
2. Drainage Basin Parameters (This information should be provided for	each bas	sin):							
Drainage Basin/Outfall Area N	o. =	A 5-7							
Total drainage basin/outfall ar Predevelopment impervious area within drainage basin/outfall ar Post-development impervious area within drainage basin/outfall ar Post-development impervious fraction within drainage basin/outfall ar LM THIS BA	ea = ea = ea = ea = sin =	3.96 0.00 1.43 0.36 1283	acres acres acres Ibs.	# of Lots	10	SF/Lot	6225	1.43	acres of IC for lots acres of street
3. Indicate the proposed BMP Code for this basin.									
Proposed BM Removal efficien 4. Calculate Maximum TSS Load Removed (L _B) for this Drainage Basin	ΛΡ = Veg cy = by the se	etated Fil 80	Iter Strips percent			Aqualog Bioreten Contech Construc Extende Grassy S Retentic Sand Fil Stormce Vegetati Vortech: Wet Bas Wet Va	ic Cartrid tion I StormFil cted Wett d Detenti Swale on / Irrigat ter ptor ed Filter S s sin Jt	ge Filter ter and on ion Strips	
RG-348 Page 3-33 Equation 3.7:	La ≖ (BM	P efficien	cv) x P x (A,	x 34.6 + A _e x 0.54)					
where:	$A_{c} = Tota$ $A_{i} = Impi$ $A_{P} = Perional L_{R} = TSSA_{c} = 1$	al On-Site ervious ar vious area 5 Load ren 3.96	drainage are ea proposed remaining ir noved from II acres	ea in the BMP catc I in the BMP catchr n the BMP catchren his catchment area	hment ment ar ent are by the	area ea a propos	ed BMP		
	A ₁ =	1.43	acres	# of Lots	10	SF/Lot	EDDE	1 4	acres of IC for late
	Ce = L _R =	2.53 1341	lbs		10		0220	1.4.	acres of street

Desired L _{M THIS BASIN} =	1283	lbs.			
F =	0.96				
6. Calculate Capture Volume required by the BMP Type for this drainage bas	sin / outfall	area.	Calculations from RG-	348 Pages 3-34 to 3	3-36
Rainfall Depth = Post Develooment Runoff Coefficient =	2.80 0.29	inches			
On-site Water Quality Volume =	11598	cubic feet			
	Calculation	s from RG-348	Pages 3-36 to 3-37		
Off-site area draining to BMP =	0.00	acres			
Impervious fraction of off-site area =	0.00	acres			
Off-site Runoff Coefficient = Off-site Water Quality Volume =	0.00 0	cubic feet			
Storage for Sediment =	2320				
Total Capture Volume (required water quality volume(s) x 1.20) = The following sections are used to calculate the required water quality volum The values for BMP Types not selected in cell C45 will show NA.	13918 me(s) for th	cubic feet re selected BMP			
7. Retention/Irrigation System	Designed a	s Required in RG	1-348	Pages 3-42 to 3-46	
Required Water Quality Volume for retention basin =	NA	cubic feet			
Irrigation Area Calculations:					
Soil infiltration/permeability rate = Irrigation area =	0.1 NA NA	in/hr square feet acres	Enter determined pe	rmeability rate or assumed v	alue of 0.1
8. Extended Detention Basin System	Designed a	is Required in RC	à-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 a	is Required in RC	3-348	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 = Minimum sedimentation basin area =	NA NA	square feet square feet	For minimum water For maximum water	depth of 2 feet 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 = Minimum sedimentation basin area =	NA NA	square feet square feet	For minimum water For maximum water	depth of 2 feet depth of 8 feet	
10. Bioretention System	Designed	as Required in R	3-348	Pages 3-63 to 3-65	
Required Water Quality Volume for Bioretention Basin =	NA	cubic feet			
11. Wet Basins	Designed	as Required in R	G-348	Pages 3-66 to 3-71	
Required capacity of Permanent Pool ≂ Required capacity at WOV Elevation ≂	NA NA	cubic feet cubic feet	Permanent Pool Cap Total Capacity shou plus a second WQV	pacity is 1.20 times the WQV Id be the Permanent Pool Ca	apacity
12. Constructed Wetlands	Designed	as Required in R(3-348	Pages 3-71 to 3-73	
Required Water Quality Volume for Constructed Wetlands =	= NA	cubic feet			
<u>13. AquaLoqic[™] Cartridge System</u>	Designed	as Required in Ri	G-348	Pages 3-74 to 3-78	

** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with maintenance contract with AquaLogic¹⁹.

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 REMOVAL	S ARE BASE	ED UPON FLOW RATE	S - NOT CALC	JLATED WATER QUALITY VOLUMES
15. Grassy Swales D	esigned as R	lequired in RG-348	Pa	ges 3-51 to 3-54
Design parameters for the swate:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfati intensity = i = Swale Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	0.00 0.00 1.1 0.01 3 0.33 #DIV/0!	acres acres in/hr tt/tt s tt		
A _{CS} = cross-sectional area of flow in Swale =	#DIV/01	sf		
P _w = Wetted Perimeter =	#DIV/01	feet		
R_{H} = hydraulic radius of flow cross-section = A_{CS}/P_{W} = n = Manning's roughness coefficient =	#DIV/0! 0.2	feet 2		
15A. Using the Method Described in the RG-348				
Manning's Equation: $Q = 1.49 A_{CS} R_{H}^{-23} S^{0.5}$ n				
$b = \frac{0.134 \times Q}{y^{1.67}} - zy =$	#DIV/01	feet		
Q = CiA =	#D!V/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 R	G-348, the design para	neters must be	modified and the solver rerun.
15B. Alternative Method using Excel Solver				
Design Q = CiA =	#DIV/0!	cfs		
Manning's Equation Q = Swale Width=	0.7 6.0	6 cfs 0 ft	Error 1 =	#DIV/0!
Instructions are provided to the right (green comments).				
Flow Vetocity Minimum Length =	#DIV/01 #DIV/01	ft/s ft		
Instructions are provided to the right (blue comments).				
Design Width =	·	6 ft		
Design Discharge =	0.7	6 cfs	Error 2 =	#DIV/0!
Design Deptn = Flow Velocity ≠	0.3	2 cfs		
Minimum Length ≂	97.4	8 ft		
If any of the resulting values do not meet the design requirement set forth in If any of the resulting values still do not meet the design requirement set fort	RG-348, the h in RG-348	design parameters m widening the swale b	ay be modified ottom value m	and the solver rerun. ay not be possible.

16. Vegetated Filter Strips

Designed as Required in RG-348

17. Wet Vaults	Designed as I	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 = i = design rainfall intensity = A = drainage area in acres =	0.2 1.	2 1 in/hour 1 acres	C = Runoff Coefficien	n = 0.546 (IC) ² + 0.328 (IC) + 0.03
Q = flow rate in cubic feet per second =	0.2	4 cubic feet/se	с	
RG-348 Page 3-31 Equation 3.5: V _{OR} = Q/A				
Q = Runoff rate calculated above = A = Water surface area in the wet vault =	0.2 15	4 cubic feet/se 0 square feet	с	
V _{OR} = Overflow Rate =	0.0	0 feet/sec		
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	5	3 percent		
Load removed by Wet Vault =	#VALUE!	lbs		
If a bypass occurs at a rainfall intensity of leas 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 = Efficiency Reduction for Actual Rainfall Intensity =	0.7	5 percent 3 percent		
Resultant TSS Load removed by Wet Vault =	#VALUE!	lbs		
18. Permeable Concrete	Designed as	Required in R(3-348	Pages 3-79 to 3-83
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZO	INE			
19. BMPs Installed in a Series	Designed as	Required in R(3-348	Pages 3-32
Michael E. Barrett, Ph.D., P.E. recommended that the coeffic	ient for E ₂ be	changed from	n 0.5 to 0.65 on May 3	2006
$E_{YOY} = [1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100 =$	94.0	1 percent	NET EFFICIENCY OF	THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = $E_1 =$	89.0	0 percent		
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 =	70.0	0 percent		
EFFICIENCY OF THE THIRD BMP IN THE SERIES \thickapprox E3 =	0.0	0 percent		
THEREFORE, THE NET LOAD REMOVAL WOULD BE: (A, AND A, VALUES ARE FROM SECTION 3 ABOVE)				
L _R = E _{TOY} X P X (A ₁ X 34.6 X A _P X0.54) =	1576.2	28 lbs		
20. Stormeentor				
Required TSS Removal in BMP Drainage Area= Impervious Cover Overtreatment= TSS Removal for Uncaptured Area =	NA 0.0000 0.00	lbs ac lbs		
Effective Area =	NA	EA		
Calculated Model Size (if multiple values provided in Calculated Model Size or if you are observed a local value of the second s	#N/A	Model Size		
woder Size of it you are choosing a larger model Size) =	U	would Size		
Surface Area =	#N/A	ft ²		
Overflow Rate =	#VALUE!	Vor		
Rounded Overflow Rate =	#VALUE!	Var		
BMP Efficiency % =	#VALUE!	% 15 -		
	" VALUE!	IUS		

		TSS Load Credit =	#VALUE!	lbs
	Is Sufficient	Treatment Available? (TSS Credit > TSS Uncapt.)	#VALUE ¹	
		TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	
01 Vortech				
21. Vonech		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	
	A	ctual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
		Surface Area =	7.10	ft²
		Overflow Rate =	#VALUE!	Va
		Rounded Overflow Rate =	#VALUE!	Var
		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 Nam Date Prepare	e: <mark>Mano</mark> d: 3/10/	r Creek Unit 2015	5
Additional information is provided for cells with a red triang Text shown in blue indicate location of instructions in the Technic Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Cha	le in th cal Guid anges to	e upper lance Ma o these f	right corn inual - RG- ields will i	er. Place the cur 348. remove the equa	tions use	r the cell. ed in the spr	eadsheet.
1. The Required Load Reduction for the total project:	Calc	ulations fr	om RG-348		Pages :	3-27 to 3-30	
Page 3-29 Equation 3.3:	L _M = 27.2	!(A _N x P)					
where: L _M total Proje	_{:ct} = Req A _N = Net P = Ave	uired TSS Increase ii rage annu	removal resu n impervious al precipitatic	ulting from the propos area for the project on, inches	ed develop	oment = 80% of	increased load
Site Data: Determine Required Load Removal Based on the Entire Pro	piect						
Total post-development impervious area within the limits of the plan Total post-development impervious area within the limits of the plan Total post-development impervious area within the limits of the plan Total post-development impervious cover fraction	nty = 1 ° = 1 ° = 1 ° = 1 ° = P =	Cornal 45.67 0.00 17.14 0.38 33	acres acres acres inches	Lots a	Streets SF/Lot 2	236 6,225 510	.065 5.419 11.718 17.14
LM TOTAL PROJE * The values entered in these fields should be for the total project area	ECT =	15383	íbs.				
Number of drainage basins / outfalls areas leaving the plan ar	ea =	9					
2. Drainage Basin Parameters (This information should be provided for Drainage Basin/Outfall Area N Total drainage basin/outfall ar Predevelopment impervious area within drainage basin/outfall ar Post-development impervious area within drainage basin/outfall ar Post-development impervious fraction within drainage basin/outfall ar L _{M THIS BA}	<u>each ba</u> lo. = ea = ea = ea = ea = sin =	sin): A 5-8 2.88 0.00 0.57 0.20 513	acres acres acres lbs.	# of Lots	SF/Lot 4	6225	0.57 acres of IC for lots - acres of street
3. Indicate the proposed BMP Code for this basin,							
Proposed Br Removal efficier 4. Calculate Maximum TSS Load Removed (L_) for this Drainage Basin	MP = Veç icy ≈	etated Fil	Iter Strips percent		Aqualo Biorete Contec Constri Extend Grassy Retent Sand F Stormo Vegeta Vortec Wet B2 Wet Va	gic Cartridge Fi Intion In Storm Filter Jucted Wetland ed Detention Swale ion / Irrigation iller reptor ted Filter Strips hs asin ault	iter
4. Calculate Maximum 135 Load Hemoved (Lg) for this brainage basin	by the s	in the second					
HG-348 Page 3-33 Equation 3.7:	L _R ≠ (8N	16 etticieu	cy) x P x (A ₁)	x 34.6 + A _P x 0.54)			
where:	$A_{C} = Tot$ $A_{I} = Imp$ $A_{P} = Per$ $L_{R} = TSP$	al On-Site pervious ar vious area S Load rer	drainage are ea proposed a remaining ir noved from th	ea in the BMP catchm in the BMP catchmer h the BMP catchment his catchment area by	ent area It area area the propo	sed BMP	
	A _c =	2.88	acres				
	A ₄ =	0.57	acres	# of Lots	SF/Lot		
	A _P = L _R =	2.31 555	acres Ibs		4	6225	0.57 acres of IC for lots 0 acres of street

Desired L _{M THIS BASIN} =	513	lbs.			
F =	0.92				
6. Calculate Capture Volume required by the BMP Type for this drainage bas	sin / outfall ar	<u>ea.</u>	Calculations from RG-	348 Pages 3-34 to 3-36	
Rainfall Depth = Post Development Runoff Coefficient = On-site Water Quality Volume =	2.00 0.20 4181	inches cubic feet			
	Calculations I	rom RG-348	Pages 3-36 to 3-37		
Olf-site area draining to BMP = Off-site Impervious cover draining to BMP ≈ Impervious fraction of off-site area = Off-site Runoff Coefficient = Off-site Water Quality Volume =	0.00 0.00 0.00 0	acres acres cubic feet			
Storage for Sediment = Total Capture Volume (required water quality volume(s) x 1.20) = The following sections are used to calculate the required water quality volu The values for BMP Types not selected in cell C45 will show NA. 7. Betention/Irrigation System	836 5017 me(s) for the Designed as	cubic feet selected BMP	-348	Pages 3-42 to 3-46	
Bequired Water Quality Volume for retention basin -	NΔ	cubic feet		1 4903 0 12 10 0 10	
Irrination Area Calculations:	10	CODIC IEET			
Soil infiltration/permeability rate = Irrigation area =	0.1 NA NA	in/hr square feet acres	Enter determined per	rmeability rate or assumed value of	f 0.1
8. Extended Detention Basin System	Designed as	Required in RG	i-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	3-348	Pages 3-58 to 3-63	
9A. Full Sedimentation and Filtration System					
9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin =	NA	cubic feet			
9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin = Minimum filter basin area =	NA NA	cubic feel square feet			
9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area =	NA NA NA	cubic feet square feet square feet square feet	For minimum water For maximum water	depth of 2 feet depth of 8 feet	
 <u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basin = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 	NA NA NA	cubic feet square feet square feet square feet	For minimum water For maximum water	depth of 2 feet depth of 8 feet	
 <u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basin = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = 	NA NA NA NA	cubic feet square feet square feet square feet cubic feet	For minimum water of For maximum water	depth of 2 feet depth of 8 feet sf at 4' of depth	
<u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basin = Minimum filter basin area = Maximum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area =	NA NA NA NA	cubic feet square feet square feet square feet cubic feet square feet	For minimum water of For maximum water	depth of 2 feet depth of 8 feet sf at 4' of depth	
 9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basins = Minimum filter basin area = 	NA NA NA NA NA	cubic feet square feet square feet square feet square feet square feet square feet	For minimum water For maximum water #VALUE! For minimum water For maximum water	depth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 8 feet	
<u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basin = Minimum filter basin area = Maximum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Minimum sedimentation basin area =	NA NA NA NA NA NA NA NA NA	cubic feet square feet square feet cubic feet square feet square feet square feet square feet	For minimum water o For maximum water #VALUE! For minimum water For maximum water 3-348	depth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3-65	
9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basins = Minimum filter basin area = Minimum sedimentation basin area = M	NA NA NA NA NA NA NA NA NA NA NA	cubic feet square feet square feet square feet cubic feet square feet square feet Required in RC cubic feet	For minimum water For maximum water #VALUE! For minimum water For maximum water 3-348	depth of 2 feet depth of 5 feet sf at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3-65	
9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin = Minimum filter basin area = Maximum sedimentation basin area = 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basins = Minimum filter basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = 10. Bioretention System Required Water Quality Volume for Bioretention Basin =	NA NA NA NA NA NA Designed as NA	cubic feet square feet square feet cubic feet square feet square feet square feet Required in RC cubic feet	For minimum water o For maximum water #VALUE! For minimum water For maximum water 3-348	depth of 2 feet depth of 5 feet sf at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3-65 Pages 3-66 to 3-71	
<u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basin = Minimum filter basin area = Maximum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = 10. Bioretention System Required Water Quality Volume for Bioretention Basin = <u>11. Wet Basins</u> Partial Sedimentation basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = Maximum sedimentation basin area = Maximu	NA NA NA NA NA Designed as NA Designed as NA	cubic feel square feet square feet cubic feet square feet square feet square feet cubic feet cubic feet cubic feet cubic feet	For minimum water of For maximum water #VALUE! For minimum water For maximum water 3-348 Permanent Pool Cap Total Capacity shou plus a second WQV.	depth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3-65 Pages 3-66 to 3-71 pacity is 1.20 times the WQV Id be the Permanent Pool Capacity	ł.
9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basins = Minimum filter basin area = Minimum sedimentation basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Minimum filter basin area = Minimum sedimentation basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = Maximum sedimentation basin area = Maximum sedimentatio	NA NA NA NA NA NA Designed as NA Designed as NA NA	cubic feet square feet square feet cubic feet square feet square feet square feet Required in RC cubic feet cubic feet cubic feet cubic feet	For minimum water of For maximum water #VALUE! For minimum water For maximum water 3-348 3-348 Permanent Pool Cap Total Capacity shou plus a second WQV. 3-348	depth of 2 feet depth of 8 feet sl at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3-65 Pages 3-66 to 3-71 pages 3-66 to 3-71 depth is 1.20 times the WQV Id be the Permanent Pool Capacity Pages 3-71 to 3-73	
9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin area = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basins area = Minimum filter basin area = Minimum filter basin area = Minimum filter basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Minimum filter basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Maximum sedimentation basin area =	NA NA NA NA NA NA Designed as NA Designed as NA	cubic feet square feet square feet cubic feet square feet square feet square feet square feet cubic feet Required in RC cubic feet Required in RC cubic feet cubic feet	For minimum water of For maximum water #VALUE! For minimum water For maximum water 3-348 3-348 Permanent Pool Cap Total Capacity shou plus a second WQV. 3-348	depth of 2 feet depth of 8 feet st at 4' of depth depth of 2 feet depth of 2 feet depth of 8 feet Pages 3-63 to 3-65 Pages 3-66 to 3-71 pacity is 1.20 times the WQV Id be the Permanent Pool Capacity Pages 3-71 to 3-73	

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 BMP& / LOAD REMOVAL	S ARE BASE	D UPON FLOW RATES	NOT CALCI	JLATED WATER QUALITY VOLUMES
15. Grassy Swales	esigned as R	equired in RG-348	Pa	ges 3-51 to 3-54
Design parameters for the swale:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfat! intensity = i = Swale Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	0.00 0.00 1.1 0.01 3 0.33 #DIV/0 ¹	acres acres in/hr ft/ft ft		
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 = n = Manning's roughness coefficient =	#DIV/01 0.2	feet		
15A. Using the Method Described in the RG-348				
Manning's Equation: $Q = 1.49 A_{CS} R_{H}^{23} S^{0S}$ n				
$b = \frac{0.134 \times Q}{y^{1.57} S^{0.5}} - zy =$	#DIV/0!	feet		
Q = CiA =	#D1V/01	cfs		
To calculate the flow velocity in the swale:				
V (Velocity of Flow in the swale) = Q/A_{CS} =	#DIV/01	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 s	set forth in RC	3-348, the design parame	ters must be r	nodified and the solver rerun.
15B. Alternative Method using Excel Solver				
Design Q ≃ CiA =	#DIV/0!	cfs		
Manning's Equation Q = Swale Width=	0 76 6.00	5 cfs) ft	Error 1 =	#DIV/0!
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	#DIV/0! #DIV/0!	ft/s ft		
Instructions are provided to the right (blue comments).				
Design Width = Design Discharge = Design Depth = Flow Velocity = Minimum Length =	0 74 0.33 0.33 97.44	5 ft 5 cfs 3 ft 2 cfs 3 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

17. Wet Vaults	Designed as F	lequired in RG	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 = i = design rainfall intensity = A = drainage area in acres =	0.12 1.	2 1 in/hour 1 acres	C = Runoff Coefficie	nt = 0.546 (IC) ² + 0.328 (IC) + 0.03
Q = flow rate in cubic feet per second =	0.1	3 cubic feet/se	с	
RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$				
Q = Runoff rate calculated above = A = Water surface area in the wet vauit =	0.1	3 cubic feet/se 3 square leet	c	
V _{OR} = Overflow Rate =	0.0) feet/sec		
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	5	3 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 = Efficiency Reduction for Actual Rainfall Intensity ≂	<mark>0.7</mark> 0.8	5 percent 3 percent		
Resultant TSS Load removed by Wet Vault =	#VALUE!	lbs		
18. Permeable Concrete	Designed as I	Required in RC	i-348	Pages 3-79 to 3-83
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZO	NE			
19. BMPs Installed in a Series	Designed as I	Required in RC	3-348	Pages 3-32
Michael E. Barrett, Ph.D., P.E. recommended that the coeffic	ient for E ₂ be	changed from	n 0.5 to 0.65 on May 3	3, 2006
$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$	94.0	1 percent	NET EFFICIENCY O	F THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E, =	89.0	0 percent		
EFFICIENCY OF THE SECOND BMP IN THE SERIES = ${\rm E_2}$ =	70.0	o percent		
EFFICIENCY OF THE THIRD BMP IN THE SERIES = $E_3 =$	0.0	0 percent		
THEREFORE, THE NET LOAD REMOVAL WOULD BE: (A; AND A $_{\rm P}$ VALUES ARE FROM SECTION 3 ABOVE)				
L _R = E _{TOT} X P X (A, X 34.6 X A _P X0.54) =	652.2	2 lbs		
20. Stormceptor Required TSS Removal in BMP Drainage Area= Impervious Cover Overtreatment= TSS Removal for Uncaptured Area =	NA 0.0000 0.00	lbs ac Ibs		
Effective Area =	NA	EA		
Catculated Model Size(s) = Actual Modet Size (if multiple values provided in Catculated Model Size or if you are choosing a larger model size) =	#N/A	Model Size		
Quideos Ares -	#NI/A	H ²		
	#VALUE	Var		
Bounded Overflow Rate =	#VALUE	V~		
RMP Efficiency % =	#VALUE!	%		
L _R Value =	#VALUE!	lbs		

	TSS Load Credit =	#VALUE!	lbs
	Is Sufficient Treatment Available? (TSS Credit \geq 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	ħ²
	Overflow Rate =	#VALUE!	V _{or}
	Rounded Overflow Rate =	#VALUE!	V _e v
	BMP Efficiency % =	#VALUE!	%
	L _R Value =	#VALUE!	lbs
	TSS Load Credit =	#VALUE!	lbs
	Is Sufficient Treatment Available? (TSS Credit \geq TSS Uncapt.)	#VALUE!	
	TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE1	

Texas Commission on Environmental Quality									
TSS Removal Calculations 04-20-2009				Project N Date Prepa	ame: ared:	Manor 3/10/2	Creek	Unit 5	
Additional information is provided for cells with a red triang Text shown in blue indicate location of instructions in the Technic Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Cha	le in th cal Guid inges to	e upper lance Ma	right corn inual - RG- ields will i	er. Place the o 348. remove the eq	curso uatio	or over	the cel	II. e spreads	sheet.
1. The Required Load Reduction for the total project:	Calc	ulations fr	om AG-348			Pages 3	-27 to 3-3	30	
Page 3-29 Equation 3.3: L	L _M = 27.2	(A _N x P)							
where: L _{M TOTAL PROJE}	_{CT} = Requ A _N = Net i P = Aver	uired TSS increase ir rage annua	removal resu n impervious al precipitatio	ulting from the prop area for the projec on, inches	posed ct	develop	ment = 80	0% of incre	ased load
Site Data: Determine Required Load Removal Based on the Entire Pro	piect								
Coun Total project area included in plan Predevelopment impervious area within the limits of the plar Total post-development impervious area within the limits of the pla Total post-development impervious cover fraction	n'= n'= n'= P=	Comal 45.67 0.00 17.14 0.38 33	acres acres acres inches	Lots	82	Streets SF/Lot 6	.225	236,065 510,450	5.419 11.718 17 14
L M TOTAL PROJE	ст =	15383	lbs.						
The values entered in these helds should be for the total project area.	7								
Number of drainage basins / outfalls areas leaving the plan are	ea =	9							
2. Drainage Basin Parameters (This information should be provided for Drainage Basin/Outfall Area N	each bas Io. =	<u>sin):</u> A 5-9							
Total drainage basin/outfall ar Predevelopment impervious area within drainage basin/outfall ar Post-development impervious area within drainage basin/outfall ar Post-development impervious fraction within drainage basin/outfall ar L _{M THES BA}	ea = ea = ea = ea = sin =	2.60 0.00 0.57 0.22 513	acres acres acres Ibs.	# of Lots	4	SF/Lot	6225	0.57	acres of IC for lots acres of street
3. Indicate the proposed BMP Code for this basin.									
Proposed BN	MP = Veg	etated Fil	ter Strips						
Removal efficien	юу =	80	percent			Aqualog Bioreter Contech Constru Extende Grassy Retentio Sand Fi Stormce Vegetat Vortech Wet Ba: Wet Va	ac Cartrio htton StormFri cted Wele ad Detent Swale on / Irriga liter eptor ed Filter s sin ult	dge Filter Itand ion Ition Strips	
4. Calculate Maximum TSS Load Removed (L _B) for this Drainage Basin	by the se	elected B#	МР Туре.						
RG-348 Page 3-33 Equation 3.7:	L _R = (BN	1P efficient	cy) x P x (A _i >	x 34.6 + A _P x 0.54)					
where:	$A_c = Tota$ $A_i = Imp$ $A_p = Per$ $L_n = TSS$	al On-Site iervious ar vious area S Load ren	drainage are ea proposed i remaining ir noved from th	ea in the BMP catc in the BMP catchr in the BMP c atchme nis catchment area	hment ment a ent are a by th	area area ea e propos	ed BMP		
	A _C =	2.60	acres						
	A ₁ =	0.57	acres	# of Lots		SF/Lot	6005	0.5	7 aprop of 10 for lot-
	L _R =	551	lbs		4		0223	0.5	0 acres of street

Desired L _{M THIS BASIN} =	513	lbs.			
F =	0.93				
6. Calculate Capture Volume required by the BMP Type for this drainage bas	sin / outfall a	rea.	Calculations from RG-	348 Pages 3-34 to 3-36	
Rainfall Depth =	2.20	inches			
Post Development Runoff Coefficient = On-site Water Quality Volume ≠	0.21 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			
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 volu-	me(s) for the	selected BMP			
7. Retention/Irrigation System	Designed as	Required in RG	3-348	Pages 3-42 to 3-46	
Required Water Quality Volume for retention basin =	NA	cubic feet			
Irrigation Area Calculations:					
Soil infiltration/normaphility rate -	0.1	in/hr	Enter determined on	mashilitu rata or accumed value	6 of 0 1
Irrigation area =	NA	square feet	Enter determined pe	rineaulity rate of assumed value	2 01 0.1
	NA	acres			
8. Extended Detention Basin System	Designed as	Required in RC	3-348	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	s Required in RC	3-348	Pages 3-58 to 3-63	
9A. Full Sedimentation and Filtration System					
Water Quality Volume for sedmentation basin =	NA	cubic feet			
Minimum filter basin area =	NA	square feet			
Maximum sedmentation 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 Bioratention System	Designed a	Boguirad in R	2.248	Page 2 62 to 2 65	
To. Diolecention System	Designed a	s nequired in m	a-a+a	rages 3-03 (0.3-03	
Required Water Quality Volume for Bioretention Basin =	: NA	cubic feet			
11. Wet Basins	Designed a	s Required in R	G-348	Pages 3-66 to 3-71	
Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Car	pacity is 1.20 times the WQV	
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity shou plus a second WQV	Id be the Permanent Pool Capac	city
12. Constructed Wollands	Designed -	Required in D	0.349	Pages 2.71 to 2.72	
12. Constructed Wetlands	Designed a	s Hequired in Ri	3-348	Pages 3-71 to 3-73	
Required Water Quality Volume for Constructed Wetlands =	NA	cubic feet			
13. AquaLogic'" Cartridge System	Designed a	s Required in R	G-348	Pages 3-74 to 3-78	

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 REMOVAL	S ARE BASI	ED UPON FLOW RA	TES - NOT CALC	ULATED WATER QUALITY VOLUMES
15. Grassy Swales D	esigned as P	lequired in RG-348	Pa	ages 3-51 to 3-54
Design parameters for the swale:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfall intensity = i = Swale Stope = Side Stope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	0.00 0.00 1. 0.01 8 0.00 0.00 8 #DIV/01) acres) acres l in/hr th/t 1 ft		
A_{CS} = cross-sectional area of flow in Swale = P_W = Wetted Perimeter = R_H = hydraulic radius of flow cross-section = A_{CS}/P_W = n = Manning's roughness coefficient =	#DIV/0! #DIV/0! #DIV/0! 0.:	sf feet feet 2		
15A. Using the Method Described in the RG-348				
Manning's Equation: $Q = 1.49 A_{CS} R_{H}^{23} S^{0.5}$ n				
$b = \frac{0.134 \times Q}{y^{1.67}} - zy =$	#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/01	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 s	set forth in R	G-348, the design pa	rameters must be	modified and the solver rerun.
a so i so sen recente i concerna de concerna de anna de anna de anna de an				
15B. Alternative Method using Excel Solver				
Design Q = CiA =	#DIV/0!	cfs		
Manning's Equation Q ≂ Swale Width=	0.7 6.0	6 cfs 0 ft	Error 1 =	#DIV/0!
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	#DIV/0! #DIV/0!	ft/s ft		
Instructions are provided to the right (blue comments).				
Design Width = Design Discharge = Design Depth = Flow Velocity = Minimum Length =	0.7 0 3 0.3 97.4	6 ft 6 cfs 3 ft 2 cfs 8 ft	Error 2 =	#DIV/0!
It any of the resulting values do not meet the design requirement set forth in	HG-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

17. Wet Vaults	Designed as P	equired 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 = Civ	A			
C = runoff coefficient for the drainage area = i = design rainfall intensity = A = drainage area in acres =	= 0.10 = 1.1) in/hour acres	C = Runoff Coefficie	nt = 0.546 (IC) ² + 0.328 (IC) + 0.03
Q = flow rate in cubic feet per second	= 0.14	cubic feet/se	c	
RG-348 Page 3-31 Equation 3.5: V _{OR} = Q//	A			
Q = Runoff rate calculated above A = Water surface area in the wet vault :	= 0.14 = 150	t cubic feet/se square feet	ec.	
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	- 01	5 in/hour		
Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 Efficiency Reduction for Actual Rainfall Intensity	= 0.7 = 0.8	5 percent 3 percent		
Resultant TSS Load removed by Wet Vault	= #VALUE!	lbs		
18. Permeable Concrete	Designed as F	Required in RC	3-348	Pages 3-79 to 3-83
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING Z	ONE			
19. BMPs Installed in a Series	Designed as I	Required in RC	6-348	Pages 3-32
Michael E. Barrett, Ph.D., P.E. recommended that the coeff	icient for E2 be	changed from	n 0.5 to 0.65 on May	3, 2006
$E_{\texttt{TOT}} = [1 \cdot ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100$	= 94.0	1 percent	NET EFFICIENCY O	F THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E_1	= 89.0	opercent		
EFFICIENCY QF THE SECOND BMP IN THE SERIES = E_2	70.0	percent		
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3	= 0.0	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, X 34.6 X A _P X0.54)	= 647.5	3 lbs		
20. Stormceptor Required TSS Removal in BMP Drainage Area Impervious Cover Overtreatment TSS Removal for Uncaptured Area BMP Sizing Effective Area Calculated Model Size(s) Actual Model Size (if multiple values provided in Calculate Model Size or if you are choosing a larger model size)	= NA = 0.000 = 0.00 = NA = #N/A d = 0	ibs ac Ibs E A Model Size		
Surface Area Overflow Rate Rounded Overflow Rate BMP Efficiency % L _R Value	= #N/A = #VALUE! = #VALUE! = #VALUE! = #VALUE!	ft ² V _{or} V _α %		

		TSS Load Credit =	#VALUE!	lbs
	Is Sufficient	Treatment Available? (TSS Credit > TSS Uncapt.)	#VALUE!	
		TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE ¹	
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
	8MP Sizing			
		Effective Area =	NA	EA
		Calculated Model Size(s) =	#N/A	
	A	ctual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
	¢	ctual Model Size (if choosing larger model size) = Surface Area =	Vx1000 7.10	Pick Model Size
	Ļ	ctual Model Size (if choosing larger model size) = Surface Area = Overflow Rate =	Vx1000 7.10 #VALUE!	Pick Model Size ft ² V _{or}
	ļ	ctual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate =	V×1000 7.10 #VALUE! #VALUE!	Pick Model Size ft ² V _{or} V _{or}
	4	ctual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % =	Vx1000 7.10 #VALUE! #VALUE! #VALUE!	Pick Model Size ft ² V _{or} %
	4	ctual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % = L _b Value =	Vx1000 7.10 #VALUE! #VALUE! #VALUE! #VALUE!	Pick Model Size ft ² V _o V _o lbs
	4	Actual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % = L _R Value =	Vx1000 7.10 #VALUE! #VALUE! #VALUE! #VALUE!	Pick Model Size ft ² V _o V _o N ₅ Ibs
	4	ctual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % = L _R Value = TSS Load Credit =	Vx1000 7.10 #VALUE! #VALUE! #VALUE! #VALUE!	Pick Model Size tt ² V _{or} V _{or} % Ibs ibs
	s Sufficient	totual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % = L _R Value = TSS Load Credit = Treatment Available? (TSS Credit ≥ TSS Uncapt.)	Vx1000 7.10 #VALUE! #VALUE! #VALUE! #VALUE!	Pick Model Size ft ² V _{or} V _{or} % Ibs Ibs

Texas Commission on Environmental Quality								
TSS Removal Calculations 04-20-2009				Project Date Pre	Name: M epared:	anor Creek U 3/10/2015	Jnit 5 & 6	
Additional information is provided for cells with a red triany. Text shown in blue indicate location of instructions in the Techn Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Characters shown in black (Bold) are calculated fields.	gle in t ical Gu anges	the upper idance M to these	r right corr anual - RG- fields will	ner. Place the -348. remove the e	e cursor	over the cell s used in the	l. e spreadst	neet.
1. The Required Load Reduction for the total project:	Ca	alculations	rom RG-348		Pa	ages 3-27 to 3-3	0	
Page 3-29 Equation 3.3:	L _M = 27	2(A _N x P)						
where: L _{M TOTAL PRCJ}	_{ECT} = Re A _N = Ne P = AN	equired TSS et increase verage annu	S removal res in impervious ual precipitatio	ulting from the p area for the pro on, inches	roposed de ject	evelopment = 80	% of increas	sed load
Site Data: Determine Required Load Removal Based on the Entire Pr	oject							
Cou Total project area included in plan Predevelopment impervious area within the limits of the pla	nty≃ n°= un°≃	Comal 45.67 0.00	acres		S	treets	236,06	<mark>5</mark> 5.419
Total post-development impervious area within the limits of the pl Total post-development impervious cover fractic	an" = on ' = P =	17.14 0.38 33	acres inches	Lots	82 82	F/Lot 6,225	510,45	0 11.718 17.14
LM TOTAL PROJ	ECT =	15383	lbs.					
Number of drainage basins / outfalls areas leaving the plan a	rea =	9						
2. Drainage Basin Parameters (This information should be provided to Drainage Basin/Outfall Area	r each b No. =	asin): A 5-12						
Total drainage basin/outfall a Predevelopment impervious area within drainage basin/outfall a Post-development impervious area within drainage basin/outfall a Post-development impervious fraction within drainage basin/outfall a المالية الم	rea = rea = rea ≖ rea = _{ASIN} =	0.30 0.00 0.20 0.68 183	acres acres acres lbs.	# of Lots	0 0	F/Lot 6225 8905	0. 0. 0.	00 acres of IC 20 acres of str 20 Total IC (a
3. Indicate the proposed BMP Code for this basin.								
Proposed B Removal efficie 4. Calculate Maximum TSS Load Removed (L _a) for this Drainage Basin RG-348 Page 3-33 Equation 3.7: where:	$MP = N$ $ncy =$ $L_{R} = (E$ $A_{c} = T$ $A_{r} = In$	one 0 selected E BMP efficien otal On-Site	percent MP Type, Icy) x P x (A ₁) a drainage arc rea proposed	x 34.6 + A _P x 0.5 ea in the BMP cat	A B C C C C C C C C C C C C C C C C C C	qualogic Cartrid ioretention contect StormFil constructed Wetl ixtended Detenti israssy Swale letention / Irrigat iand Filter itormceptor /egetated Filter S fortechs Vet Basin Vet Vault	lge Filter land ion tion Strips	
	$A_1 = In$ $A_p = P$ $L_p = T$	npervious a ervious are SS Load re	rea proposed a remaining in moved from th	t in the BMP cate n the BMP catch his catchment ar	chment are ment area	a proposed BMP		
	с _н – 1	SS LOAD (P		no catorinent di	ca by me			
	A _C ≂ A _l =	0.30	acres acres	# of Lots	0	6225	0	00 acres of IC
	A _P =	0.10	acres			8905	0	20 acres of str
	L _A =	0	ibs				0	20 Total IC (a

Desired L _{M THIS BASIN} =	0	lbs			
F =	#DIV/0!				
6. Calculate Capture Volume required by the BMP Type for this drainage bas	in / outfall are	<u>ea.</u>	Calculations from RG-348	Pages 3-34 to 3-36	
Baufall Depth =	#DIV/0!	inches			
Post Development Runolf Coefficient = On-site Water Quality Volume =	0.49 #DIV/0!	cubic feet			
	#D11/01				
	Calculations fr	om RG-348	Pages 3-36 to 3-37		
Off-site area draining to BMP =	0.00	acres			
Impervious fraction of off-site area =	0	40.05			
Off-site Runoff Coefficient = 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 values for BMP Types not selected in cell C45 will show NA.	me(s) for the s	Selected Divin	e and a second		
7. Retention/Irrigation System	Designed as F	Required in RC	3-348 Pages 3-4	2 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 teet acres			
8. Extended Detention Basin System	Designed as F	Required in RC	3-348 Pages 3-4	6 to 3-51	
Required Water Quality Volume for extended detention basin =	NA	cubic feet			
9. Filter area for Sand Filters	Designed as f	Required in R	3-348 Pages 3-5	8 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 = Minimum sedimentation basin area =	NA NA	square feet square feet	For minimum water depth of 2 For maximum water depth of 8	feet	
98. Partial Sedimentation and Filtration System					
Water Quality Volume for combined basins -	NA	cubic feet	SF @ Given Depth	Given Depth Width	60
Minimum filter basin area -	NA	square feet	P F F B P B F		60
Maximum sedimentation basin area -	NA	square feet	For minimum water danth of 2	fast	60
Minimum sedimentation basin area =	NA	square feet	For Given water depth of a	Inst	60
	NA	Square leet	For maximum water deput of c		60
10. Bioretention System	Designed as I	Required in Ri	G-348 Pages 3-6	33 to 3-65	
Required Water Quality Volume for Bioretention Basin =	NA	cubic feet			
11. Wet Basins	Designed as I	Required in R	G-348 Pages 3-6	56 to 3-71	
Required capacity of Permanant Pool -	NA	cubic feet	Permanent Pool Canacity is 1	20 times the WOV	
Required capacity of Fernalient Fool = Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity should be the P plus a second WQV.	Permanent Pool Capacity	
12. Constructed Wetlands	Designed as I	Required in R	G-348 Pages 3-7	71 to 3-73	
Described Water Over the Values for Overset at the	11.	aubus (
Required water quality volume for Constructed Wellands =	NA	cuoic teet			
13. AquaLogic [™] Cartridge System	Designed as	Required in R	G-348 Pages 3-3	74 to 3-78	

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 REMOVAL	S ARE BASE	D UPON FLOW RATES	NOT CALCU	JLATED WATER QUALITY VOLUMES
15. Grassy Swales D	esigned as Re	equired in RG-348	Pa	ges 3-51 to 3-54
Design parameters for the swale:				
Drainage Area to be Treated by the Swale =: A = Impervious Cover in Drainage Area = Rainfall intensity = 1 = Swale Slope = Side Slope (z) = Design Water Depth =: y = Weighted Runoff Coefficient = C =	0.00 0.00 1.1 0.01 3 0.33 #DIV/0!	acres acres in/hr ft/ft		
A_{CS} = cross-sectional area of flow in Swale = P_{W} = Wetted Perimeter = R_{H} = hydraulic radius of flow cross-section $\approx A_{CS}/P_{W} =$ n = Manning's roughness coefficient =	#DIV/01 #DIV/01 #DIV/0! 0 2	sf feet feet		
15A. Using the Method Described in the RG-348				
Manning's Equation: Q = <u>1.49</u> A _{CS} R _H ²³ S ⁰⁵ n				
$b = \frac{0.134 \times Q}{y^{1.67}} - zy = y^{1.67} S^{0.5}$	#D1V/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) =	#D{V/0!	feet		
If any of the resulting values do not meet the design requirement :	set forth in RG	i-348, the design parame	ters must be r	nodified and the solver rerun.
15B. Alternative Method using Excel Solver				
Design Q = CiA =	#DIV/0!	cfs		
Manning's Equation Q = Swale Width=	0.76	cfs ft	Error 1 =	#DiV/0!
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	#DIV/0! #DIV/0!	ft/s ft		
Instructions are provided to the right (blue comments).				
Design Width = Design Discharge = Design Depth = Flow Velocity = Minimum Length =	6 0.76 0.33 0.32 97.48	ft ccts ft ccts ft ft	Error 2 ≖	#DIV/01
It any or the resulting values do not meet the design requirement set forth in If any of the resulting values still do not meet the design requirement set fort	h in RG-348, the t	widening the swale bot	be modified tom value ma	and the solver rerun. In not be possible.

16. Vegetated Filter Strips

Designed as Required in RG-348

17. Wet Vaults	Designed as F	Required in RO	-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 ≍ i ≃ design rainfall intensity = A = drainage area in acres =	0.5	1 1 in/hour 1 acres	C = Runoff Coefficient = 0.546 (IC) ² + 0.328 (IC) + 0.03	
Q = flow rate in cubic feet per second =	0.5	6 cubic feet/se	c	
RG-348 Page 3-31 Equation 3 5: V _{on} = Q/A				
Q = Runolf rate calculated above = A = Water surface area in the wet vault =	0.5 15	6 cubic feet/se 0 square feet	c	
V _{OR} = Overflow Rate =	0.0	0 feet/sec		
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	5	3 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 = Efficiency Reduction for Actual Rainfall Intensity =	0.7	5 percent 3 percent		
Resultant TSS Load removed by Wet Vault =	#VALUE!	lbs		
18. Permeable Concrete	Designed as	Required in R	-348 Pages 3-79 to 3-83	
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZO	DNE		no periodi di periodi di contra senderaria	
19. BMPs Installed in a Series	Designed as	Required in R(i-348 Pages 3-32	
Michael E. Barrett, Ph.D., P.E. recommended that the coeffic	cient 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 =	94.0	1 percent	NET EFFICIENCY OF THE BMPs IN THE SERIES	
EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 =	89.0	0 percent		
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_z =	70.0	percent		
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 =	0.0	0 percent		
THEREFORE, THE NET LOAD REMOVAL WOULD BE: (A, AND A, VALUES ARE FROM SECTION 3 ABOVE)				
L _R = E _{TOT} X P X (A ₁ X 34.6 X A _P X0.54) =	221.0)3 lbs		
20. Stormceptor				
Required TSS Removal in BMP Drainage Area= Impervious Cover Overtreatment TSS Removed (for Incentional Area)	NA 0.0000	lbs ac		
BMP Sizing	0.00	03		
Effective Area =	= NA	EA		
Calculated Model Size(s) = Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) =	= #N/A 1 = 0	Model Size		
Surface Area =	= #N/A	ft ²		
Overflow Rate =	#VALUE!	Vor		
Rounded Overflow Rate = BMP Efficiency % =	#VALUE! #VALUE!	V _{ar} %		

		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 Variante				
21. Vonech		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	
	ļ	Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
		Surface Area =	7.10	ft²
		Overflow Rate =	#VALUE!	Var
		Rounded Overflow Rate =	#VALUE!	Va
		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 Date Pro	Name: epared:	Manor Creek I 3/10/2015	Jnit 5 & 6	
Additional information is provided for cells with a red tria Text shown in blue indicate location of instructions in the Tech Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields.	angle in nnical G Change	the uppe luidance M s to these	r <mark>right cor</mark> anual - RG fields will	ner. Place th -348. remove the e	e curso equatic	or over the cel	l. e spreadsl	heet.
1. The Required Load Reduction for the total project:	C	Calculations	from RG-348			Pages 3-27 to 3-3	0	
Page 3-29 Equation 3.	3: L _M = 2	27.2(A _N x P)						
where: L _{M TOTAL PP}	$A_{N} = P$ P = P	Required TS Net increase Average anni	S removal res in impervious ual precipitat	sulting from the p s area for the pro ion, inches	roposed iject	development = 80)% of increa	sed load
Site Data: Determine Required Load Removal Based on the Entire	Project							
C Total project area included in p Predevelopment impervious area within the limits of the Total post-development impervious area within the limits of the Total post-development impervious cover frac	ounty = plan = plan = ction = P =	45.67 0.00 17.14 0.38 33	acres acres acres inches	Lots	82	Streets SF/Lot 6,225	236,06 510,45	5 5.419 60 11.718 17.14
LM TOTAL P	ROJECT =	15383	lbs.					
* The values entered in these fields should be for the total project a	rea.							
Number of drainage basins / outfalls areas leaving the plar	n area =	9						
2. Drainage Basin Parameters (This information should be provided	for each	basin):						
Drainage Basin/Outfall Are	a No. =	A 5-4A						
Total drainage basin/outlal Predevelopment impervious area within drainage basin/outlal Post-development impervious area within drainage basin/outlal Post-development impervious fraction within drainage basin/outlal Ц _{м тн}	area = area = area = area = s bas'n =	0.28 0.00 0.17 0.61 152	acres acres acres Ibs.	# of Lots	0	SF/Lot 6225 7396	0 0 0	00 acres of IC 17 acres of str .17 Total IC (a
3. Indicate the proposed BMP Code for this basin.								
Proposed Removal effic	d BMP = ciency =	None 0	percent					
						Aqualogic Cartric Bioretention Contech StormFi Constructed Wet Extended Detent Grassy Swale Retention / Irriga Sand Filter Stormceptor Vegetated Filter Vortechs Wet Basin Wet Vault	lge Filter Iter Iand ion Iton Strips	
4. Calculate Maximum 155 Load Removed (La) for this Urainage Ba		e selected E	imP Type.					
HG-348 Page 3-33 Equation 3	7. L _A =	(BMP efficier	тсу) х Р х (А _I	x 34.6 + A _P x 0.5	54)			
where:	A _C = A _i =	Total On-Site	e drainage ar	ea in the BMP ca d in the BMP cat	atchmen chment a	t area		
	A _P = L _R =	Pervious are TSS Load re	a remaining moved from	in the BMP catch this catchment a	iment ari rea by th	e proposed BMP		
	A _C =	0.28	acres	# of Lots		SF/Lot		
	A ₁ =	0.17	acres		C	6225	C	00 acres of IC
	н _е = L ₈ =	0.11	lbs			7396	0	.17 acres of st .17 Total IC (a

0.17 Total IC (a

Desired L _{M THIS} BASIN =	0	lbs.					
F =	#DIV/0!						
6. Calculate Capture Volume required by the BMP Type for this drainage bas	sin / outfall are	<u>a.</u>	Calculations from RG-	348 Pa	ges 3-34 to 3-	-36	
Rainfall Depth = Post Development Runoff Coefficient = On-site Water Quality Volume =	#DIV/0! 0.42 #DIV/0!	inches cubic feet					
	Calculations fr	om RG-348	Pages 3-36 to 3-37				
Off-site area draining to BMP = Off-site Impervious cover draining to BMP = Impervious fraction of off-site area = Off-site Runoff Coefficient =	0.00 0.00 0 0.00	acres acres					
Off-site Water Quality Volume =	#DIV/0!	cubic feet					
Storage for Sediment = Total Capture Volume (required water quality volume(s) x 1.20) = The following sections are used to calculate the required water quality volu The values for BMP Types not selected in cell C45 will show NA. 7. Betention/Trigation System	#DIV/0! #DIV/01 me(s) for the s	cubic feet selected BMP	3-348	Pages 3-42 to 3-	16		
Beouired Water Quality Volume for retention basin =	NA	cubic feet					
Irritation Area Calculations:	114						
Soil infiltration/permeability rate = Irrigation area =	0.1 NA NA	in/hr square feet acres	Enter determined per	rmeability rate of	assumed vi	alue of 0.1	í.
8. Extended Detention Basin System	Designed as F	Required in RC	3-348	Pages 3-46 to 3-	51		
Required Water Quality Volume for extended detention basin =	NA	cubic feet					
9. Fitter area for Sand Filters	Designed as F	Required in RC	3-348	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 = Minimum sedimentation basin area =	NA NA	square feet square feet	For minimum water of For maximum water	depth of 2 feet depth of 8 feet			
9B. Partial Sedimentation and Filtration System				_			
Water Quality Volume for combined basins =	NA	cubic feet	SF @ Given Depth #VALUE!	Gi	ven Depth	Width 5	60
Minimum filter basin area =	NA	square feet					60
Maximum sedimentation basin area =	NA NA	square feet square feet	For minimum water For Given water dep	depth of 2 feet			60 60
Minimum sedimentation basin area =	NA	square feet	For maximum water	depth of 8 feet			60
10. Bioretention System	Designed as I	Required in R	G-348	Pages 3-63 to 3-	65		
Required Water Quality Volume for Bioretention Basin =	NA	cubic feet					
11. Wet Basins	Designed as I	Required in R	G-348	Pages 3-66 to 3-	71		
Required capacity of Permanent Pool = Required capacity at WQV Elevation =	NA NA	cubic feet cubic feet	Permanent Pool Cap Total Capacity shou plus a second WQV.	acity is 1.20 tim Id be the Permar	es the WQV trent Pool Ca	pacity	
12. Constructed Wetlands	Designed as	Required in R	G-348	Pages 3-71 to 3-	73		
Required Water Quality Volume for Constructed Wetlands =	NA	cubic feet					
<u>13. AquaLogic[™] Cartridge System</u>	Designed as	Required in R	G-348	Pages 3-74 to 3-	78		

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 REMOVAL	S ARE BAS	ED UPON FLOW RATE	5 - NOT CALCI	LATED WATER QUALITY VOLUMES
15. Grassy Swales D	esigned as F	Required in RG-348	Pa	ges 3-51 to 3-54
Design parameters for the swale:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfall intensity = i = Swale Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	0.0 0.0 1. 0.0 9.3 #DIV/0!	0 acres 0 acres 1 in/hr 1 ft/ft 3 3 ft		
$\label{eq:A_CS} A_{CS} = cross-sectional area of flow in Swale = $P_W = Wetted Perimeter = $R_H = hydraulic radius of flow cross-section = $A_{CS}/P_W = $n = Manning's roughness coefficient = $15A. Using the Method Described in the RG-348}$	#DIV/0! #DIV/0! #DIV/0! 0	sf feet feet 2		
Manning's Equation: Q = <u>1.49</u> A _{CS} R _H ²³ S ⁰⁵ n				
$b = \frac{0.134 \times Q}{y^{167}} - zy = y^{167}$	#DIV/0'	feet		
Q = CiA =	#DIV/0!	cfs		
To calculate the flow velocity in the swale:				
V (Velocity of Flow in the swale) = O/A_{CS} =	#D1V/01	ft/sec		
To calculate the resulting swale length:				
L = Minimum Swale Length = V (ft/sec) * 300 (sec) =	#DIV/01	feet		
If any of the resulting values do not meet the design requirement s	sel forth in R	G-348, the design parar	neters must be r	nodified and the solver rerun.
15B. Alternative Method using Excel Solver				
Design Q = CiA =	#DIV/0!	cfs		
Manning's Equation Q = Swate Width=	0.7 6.0	'6 cfs 00 ft	Error 1 =	#DIV/01
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	#DIV/01 #DIV/0!	ft/s ft		
Instructions are provided to the right (blue comments).				
Design Width = Design Discharge = Design Depth = Flow Velocity = Minimum Length =	0.7 0.2 0.2 97,4 BG-348 the	6 ft 76 cfs 33 ft 32 cfs 88 ft design parameters or	Error 2 =	#DIV/0!
If any of the resulting values still do not meet the design requirement set form	h in RG-348	, widening the swale b	ottom value ma	ay not be possible.

16. Vegetated Filter Strips

Designed as Required in RG-348

17. Wet Vaults	Designed as	Required in RC	3-348 Pages 3-30 to 3-32 & 3-79
Required Load Removal Based upon Equation 3.3 =	NA	íbs	
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 = i = design rainfall intensity =	0	43 1.1 in/hour	C = Runoff Coefficient = 0.546 $(IC)^2$ + 0.328 (IC) + 0.03
A = drainage area in acres =		t acres	
Q = flow rate in cubic feet per second =	0	47 cubic feet/se	ec
RG-348 Page 3-31 Equation 3.5: V _{OR} = Q/A			
Q = Runoff rate calculated above = A = Water surface area in the wet vault =	0	47 cubic feet/se 50 square feet	ec
V _{DR} = Overflow Rate =	0	00 feet/sec	
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =		53 percent	
Load removed by Wet Vauit =	#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 = Efficiency Reduction for Actual Rainfall Intensity =	0	.75 percent .83 percent	
Resultant TSS Load removed by Wet Vault =	#VALUE	lbs	
18. Permeable Concrete	Designed a	Required in R	G-348 Pages 3-79 to 3-83
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZO	DNE		
19. BMPs Installed in a Series	Designed a	Required in R	G-348 Pages 3-32
Michael E. Barrett, Ph.D., P.E. recommended that the coeffic	tient for E ₃ b	e changed from	m 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, =	89	00 percent	
EFFICIENCY OF THE SECOND BMP IN THE SERIES \approx E2 \approx	70	00 percent	
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_{a} =	c	00 percent	
THEREFORE, THE NET LOAD REMOVAL WOULD BE: (A, AND A, VALUES ARE FROM SECTION 3 ABOVE)			
L _R = E _{TOT} X P X (A ₁ X 34.6 X A _P X0.54) =	: 184	.08 lbs	
20. Stormceptor			
Required TSS Removal in BMP Drainage Area= Impervious Cover Overtreatment= TSC Parametrical Areas	NA 0.0000	lbs ac	
BMP Sizing	. 0.00	5	
Effective Area = Calculated Model Size(s) = Actual Model Size (if multiple values provided in Calculated	= NA = #N/A	EA	
Model Size or if you are choosing a larger model size) =	0	Model Size	
Surface Area =	#N/A	ft ²	
Overflow Rate =	= #VALUE	ι V _{or} ι V	
BMP Efficiency % =	⊧ #VALUE ⊧ #VALUE	: ⊻or !%	

		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.) =	#VALUE1				
21 Vortach							
ZI. VOILECII		Bequired TSS Bemoval 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!	Va			
		Rounded Overflow Rate =	#VALUE!	Va			
		BMP Efficiency % =	#VALUE!	%			
		L _R Value =	#VALUE	lbs			
		TSS Load Credit =	#VALUE!	lbs			
	Is Sufficient	Treatment Available? (TSS Credit > TSS Uncapt.)	#VALUÉ!				
		TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE1				
Texas Commission on Environmental Quality							
---	---	---	---	--	--	---	--
TSS Removal Calculations 04-20-2009				Project Name: Date Prepared:	Manor 3/10/2	Creek Unit 5 015	
Additional information is provided for cells with a red trian Text shown in blue indicate location of instructions in the Techn Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Ch	gle in th ical Guid anges to	e upper ance Ma o these fi	right corne nual - RG-3 ields will re	er. Place the curs 348. emove the equation	or over	the cell. d in the spre	adsheet.
1. The Required Load Reduction for the total project:	Calc	ulations fro	om RG-348		Pages 3-	27 to 3-30	
Page 3-29 Equation 3.3:	L _M = 27.2	(A _N x P)					
where: L _{M TOTAL PRO} .	u _{ECT} = Requ A _N ≠ Neti P = Aven	uired TSS increase in rage annua	removal resu i impervious a al precipitation	Hing from the proposed area for the project n, inches	l developr	nent = 80% of ir	creased load
Site Data [.] Determine Required Load Removal Based on the Entire Pri Cou Total project area included in pla Predevelopment impervious area within the limits of the pla Total post-development impervious area within the limits of the pla Total post-development impervious cover fraction	roject unty = 1 an = an = Dn = P =	Comal 45.67 0.00 7.84 0.17 33	acres acres acres inches	Lots 37	Streets SF/Lot 6,	225 23 0	. <mark>.142</mark> 2.551
* The values entered in these fields should be for the total project are	JECT =	7036	lbs.				
Number of drainage basins / outfalls areas leaving the plan a	irea =	6					
2. Drainage Basin Parameters (This information should be provided fo	or each bas	sin):					
Drainage Basin/Outfall Area	No. =	A 5-1					
Total drainage basin/outfall a Predevelopment impervious area within drainage basin/outfall a Post-development impervious area within drainage basin/outfall a Post-development impervious fraction within drainage basin/outfall a السل لاست	area = area = area = area = _{BASIN} =	12.56 0.00 5.49 0.44 4927	acres acres acres lbs.	# of Lots 23	SF/Lot 95920.	6225 4406	3.29 acres of IC for lots 2.20 acres of street 5.49 Total IC (acres)
3. Indicate the proposed BMP Code for this basin.							
Proposed E Removal efficie 4. Calculate Maximum TSS Load Removed (L _p) for this Drainage Basin	3MP = San ancy = n by the se	d Filter 89	percent MP Type.		Aqualog Bioreten Contech Construt Extende Grassy S Retentio Sand Fil Stormce Vegetatt Vortechs Wet Bas Wet Vau	ic Cartridge Filte tion StormFilter cted Wetland d Detention Swale in / Irrigation tter ptor ed Filter Strips s sin Jit	er
RG-348 Page 3-33 Equation 3.7	L _R ≂ (BM	P efficienc	cy) x P x (A ₁ x	34.6 + A _P x 0.54)			
where:	A _c = Tota A _i = Imp A _P = Per L _B = TSS	al On-Site ervious are vious area S Load rem	drainage area ea proposed i remaining in noved from th	a in the BMP catchmen in the BMP catchment a the BMP catchment ar is catchment area by th	it area area rea ne proposi	ed BMP	
	A _c =	12.56	acres	0	051		
	A ₁ = A _c =	5.49	acres	# of Lots	S⊢/Lot	6225	3.29 acres of IC for lots
	L _R =	5690	ibs	2.	g	95920	2.20 acres of street

Desired L _{M THIS} BASIN =	5441	lbs.						
F =	0.96							
6. Calculate Capture Volume required by the BMP Type for this drainage ba	sin / outfall are	ea.	Calculations from RG	-348 P	ages 3-34 ti	0 3-36		

Haintall Depth = Post Development Runoff Coefficient =	0.32	inches						
On-site Water Quality Volume =	41470	cubic feet						
	Calculations f	rom 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						
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 volu The values for PMP Turner not calculate in call C45 will show NA	me(s) for the	selected BMP						
7. Retention/Irrigation System	Designed as I	Required in RG	-348	Pages 3-42 to 3	-46			
Required Water Quality Volume for retention basin -	NA	cubic feet						
nequired water Obality volume for retention basin =		CUDIC IEE						
Irrigation Area Calculations:								
Soil infiltration/permeability rate =	0.1	in/hr	Enter determined pr	irmeability rate	or assume	d value of	0.1	
Irrigation area =	NA NA	square feet						
	114	acres						
8. Extended Detention Basin System	Designed as i	Required in RG	3-348	Pages 3-46 to 3	3-51			
Required Water Quality Volume for extended detention basin =	NA	cubic feet						
9. Filter area for Sand Filters	Designed as	Required in RC	3-348	Pages 3-58 to 3	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								
Water Quality Valuma for combined bacing	40764	aubia faat	SF @ Given Depth	(Given Depth	Width	00	Length
Water cluaily volume to combined basins =	- 49704	souare feet	.₽,114.20			5.40	90	46.07765
	10000		Equipier and	double at 0 to 1			00	104.040
Maximum sedimentation basin area	3448	square feet	For Given water de	oepth of 2 reet			90 90	38.31365
Minimum sedimentation basin area	= 1037	square feet	For maximum wate	r depth of 8 feet			90	11.51941
10 Bioretention System	Decigned as	Required in Bi	3.948	Pages 2-63 to	9.65			
To: Bioletention System	Designed as	rioquirou in riv	0.040	rages 0-05 to	3-03			
Required Water Quality Volume for Bioretention Basin :	= NA	cubic feet						
AA WAA Daalaa	Designed as	Description Dr	2 0 10	Berne & CO. In	0.74			
11. Wet Basins	Designed as	Hequited in Hi	3-348	Pages 3-66 to	3-71			
Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Ca	pacity is 1.20 ti	mes the WO	V		
Hequired capacity at WOV Elevation =	. NA	cubic reet	plus a second WQV	l.	anen rool	vapacity		
12 Constructed Watlands	Designed an	Required in D	3-348	Pages 3 71 to	3.73			
12. CONSTRUCTED WEIRINGS	wesigned as	nequired in Hi	0-040	Fages 3-71 (0	0-10			
Required Water Quality Volume for Constructed Wetlands	= NA	cubic feet						
TH								
13. AquaLogic ¹⁷⁷ Cartridge System	Designed as	Required in Ri	G-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 TM

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 REMOVAL	S ARE BASE	ED UPON FLOW R	ATES - NOT CALC	ULATED WATER	QUALITY VOLUMES
15. Grassy Swales D	esigned as R	Required in RG-348	Pa	iges 3-51 to 3-54	
Design parameters for the swale:					
Drainane Area to be Treated by the Swale - A -	0.00	acres			
Impervious Cover in Drainage Area =	0.00	acres			
Rainfall intensity = i =	1.1	1 in/hr			
Swale Slope =	0.01	1 10/11			
Design Water Depth = y =	0.25	5 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 = n = Manning's roughness coefficient =	#DIV/0! 0.;	feet 2			
15A. Using the Method Described in the RG-348					
Manning's Equation: $Q = 1.49 A_{cs} R_{H}^{23} S^{05}$ n					
$h = 0.134 \times Q_{-2V} =$	#DIV/01	feet			
y ¹⁶⁷ S ⁰⁵					
Q = CiA =	#D!V/0!	cfs			
To calculate the flow velocity in the swale:					
V (Velocity of Flow in the swale) = Q/A_{CS} =	#DIV/01	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 R(G-348, the design p	arameters must be	nodified and the	solver rerun.
15B. Alternative Method using Excel Solver					
Design $\Omega = CiA =$	#DIV/0	cls			
Manning's Equation O -	27	4 cfs	Fror 1 -	5.82	
Swale Width=	36.9	1 ft		5 62	
Instructions are provided to the right (green comments).					
Flow Velocity Minimum Length =	#D1V/0! #D1V/0!	tt/s It			
Instructions are provided to the right (blue comments).					
Design Width =	1	6 ft			
Design Discharge =	0.7	6 cfs	Error 2 =	#DIV/0!	
Design Deptn = Flow Velocity =	0.3	2 cfs			
Minimum Length ≠	97.4	8 ft			
If any of the resulting values do not meet the design requirement set forth in If any of the resulting values still do not meet the design requirement set fort	RG-348, the th in RG-348.	design parameter widening the swa	s may be modified le bottom value m	and the solver r ay not be possib	erun. Ile.

16. Vegetated Filter Strips

Designed as Required in RG-348 Pages 3-55 to 3-57

17. Wet Vaults	Designed as P	lequired 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	r			
C = runoff coefficient for the drainage area = i = design rainfall intensity = A = drainage area in acres =	0.28 1.	} Fin/hour Facres	C = Runoff Coefficie	nt = 0.546 (IC) ² + 0.328 (IC) + 0.03
Q = flow rate in cubic feet per second =	0.3	I cubic feet/se	c	
RG-348 Page 3-31 Equation 3.5: $V_{OR} \approx Q/A$	L.			
Q = Runoff rate calculated above = A = Water surface area in the wet vault =	= 0.3 ⁻ = 150	l cubic feet/se square feet	c	
V _{OR} = Overflow Rate =	.0.0) feet/sec		
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	- 5	ercent		
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 =	- 0.1	5 in/hour		
Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = Efficiency Reduction for Actual Rainfall Intensity =	= 07 = 0.8	5 percent 3 percent		
Resultant TSS Load removed by Wet Vault =	= #VALUE!	lbs		
18. Permeable Concrete	Designed as I	Required in RC	3-348	Pages 3-79 to 3-83
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING Z	ONE			
19. BMPs Installed in a Series	Designed as I	Required in RC	3-348	Pages 3-32
Michael E. Barrett, Ph.D., P.E. recommended that the coeffi	cient for E2 be	changed from	n 0.5 to 0.65 on May	3, 2006
$E_{TOT} = [1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100 =$	= 94.0	1 percent	NET EFFICIENCY O	F THE BMPS IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 :	89.0	0 percent		
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2	70.0	0 percent		
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3	0.0	o 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 _P X0.54)	= 6009.9	2 lbs		
20. Stormceptor				
Required TSS Removal in BMP Drainage Area Impervious Cover Overtreatment TSS Removal for Uncaptured Area	= NA = 0.0000 = 0.00	lbs ac lbs		
Effective Area Calculated Model Size(s) Actual Model Size (if multiple values provided in Calculate	= NA = #N/A d	EA		
Model Size or if you are choosing a larger model size)	= 0	Model Size		
Surface Area Overflow Rate	= #N/A = #VALUE!	ft ^z V _{or}		
Rounded Overflow Rate	= #VALUE!	Va		
BMP Efficiency %	= #VALUE!	%		

		L ₈ Value =	#VALUE!	los
		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!	Vor
		Rounded Overflow Rate =	#VALUE!	Vor
		BMP Efficiency % =	#VALUE!	%
		L _R Value =	#VALUE!	lbs
		TSS Load Credit =	#VALUE!	lbs
	Is Sulficient	t 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: Date Prepared:	Manor Creek Unit 5 3/10/2015	
Additional information is provided for cells with a real Text shown in blue indicate location of instructions in the Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated field	d triangle in Technical G Is. Changes	the upper uidance Ma s to these f	right corn nual - RG- ields will i	er. Place the curs 348. remove the equation	or over the cell.	adsheet.
1. The Required Load Reduction for the total project:	c	Calculations fr	om RG-348		Pages 3-27 to 3-30	
Page 3-29 Equat	ion 3.3. L _M = 2	27.2(A _N x P)				
where: L _{M T}	otal project = F A _N = N P = A	Required TSS Net increase ir Average annu	removal resu n impervious al precipitatio	ulting from the proposed area for the project in, inches	d development = 80% of ir	ncreased load
Site Data: Determine Required Load Removal Based on the f Total project area include Predevelopment impervious area within the limits o Total post-development impervious area within the limits Total post-development impervious covi	Entire Project County = ed in plan * = of the plan * = of the plan * = er fraction * = P =	Comal 45.67 0.00 8.231 0.18 33	acres acres acres inches	Lots 38	Streets SF/Lot 6,225 236	2,983 2.800 5,550 5.430 8.23
${\sf L}_{\rm MT}$ * The values entered in these fields should be for the total proj	CTAL PROJECT =	7388	lbs.			
Number of drainage basins / outfalls areas leaving th	e plan area =	9				
2. Drainage Basin Parameters (This information should be prov	vided for each	basin):				
Drainage Basin/Outfa	III Area No. =	A 5-2				
Total drainage basin Predevelopment impervious area within drainage basin Post-development impervious area within drainage basin Post-development impervious fraction within drainage basin	'outfall area = 'outfall area = 'outfall area = 'outfall area = L _{M THIS BASIN} =	1.02 0.00 0.68 0.67 610	acres acres acres ibs.	# of Lots 3.5	SF/Lot 5 6225 7825.4103	0.50 acres of IC for lots 0.18 acres of street 0.68 Total IC (acres)
3. Indicate the proposed BMP Code for this basin.						
Pro Bemov	posed BMP = (a) efficiency =	Grassy Swale	percent			
					Aqualogic Cartridge Filk Bioretention Contech StormFilter Constructed Wetland Extended Detention Grassy Swale Retention / Irrigation Sand Filter Stormceptor Vegetated Filter Strips Vortechs Wet Basin Wet Vault	ər
 Calculate Maximum TSS Load Removed (L_p) for this Drainac 	e Basin by the	e selected Bl	ИР Түре.			
RG-348 Page 3-33 Equa	tion 3.7: L _B =)	(BMP efficiend	cy) x P x (A,)	(34.6 + A _P x 0.54)		
where:	$A_{C} =$ $A_{r} =$ $A_{P} =$ $L_{R} =$ $A_{C} =$	Total On-Site Impervious ar Pervious area TSS Load ren 0.85	drainage are ea proposed remaining ir noved from th acres	a in the BMP catchmer in the BMP catchment in the BMP catchment at the BMP catchment area by the	nt area area ne proposed BMP	
	Α _ι	0.47	acres acres	# of Lots	SF/Lot 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

F = 1.00 Activation from RG-348 Pages 3-34 to 3-36 Section from RG-348 Pages 3-36 to 3-37 Section from RG-348 Pages 3-36 to 3-37 Calculations from RG-348 Pages 3-36 to 3-37 Calculations from RG-348 Pages 3-36 to 3-37 Off-site area draining to BMP = 0.00 acres Designed as from RG-348 Pages 3-36 to 3-37 Off-site area draining to BMP = 0.00 acres Designed as Required to red activation of the section o
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 Off-site Impervious fraction of off-site area a 0 Off-site Water Quality Volume = 0 cubic feet 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. Pages 3-42 to 3-46 Yeageired Water Quality Volume for retention basin = NA cubic feet
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 Off-site Impervious fraction of off-site area = 0 Off-site Runoff Coefficient = 0.00 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) to reter quality volume(s) for the selected BMP. The values for BMP Types not selected in cell C45 will show NA. Z. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46
Hainfall 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 Off-site Impervious fraction of off-site area = 0 Off-site Runoff Coefficient = 0.00 Off-site Water Quality Volume = 0 Cubic feet Storage for Sediment = Storage for Sediment = 952 Total Capture Volume (required water quality volume(s) x 1.20) = \$714 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 cett C45 will show NA. Z. Retentior/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46 Required Water Quality Volume for retention basin = NA cubic feet
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 Off-site Impervious fraction of off-site area = 0 off-site Runoff Coefficient = 0.00 Off-site Runoff Coefficient = 0.00 oubic feet oubic feet Storage for Sediment = 952 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. Pages 3-42 to 3-46 Y. Retention/Irrigation System Designed as Required in RG-348 Pages 3-42 to 3-46
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 0 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. Designed as Required in RG-348 Pages 3-42 to 3-46 Required Water Quality Volume for retention basin = NA cubic feet NA
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
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 Autor Quality Volume = 0 cubic feet Storage for Sediment = 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. Z. 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
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. <u>7. Retention/Irrigation System</u> Designed as Required in RG-348 Pages 3-42 to 3-46 Required Water Quality Volume for retention basin = NA cubic feet
Olf-site Value Coefficient = 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
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
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
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 Required Water Quality Volume for retention basin = NA cubic feet
The values for BMP Types not selected in cell C45 will show NA. Designed as Required in RG-348 Pages 3-42 to 3-46 7. Retention/Irrigation System NA cubic feet
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
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 leet
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! 5 90 #VALUE!
Minimum filter basin area = NA souare feet 90 #VALUE
Maximum sedimentation basin area = NA source 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 teet For maximum water depth of 8 teet 90 #VALUE!
10 Bioretention System Deciment as Benuired in BG-349 Pages 3-63 to 3-65
To bioleterinon system
Required Water Quality Volume for Bioretention Basin = NA cubic feet
11. Wet Basins Designed as Required in BG-348 Pages 3-66 to 3-71
The bound of the b
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.
Required capacity of Permanent Pool = Required capacity at WQV Elevation = NA cubic feet cubic feet Permanent Pool Capacity is 1.20 times the WQV 12. Constructed Wetlands Designed as Required in RG-348 Pages 3-71 to 3-73
Required capacity of Permanent Pool = Required capacity at WQV Elevation = NA NA cubic feet cubic feet Permanent Pool Capacity is 1.20 times the WQV 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

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 REMOVAL	S ARE BASE	D UPON FLOW RATES	- NOT CALC	ULATED WATER QUALITY VOLUMES
15. Grassy Swales	esigned as R	equired in RG-348	Pa	iges 3-51 to 3-54
Design parameters for the swale:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfall intensity = i = Swate Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	1.02 #VALUE! 1.1 0.025 3 0.25 #VALUE!	acres acres in/hr ft/ft ft		
Acs = 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 = n ≃ Manning's roughness coefficient ≭	#VALUE! 0.2	feet		
15A. Using the Method Described in the RG-348				
Manning's Equation: $Q = 1.49 A_{CS} R_{H}^{23} S^{05}$ n				
$b = \frac{0.134 \times Q}{y^{1.87} S^{0.5}} - zy =$	#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 (tt/sec) * 300 (sec) =	#VALUE!	feet		
if any of the resulting values do not meet the design requirement	set forth in RC	3-348, the design parame	eters must be i	modified and the solver rerun.
15B. Alternative Method using Excel Solver				
Design Q = CiA =	#VALUE!	cfs		
Manning's Equatron Q = Swale Width=	4.34 36.91	t cfs ft	Error 1 =	5.82
instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	#VALUE! #VALUE!	ft/s ft		
Instructions are provided to the right (blue comments).				
Design Width =		5 ft		
Design Discharge =	1.20) cfs	Error 2 =	#VALUE!
Design Depth =	0.33	3 ft		
Flow Velocity ≠ Minimum Length =	154.12	2 ft		
If any of the resulting values do not meet the design requirement set forth in If any of the resulting values still do not meet the design requirement set for	RG-348, the th in RG-348,	design parameters may widening the swale bo	be modified tom value m	and the solver rerun. ay not be possible.

16. Vegetated Filter Strips

Designed as Required in RG-348

Pages 3-55 to 3-57

17. Wet Vaults	Designed as F	lequired in RG	-348 Pa	iges 3-30 to 3-32 & 3-79
Required Load Removal Based upon Equation 3.3 \approx	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 = i = design rainfall intensity = A = drainage area in acres =	0.49 1.1) i in/hour I acres	C = Runoff Coefficient =	= 0.546 (IC) ² + 0.328 (IC) + 0.03
Q = flow rate in cubic feet per second =	0.54	t cubic feet/se	с	
RG-348 Page 3-31 Equation 3 5: $V_{OR} = Q/A$				
Q = Runoff rate calculated above = A = Water surface area in the wet vault =	0.54	t cubic feet/se square feet	c	
V _{OR} = Overflow Rate =	0.00) feet/sec		
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	5	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 = Efficiency Reduction for Actual Rainfall Intensity =	0.7	5 percent 3 percent		
Resultant TSS Load removed by Wet Vault =	#VALUE!	lbs		
18. Permeable Concrete	Designed as F	Required in R	i-348 Pa	ages 3-79 to 3-83
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZO	DNE			
19. BMPs Installed in a Series	Designed as I	Required in R	i-348 Pa	ages 3-32
Michael E. Barrett, Ph.D., P.E. recommended that the coeffic	tient for E ₂ be	changed from	n 0.5 to 0.65 on May 3, 2	006
$E_{TOT} = [1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100 \approx$	94.0	1 percent	NET EFFICIENCY OF T	HE BMPS IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 =	89.0	0 percent		
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_{2} =	70.0	o percent		
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_s =	0.0	o 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, X 34.6 X A _P X0.54) =	506.2	1 lbs		
20. Stormceptor	(All stress of the	-		
Required TSS Removal in BMP Drainage Area Impervious Cover Overtreatment= TSS Removal for Uncaptured Area	0.0000 0.00	lbs ac Ibs		
BMP Sizing		F A		
Effective Area = Calculated Model Size(s) = Actual Model Size (if multiple values provided in Calculate Model Size or if you are choosing a larger model size) =	#N/A	EA Model Size		
	46174	u ²		
Surface Area = Overflow Bate =	= #N/A = #VALLI⊏!	11 ⁻ V_		
Rounded Overflow Rate =	#VALUE!	Va		
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				
ZI. VOILECII		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	
	Þ	Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
		Surface Area =	7.10	ft²
		Overflow Rate =	#VALUE!	V _{or}
		Rounded Overflow Rate =	#VALUE!	Va
		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				Proj Date	ect Name: Prepared:	Manor 3/10/2	Creek 2015	Unit 5	
Additional information is provided for cells with a red triang Text shown in blue indicate location of instructions in the Technic Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Cha	le in ti cal Gui nges t	he uppe idance M to these	r right cor anual - RG fields will	ner. Place I-348. remove th	the curs	or over	the cel	ll. e spread	sheet.
1. The Required Load Reduction for the total project:	Ca	lculations	from RG-348			Pages 3	-27 to 3-3	30	
Page 3-29 Equation 3.3; 1	-м = 27.	.2(A _N x P)							
where: L _{M TOTAL PROJEC}	_{ct} = Re A _N = Ne P = Ave	equired TS t increase erage ann	S removal re in imperviou ual precipitat	sulting from th s area for the ion, inches	e p r oposed project	develop	ment = 8	0% of incre	eased load
Site Data: Determine Required Load Removal Based on the Entire Pro	lect								
Coun Total project area included in plan Predevelopment impervious area within the limits of the plan Total post-development impervious area within the limits of the plan Total post-development impervious cover fraction		Comal 45.67 0.00 8.231 0.18	acres acres acres	Lots	38	Streets SF/Lot	i,225	121,983 236,550	2.800 5.430
	P = [33							8.23
* The values entered in these fields should be for the total project area.	ст =	7388	lbs.						
Number of drainage basins / outfalls areas leaving the plan are	ea =	9							
2 Drainage Basin Parameters (This information should be provided for	each h	asin).							
Drainage Basin/Outfall Area N	0. =	A 5-3							
		0.00		4 -1		050 -4			
Predevelopment impervious area within drainage basin/outfall are Post-development impervious area within drainage basin/outfall are Post-development impervious fraction within drainage basin/outfall are Lit THES BAS	ea = ea = ea = ea =	0.00 0.07 0.26 64	acres acres lbs.	# 0) LOIS	0 5	SFILO	6225	0.07	acres of IC for lots acres of street
3. Indicate the proposed BMP Code for this basin.									
Pronosed RM		adetated F	itter Strips						
Removal efficien	cy =	80	percent			Aqualog Bioreter Contech Constru Extende Grassy Retentut Sand Fi Stormce Vegetat Vortech Wet Ba Wet Va	gic Cartrid ntion n StormFe ed Detent Swale on / Irriga ilter ee Filter s sin ult	dge Filter Itland ion ttion Strips	
4. Calculate Maximum TSS Load Removed (L _R) for this Drainage Basin	by the s	selected E	BMP Type.						
RG-348 Page 3-33 Equation 3.7:	L _R = (B	MP efficie	ncy) x P x (A _r	, x 34.6 + A _P x	0.54)				
where:	A _C = To A _i = Im A _P = Pe L _R = TS	otal On-Siti npervious a ervious are SS Load re	e drainage ai area propose a remaining emoved from	rea in the BMP d in the BMP o in the BMP ca this catchmen	^D catchmen catchment a ttchment are it area by th	t area area ea e propos	ed BMP		
	A _C =	0.28	acres						
	A ₁ =	0.07	acres	# of Lots		SF/Lot			
	A _P =	0.21	acres		0.5	5	6225	0.0	7 acres of IC for lots

L_R = **68** lbs

0 acres of street

Desired L _{M THIS BASIN} =	64	lbs.			
F =	0.94				
6. Calculate Capture Volume required by the BMP Type for this drainage bas	sin / outfall ar	ea.	Calculations from RG-	348 Pag	ges 3-34 to 3-36
	0.40	teretere e			
Rainfall Depth = Post Development Runoff Coefficient =	2.40 0.23	inches			
On-site Water Quality Volume =	571	cubic feet			
	Calculations I	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 traction of off-site area = 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 volu	me(s) for the	selected BMP			
7. Retention/Irrigation System	Designed as	Required in RG	-348	Pages 3-42 to 3-4	46
Hequired Water Quality Volume for refention basin =	NA	cubic feet			
Irrigation Area Calculations:					
Soil infiltration/permeability rate =	0.1	in/hr	Enter determined per	meability rate or	assumed value of 0.1
Irrigation area =	NA	square feet			
	NA	acres			
8. Extended Detention Basin System	Designed as	Required in RG	1-348	Pages 3-46 to 3-	51
Bequired Water Quality Volume for extended detention basin =	NA	cubic feet			
····					
9. Filter area for Sand Filters	Designed as	Required in RG	3-348	Pages 3-58 to 3-6	53
9A. Full Sedimentation and Filtration System					
Water Quality Volume for sedimentation basin =	NA	cubic feet			
Minimum filter basin area =	NA	square feet			
		square reer			
Maximum sedimentation basin area =	NA	square feet	For minimum water	lepth of 2 feet	
Maximum sedimentation basin area = Minimum sedimentation basin area =	NA NA	square feet square feet	For minimum water of For maximum water	lepth of 2 feet depth of 8 feet	
Maximum sedimentation basin area = Minimum sedimentation basin area = 9B. Partial Sedimentation and Filtration System	NA NA	square feet square feet	For minimum water For maximum water	lepth of 2 feet depth of 8 feet	
Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins =	NA NA	square feet square feet cubic feet	For minimum water of For maximum water	lepth of 2 feet depth of 8 feet sf at 4' of depth	
Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area =	NA NA NA	square feet square feet cubic feet square feet	For minimum water (For maximum water #VALUE!	lepth of 2 feet depth of 8 feet sf at 4' of depth	
Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area =	NA NA NA NA	square feet square feet cubic feet square feet	For minimum water of For maximum water #VALUE! For minimum water of	lepth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet	
Maximum sedimentation basin area = Minimum sedimentation basin area = 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area =	NA NA NA NA NA	square feet square feet cubic feet square feet square feet square feet	For minimum water For maximum water #VALUE! For minimum water For maximum water	lepth of 2 feet depth of 8 feet sf at 4' of depth lepth of 2 feet depth of 8 feet	
Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area =	NA NA NA NA	square feet square feet cubic feet square feet square feet square feet	For minimum water For maximum water #VALUE! For minimum water For maximum water	lepth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 8 feet	_
Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area =	NA NA NA NA Designed as	square feet square feet cubic feet square feet square feet Required in RC	For minimum water (For maximum water #VALUE! For minimum water (For maximum water 3-348	lepth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3-	35
Maximum sedimentation basin area = Minimum sedimentation basin area = 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 10. Bioretention System Required Water Quality Volume for Bioretention Basin =	NA NA NA NA Designed as	square feet square feet cubic feet square feet square feet square feet Required in RC cubic feet	For minimum water For maximum water #VALUE! For minimum water For maximum water 3-348	lepth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3-	65
Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 10. Bioretention System Required Water Quality Volume for Bioretention Basin =	NA NA NA NA Designed as NA	square feet square feet cubic feet square feet square feet Required in RC cubic feet	For minimum water (For maximum water #YALUE! For minimum water (For maximum water 3-348	lepth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3-	65
Maximum sedimentation basin area = Minimum sedimentation basin area = 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 10. Bioretention System Required Water Quality Volume for Bioretention Basin = 11. Wet Basins	NA NA NA NA Designed as NA	square feet square feet cubic feet square feet square feet Required in RC cubic feet Required in RC	For minimum water For maximum water #VALUE! For minimum water For maximum water 3-348	lepth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3-	85 71
Maximum sedimentation basin area = Minimum sedimentation basin area = 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 10. Bioretention System Required Water Quality Volume for Bioretention Basin = 11. Wet Basins Required capacity of Permanent Pool = Required capacity of Permanent Pool =	NA NA NA NA Designed as NA Designed as NA	square feet square feet cubic feet square feet square feet Required in RC cubic feet Required in RC cubic feet	For minimum water of For maximum water #VALUE! For minimum water For maximum water 5-348 3-348 Permanent Pool Cap Total Capacity shou plus a second WQV	lepth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3- Pages 3-66 to 3- acity is 1.20 time id be the Perman	55 71 Is the WQV ent Pool Capacity
Maximum sedimentation basin area = Minimum sedimentation basin area = 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 10. Bioretention System Required Water Quality Volume for Bioretention Basin = 11. Wet Basins Required capacity of Permanent Pool = Required capacity at WQV Elevation =	NA NA NA NA Designed as NA Designed as NA	square feet square feet square feet square feet square feet square feet Required in RC cubic feet cubic feet cubic feet	For minimum water of For maximum water #VALUE! For minimum water For maximum water 3-348 3-348 Permanent Pool Cap Total Capacity shou plus a second WQV.	lepth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3- Pages 3-66 to 3- acity is 1.20 time d be the Perman	65 71 Is the WQV ent Pool Capacity
Maximum sedimentation basin area = Minimum sedimentation basin area = 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 10. Bioretention System Required Water Quality Volume for Bioretention Basin = 11. Wet Basins Required capacity of Permanent Pool = Required capacity at WQV Elevation = 12. Constructed Wetlands	NA NA NA NA Designed as NA Designed as NA	square feet square feet cubic feet square feet square feet square feet Required in RC cubic feet Required in RC cubic feet Required in RC	For minimum water of For maximum water #VALUE! For minimum water For maximum water 3-348 3-348 Permanent Pool Cap Total Capacity shou plus a second WQV. 3-348	lepth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3- Pages 3-66 to 3- acity is 1.20 time d be the Perman Pages 3-71 to 3-	65 71 Is the WQV ent Pool Capacity 73
Maximum sedimentation basin area = Minimum sedimentation basin area = 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = 10. Bioretention System Required Water Quality Volume for Bioretention Basin = 11. Wet Basins Required capacity of Permanent Pool = Required capacity at WQV Elevation = 12. Constructed Wetlands	NA NA NA NA Designed as NA Designed as NA NA	square feet square feet square feet square feet square feet square feet cubic feet Required in RC cubic feet cubic feet Required in RC cubic feet	For minimum water of For maximum water #VALUE1 For minimum water For maximum water 3-348 3-348 Permanent Pool Cap Total Capacity shou plus a second WQV. 3-348	lepth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3- Pages 3-66 to 3- acity is 1.20 time d be the Perman Pages 3-71 to 3-	65 71 Is the WQV ent Pool Capacity 73
Maximum sedimentation basin area = Minimum sedimentation basin area = 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 10. Bioretention System Required Water Quality Volume for Bioretention Basin = 11. Wet Basins Required capacity of Permanent Pool = Required capacity of Permanent Pool = Required capacity at WQV Elevation = 12. Constructed Wetlands	NA NA NA NA Designed as NA Designed as NA	square feet square feet square feet square feet square feet square feet Required in RC cubic feet Required in RC cubic feet Required in RC	For minimum water of For maximum water #VALUE! For minimum water For maximum water 3-348 Permanent Pool Cap Total Capacity shou plus a second WQV. 3-348	lepth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3- Pages 3-66 to 3- acity is 1,20 time d be the Perman Pages 3-71 to 3-	65 71 Is the WQV Ient Pool Capacity 73

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 REMOVAL	S ARE BASE	D UPON FLOW RATES	- NOT CALCI	JLATED WATER QUALITY VOLUMES
15. Grassy Swales D	esigned as R	equired in RG-348	Pa	ges 3-51 to 3-54
Design parameters for the swale:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfall Intensity = i = Swale Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	0.00 1.1 0.01 3 0.33 #DIV/0!	acres acres in/hr tt/tt s tt		
A _{CS} = cross-sectional area of flow in Swale =	#DIV/0!	sf		
P _w = Wetted Perimeter =	#DIV/0!	feet		
$R_{H} = hydraulic radius of flow cross-section = ACS/Pw = n = Manning's roughness coefficient =$	#DIV/0! 0.2	feet 2		
15A. Using the Method Described in the RG-348				
Manning's Equation: $Q = 1.49 A_{CS} R_{H}^{23} S^{0.5}$ n				
$b = \frac{0.134 \times Q}{y^{167}} \cdot zy =$	#DIV/01	feet		
Q = CiA =	#DIV/01	cfs		
To calculate the flow velocity in the swale:				
V (Velocity of Flow in the swate) = Q/A_{CS} =	#DIV/01	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 s	set forth in R	G-348, the design parame	ters must be r	nodified and the solver rerun.
15B. Alternative Method using Excel Solver				
Design Q = CiA =	#DIV/01	cfs		
Manning's Equation Q = Swale Width=	0.7) 6.0	6 cfs 0 ft	Error 1 =	#DIV/01
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	#DIV/0! #DIV/0!	ft/s ft		
Instructions are provided to the right (blue comments).				
Design Width = Design Discharge = Design Depth = Flow Velocity = Minimum Length =	0.7 0.3 0.3 97.4	6 ft 6 cfs 3 ft 2 cfs 8 ft	Error 2 ≠	#D!V/01
If any of the resulting values do not meet the design requirement set forth in If any of the resulting values still do not meet the design requirement set fort	RG-348, the h in RG-348,	design parameters may widening the swale bot	be modified tom value ma	and the solver rerun. ay not be possible.

16. Vegetated Filter Strips

Designed as Required in RG-348

Pages 3-55 to 3-57

Required Lead Return to Require the Land return to a line of the land return to a line	17. Wet Vaults	Designed as Required in RG-348		-348 Pages 3-30 to 3-32 & 3-79	
<th and="" between="" colspace="" t<="" td="" the="" twee="" tweek="" week=""><td>Required Load Removal Based upon Equation 3.3 =</td><td>NA</td><td>lbs</td><td></td></th>	<td>Required Load Removal Based upon Equation 3.3 =</td> <td>NA</td> <td>lbs</td> <td></td>	Required Load Removal Based upon Equation 3.3 =	NA	lbs	
$ \begin{array}{c} eq:hardbardbardbardbardbardbardbardbardbardb$	First calculate the load removal at 1.1 in/hour				
$ \left(\begin{array}{c} \begin{array}{c} 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 &$	RG-348 Page 3-30 Equation 3.4: Q = CiA				
$ \begin{array}{c} \label{eq:approximation} \begin{tabular}{lllllllllllllllllllllllllllllllllll$	C ≂ runoff coefficient for the drainage area = i = design rainfall intensity = A ≈ drainage area in acres =	0.15 1.1 1	in/hour acres	C = Runoff Coefficient = 0.546 (IC) ² + 0.328 (IC) + 0.03	
$ \begin{array}{llllllllllllllllllllllllllllllllllll$	$Q \approx flow$ rate in cubic feet per second =	0.16	cubic feet/se		
$ \begin{array}{llllllllllllllllllllllllllllllllllll$	RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$				
$\begin{split} & \begin{array}{c} & 0 \\ &$	Q = Runoff rate calculated above = A = Water surface area in the wet vault =	0.16 150	cubic feet/se square feet	ic	
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-3) (RG - VEVLUE) SB percent Load removed by Wet Vaul (RG - VEVLUE) FVALUE) Is Stabppos occurs at a rainfall intensity of the actual rainfall intensity rate 0.5 in/hour Actual Rainfall Intensity of which Wet Vaul bypass Occurs (RG - VEVLUE) 0.5 in/hour Fraction of rainfall intensity at which Wet Vaul bypass Occurs (RG - VEVLUE) 0.75 percent (RG - VEVLUE) Resultant TSS Load removed by Wet Vaul (RG - VEVLUE) is Resultant TSS Load removed by Wet Vaul (RG - VEVLUE) is Stapper Socorrete Pages 3.79 to 3.83 PEMEE ADDE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTION UNCURD SOCORRETE MAY ONLY BE USED ON THE CONTRIBUTION UNCURD SOCORRETE MAY ONLY BE USED ON THE CONTRIBUTION UNCURD SOCORRETING (RG - VEVLUE) Pages 3.79 to 3.83 PEMEE ADDE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTION UNCURD SOCORRETING (RG - VEVLUE) Pages 3.79 to 3.83 PEMEE ADDE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTION UNCURD SOCORRETING (RG - VEVLUE) Pages 3.79 to 3.83 Stappe Installed in a Series Designed as Required in RG-348 Pages 3.79 to 3.83 EFFICIENCY OF FIRST BMP IN THE SERIES E.F. 90.00 percent VEVLUE) EFFICIENCY OF FIRST BMP IN THE SERIES E.F. 0.00 percent VEVLUE) EFFICIENCY OF THE THIAD DEMOVAL WOULD BE 0.00 percent </td <td>V_{OR} = Overflow Rate =</td> <td>0.00</td> <td>feet/sec</td> <td></td>	V _{OR} = Overflow Rate =	0.00	feet/sec		
$\begin{tabular}{lllllllllllllllllllllllllllllllllll$	Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	53	percent		
Seconds at a rainfall intensity of less than 1.1 informs Actual Rainfall Intensity at which Wet Vault bypass Occurs at a rainfall intensity at which Wet Vault bypass Occurs at a O.5 infhour Fraction of rainfall Intensity at which Wet Vault bypass Occurs at a Contrainfall Intensity at which Wet Vault bypass Occurs at a O.5 infhour Fraction of rainfall Intensity at which Wet Vault bypass Occurs at a Contrainfall Intensity at which Wet Vault Base 0.5 infhour Fraction of rainfall Intensity at which Wet Vault and Rainfall Intensity at Wet Vault at the Vault Det Base 0.83 percent Itemseable Concrete Designed as Required in RG-348 Pages 3-79 to 3-83 PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZUME Pages 3-29 Pages 3-29 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 F, be changed from 0.5 to 0.65 on May 3, 2005 EFror = (1 - ((1 - E_i) X (1 - 0.65E_j) X (1 - 0.25E_j))] X 100 = 9.01 percent NET EFFICIENCY OF THE BMPS IN THE SERIES = E_i = 89.00 percent EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_i = 0.00 percent EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_i = 0.00 percent HEREFORE, THE NET LOAD REMOVAL WOULD BE: La = E_{TOT} X P X (A, X346 X A, X0.54) = 0.19 lbs Sta 19 lbs	Load removed by Wet Vault =	#VALUE!	lbs		
Actual Rainfall Intensity at which Wer Vault bypass Occurs 0.5 in/hour Fraction of rainfall Intensity at which Wer Vault Bainfall Intensity 0.75 percent Besuitant TSS Load removed by Wet Vault #VALUE! Is. Permeable Concrete Designed as Required in RG-348 Pages 3.79 to 3.83 PERMEABLE CONCRETE MAX ONLY BE USED ON THE CONTRIBUTING Designed as Required in RG-348 Pages 3.92 Michael E. Barrett, Ph.D. P. E. recommended that the coefficiency of Fings TSM PINTHE SERIES = 8900 percent NET EFFICIENCY OF FINES BMP IN THE SERIES = 8900 percent EFFICIENCY OF FINES BMP IN THE SERIES = 5 0.00 percent NET EFFICIENCY OF THE THIRD BMP IN THE SERIES = 9000 percent EFFICIENCY OF THE SECOND BMP IN THE SERIES = 5 0.00 percent VIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	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				
Fraction of rainfail treated from Figure 3-2 RG-348 Page 3-3 $=$ 0.75 percentBesultant TSS Load removed by Wet Vat $=$ #VALUEI $=$ 18. Permeable Concrete Pages 3-79 to 3-83 19. PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZOUE Pages 3-79 to 3-83 PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZOUE Pages 3-32 19. BMPs Installed in a Series Designed as Required in RG-348Pages 3-32 Michael E. Barrett, Ph.D. P. E. recommended that the coefficient for E₂ be changed from 0.5 to 0.65 on May 3, 2006EFFICIENCY OF FIRST BMP IN THE SERIES = $=$89.00 percentEFFICIENCY OF FIRST BMP IN THE SERIES = $=$0.00 percentVET EFFICIENCY OF THE THIRD BMP IN THE SERIES = $=$0.00 percentEFFICIENCY OF THE THIRD BMP IN THE SERIES = $=$0.00 percentVET EFFICIENCY OF THE THIRD BMP IN THE SERIES = $=$0.00 percentHEREFORE, THE NET LOAD REMOVAL WOULD BE: (A, AND A, VALUES ARE FROM SECTION 3 ABOVE):$=$$=$$=$$L_{n} = E_{TOT} X P X (A, X34.6 X A, X0.54) =$$=$$=$$=$$L_{n} = E_{TOT} X P X (A, X34.6 X A, X0.54) =$$=$$=$$=$	Actual Rainfall Intensity at which Wet Vault bypass Occurs =	0.5	in/hour		
Besultant TSS Load removed by Wet Value # #VALUE! Ibs18. Permeable ConcreteDesigned as Required in RG-348Pages 3-79 to 3-83PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING CONCRETE MAY ONLY BE USED ON THE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING CONCRETE MAY ONLY BE USED ON THE CONCRETE MAY ONLY BE USED ON THE CONCRETE MAY ONLY BE USED ON THE CONCRETE IN THE SERIES INTO TH	Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = Efficiency Reduction for Actual Rainfall Intensity =	0.75	percent percent		
18. Permeable ConcreteDesigned in RG-348Pages 3-79 to 3-83PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING-USETermeable din a SerieDesigned in RG-348Pages 3-32Michael E. Barrett, Ph.D., P.E. recommended that the coefficiency of FIRST BMP IN THE SERIES = 194.01 percentNET EFFICIENCY OF THE BMP's IN THE SERIES = 2EFFICIENCY OF FIRST BMP IN THE SERIES = 189.00 percentEFFICIENCY OF THE SECOND BMP IN THE SERIES = 20.00 percentEFFICIENCY OF THE THIND BMP IN THE SERIES = 20.00 percentEFFICIENCY OF THE THIND BMP IN THE SERIES = 20.00 percentLEREFCORE, THE NET LOAD REMOVAL WOULD BEE: (AND A, VALUES ARE FROM SECTION 3 ABOVE:LEREFCORE, THE NET LOAD REMOVAL WOULD BEE: (A, ND A, VALUES ARE FROM SECTION 3 ABOVE:Len = $1_{TOT} X P X (A, 24.6 X A, p. X).5BO.19 Ibs$	Resultant TSS Load removed by Wet Vault =	#VALUE!	lbs		
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, be changed from 0.5 to 0.65 on May 3, 2005 $E_{ror} = (1 - ((1 - E_s) X (1 - 0.65E_s) x (1 - 0.25E_s))] X 100 = 94.01 percent NET EFFICIENCY OF THE BMPs IN THE SERIES EFFICIENCY OF FIRST BMP IN THE SERIES = E_s = 89.00 percent EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_s = 70.00 percent EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_a = 0.00 percent THEREFORE, THE NET LOAD REMOVAL WOULD BE: (A AND Ap VALUES ARE FROM SECTION 3 ABOVE) L_{n} = E_{Tot} X P X (A_{1} X 34.6 X A_{p} X 0.54) = 80.19 lbs $	18. Permeable Concrete	Designed as P	lequired in R(G-348 Pages 3-79 to 3-83	
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Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E, be changed from 0.5 to 0.65 on May 3, 2006 $L_{ror} = \{1 \cdot ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100 =$ 94.01 percentNET EFFICIENCY OF THE BMPs IN THE SERIESEFFICIENCY OF FIRST BMP IN THE SERIES = E_1 =89.00 percentEFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 =70.00 percentEFFICIENCY OF THE THIRD BMP IN THE SERIES = E_a =0.00 percentTHEREFORE, THE NET LOAD REMOVAL WOULD BE: (A; AND A, VALUES ARE FROM SECTION 3 ABOVE)80.19 lbs	19. BMPs Installed in a Series	Designed as F	lequired in R0	3-348 Pages 3-32	
$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 = 94.01 \text{ percent} \text{ NET EFFICIENCY OF THE BMPs IN THE SERIES}$ $EFFICIENCY OF FIRST BMP \text{ IN THE SERIES} = E_1 = 89.00 \text{ percent}$ $EFFICIENCY OF THE SECOND BMP \text{ IN THE SERIES} = E_2 = 70.00 \text{ percent}$ $EFFICIENCY OF THE THIRD BMP \text{ IN THE SERIES} = E_3 = 0.00 \text{ percent}$ $THEREFORE, THE NET LOAD REMOVAL WOULD BE:$ $(A_1 \text{ AND } A_P \text{ VALUES ARE FROM SECTION 3 ABOVE)}$ $L_R = E_{TOT} X P X (A_1 X 34.6 X A_P X 0.54) = 80.19 \text{ lbs}$	Michael E. Barrett, Ph.D., P.E. recommended that the coeffic	ient for E, be	changed from	n 0.5 to 0.65 on May 3, 2006	
EFFICIENCY OF FIRST BMP IN THE SERIES = $E_1 =$ 89.00 percentEFFICIENCY OF THE SECOND BMP IN THE SERIES = $E_2 =$ 70.00 percentEFFICIENCY OF THE THIRD BMP IN THE SERIES = $E_3 =$ 0.00 percentTHEREFORE, THE NET LOAD REMOVAL WOULD BE: (A; 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	E _{TOY} = [1 - ((1 - E ₁) X (1 - 0.65E ₂) x (1 - 0.25E ₃))] X 100 =	94.01	l percent	NET EFFICIENCY OF THE BMPs IN THE SERIES	
EFFICIENCY OF THE SECOND BMP IN THE SERIES = $E_2 =$ 70.00 percentEFFICIENCY OF THE THIRD BMP IN THE SERIES = $E_3 =$ 0.00 percentTHEREFORE, THE NET LOAD REMOVAL WOULD BE: (A; 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	EFFICIENCY OF FIRST BMP IN THE SERIES = E, =	89.00	percent		
EFFICIENCY OF THE THIRD BMP IN THE SERIES = $E_3 = 0.00 \text{ percent}$ THEREFORE, THE NET LOAD REMOVAL WOULD BE: (A, AND A _P VALUES ARE FROM SECTION 3 ABOVE) $L_8 = E_{TOT} X P X (A_1 X 34.6 X A_P X0.54) = 80.19 \text{ lbs}$	EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 =	70.00	percent		
THEREFORE, THE NET LOAD REMOVAL WOULD BE: (A: AND Ap VALUES ARE FROM SECTION 3 ABOVE) L _R = E _{TOT} X P X (A; X 34.6 X Ap X0.54) = 80.19 lbs	EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 =	0.00	percent		
$L_{P} = E_{TOT} \times P \times (A_{I} \times 34.6 \times A_{P} \times 0.54) = 80.19 \text{ lbs}$	THEREFORE, THE NET LOAD REMOVAL WOULD BE: (A: AND A: VALUES ARE FROM SECTION 3 ABOVE)				
	L _A = E _{TOT} X P X (A ₁ X 34.6 X A _P X0.54) =	80.19	9 lbs		
20. Stormceptor Required TSS Removal in BMP Drainage Area= NA Ibs Impervious Cover Overtreatment= 0.0000 ac TSS Removal for Uncaptured Area = 0.00 Ibs BMP Sizing Effective Area = NA EA	20. Stormceptor Required TSS Removal in BMP Drainage Area= Impervious Cover Overtreatment= TSS Removal for Uncaptured Area = BMP Sizing	NA 0.0000 0.00	lbs ac lbs FA		
Calculated Model Size(s) = #N/A Actual Model Size (if multiple values provided in Calculated	Calculated Model Size (if multiple values provided in Calculated Actual Model Size (if multiple values provided in Calculated	#N/A			
Model Size or if you are choosing a larger model size) = 0 Model Size	Model Size or if you are choosing a larger model size) =	0	Model Size		
Max M H - Commence commence	Surface Area =	#N/A	ft ²		
Surface Area = $\#N/A$ tt^2	Overflow Rate =	#VALUE!	Vor		
Surface Area = $\#N/A$ ft ² Overflow Rate = $\#VALUE!$ V_{or}	Hounded Overflow Rate =	#VALUE!	V or %		
Surface Area = $\#N/A$ ft ² Overflow Rate = $\#VALUE!$ V_{cr} Rounded Overflow Rate = $\#VALUE!$ V_{cr} BMP Efficiency % = $\#VALUE!$ %	Divir Enciency %=	# #ALUE!	10		

		TSS Load Credit =	#VALUE!	lbs
	Is Sufficient	Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE!	
		TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	
21 Vortech				
21. 101001		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!	Var
		Rounded Overflow Rate =	#VALUE!	Va
		BMP Efficiency % =	#VALUE!	%
		L. Malue		100 C
			#VALUE'	lbs
		TSS Load Credit =	#VALUE!	lbs
		TSS Load Credit =	#VALUE!	lbs
	Is Sufficient	L _R value = TSS Load Credit = Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE! #VALUE!	lbs
	Is Sufficient	TSS Load Credit = TSS Load Credit = Treatment Available? (TSS Credit <u>></u> TSS Uncapt.) TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE! #VALUE! #VALUE!	lbs

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Texas Commission on Environmental Quality									
TSS Removal Calculations 04-20-2009				Project N Date Prep	lame: bared:	Manor 3/10/3	Creek U 2015	Jnit 5	
Additional information is provided for cells with a red triang Text shown in blue indicate location of instructions in the Technic Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Cha	le in th cal Guid nges t	ne upper dance Ma o these f	right corr anual - RG- fields will	ner. Place the -348. remove the eq	curse	or over	the celled in the	l. e sprea	dsheet.
1. The Required Load Reduction for the total project:	Cal	culations f	rom RG-348			Pages 3	-27 to 3-3	0	
Page 3-29 Equation 3.3: L	-м = 27.2	2(A _N x P)							
where: L _{M TOTAL PROJE}	ct = Rec A _N = Net P = Ave	uired TSS increase i rage annu	removal res n impervious al precipitatio	ulting from the pro area for the proje on, inches	oposed ct	develop	ment ≃ 80)% of inc	reased load
Site Data: Determine Required Load Removal Based on the Entire Pro	ject								
Coun Total project area included in plan Predevelopment impervious area within the limits of the plar Total post-development impervious area within the limits of the pla Total post-development impervious cover fraction	ty = ° = n° = n° = P =	Comal 45.67 0.00 8.231 0.18 33	acres acres acres inches	Lots	38	Streets SF/Lot	1,225	121,983 236,550	2.800 5.430 8.23
	c1 =	7388	lbs.						
* The values entered in these fields should be for the total project area.									
Number of drainage basins / outfalls areas leaving the plan are	∋a =	9							
2. Drainage Basin Parameters (This information should be provided for	each ba	sin):							
Drainage Basin/Outfall Area N	0. =	A 5-4							
Total drainage basin/outfall ar Predevelopment impervious area within drainage basin/outfall ar Post-development impervious area within drainage basin/outfall ar Post-development impervious fraction within drainage basin/outfall ar المناسبة هم:	9a = 9a = 9a = 9a = 9a =	5.24 0.00 0.71 0.14 641	acres acres acres Ibs.	# of Lots	5	SF/Lot	6225	071	acres of IC for lots acres of street
3. Indicate the proposed BMP Code for this basin.									
Procosed BN	1P = Ve	aetated Fi	Iter Strips						
Removal efficien	су =	80	percent			Aqualog Bioreter Contect Constru Extende Grassy Retention Sand F Stormod Vegetal Vortech Wet Ba Wet Va	gic Cartrid htion h StormFil d Detenti Swale on / Irrigat liter ed Filter s sin sin ult	lge Filter land on tion Strips	
4. Calculate Maximum TSS Load Removed (L _R) for this Drainage Basin	by the s	elected B	MP Type.						
RG-348 Page 3-33 Equation 3.7:	L _A = (BN	AP efficien	су) х Р х (А _і	x 34.6 + A _P x 0.54)				
where:	A _C = Τοι A _I = Imp A _P = Pe L _R = TS	al On-Site pervious a rvious area S Load rer	drainage are rea proposed a remaining in noved from th	ea in the BMP cate I in the BMP catch n the BMP catchm his catchment area	chment ment a lient are a by th	l area nrea ea e propos	ed BMP		
	A _C =	5.24	acres	2 2 2 2					
	A _i = A _n =	0.71	acres	# of Lots	F	SF/Lot	6225	0.7	1 acres of IC for lots
	L _R =	717	lbs			•	JELU	0.7	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 bas	in / outfall ar	ea.	Calculations from RG-	348	Pages 3-34 to 3-36
	Rainfall Depth =	1.60	inches			
	Post Development Runoff Coefficient = On-site Water Quality Volume =	0.16 4731	cubic feet			
		Calculations (rom RG-348	Pages 3-36 to 3-37		
0#	Off-site area draining to BMP =	0.00	acres			
01	Impervious fraction of off-site area =	0	46,65			
	Off-site Runoff Coefficient =	0.00	cubic feat			
	On-site Water Quality Volume =	U	CUDIC lee(
	Storage for Sediment =	946				
Total Capture Volume (req	uired water quality volume(s) x 1.20) =	5677	cubic feet			
The values for BMP Types not selecte	ed in cell C45 will show NA.	me(s) for the	selected BMP	,		
7. Retention/Irrigation System		Designed as	Required in RG	3-34B	Pages 3-42 to	3-46
Required W	ater Quality Volume for retention basin =	NA	cubic feet			
Irrigation Area Calculat	lions:					
	Soil infiltration/permeability rate = Irrigation area =	0.1 NA NA	in/hr square feet acres	Enter determined per	meability rat	e or assumed value of 0.1
8. Extended Detention Basin System		Designed as	Required in RG	3-348	Pages 3-46 to	0 3-51
Required Water Quali	ty Volume for extended detention basin =	NA	cubic feet			
9. Filter area for Sand Filters		Designed as	Required in RG	3-348	Pages 3-58 t	0 3-63
94 Full Sedimentatio	n and Eiltration System					
3A. Pur Sedimentario	n and r mation bystem					
Water	Quality Volume for sedimentation basin =	NA	cubic feet			
	Minimum filter basin area =	NA	square feet		1. w 1. we	
	Maximum sedimentation basin area = Minimum sedimentation basin area =	NA NA	square feet square feet	For minimum water of For maximum water	depth of 2 fee depth of 8 fe	et
9B. Partial Sedimenta	tion and Filtration System					
Wa	ter Quality Volume for combined basins =	NA	cubic feet	#VALUE!	sf at 4' of dep	oth
	Minimum filter basin area ≈	NA	square feet			
	Maximum sedimentation basin area = Minimum sedimentation basin area =	NA NA	square feet square feet	For minimum water For maximum water	depth of 2 fee depth of 8 fe	at et
10. Bioretention System		Designed as	Required in RC	3-348	Pages 3-63 t	0 3-65
Required Wate	r Quality Volume for Bioretention Basin =	NA	cubic feet			
11. Wet Basins		Designed as	Required in RO	3-348	Pages 3-66 t	o 3-71
	Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Can	acity is 1.20	times the WQV
	Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity shou plus a second WQV.	Id be the Per	manent Pool Capacity
12. Constructed Wetlands		Designed as	Required in RO	G-348	Pages 3-71 I	0 3-73
Required Water Ou	uality Volume for Constructed Wetlands =	NA	cubic feet			
13. AquaLogic [™] Cartridge System		Designed as	Required in RO	G-348	Pages 3-74 I	0 3-78

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RiA _F) =	NA NA NA	cubic feet cartridges 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 REMOVAL	S ARE BASE	ED UPON FLOW RATES	- NOT CALC	JLATED WATER QUALITY VOLUMES
15. Grassy Swales De	esigned as R	lequired in RG-348	Pa	iges 3-51 to 3-54
Design parameters for the swale:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfall intensity = i = Swale Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	0.00 0.00 1.1 0.01 3 0.33 #DIV/0!	acres acres t in/hr t tr/tt 3 ft		`
$\label{eq:Acs} \begin{array}{l} {\sf A_{cs}} = {\sf cross}{\sf -}{\sf sectional} \mbox{ area of flow in Swale} = \\ {\sf P}_w = {\sf Wetted} \mbox{ Perimeter} = \\ {\sf R}_{\sf H} = {\sf hydraulic} \mbox{ radius of flow cross}{\sf -}{\sf section} = {\sf A}_{cs}/{\sf P}_w = \\ {\sf n} = {\sf Manning}{\sf 's roughness coefficient} = \end{array}$	#DIV/0! #DIV/0! #DIV/0! 0.;	sf feet feet 2		
15A. Using the Method Described in the RG-348				
Manning's Equation: $Q = 1.49 A_{CS} R_{H}^{23} S^{0.5}$ n				
$b = \frac{0.134 \times Q}{y^{1.67} S^{0.6}} - zy =$	#DIV/01	feet		
Q = CiA =	#DIV/01	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 = Minímum Swale Length = V (ft/sec) * 300 (sec) =	#D!V/0!	feet		
If any of the resulting values do not meet the design requirement s	set forth in R	G-348, the design param	eters must be r	modified and the solver rerun.
15B. Alternative Method using Excel Solver				
Design 0 - CiA -	#DIV/01	cls		
Manning's Equation Q = Swale Width=	0.7 6.0	6 cfs 0 ft	Error 1 ≂	#DIV/0'
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	#DIV/01 #D1V/01	ft/s ft		
Instructions are provided to the right (blue comments).				
Design Width ⇔ Design Discharge = Design Depth = Flow Velocity = Minimum Length =	0.7 0.3 0.3 97.4	6 ft 6 cfs 3 ft 2 cfs 8 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

17. Wet Vaults	Designed as f	Required in RC	-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 =	0.0	в	C = Runoff Coefficient = 0.546 (IC) ² + 0.328 (IC) +	0.03
i = design ranfall intensity = A = drainage area in acres ≠	1.	1 in/hour 1 acres		
Q = flow rate in cubic feet per second =	0.0	9 cubic feet/se	c	
RG-348 Page 3-31 Equation 3.5: V _{OR} = Q/A				
Q \approx Runoff rate calculated above = A = Water surface area in the wet vault \approx	0.0 15	9 cubic feet/se 0 square feet	c	
V _{oR} = Overflow Rate =	0.0	0 feet/sec		
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	5	3 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 = Efficiency Reduction for Actual Rainfall Intensity =	0.7	5 percent 3 percent		
Resultant TSS Load removed by Wet Vault =	#VALUE!	lbs		
18. Permeable Concrete	Designed as	Required in RO	i-348 Pages 3-79 to 3-83	
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZO	NE			
19. BMPs Installed in a Series	Designed as	Required in RO	3-348 Pages 3-32	
Michael E. Barrett, Ph.D., P.E. recommended that the coeffic	ient for E ₂ be	changed from	0.5 to 0.65 on May 3, 2006	
$E_{TOT} = \{1 \cdot ((1 \cdot E_1) \times (1 \cdot 0.65E_2) \times (1 \cdot 0.25E_2))\} \times 100 =$	94.0	1 percent	NET EFFICIENCY OF THE BMPs IN THE SERIES	
EFFICIENCY OF FIRST BMP IN THE SERIES = E, =	89.0	o percent		
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_{2} =	70 0	0 percent		
EFFICIENCY OF THE THIRD BMP IN THE SERIES = ${\rm E_3}$ =	0.0	o 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, X 34.6 X A _P X0.54) =	842.7	5 lbs		
20. Stormentor				
Required TSS Removal in BMP Drainage Area=	NA	lbs		
Impervious Cover Overtreatment≂ TSS Removal for Uncaptured Area ⇒	0.0000	ac Ibs		
BMP Sizing	o fai			
Effective Area =	NA #N/A	EA		
Actual Model Size (if multiple volues provided in Calculated		Model Oir-		
model Size or if you are choosing a larger model size) =	0	Model Size		
Surface Area =	#N/A	ft ²		
Overflow Rate =	#VALUE!	Vor		
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
	Actual Model Size (if choosing larger model size) = Surface Area =	Vx1000 7.10	Pick Model Size
	Actual Model Size (if choosing larger model size) = Surface Area = Overflow Rate =	Vx1000 7.10 #VALUE!	Pick Model Size ft ² V _{or}
	Actual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate =	Vx1000 7.10 #VALUE! #VALUE!	Pick Model Size ft ² V _o V _o
	Actual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % =	Vx1000 7.10 #VALUE! #VALUE! #VALUE!	Pick Model Size ft ² V _{or} %
	Actual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % = L _o Value =	Vx1000 7.10 #VALUE! #VALUE! #VALUE! #VALUE!	Pick Model Size ft ² V _{or} %
	Actual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % = L _R Value =	Vx1000 7.10 #VALUE! #VALUE! #VALUE! #VALUE!	Pick Model Size tt ² V _o V _o % ibs
	Actual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % = L _R Value = TSS Load Credit =	Vx1000 7.10 #VALUE! #VALUE! #VALUE! #VALUE! #VALUE!	Pick Model Size tt ² V _o V _o V _o Ibs
	Actual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % = L _R Value = TSS Load Credit =	Vx1000 7.10 #VALUE! #VALUE! #VALUE! #VALUE!	Pick Model Size tt ² V _o V _o % łbs
	Actual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % = L _R Value = TSS Load Credit = Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	Vx1000 7.10 #VALUE! #VALUE! #VALUE! #VALUE! #VALUE!	Pick Model Size tt ² V _α V _α bs Ibs
	Actual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % = L _R Value = TSS Load Credit = Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	Vx1000 7.10 #VALUE! #VALUE! #VALUE! #VALUE! #VALUE! #VALUE!	Pick Model Size tt ² V _α V _α bs Ibs
	Actual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % = L _R Value = TSS Load Credit = Is Sufficient Treatment Available? (TSS Credit <u>></u> TSS Uncapt.)	Vx1000 7.10 #VALUE! #VALUE! #VALUE! #VALUE! #VALUE! #VALUE!	Pick Model Size tt ² V _α V _α % ibs

Texas Commission on Environmental Quality									
TSS Removal Calculations 04-20-2009				Proj Date	ect Name: Prepared:	Manor 3/10/2	Creek Ur 2015	nit 5	
Additional information is provided for cells with a red triang Text shown in blue indicate location of instructions in the Techni Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Cha	gle in th ical Guid anges t	ne upper dance Ma o these	r <mark>right cor</mark> anual - RG fields will	ner. Place -348. remove the	the curs	or over	the cell. ed in the s	spread	sheet.
1. The Required Load Reduction for the total project:	Cal	culations f	rom RG-348			Pages 3	-27 to 3-30		
Page 3-29 Equation 3.3:	Ц" = 27.:	2(A _N x P)							
where: L _{M TOTAL PROJE}	_{ECT} = Reo A _N = Net P ≈ Ave	quired TSS increase i erage annu	6 removal res in impervious ual precipitati	sulting from th s area for the j ion, inches	e proposeo project	d develop	ment = 80%	of incre	ased load
Site Data: Determine Required Load Removal Based on the Entire Pro	oiect								
Cour Total project area included in plar Predevelopment impervious area within the limits of the pla Total post-development impervious area within the limits of the pla Total post-development impervious cover fractio	nty = n * = an * = m * = P =	Comal 45.67 0.00 8.231 0.18 33	acres acres acres inches	Lots	38	Streets SF/Lot €	1	21,983	2.800 5.430 8.23
* The values entered in these fields should be for the total project area	ect = L	7388	lbs						
Number of drainage basins / outfalls areas leaving the plan ar	rea =	9							
2. Drainage Basin Parameters (This information should be provided for Drainage Basin/Outfall Area N Total drainage basin/outfall ar Predevelopment impervious area within drainage basin/outfall ar Post-development impervious area within drainage basin/outfall ar Post-development impervious fraction within drainage basin/outfall ar Post-development impervious fraction within drainage basin/outfall ar	r each ba No. = rea = rea = rea = rea = asin =	A 5-5 0.83 0.00 0.29 0.34 257	acres acres acres	# of Lots	2	SF/Lot	6225	0.29	acres of IC for lots acres of street
3. Indicate the proposed BMP Code for this basin.									
4. Calculate Maximum TSS Load Removed (L _a) for this Drainage Basin RG-348 Page 3-33 Equation 3.7: where:	$MP = Ve_{ncy} =$ $by the s$ $L_{R} = (BI$ $A_{c} = To$ $A_{i} = Im_{i}$ $A_{p} = Pe$ $L_{R} = TS$	elected Fi 80 MP efficier tal On-Site pervious a rvious are S Load rei	MP Type. http://www.inter- i	x 34.6 + A _P x rea in the BMP d in the BMP c in the BMP ca this catchmen	0.54) ⁹ catchmer atchment tchment ar t area by th	Aqualog Bioretei Contect Constru- Extende Grassy Retenti- Sand F Stormor Vegeta: Vortect Wet Ba Wet Va	gic Cartridge tition n StormFilte ed Detentior Swale on / Irrigatio Iter sptor ed Filter Str sin ult	e Filter r n ríps	
	A _C = A ₁ = A _P = L _R =	0.83 0.29 0.54 269	acres acres acres Ibs	# of Lots		SF/Lot 2	6225	0.29	acres of IC for lots acres of street

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

Desired L _{M THIS} BASIN ≈	257	lbs			
F =	0.96				
6. Calculate Capture Volume required by the BMP Type for this drainage bas	sin / outfall are	ea.	Calculations from RG-	348 1	Pages 3-34 to 3-36
Rainfall Depth = Post Development Runoff Coefficient = On-site Water Quality Volume =	2.80 0.28 2364	inches cubic feet			
	Calculations f	om RG-348	Pages 3-36 to 3-37		
Off-site area draining to BMP =	0.00	acres			
Off-site Impervious cover draining to BMP = Impervious fraction of off-site area =	0.00	acres			
Off-site Runoff Coefficient =	0.00	2011-04-04-04-04-04-04-04-04-04-04-04-04-04-			
Off-site Water Quality Volume =	0	cubic feet			
Storage for Sediment =	473				
Total Capture Volume (required water quality volume(s) x 1.20) = The following sections are used to calculate the required water quality volu The values for BMP Types not selected in cell C45 will show NA.	2836 me(s) for the	cubic feet selected BMP			
7. Retention/Irrigation System	Designed as I	Required in RG	1-348	Pages 3-42 to	3-46
Required Water Quality Volume for retention basin =	NA	cubic feet			
Irrigation Area Calculations:					
Soil infiltration/permeability rate = Irrigation area =	0.1 NA NA	in/hr square feet acres	Enter determined per	meability rate	or assumed value of 0.1
8. Extended Detention Basin System	Designed as I	Required in RC	3-348	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 l	Required in RC	3-348	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 = Minimum sedimentation basin area =	NA NA	square feet square feet	For minimum water of For maximum water	depth of 2 feet depth of 8 fee	t
9B. Partial Sedimentation and Filtration System					
Water Quality Volume for combined basins =	= NA	cubrc feet	#VALUE!	sf at 4' of dept	h
Minimum filter basin area =	= NA	square feet			
Maximum sedimentation basin area = Minimum sedimentation basin area =	= NA = NA	square feet square feet	For minimum water For maximum water	depth of 2 feet depth of 8 fee	
10. Bioretention System	Designed as	Required in RO	3-348	Pages 3-63 to	3-65
Required Water Quality Volume for Bioretention Basin -	= NA	cubic feet			
11. Wet Basins	Designed as	Required In R	3-348	Pages 3-66 to	3-71
Required capacity of Permanent Pool = Required capacity at WQV Elevation =	NA NA	cubic feet cubic feet	Permanent Pool Cap Total Capacity shou plus a second WQV.	acity is 1.20 t Id be the Perm	mes the WQV tanent Pool Capacity
12. Constructed Wetlands	Designed as	Required in R	3-348	Pages 3-71 to	3-73
Required Water Quality Volume for Constructed Wetlands :	≖ NA	cubic feet			
13. AquaLogic [™] Cartridge System	Designed as	Required in R	G-348	Pages 3-74 to	3-78

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV ≠ Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 REMOVAL	S ARE BASI	ED UPON FLOW RAT	ES - NOT CALC	ULATED WATER QUALITY VOLUMES
15. Grassy Swales D	esigned as F	equired in RG-348	Pa	ges 3-51 to 3-54
Design parameters for the swale:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfall intensity = i = Swale Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	0.00 0.00 1.1 0.01 3 0.30 #DIV/0!	acres acres in/hr ft/ft ft		
$\label{eq:Acs} A_{CS} = cross-sectional area of flow in Swale = P_w = Wetted Perimeter = R_H = hydraulic radius of flow cross-section = A_{CS}/P_w = n = Manning's roughness coefficient =$	#DIV/0! #DIV/0! #DIV/01 0.2	sf feet feet 2		
15A. Using the Method Described in the RG-348				
Manning's Equation: $Q = 1.49 A_{CS} B_{H}^{23} S^{05}$ n				
b = <u>0.134 x O</u> zy = y ¹⁶⁷ S ⁰⁵	#DIV/0!	feet		
Q = CiA =	#DIV/0!	cfs		
To calculate the flow velocity in the swale:				
V (Velocity of Flow in the swale) = Ω/A_{rec} =	#DIV/01	ft/sec		
To calculate the resulting swale length:	RDIV/0.	10360		
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 R	G-348, the design para	ameters must be i	modified and the solver rerun.
15B. Alternative Method using Excel Solver				
-				
Design Q = CiA =	#DIV/0!	cfs		
Manning's Equation Q = Swale Width=	0.7 6.0	6 cfs 0 ft	Error 1 =	#DIV/0!
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length ≃	#DIV/0! #DIV/0!	ft/s ft		
Instructions are provided to the right (blue comments).				
Design Width = Design Discharge = Design Depth = Flow Velocity = Minimum Length =	0.7 0.3 0.3 97.4	6 ft 6 cfs 3 ft 2 cfs 8 ft	Error 2 =	#DIV/0!

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

17. Wet Vaults	Designed as F	lequired 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 = Ci/			
C = runoff coefficient for the drainage area ≠ i ≈ design rainfall intensity = A = drainage area in acres =	0.2 1.	1 1 in/hour 1 acres	C = Runoff Coefficient = 0.546 (IC) ² + 0.326 (IC) + 0.03
Q = flow rate in cubic feet per second	0.2	3 cubic feet/se	c
RG-348 Page 3-31 Equation 3.5: V _{on} = Q//	k.		
Q = Runoff rate calculated above = A = Water surface area in the wet vault =	0.2 15	3 cubic feet/se 0 square feet	c
V _{CR} = Overflow Rate =	= 0.0	0 feet/sec	
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31)	- 5	3 percent	
Load removed by Wet Vault	#VALUE	ibs	
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 Efficiency Reduction for Actual Rainfall Intensity	= 0.7 = 0.8	5 percent 3 percent	
Resultant TSS Load removed by Wet Vault	= #VALUE!	lbs	
18. Permeable Concrete	Designed as	Required in RC	1-348 Pages 3-79 to 3-83
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING Z	ONE		
19. BMPs Installed in a Series	Designed as	Required in R	3-348 Pages 3-32
Michael E. Barrett, Ph.D., P.E. recommended that the coeff	cient for E ₂ be	changed from	n 0.5 to 0.65 on May 3, 2006
$E_{TOT} = [1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100$	= 94.0	1 percent	NET EFFICIENCY OF THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E,	89.0	0 percent	
EFFICIENCY OF THE SECOND BMP IN THE SERIES = ${\rm E_2}$	70.0	o percent	
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3	- 0.0	0 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 _i X 34.6 X A _P X0.54)	= 315.8	9 lbs	
20. Stormceptor Required TSS Removal in BMP Drainage Area Impervious Cover Overtreatment TSS Removal for Uncaptured Area BMP Sizing Effective Area Calculated Model Size(s) Actual Model Size (if multiple values provided in Calculate Model Size as id use are shown on longer model Size)	= NA = 0.000 = 0.00 = NA = #N/A d	lbs ac Ibs EA	
Surface Area Overflow Rate Rounded Overflow Rate BMP Efficiency % L _R Value	= #N/A = #VALUE! = #VALUE! = #VALUE! = #VALUE!	tt ² V _α V _α % Ibs	

		TSS Load Credit =	#VALUE!	lbs
	Is Sufficient	Freatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE	
		TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	
21 Vortech				
<u></u>		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	
	A	ctual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
		Surface Area =	7.10	ft ²
		Overflow Rate =	#VALUE!	V _{or}
		Rounded Overflow Rate =	#VALUE!	V _{or}
		BMP Efficiency % =	#VALUE!	%
		L ₈ Value =	#VALUE!	lbs
		L _R Value = TSS Load Credit =	#VALUE! #VALUE!	lbs
	Is Sufficient	L _R Value = TSS Load Credit = Treatment Available? (TSS Credit ≥ TSS Uncapt.)	#VALUE! #VALUE! #VALUE!	ibs Ibs
	Is Sufficient	L _R Value = TSS Load Credit = Treatment Available? (TSS Credit ≥ TSS Uncapt.) TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE! #VALUE! #VALUE! #VALUE!	ibs Ibs

TSS Removal Calculations 04-20-2009	Project Name: Manor Creek Unit 5 Date Prepared: 3/10/2015 Vace the cursor over the cell.
	lace the cursor over the cell.
Additional Information is provided for cells with a red triangle in the upper right corner. P 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	ve 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 x P)	
where: L _{M TOTAL PROJECT} = Required TSS removal resulting fr A _N ≈ Net increase in impervious area fo P = Average annual precipitation, inch	rom the proposed development \approx 80% of increased load or the project tes
Site Data: Determine Required Load Removal Based on the Entire Project County = Comal Total project area included in plan * = 45.67 acres Predevelopment impervious area within the limits of the plan * = 0.00 acres Total post-development impervious cover fraction * = 0.18 P = 33 inches	Streets SF/Lot 38 6,225 236,550 5.430 8.23
LM TOTAL PROJECT = 7388 lbs. * The values entered in these fields should be for the total project area.	
Number of drainage basins / outfalls areas teaving the plan area =	
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 I Predevelopment impervious area within drainage basin/outfall area = 0.00 acres Post-development impervious area within drainage basin/outfall area = 0.43 acres Post-development impervious fraction within drainage basin/outfall area = 0.43 acres Post-development impervious fraction within drainage basin/outfall area = 0.11 b L _{M THIS BASIN} = 385 lbs	Lots SF/Lot 3 6225 0.43 acres of IC for lots 0 - acres of street
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 _B) for this Drainage Basin by the selected BMP Type.	Wet Value
RG-348 Page 3-33 Equation 3.7: L _R = (BMP efficiency) x P x (A _r x 34.6 -	+ A _P × 0.54)
where: $A_c = Total On-Site drainage area in the A_i = Impervious area proposed in the Bi A_P = Pervious area remaining in the Bi L_R = TSS Load removed from this cate$	e BMP catchment area BMP catchment area MP catchment area chment area by the proposed BMP

A ₁ =	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 basic	4 =	385	bs.			
5	=	0.87				
6. Calculate Capture Volume required by the BMP Type for this drainage	basin / o	outfall area	<u>.</u>	Calculations from RG-	348	² ages 3-34 to 3-36
Rainfall Dept Post Development Runoff Coefficient On-site Water Quality Volume	1 = = = =	1.44 0.13 2738	nches cubic feet			
	Calc	culations from	n RG-348	Pages 3-36 to 3-37		
Off-site area draining to BM/ Off-site Impervious cover draining to BM/ Impervious fraction of off-site area Off-site Runoff Coefficien Off-site Water Quality Volumi	P = D = a = t = e =	0.00 0.00 0.00 0.00	acres acres cubic feet			
Storage for Sedimen Total Capture Volume (required water quality volume(s) x 1.20 The following sections are used to calculate the required water quality vo The values for BMP Types not selected in cell C45 will show NA.	t =) = olume(s	548 3285 s) for the se	cubic feet lected BMP.			
7. Retention/Irrigation System	Desi	igned as Re	quired in RG	-348	Pages 3-42 to	3-46
Required Water Quality Volume for retention basi	n =	NA	cubic feet			
Irrigation Area Calculations: Soil infiltration/permeability rat Irrigation are	e ≕ a =	0.1 NA NA	in/hr square feet acres	Enter determined per	rmeability rate	or assumed value of 0.1
8. Extended Detention Basin System	Desi	igned as Re	quired in RG	i-348	Pages 3-46 to	3-51
Required Water Quality Volume for extended detention basi	n =	NA	cubic feet			
9. Filter area for Sand Filters	Des	signed as Re	equired in RG	i-348	Pages 3-58 to	3-63
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System	Des	signed as Re	equired in RG	3-348	Pages 3-58 to	3-63
<u>9. Filter area for Sand Filters</u> <u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basi	Desi	signed as Re	equired in RG	3-348	Pages 3-58 to	3-63
<u>9. Filter area for Sand Filters</u> <u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basi Minimum filter basin are	Des n = a <i>=</i>	iigned as Re NA NA	equired in RG cubic feet square feet	5-348	Pages 3-58 to	3-63
<u>9. Filter area for Sand Filters</u> <u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basi Minimum filter basin are Maximum sedimentation basin are Minimum sedimentation basin are	Des n = a = a = a =	NA NA NA NA NA	equired in RG cubic feet square feet square feet square feet	-348 For minimum water o For maximum water	Pages 3-58 to depth of 2 feet depth of 8 fee	3-63
<u>9. Filter area for Sand Filters</u> <u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basis Minimum filter basin are Maximum sedimentation basin are Minimum sedimentation basin are <u>9B. Partial Sedimentation and Filtration System</u>	Des: n = a = a = a =	NA NA NA NA NA	equired in RG cubic feet square feet square feet square feet	-348 For minimum water o For maximum water	Pages 3-58 to depth of 2 feet depth of 8 fee	3-63 I
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basis Minimum filter basin are Maximum sedimentation basin are Minimum sedimentation basin are 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basin	Desi n = a = a = a = s =	NA NA NA NA NA	equired in RG cubic feet square feet square feet square feet cubic feet	-348 For minimum water o For maximum water #VALUE!	Pages 3-58 to depth of 2 feet depth of 8 fee sf at 4' of dept	3-63 I
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basis Minimum filter basin are Maximum sedimentation basin are Minimum sedimentation basin are Water Quality Volume for system 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basin Minimum filter basin are	Des: n = a = a = a = s = a =	NA NA NA NA NA NA	cubic feet square feet square feet square feet cubic feet square feet	3-348 For minimum water For maximum water #VALUE!	Pages 3-58 to depth of 2 feet depth of 8 fee sf at 4' of dept	3-63 I
9. Filter area for Sand Filters 9. Filter area for Sand Filters 9. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basis Minimum filter basin are Maximum sedimentation basin are Minimum sedimentation basin are Water Quality Volume for combined basin Water Quality Volume for combined basin Minimum filter basin are Maximum sedimentation basin are Maximum sedimentation basin are	Desi n = a = a = a = s = a = a = a =	NA NA NA NA NA NA NA NA	cubic feet square feet square feet square feet cubic feet square feet square feet	5-348 For minimum water of For maximum water #VALUE! For minimum water of For maximum water	Pages 3-58 to depth of 2 feet depth of 8 fee sf at 4' of dept depth of 2 feet depth of 8 fee	3-63 t
 <u>9. Filter area for Sand Filters</u> <u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basis Minimum filter basin are Maximum sedimentation basin are <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basin Minimum filter basin are Maximum sedimentation basin are Minimum filter basin are Mater Quality Volume for combined basin Minimum filter basin are Minimum sedimentation basin are Minimum sedimentation basin are Minimum sedimentation basin are Minimum sedimentation basin are 	Desi n = a = a = s = a = a = a = a = a = Des	NA NA NA NA NA NA NA Signed as Re	equired in RG cubic feet square feet square feet square feet square feet square feet square feet square feet	3-348 For minimum water o For maximum water #VALUE! For minimum water For maximum water 3-348	Pages 3-58 to depth of 2 feet depth of 8 fee sf at 4' of dept depth of 2 feet depth of 2 feet depth of 3 fee Pages 3-63 to	3-63 h 3-65
 <u>9. Filter area for Sand Filters</u> <u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basis Minimum filter basin are Maximum sedimentation basis are <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basin Minimum filter basin are Maximum sedimentation basis are Minimum filter basis are Mater Quality Volume for combined basis Minimum filter basis are Minimum filter basis are Minimum sedimentation basis are Minimum filter basis are Minimum sedimentation basis are Minimum sedimentation basis are Minimum sedimentation basis are 	Desi n = a = a = s = a = a = a = a = Des n =	NA NA NA NA NA NA Signed as Ro NA	equired in RG cubic feet square feet square feet square feet square feet square feet square feet square feet cubic feet	3-348 For minimum water o For maximum water #VALUE! For minimum water For maximum water 3-348	Pages 3-58 to depth of 2 feet depth of 8 fee sf at 4' of dept depth of 2 feet depth of 8 fee Pages 3-63 to	3-63 h 3-65
 <u>9. Filter area for Sand Filters</u> <u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basis are Minimum filter basin are Maximum sedimentation basin are Minimum sedimentation basin are Water Quality Volume for combined basin Minimum filter basin are Maximum sedimentation basin are Minimum sedimentation basin	Desi n = a = a = s = a = a = a = bes n = Des	NA NA NA NA NA NA Signed as Ro NA	equired in RG cubic feet square feet square feet square feet square feet square feet square feet square feet cubic feet cubic feet	-348 For minimum water o For maximum water #VALUE! For minimum water For maximum water 3-348	Pages 3-58 to depth of 2 feet depth of 8 fee sf at 4' of dept depth of 2 feet depth of 8 fee Pages 3-63 to Pages 3-66 to	3-63 h 3-65 3-71
 9. Filter area for Sand Filters 9. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basis Minimum filter basin are Maximum sedimentation basis are Minimum sedimentation basis are 98. Partial Sedimentation and Filtration System Water Quality Volume for combined basis Water Quality Volume for combined basis are Minimum filter basis are Maximum sedimentation basis are Minimum filter basis are Minimum filter basis are Minimum sedimentation basis are Minimum sedimentation basis are Minimum filter basis are Minimum filter basis are Minimum filter basis are Minimum sedimentation basis are Minimum sedimentation basis are Minimum filter basis are Minimum sedimentation basis Minimum sedimentati	Desi n = a = a = s = a = a = a = Des n = Des	igned as Re NA NA NA NA NA Signed as Re NA Signed as Re NA	equired in RG cubic feet square feet square feet square feet square feet square feet square feet square feet cubic feet cubic feet cubic feet cubic feet	3-348 For minimum water of For maximum water #VALUE! For minimum water For maximum water 3-348 Permanent Pool Cap Total Capacity shou plus a second WQV.	Pages 3-58 to depth of 2 feet depth of 8 fee sf at 4' of dept depth of 2 feet depth of 8 fee Pages 3-63 to Pages 3-66 to pacity is 1.20 ti Id be the Perm	3-63 t 3-65 3-71 mes the WQV senent Pool Capacity
9. Filter area for Sand Filters 9. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basis Minimum filter basin are Maximum sedimentation basin are Minimum sedimentation basin are Minimum sedimentation basin are Maximum sedimentation basin are Maximum sedimentation basin are Water Quality Volume for combined basin Water Quality Volume for combined basin Minimum filter basin are Maximum sedimentation basis are Maximum sedimentation basis are Maximum sedimentation basis Maximum sedimentation basis Maximum sedimentation basis Maximum sedimentation basis Required Water Quality Volume for Bioretention Basis 11. Wet Basins Required capacity of Permanent Poor Required capacity at WQV Elevation 12. Constructed Wetlands	Desi n = a = a = is = a = is = a = Des in = Des Des	NA NA NA NA NA NA Signed as Ro NA signed as Ro NA	equired in RG cubic feet square feet square feet square feet square feet square feet square feet square feet cubic feet cubic feet cubic feet cubic feet cubic feet	3-348 For minimum water of For maximum water #VALUE1 For minimum water For maximum water 3-348 3-348 Permanent Pool Cap Total Capacity shou plus a second WQV. 3-348	Pages 3-58 to depth of 2 feet depth of 8 fee sf at 4' of dept depth of 8 fee Pages 3-63 to Pages 3-66 to pacity is 1.20 ti Id be the Parm Pages 3-71 to	3-63 t h 3-65 3-71 arres the WQV arrent Pool Capacity 13-73
9. Filter area for Sand Filters 9. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basis Minimum filter basin are Maximum sedimentation basis Maximum sedimentation basis 98. Partial Sedimentation and Filtration System Water Quality Volume for combined basis Minimum filter basis are Minimum filter basis are Maximum sedimentation basis are Minimum filter basis are Minimum filter basis are Maximum sedimentation basis Maximum sedimentation basis Minimum filter basis Maximum sedimentation basis Minimum filter basis Maximum sedimentation basis Maximum sedimentation basis Minimum filter basis Required Water Quality Volume for Bioretention Basis 11. Wet Basins Required capacity of Permanent Poor Required water Quality Volume for Constructed Wetlands Bequired Water Quality Volume for Constructed Wetlands	Desi n = a = a = is = a = a = Des in = Des ts = ts =	signed as Re NA NA NA NA NA Signed as Re NA Signed as Re NA	equired in RG cubic feet square feet square feet square feet square feet square feet square feet square feet square feet cubic feet cubic feet cubic feet cubic feet cubic feet	3-348 For minimum water of For maximum water #VALUE! For minimum water For maximum water 3-348 Permanent Pool Cap Total Capscity shou plus a second WQV. 3-348	Pages 3-58 to depth of 2 faet depth of 8 fae sf at 4' of dept depth of 2 faet depth of 2 faet depth of 2 faet depth of 3 fae Pages 3-63 to Pages 3-66 to pacity is 1.20 ti Id be the Parm Pages 3-71 to	3-63 t h 3-65 3-71 mes the WQV anent Pool Capacity 3-73

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 REMOV	ALS ARE BAS	ED UPON FLOW RA	TES - 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;			
$\begin{array}{l} \mbox{Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfall intensity = i = Swale Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C = A_{CS} = cross-sectional area of flow in Swale = P_w = Wetted Perimeter = R_H = hydraulic radius of flow cross-section = A_{CS}/P_w = n = Manning's roughness coefficient = 15A. Using the Method Described in the RG-348 \\ Manning's Equation: Q = 1.49 A_{CS} R_H^{23} S^{0.4} n \end{array}$	= 0.0 = 0.0 = 1 = 0.1 = #DIV/0! = #DIV/0! = #DIV/0! = #DIV/0!	00 acres 00 acres 11 in/hr 11 fn/ft 33 ft 53 ft feet feet 56 feet 52	
b = <u>0.134 x Q</u> - zy = y ^{1 57} S ^{0 5}	= #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/01 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 = Swale Width=	0.76 cfs 6.00 ft	Error 1 =	#DIV/0

Instructions are provided to the right (green comments).

Flow Velocity Minimum Length =	#DIV/0! #DIV/0!	ft/s ft		
Instructions are provided to the right (blue comments).				
Design Width =		6 ft		
Design Discharge =	0.1	76 cfs	Error 2 ≈	#D1V/01
Design Depth =	0.3	33 ft		
Flow Velocity =	0.3	32 cfs		
Minimum Length =	97.4	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

17. Wet Vaults	Designed as F	lequired 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 = i = design rainfall intensity = A = drainage area in acres =	0.07	r I in/hour I acres	C = Runoff Coefficient = 0.546 $(IC)^2$ + 0.328 (IC) + 0.03
Q = flow rate in cubic feet per second =	0.08	B cubic feet/se	c
RG-348 Page 3-31 Equation 3.5: V _{OR} = Q/A			
Q = Runoff rate calculated above = A = Water surface area in the wet vault =	0.04	3 cubic feet/se 3 square feet	c
V _{oR} = Overflow Rate =	0.0) feet/sec	
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	5	3 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 = Efficiency Reduction for Actual Rainfall Intensity =	0.7	5 percent 3 percent	
Resultant TSS Load removed by Wet Vault =	#VALUE	lbs	
18. Permeable Concrete	Designed as I	Required in RC	9-348 Pages 3-79 to 3-83
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZO	INE		
19. BMPs installed in a Series	Designed as I	Required in R	G-348 Pages 3-32
Michael E. Barrett, Ph.D., P.E. recommended that the coeffic	tient for E ₂ be	changed from	n 0.5 to 0.65 on May 3, 2006
$E_{TOT} = [1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100 =$	94.0	1 percent	NET EFFICIENCY OF THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E, =	89.0	percent	
EFFICIENCY OF THE SECOND BMP IN THE SERIES = $\mathrm{E_2}$ =	70.0	0 percent	
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_{a} =	0.0	0 percent	
THEREFORE, THE NET LOAD REMOVAL WOULD BE: $(A_1 \text{ AND } A_p \text{ VALUES ARE FROM SECTION 3 ABOVE})$			
L _R = E _{TOT} X P X (A _I X 34.6 X A _P X0.54) =	519.3	2 lbs	
20. Stormceptor			
Required TSS Removal in BMP Drainage Area=	NA	lbs	
TSS Removal for Uncaptured Area =	0.00	ac Ibs	
BMP Sizing		54	
Effective Area = Calculated Model Size(s) =	NA #N/A	EA	
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/Δ	ft ²	
Overflow Rate =	#VALUE!	Va	
Rounded Overflow Rate =	#VALUE!	Var	
BMP Efficiency % =	#VALUE!	%	
L _B Value =	#VALUE!	lbs	

	TSS Load Credit =	#VALUE!	lbs
	ls Sufficient Treatment Avaiłable? (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
	Actual Model Size (if choosing larger model size) = Surface Area =	Vx1000 7.10	Pick Model Size
	Actual Model Size (if choosing larger model size) ⇒ Surface Area ⇒ Overflow Rate =	Vx1000 7.10 #VALUE ¹	Pick Model Size ft ² V _{or}
	Actual Model Size (if choosing larger model size) ⇒ Surface Area ⇒ Overflow Rate = Rounded Overflow Rate =	V×1000 7.10 #VALUE ¹ #VALUE ¹	Pick Model Size ft ² V _α V _α
	Actual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % =	Vx1000 7.10 #VALUE ¹ #VALUE ¹ #VALUE!	Pick Model Size ft ² V _α V _α
	Actual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % = L _R Value =	V×1000 7.10 #VALUE ¹ #VALUE ¹ #VALUE! #VALUE!	Pick Model Size ft^2 V_{α} V_{α} %
	Actual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % = L _R Value = TSS Load Credit =	Vx1000 7.10 #VALUE! #VALUE! #VALUE! #VALUE!	Pick Model Size ft^2 V_{cr} V_{cr} V_{cr} Ibs
	Actual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % = L _R Value = TSS Load Credit = Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.)	Vx1000 7.10 #VALUE ¹ #VALUE ¹ #VALUE ¹ #VALUE ¹ #VALUE ¹	Pick Model Size ft ² V _a V _a % Ibs
	Actual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % = L _R Value = ISS Load Credit = Is Sufficient Treatment Available? (TSS Credit ≥ TSS Uncapt.) TSS Treatment by BMP (LM + TSS Uncapt.) =	Vx1000 7.10 #VALUE ¹ #VALUE ¹ #VALUE ¹ #VALUE ¹ #VALUE ¹	Pick Model Size ft ² V _α V _α % Ibs

<form> 25 Standard Calculation 24 - 20 - 20 - 20 - 20 - 20 - 20 - 20 -</form>	Texas Commission on Environmental Quality						
Additional information is provided for calls with a red triangle in the upper right conce. Place the curst over the call. The those in build information is inclusted on in the chancel Guidance Manuel - RG-348. The call is inclusted in the interpreter in the chancel Guidance Manuel - RG-348. The Guidance for the table trian is inclusion in the chancel Guidance Manuel - RG-348. The Guidance Manuel - RG-348 The Guidance M	TSS Removal Calculations 04-20-2009				Project Name: Date Prepared:	Manor Creek Unit 3/10/2015	5 & 6
1.0.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1	Additional information is provided for cells with a red triang Text shown in blue indicate location of instructions in the Techni Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Cha	gle in th ical Guid anges to	te upper dance Ma o these fi	right corner nual - RG-34 elds will rer	. Place the curs 8. move the equation	or over the cell. ons used in the spr	eadsheet.
<text> Page 32 Equation 3.1 Lip = 27.2(A, VF) Inter Call and page 30.0 minute of the paints in the proposed development = 0% of increased and and page 30.0 minute of the paints in the paints in the paints in the paint in the</text>	1. The Required Load Reduction for the total project:	Cal	culations fro	om RG-348		Pages 3-27 to 3-30	
where: Lational rescuent of Respurised TSS services are submit of the pain of the proposed development = 00% of increased load A_{1} is 24 in proposed are submit of the pain A_{1} is 24 in proposed A_{2} is 24 in order A_{2} order A_{2} is 24 in order A_{2} ord	Page 3-29 Equation 3.3:	L _M = 27.2	2(A _N x P)				
See Data: Determine Required Load Removal Based on the EMP Project Trait property and included in plan i and i an	where: L _{M TOTAL PROJ}	_{ECT} = Rec A _N = Net P = Ave	quired TSS increase in rage annua	removal resulti impervious are I precipitation,	ng from the proposed ea for the project inches	d development = 80% of	increased load
$\frac{1}{12} \frac{1}{12} \frac$	Site Data: Determine Required Load Removal Based on the Entire Pri	oject	C				
Predevelopment impervious area within the limits of the plan "= 0.04 acres Lots SFLot 236.065 5.19 Total post-development impervious cover fraction "= 0.33 inches 25.25 study to 11.718 Lutral, modert = 15383 lbs. * The values entered in these fields should be for the total project area. Number of dramage basins / outfalls areas leaving the plan area = 9 2. Drainage Basin Parameters IThis information should be provided for each basin: Drainage Basin Parameters IThis information should be provided for each basin: Drainage Basin/Quutfall area = 0.28 acres # of Lots SFLot Predevelopment impervious area within dramage basin/Quutfall area = 0.00 acres 0 to 8225 0.00 acres of to 7.2455 0.00 acres of U.T acres 0.00 acres 7.2956 0.17 acres 0.17 acres 0.017 acr	Total project area included in plan	nty = n " =	45.67	acres		Streets	
Total post-development impervious sover fraction $\frac{1}{2} - \frac{0.33}{33}$ inches $\frac{1}{12} + \frac{1}{12} + \frac{1}{$	Predevelopment impervious area within the limits of the pla Total post-development impervious area within the limits of the pla	in * = an° =	0.00	acres L	.ots	SF/Lot	236,065 5.419
Let to take processed if the solution best fields should be for the total project area: Index and the set fields should be for the total project area: Index and the set fields should be for outded for each basint: Drainage Basin/Outfall Area No. A 5+A The outdown integrition area within drainage basin/outfall area = 0.28 areas 10 lots 0 5225 0.00 acres of LC Prodevelopment integritions area within drainage basin/outfall area = 0.27 areas 10 lots 0 5225 0.00 acres of LC Post-development integritions areas within drainage basin/outfall area = 0.07 areas 0.07 acres of LC 0.07 acres of LC Post-development integritions areas within drainage basin/outfall area = 0.07 areas 0.07 acres of LC 0.07 acres of LC Internet the proposed BMP Code for this basin. Encrement Encrement Filender 0 percent Analogic Carringe Filender Biorderinion Constructed Method State Basin but the setected BMP Type. More the set out area of the Stronger area of the Str	Total post-development impervious cover fractio	P =	0.38 33	inches	82	6,225	510,450 11.718 17.14
* The values entered in these fields should be for the total project area. A under of dramage basins / outfalls areas leaving the pinan area Image basin/outfall areas leaving the pinan area A claimage basin/outfall areas leaving the pinan area Image basin/outfall areas Image basin/outfall areas A claimage basin/outfall areas Image basin/outfall areas Image basin/outfall areas Image basin/outfall areas A claimage basin/outfall area Image		ЕСТ =	15383	lbs.			
Autor of dramage basins / outfails areas leaving the plan area 	* The values entered in these fields should be for the total project area	b.					
2. Obtainade 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 S FLot Predevelopment impervious area within drainage basin/Outfall area = 0.00 acres # of Lots 0 5225 0.00 acres of IC Post-development impervious fraction within drainage basin/Outfall area = 0.17 acres # of Lots 0 .07 acres of ar Predevelopment impervious fraction within drainage basin/Outfall area = 0.17 acres # 0.00 acres of IC Juntes seave 152 bs. 0.17 acres of ar 0.17 acres of ar Juntes seave 152 bs. 0.17 acres of ar 0.17 acres of ar Constructed With drainage basin/Outfall area = 0 percent Aqualogic Carridge Friter Bioretention Constex StormFilter Constructed Wetland Constructed Wetland Extended Datention Constex StormFilter Sormeoptor Vorteets Wet Basin Wet Basin Wet Basin Wet Basin Wet Basin Vorteets Vorteets Wet Basin Wet Basin Wet Basin Wet Basin Vorteets Wet Basin Wet Aurit <t< td=""><td>Number of drainage basins / outfalls areas leaving the plan ar</td><td>rea =</td><td>9</td><td></td><td></td><td></td><td></td></t<>	Number of drainage basins / outfalls areas leaving the plan ar	rea =	9				
Drainage Basin/Outfall Area No. =A 5+1ATotal drainage basin/outfall area =0.28acres * 0 ottosSF/LotPredevelopment impervious area within drainage basin/outfall area =0.01acres ottos052250.00 acres ottosPost-development impervious faction within drainage basin/outfall area =0.01acres ottos73960.17 acres ottosLut with as ease =152ibs	2. Drainage Basin Parameters (This information should be provided for	r each ba	isin):				
$\begin{tabular}{lllllllllllllllllllllllllllllllllll$	Drainage Basin/Outfall Area I	No. =	A 5-4A				
3. Indicate the proposed BMP Code for this basin. Proposed BMP = None Removal efficiency = 0 percent Aqualogic Cartridge Filter Biorelention Contech StormFilter Constructed Wetland Lapson and Filter Stormceeptor Aqualogic Cartridge Filter Biorelention Contech StormFilter Constructed Wetland Lapson and Filter Stormceeptor 4. Calculate Maximum TSS Load Removed (La) for this Drainage Basin by the selected BMP Type. Vertexts Wet Basin Wet Vault 7. Calculate Maximum TSS Load Removed (La) for this Drainage Basin by the selected BMP Type. Vertexts Wet Basin Wet Vault Mere: Ac = Total On-Ste Granage area in the BMP catchment area A = Impervious area proposed in the BMP catchment area A = Dervious area proposed in the BMP catchment area A = TSS Load removed from this catchment area A = TSS Load removed from this catchment area A = TSS Load removed from this catchment area A = 0.17 acres 0 625 0.00 acres of tot A = 0.11 acres 700 0.00 acres of tot A = 0.010 bis	Total drainage basin/outfall a Predevelopment impervious area within drainage basin/outfalt a Post-development impervious area within drainage basin/outfall a Post-development impervious fraction within drainage basin/outfall a L _{M THIS B}	rea = rea = rea = rea = _{ASIN} =	0.28 0.00 0.17 0.61 152	acres # acres acres Ibs.	ŧ of Lots C	SF/Lot 6225 7396	0.00 acres of IC 0.17 acres of str 0.17 Total IC (a:
Proposed BMP = Nome Removal efficiency = 0 percent Aqualogic Cartridge Filler Bioretention Contech StormFilter Contech StormFilter Stormceptor Aqualogic Cartridge Filler Bioretention Contech StormFilter Stormceptor Storm Storm Filter Stormceptor Votedhs Sand Filter Stormceptor Sand Filter Stormceptor Sand Filter Stormceptor Storm Ceptor Votedhs Votedhs Votedhs Votedhs Votedhs Votedhs Votedhs Votedhs Votedhs Votedhs Weter RG-348 Page 3-33 Equation 3.7: La = (BMP efficiency) X P x (A x 34.6 + Ap x 0.54) Votedhs Votedhs where: A_2 = Total On-Site drainage area in the BMP catchment area A_2 = Nervious area remaining in the BMP catchment area A_2 = Pervious area remaining in the BMP catchment area A_2 = Revious area remaining in the BMP catchment area A_3 = Toss Load removed from this catchment area A_4 = 0.17 SFLot A_1 = 0.17 0 6225 0.00 acres of IC 0.17 acres 0 0.17 acres 0 0 0.17 acres 0 0.17 acr	3. Indicate the proposed BMP Code for this basin.						
$A_1 \approx$ 0.17 acres 0 6225 0.00 acres of IC $A_\mu \approx$ 0.11 acres 7396 0.17 acres of str $L_B =$ 0 lbs 0.17 Total IC (acres)	A Calculate Maximum TSS Load Removed (L _a) for this Drainage Basin RG-348 Page 3-33 Equation 3.7: where:	$MP = Noincy =$ $L_{R} = (BN)$ $A_{C} = Tol$ $A_{L} = Imp$ $A_{P} = Pe$ $L_{R} = TS$ $A_{L} = TS$	elected BM MP efficience tal On-Site pervious area S Load rem	Percent IP Type. y) x P x (A, x 3/4) drainage area i ap proposed in remaining in th oved from this	4.6 + A _P x 0.54) n the BMP catchment the BMP catchment ar catchment area by th	Aqualogic Cartridge Fil Bioretention Contech StormFilter Constructed Wetland Extended Detention Grassy Swale Retention / Irrigation Sand Filter Stormceptor Vegetated Filter Strips Vortechs Wet Basin Wet Vault t area area ea te proposed BMP	iter
$A_P = 0.11$ acres 7396 0.17 acres of str $i_B = 0$ lbs 0.17 Total IC (a.		A _C = A _I ≈	0.28	acres	# 01 LOIS (SF/Lot D 6225	0.00 acres of IC
		Α _Ρ = ί _θ =	0.11 0	acres Ibs		7396	0.17 acres of str 0.17 Total IC (a

Desired L _{M THIS BASIN} =	0	lbs.					
F =	#DIV/0!						
6. Calculate Capture Volume required by the BMP Type for this drainage bas	sin / outfall are	<u>a.</u>	Calculations from RG-	348 Pa	ges 3-34 to 3	1-36	
Rainfall Depth = Post Development Runoff Coefficient = On-site Water Quality Volume =	#DIV/0! 0.42 #DIV/0!	inches cubic feet					
	Calculations fr	om RG-348	Pages 3-36 to 3-37				
Off-site area draining to BMP =	0.00	acres					
Off-site Impervious cover draining to BMP = Impervious fraction of off-site area = Off-site Runoff Coefficient =	0.00 0 0.00	acres					
Off-site Water Quality Volume =	#DIV/0!	cubic feet					
Storage for Sediment = Total Capture Volume (required water quality volume(s) x 1.20) = The following sections are used to calculate the required water quality volu The values for BMP Types not selected in cell C45 will show NA. 7. Retention/Irrigation System	#DIV/0! #DIV/0! me(s) for the s	cubic feet selected BMP	3-348	Pages 3-42 to 3-4	16		
Bequired Water Quality Volume for retention basin =	NA	cubic feet					
Irrigation Area Calculations:		000101001					
Soil infiltration/permeability rate = Irrigation area =	0.1 NA NA	in/hr square feet acres	Enter determined pe	meability rate or	assumed v	alue of 0.1	i
8. Extended Detention Basin System	Designed as F	Required in RO	3-348	Pages 3-46 to 3-1	51		
Required Water Quality Volume for extended detention basin =	NA	cubic feet					
9. Filter area for Sand Filters	Designed as F	Required in RO	G-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 = Minimum sedimentation basin area =	NA NA	square feet square feet	For minimum water For maximum water	lepth of 2 feet depth of 8 feet			
9B. Partial Sedimentation and Filtration System			SE @ Ciuca Daath	0	una Danih		
Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!	GI	ven Deptn	5	60
Minimum filter basın area =	NA	square feet					60
Maximum sedimentation basin area =	NA NA	square feet	For minimum water	depth of 2 feet			60 60
Minimum sedimentation basin area =	NA	square feet	For maximum water	depth of 8 feet			60
10. Bioretention System	Designed as I	Required in R	G-348	Pages 3-63 to 3-	65		
Required Water Quality Volume for Bioretention Basin =	NA	cubic feet					
11 Wet Basins	Designed as I	Required in R	G.348	Pages 3-66 to 3-	71		
Bequired capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Car	acity is 1.20 time	s the WQV		
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity shou plus a second WQV.	Id be the Perman	ent Pool Ca	spacity	
12. Constructed Wetlands	Designed as i	Required in R	G-348	Pages 3-71 to 3-	73		
Required Water Quality Volume for Constructed Wetlands =	= NA	cubic feet					
13. AquaLogic [™] Cartridge System	Designed as I	Required in R	G-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 ≠ Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) ≠	NA NA NA	cubic feet cartridges 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 REMOVAL	S ARE BASE	D UPON FLOW RATE	S - NOT CALC	ILATED WATER QUALITY VOLUMES
15. Grassy Swales Do	esigned as R	equired in RG-348	Pa	ges 3-51 to 3-54
Design parameters for the swale;				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfall intensity = i = Swale Slope = Side Slope (2) = Design Water Depth = y = Weighted Runoft Coefficient = C =	0.00 0.00 1.1 0.01 3 0.33 #DIV/0'	acres acres in/hr tt/ft b t		
Acs = cross-sectional area of flow in Swale =	#DIV/0!	st		
P _w = Wetted Perimeter =	#DIV/0!	feet		
R_{H} = hydraulic radius of flow cross-section = A_{CS}/P_{W} = n = Manning's roughness coefficient =	#DIV/0! 0.2	feet 2		
15A. Using the Method Described in the RG-348				
Manning's Equation: $Q \approx 1.49 A_{CS} R_{H}^{23} S^{05}$ n				
$b = \frac{0.134 \times Q}{y^{1.67}} - zy = y^{1.67}$	#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 (fl/sec) * 300 (sec) =	#DIV/01	feet		
If any of the resulting values do not meet the design requirement s	et forth in R	G-348, the design para	meters must be r	nodified and the solver rerun.
15B. Alternative Method using Excel Solver				
Design Q = CiA =	#DIV/0!	cfs		
Manning's Equation Q = Swale Width=	0.70	6 cfs 0 ft	Error 1 =	#DIV/0!
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	#DIV/0! #DIV/01	tt∕s ft		
Instructions are provided to the right (blue comments).				
Desian Width =	5	6 ft		
Design Discharge =	0.7	6 cfs	Error 2 =	#DIV/0!
Design Depth =	0.3	3 ft 2 cfs		
Flow Velocity = Minimum Length =	97.4	8 ft		
If any of the resulting values do not meet the design requirement aet forth in If any of the resulting values still do not meet the design requirement set fort	RG-348, the h in RG-348,	design parameters m widening the swale t	ay be modified ottom value mi	and the solver rerun. ay not be possible.

16. Vegetated Filter Strips

Designed as Required in RG-348

Pages 3-55 to 3-57

17. Wet Vaults	Designed as R	equired in RG	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	6	C = Runoff Coefficient = 0.546 (IC) ² + 0.328 (IC) + 0.03			
i = design rainfall intensity = A = drainage area in acres =	1.1	in/hour acres				
Q = flow rate in cubic feet per second =	0.47	cubic feet/se	ec			
RG-348 Page 3-31 Equation 3.5: $V_{OR} = Q/A$						
Q = Runoff rate calculated above = A = Water surface area in the wet vault =	0.47 cubic feet/sec 150 square feet					
V _{OR} = Overflow Rate =	0.00) feet/sec				
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	50	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	i in/hour				
Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = Efficiency Reduction for Actual Rainfall Intensity =	0.75	percent percent				
Resultant TSS Load removed by Wet Vault =	#VALUE1	lbs				
18. Permeable Concrete	Designed as F	lequired in R	G-348 Pages 3-79 to 3-83			
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZO	NE					
19. BMPs Installed in a Series	Designed as F	lequired in R	G-348 Pages 3-32			
Michael E. Barrett, Ph.D., P.E. recommended that the coeffic	tient for E ₂ be	changed from	m 0.5 to 0.65 on May 3, 2006			
$E_{TOT} = [1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 100 =$	94.0	1 percent	NET EFFICIENCY OF THE BMPs IN THE SERIES			
EFFICIENCY OF FIRST BMP IN THE SERIES = E, =	89.00 percent					
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 =	70.0	percent				
EFFICIENCY OF THE THIRD BMP IN THE SERIES = ${\rm E_3}$ =	0.0	percent				
THEREFORE, THE NET LOAD REMOVAL WOULD BE: (A, AND A, VALUES ARE FROM SECTION 3 ABOVE)						
L _R = E _{TOT} X P X (A ₁ X 34.6 X A _P X0.54) =	184.0	8 lbs				
20. Stormceptor						
Required TSS Removal in BMP Drainage Area= Impervious Cover Overtreatment= TSS Removal for Incentiver Area =	NA 0.0000	lbs ac lbs				
BMP Sizing						
Effective Area = Calculated Model Size(s) = Actual Model Size (if multiple values provided in Calculated	= NA = #N/A	ΕA				
Model Size or if you are choosing a larger model size) =	0	Model Size				
Surface Area =	= #N/A	ft ²				
Overflow Rate =	#VALUE!	Var				
Rounded Overflow Rate = BMP Efficiency % -	#VALUE!	V				
Enderiney / -						

		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	
Of Vorteeb				
21. Vonech		Bequired TSS Removal in BMP Drainage Area=	NΔ	lbs
		Impervious Cover Overtreatment=	0 0000	ac
		TSS Removal for Uncantured Area =	0.00	lbs
BMP Sizing	BMP Sizing		0.00	
	5	Effective Area =	NA	EA
		Calculated Model Size(s) =	#N/A	
		Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
				. 2
		Surface Area =	7.10	ft*
Overflow Rate =			#VALUE!	Var
Rounded Overflow Rate = BMP Efficiency % = L _R Value =			#VALUE!	V _{or}
			#VALUE!	%
			#VALUE!	lbs
TSS Load Credit =				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 (Ibs)
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



Juis Van Hende, PE 12/22/15

Required TSS Removal

9401

TCE0 R-13 2015 DEC 23 15/53


Texas Commission on Environmental Quality					
TSS Removal Calculations 04-20-2009			Project Name Date Prepared	e: Manor Creek Unit 6 d: 6/1/2015	5
Additional information is provided for cells with a red triangle Text shown in blue indicate location of instructions in the Technica Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Chan	e in the uppe al Guidance M ges to these	r right corn anual - RG-3 fields will r	er. Place the cur 348. remove the equat	sor over the cell. ions used in the spre	eadsheet.
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 x P)				
where: LM TOTAL PROJECT A _N P	= Required TS = Net increase = Average ann	S removal resu In impervious a ual precipitatio	Iting from the propose area for the project n, inches	ed development = 80% of	increased load
Site Data: Determine Required Load Removal Based on the Entire Proje County Total project area included in plan Predevelopment impervious area within the limits of the plan Total post-development impervious area within the limits of the plan Total post-development impervious cover fraction F	$ \begin{array}{l} x = & \text{Comal} \\ x = & 40.55 \\ x = & 0.00 \\ x = & 10.47 \\ x = & 0.26 \\ x = & 33 \end{array} $	acres acres acres inches	Lois 5	Streets SF/Lot 1 6,225 31	18,758 3.185 7,475 7.288 10,47
L _{M TOTAL PROJECT} * The values entered in these fields should be for the total project area.	r = 9401	lbs.			
Number of drainage basins / outfalls areas leaving the plan area	a = 6				
2. Drainage Basin Parameters (This information should be provided for e Drainage Basin/Outfall Area No Total drainage basis(suffall area	<u>ach basin):</u> . = A 6-1		H of Lois	SEd at	
Predevelopment impervious area within drainage basin/outfall area Post-development impervious area within drainage basin/outfall area Post-development impervious fraction within drainage basin/outfall area L _{M THIS} BASH	$ \begin{array}{rcl} a = & 0.00 \\ a = & 6.69 \\ a = & 0.43 \\ N = & 6009 \end{array} $	acres acres Ibs	* 01 2015	6225 123538.05	3.86 acres of IC for lots 2.84 acres of street 6.69 Total IC (acres)
3. Indicate the proposed BMP Code for this basin.					
Proposed BMF Removal efficiency	^o = Sand Filter y = 89	percent		Aqualagia Castridaa Eil	tor
		145 T		Biorelention Contech StormFilter Constructed Weltand Extended Detention Grassy Swale Retention / Irrigation Sand Filter Stormceptor Vegetated Filter Strips Vortechs Wet Basin Wet Vault	
4. Calculate maximum 155 Load Removed (L _b) for this Drainade Basin b	Y the selected E	SMP Type.	010 A 054		
RG-348 Page 3-33 Equation 3.7; L	_R = (BMP efficie	ncy) x P x (A _i x	: 34.6 + A _P x 0.54)		
where: A A L	_c = Total On-Sit A _I = Impervious a P = Pervious are R = TSS Load re	e drainage are area proposed a remaining in emoved from th	a in the BMP catchmen in the BMP catchmen the BMP catchment is catchment area by	ent area It area area The proposed BMP	
А	c = 15.07	acres			

A, =	6.69	acres	# of Lots	SF/	Lot	
Α _ρ =	8.38	acres		27	6225	3.86 acres of IC for lots
L _R =	6936	lbs		1	23538.05	2.84 acres of street

Desired L _{M THIS BASIN} =	6323	íbs						
F =	0.91							
6. Calculate Capture Volume required by the BMP Type for this drainage ba	sin / outfall are	38.	Calculations from RG	-348	Pages 3-34 to	3-36		
Rainfall Depth =	1.80	inches						
Post Development Runoff Coefficient = On-site Water Quality Volume =	0.33 32339	cubic feet						
	Calculations fr	om RG-348	Pages 3-36 to 3-37					
Off-site area draining to BMP =	0.00	acres						
Impervious fraction of off-site area =	0.00	acres						
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 volu	ime(s) for the s	selected BMP						
The values for BMP Types not selected in cell C45 will show NA. 7. Retention/Irrigation System	Decigned as P	Required in BC	3.949	Pages 3-42 to	2.46			
T. Retentioningation System	Designed as r	required in Ho	3-340	Fayes 5-42 10	3-40			
Required Water Quality Volume for retention basin =	NA	cubic feet						
Irrigation Area Calculations:								
Soil infiltration/nermeability rate -	0.1	in/hr	Enter determined pr	armenhility rate	a or assumed	value of (1 1	
Irrigation area =	NA	square feet	Enter determined pr	interacting fait	e of assumed	value of c		
	NA	acres						
	_							
8. Extended Detention Basin System	Designed as F	Required in RC	3-348	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 f	Required in RC	G-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 fee	t			
	- 4042	square leet	For maximum water	depth of a ree	rk -			
9B. Partial Sedimentation and Filtration System			SE @ Civon Dooth		Given Death	Midth	ň	onath
Water Quality Volume for combined basins =	= 38807	cubic feet	7,761.38		Given Depin	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 fee	ŧ		90	143.7293
Minimum sedimentation basin area	= 808	square feet	For Given water dep For maximum water	r depth of 8 fee	it		90	8.98308
10. Bioretention System	Designed as I	Required in R	G-348	Pages 3-63 to	3-65			
Required Water Quality Volume for Bioretention Basin	= NA	cubic feet						
11. Wet Basins	Designed as	Required in R	G-348	Pages 3-66 to	0 3-71			
Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Ca	pacity is 1.20 t	imes the WQV	1		
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity show	uld be the Perr	nanent Pool C	apacity		
			plus a second WQV	· .				
12. Constructed Wetlands	Designed as	Required in R	G-348	Pages 3-71 to	0 3-73			
Hequired Water Quality Volume for Constructed Wetlands :		- 1						
	= NA	cubic feet						
<u>13. AquaLoqic[™] Cartridge Şystem</u>	= NA	cubic feet Required in Ri	G-348	Pages 3-74 tr	0 3-78			

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV ⇒ Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 BMPB / LOAD REMOVAL	S ARE BASE	D UPON FLOW RATES	NOT CALCL	JLATED WATER QUALITY VOLUMES
15. Grassy Swales D	esigned as Re	equired in RG-348	Pa	ges 3-51 to 3-54
Design parameters for the swale:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfatl intensity = i = Swale Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	0.00 0.00 1.1 0.025 3 0.33 #DIV/0!	acres acres in/hr ft/ft ft		
A_{cs} = cross-sectional area of flow in Swale = P_w = Wetted Perimeter = R_H = hydraulic radius of flow cross-section = A_{cs}/P_w = n = Manning's roughness coefficient =	#DIV/0! #DIV/0! #DIV/0! 0.2	sf feet feet		
15A. Using the Method Described in the RG-348				
Manning's Equation: $Q = 1.49 A_{CS} R_{H}^{2/3} S^{0.5}$ n				
$b = \frac{0.134 \times Q}{y^{167}} - zy =$	#DIV/0!	feet		
Q = CiA =	#DIV/0!	cfs		
To calculate the flow velocity in the swale:				
V (Velocity of Flow in the swate) = Q/A_{CS} =	#DIV/0!	ft/sec		
To calculate the resulting swale length:				
L ∞ Minimum Swale Length = V (ft/sec) * 300 (sec) =	#DIV/0!	leet		
If any of the resulting values do not meet the design requirement s	et forth in RG	-348, the design parame	ters must be n	nodified and the solver rerun.
15B. Alternative Method using Excel Solver				
Design Q = CiA =	#D1V/0!	cfs		
Manning's Equation Q = Swale Width=	6.90 36.91) cfs ft	Error 1 =	5.82
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	#DIV/01 #DIV/01	ft/s ft		
Instructions are provided to the right (blue comments).				
Design Width = Design Discharge = Design Depth = Flow Velocity = Minimum Length =	1.20 0.33 0.51 154.12	6 ft 0 cfs 3 ft 1 cfs 2 ft	Error 2 =	

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

17. Wet Vaults	Designed as	Required in RC	3-348 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 = i = design rainfall intensity = A = drainage area in acres =	0.2 1	27 .1 in/hour 1 acres	C = Runoff Coefficient = 0.546 $(IC)^2$ + 0.328 (IC) + 0.03
Q = flow rate in cubic feet per second =	0.3	30 cubic feet/se	ec
RG-348 Page 3-31 Equation 3.5: V _{OR} = Q/A			
Q = Runoff rate calculated above = A = Water surface area in the wet vault =	0.3	30 cubic feet/se 50 square feet	20
V _{CR} = Overflow Rate =	0.0	00 feet/sec	
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	3	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 =	C	5 in/hour	
Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = Efficiency Reduction for Actual Rainfall Intensity =	0.	75 percent 33 percent	
Resultant TSS Load removed by WeI Vault =	#VALUE!	lbs	
18. Permeable Concrete	Designed as	Required in R	G-348 Pages 3-79 to 3-83
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZO	NE		
19. BMPs Installed in a Series	Designed as	Required in R	G-348 Pages 3-32
Michael E. Barrett, Ph.D., P.E. recommended that the coeffic	ient for E ₂ be	changed from	m 0.5 to 0.65 on May 3, 2006
$E_{TOT} = [1 \cdot ((1 \cdot E_1) \times (1 \cdot 0.65E_2) \times (1 - 0.25E_3))] \times 100 =$	94.	01 percent	NET EFFICIENCY OF THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E, =	89.	00 percent	
EFFICIENCY OF THE SECOND BMP IN THE SERIES \thickapprox E2 \thickapprox	70.	00 percent	
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_2 =	0.	00 percent	
THEREFORE, THE NET LOAD REMOVAL WOULD BE: (A, AND A, VALUES ARE FROM SECTION 3 ABOVE)			
L _R = E _{TDT} X P X (A ₁ X 34.6 X A _P X0.54) =	7325.	85 lbs	
20 Stormeentor			
Required TSS Removal in BMP Drainage Area=	NA	lbs	
TSS Removal for Uncaptured Area =	0.00	lbs	
BMP Sizing		5.	
Effective Area =	NA #N/A	ΕA	
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!	Var	
Rounded Overflow Rate =	#VALUE!	Var	
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 Vortach				
21. Vortech		Required TSS Removal in BMP Drainage Area=	NΔ	lbs
		Impervious Cover Overtreatment=	0 0000	ac
		TSS Removal for Uncaptured Area =	0.00	lbs
	BMP Sizing			
	5	NA	EA	
		#N/A		
	A	ctual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
		Surface Area =	7.10	ft²
		Overflow Rate =	#VALUE!	Va
		Rounded Overflow Rate =	#VALUE!	Va
		BMP Efficiency % =	#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 Date Prepared	Manor C 6/1/201	reek Unit 6 15	
Additional information is provided for cells with a red trian. Text shown in blue indicate location of instructions in the Techn Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Ch	gle in t ical Gu anges	the upper idance Ma to these f	right corn mual - RG-3 ïelds will r	er. Place the curr 348. remove the equati	sor over th ons used	ne cell. in the sprea	adsheet.
1. The Required Load Reduction for the total project:	Ca	alculations fr	om RG-348		Pages 3-27	to 3-30	
Page 3-29 Equation 3.3:	L _M = 27	7.2(A _N x P)					
where: Ly total proj	ect = Re A _N = Ne P = Av	equired TSS et increase i verage annu	removal resu n impervious al precipitatio	liting from the propose area for the project in, inches	d developme	ent = 80% of in	creased load
Site Data: Determine Required Load Removal Based on the Entire Pr Cou Total project area included in pla Predevelopment impervious area within the limits of the pla Total post-development impervious area within the limits of the pla Total post-development impervious cover fraction	roject nty = n * = an * = n * = P =	Comal 40.55 0.00 10.47 0.26 33	acres acres acres inches	Lois 51	Streets SF/Lot 6,22	138 25 317	,758 3.19 ,475 7.29 10.47
LM TOTAL PRO.	ect = a.	9401	lbs.				
Number of drainage basins / outfalls areas leaving the plan a	rea =	6					
2. Drainage Basin Parameters (This information should be provided fo	r each b	basin):					
Drainage Basin/Outfall Area	No. =	A 6-2					
Total drainage basin/outfall a Predevelopment impervious area within drainage basin/outfall a Post-development impervious area within drainage basin/outfall a Post-development impervious fraction within drainage basin/outfall a L _{M THIS B}	rea = rea = rea = rea - asin =	1.56 0.00 0.57 0.37 513	acres acres acres Ibs.	# of Lots	SF/Lot 4 62	225 0	0.57 acres of IC for lots 0.00 acres of street 0.57 Total IC (acres)
3. Indicate the proposed BMP Code for this basin.							
Proposed B Removal efficie	MP = Vi ncy =	egetated Fi 80	Iter Strips percent		Aqualogic Bioretentic Contech S Constructe Extended Grassy Sw Retention Sand Filte Storncept Vegetated Vortechs Wet Basin Wet Vault	Cartridge Filte on tormFilter de Wetland Detention rale r r Filter Strips	if
4. Calculate Maximum TSS Load Removed (L _R) for this Drainage Basir	by the	selected B	MP Type.				
RG-348 Page 3-33 Equation 3.7	L _R = (E	3MP efficien	су) х Р х (А _I х	(34.6 + A _P x 0.54)			
where:	$A_{C} = T_{A}$ $A_{f} = I_{A}$ $A_{P} = P$ $L_{R} = T$ $A_{C} =$	otal On-Site npervious ar ervious area SS Load rer 1.56	drainage are ea proposed a remaining in noved from th acres	a in the BMP catchme in the BMP catchment the BMP catchment a us catchment area by t	nt area area rea he proposed	ВМР	
	A ₁ =	0.57	acres	# of Lots	SF/Lot		
	А _Р = L _П =	0.99 536	acres Ibs		4 63	225 0	0.57 acres of IC for lots 0.00 acres of street

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

0.57 Total IC (acres)

Desired L _{M THIS} BASIN =	513	lbs.					
F=	0.96						
6. Calculate Capture Volume required by the BMP Type for this drainage bas	sin / outfall are	a.	Calculations from RG-	348	Pages 3-34 to 3-36		
Rainfall Depth =	2.80	inches					
Post Development Runoff Coefficient = On-site Water Quality Volume =	0.29 4611	cubic feet					
	Calculations fro	om 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					
Off-site Runoff Coefficient =	0.00						
Off-site Water Quality Volume =	D	cubic feet					
Storage for Sediment -	022						
Total Capture Volume (required water quality volume(s) x 1 20) =	5533	cubic feet					
The following sections are used to calculate the required water quality volu	me(s) for the s	elected BMP					
The values for BMP Types not selected in cell C45 will show NA.							
7. Retention/Irrigation System	Designed as R	lequired in RO	5-348	Pages 3-42 to	3-46		
Required Water Quality Volume for retention basin =	NA	cubic feet					
Irroation Area Calculations							
and ground and a second and a second state of the second state of							
Soil infiltration/permeability rate =	0.1	in/hr	Enter determined per	meability rate	or assumed value of ().1	
irrigation area =	NA	square teet					
	11A	acres					
8. Extended Detention Basin System	Designed as P	lequired in RC	3-348	Pages 3-46 to	3-51		
Bequired Water Quality Volume for extended detention basin =	NA	cubic feet					
required water quarky volume for extended detention basin -							
9. Filter area for Sand Filters	Designed as F	Required in RC	3-348	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 o	depth of 2 feet			
Minimum sedimentation basin area =	- NA	square leet	Por maximum water	depth of a fee			
9B. Partial Sedimentation and Filtration System							
Water Quality Volume for combined basins =	NA	cubic feet	SF @ Given Depth #VALUE!		Given Depth Width 5	L 90	ength #VALUE!
Minimum filter basin area =	- NA	square feet				90	#VALUE!
			Provide Party and a state of the			~~	
Maximum sedimentation basin area =	NA NA	square feet	For Given water dep	depth of 2 feet		90 90	#VALUE!
Minimum sedimentation basin area =	= NA	square feet	For maximum water	depth of 8 fee	t	90	#VALUE!
	-				1.121		
10. Bioretention System	Designed as H	Required in Hi	3-348	Pages 3-63 to	3-65		
Required Water Quality Volume for Bioretention Basin =	= NA	cubic feet					
11. Wet Basins	Designed as F	Required in R	G-348	Pages 3-66 to	3-71		
Required capacity of Permanent Pool = Required capacity at WQV Elevation =	NA NA	cubic feet cubic feet	Permanent Pool Cap Total Capacity shoul plus a second WQV.	ld be the Perm	mes the WQV nanent Pool Capacity		
12. Constructed Wetlands	Designed	Deputies of the De	2 248	Bagos 0.74	3 73		
12, constructed wettands	Designed as I	nequired in Ri	3-348	rages 3-71 to	13-13		
Required Water Quality Volume for Constructed Wetlands =	= NA	cubic feet					
<u>13. AquaLoqic[™] Cartridge System</u>	Designed as f	Required in R	G-348	Pages 3-74 to	3-78		

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 REMOVA	LS ARE BAS	ED UPON FLOW RATES	- NOT CALC	ULATED WATER QUALITY VOLUMES
15. Grassy Swales	Designed as	Required in RG-348	P	ages 3-51 to 3-54
Design parameters for the swale:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfall intensity = i = Swate Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	0.0 0.0 1 0.02 #DIV/0!	0 acres 0 acres 1 in/hr 5 ft/ft 3 5 ft		
A _{CS} = cross-sectional area of flow in Swale =	#DIV/0!	sf		
P _w = Wetted Perimeter =	#DIV/0!	feet		
$R_{H} = nydraulic radius of flow cross-section = ACS/PW = n = Manning's roughness coefficient =$	#DIV/0!	.2		
15A. Using the Method Described in the RG-348				
Manning's Equation. Q = <u>1.49</u> A _{CS} R _H ²³ S ⁰⁵ n				
$b = \frac{0.134 \text{ x Q}}{y^{1.67} \text{ S}^{0.5}} - zy =$	#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/01	feet		
If any of the resulting values do not meet the design requirement	t set forth in F	G-348, the design param	eters must be	modified and the solver rerun.
15B. Alternative Method using Excel Solver				
Design Q = CiA =	#DIV/0!	cfs		
Manning's Equation Q = Swale Width=	4. 36.	34 cfs 91 ft	Error 1 =	5.82
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	#DIV/01 #DiV/0!	ft/s ft		
Instructions are provided to the right (blue comments).				
Design Width = Design Discharge = Design Depth = Flow Velocity = Minimum Length =	1. 0. 0. 154.	6 ft 20 cfs 33 ft 51 cfs 12 ft	Error 2 =	#DIV/0!
If any of the resulting values do not meet the design requirement set forth in If any of the resulting values still do not meet the design requirement set fo	n RG-348, th rth in RG-34	e design parameters ma 8, widening the swale bo	y be modified ottom value n	and the solver rerun. ay not be possible.
16. Vegetated Filter Strips	Designed as	Required in RG-348		Pages 3-55 to 3-57

17. Wet Vaults	Designed a	s Required in RO	3-348 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 = Civ	Ą		
C = runoff coefficient for the drainage area = i = design rainfall intensity = A = drainage area in acres =	= C = =	.22 1.1 in/hour 1 acres	C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$
Q = flow rate in cubic feet per second	= C	.25 cubic feet/se	ec
RG-348 Page 3-31 Equation 3.5: $V_{QR} = Q/r$	4		
Q = Runoff rate calculated above A = Water surface area in the wet vault	= 0	1.25 cubic feet/se 150 square feet	20
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	i Ibs	
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 Efficiency Reduction for Actual Rainfall Intensity	= (0.75 percent 0.83 percent	
Resultant TSS Load removed by Wet Vault	= #VALUE	! Ibs	
18. Permeable Concrete	Designed a	s Required in R	G-348 Pages 3-79 to 3-83
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING 2	ONE		
19. BMPs Installed in a Series	Designed a	s Required in R	G-348 Pages 3-32
Michael E, Barrett, Ph.D., P.E. recommended that the coeff	icient for E ₂	be changed from	n 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	4.01 percent	NET EFFICIENCY OF THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E,	= 8	9.00 percent	
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2	= 70	0.00 percent	
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3	-	0.00 percent	
THEREFORE, THE NET LOAD REMOVAL WOULD BE: $(A_1 \text{ AND } A_P \text{ VALUES ARE FROM SECTION 3 ABOVE})$			
L _B = E _{TOT} X P X (A ₁ X 34.6 X A _P X0.54)	≠ 63	0.11 lbs	
20. Stormceptor			
Required TSS Removal in BMP Drainage Area Impervious Cover Overtreatmen	= NA	lbs ac	
TSS Removal for Uncaptured Area	= 0.00	lbs	
Effective Area	= NA	EA	
Calculated Model Size(s) Actual Model Size (if multiple values provided in Calculate Model Size or if you are choosing a larger model size)	= #N/A ed = 0	Model Size	
Surface Area	= #N/A	ft²	
Overflow Rate	= #VALUE		
Hounded Overflow Rate BMP Efficiency %	= #VALUE = #VALUE	=! Vor ≣! %	

		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 Vortach				
ZT. VORECH		Bequired TSS Bemoval in BMP Drainage Area=	NA	lbs
		Impervious Cover Overtreatment=	0.0000	ac
		TSS Removal for Uncaptured Area =	0.00	lbs
	BMP Sizing			
		NA	EA	
		#N/A		
	,	Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
		Surface Area =	7.10	f1 ²
		Overflow Rate =	#VALUE!	V _{ox}
		Rounded Overflow Rate =	#VALUE!	V _α
		BMP Efficiency % =	#VALUE!	%
		L _R Value =	#VALUE!	lbs
		TSS Load Credit =	#VALUE!	lbs
	Is Sufficient	Treatment Available? (TSS Credit > TSS Uncapt.)	#VALUE ¹	
		TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

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Texas Commission on Environmental Quality									
TSS Removal Calculations 04-20-2009				f D	Project Name ate Preparec	Mano 1: 6/1	/2015	Unit 6	
Additional information is provided for cells with a red triang Text shown in blue indicate location of instructions in the Technic Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Cha	le in the cal Guida inges to	these	r right cor anual - RC fields wil	rner, Pla 3-348. I remove	ce the cur the equat	sor ove	er the ce sed in th	e spread	sheet.
1. The Required Load Reduction for the total project:	Calcu	lations	rom RG-348	8		Pages	3-27 to 3	30	
Page 3-29 Equation 3.3: 1	- <u>t</u> . = 27.2(/	A _N x P)							
where. L _{M TOTAL PROJE}	_{ct} = Requi A _N = Net in P = Avera	rred TSS Increase Ige anni	S removal re in imperviou ual precipita	esulting from us area for t tion, inches	n the propose the project	ed develo	opment = 8	30% of incre	ased load
Site Data. Determine Required Load Removal Based on the Entire Pro Coun Total project area included in plan Predevelopment impervious area within the limits of the plar Total post-development impervious area within the limits of the pla Total post-development impervious cover fraction	pject = 4 n = 1 n = 1 P =	comal 40.55 0.00 10.47 0.26 33	acres acres acres inches	Lots	5	Street SF/Lo	s 1 6,225	138,758 317,475	3.19 7.29 10.47
* The values entered in these fields should be for the total project area.	ст =	9401	lbs.						
Number of drainage basins / outfalls areas leaving the plan are	ea =	6							
2. Drainage Basin Parameters (This information should be provided for	each basi	<u>in):</u>							
Drainage Basin/Outfall Area N	lo. = 🥠	A 6-3							
Total drainage basin/outfall ar Predevelopment impervious area within drainage basin/outfall ar Post-development impervious area within drainage basin/outfall ar Post-development impervious fraction within drainage basin/outfall ar L _{M THIS BA}	ea = ea = ea ≈ ea = sin =	1.68 0.00 0.57 0.34 513	acres acres acres Ibs.	# of Lo	ts	SF/Lo	1 6225 0	0.57	acres of IC for lots acres of street
3. Indicate the proposed BMP Code for this basin.	10 V		in out						
Removal efficien	ir - vege	80	percent			Aqual Biored Conte Const Exten Grass Reter Sand Storm Vege Vorte Wet E	ogic Cartr tention ech Stormf ructed We ded Deter sy Swale tition / Irrig Filter icceptor tated Filter chs Basin /ault	idge Filter Filter etland tition ation	
4. Calculate Maximum TSS Load Removed (L _R) for this Drainage Basin	by the sel	ected E	MP Type.						
RG-348 Page 3-33 Equation 3.7:	L _A = (BMF	P efficier	псу) х Р х (А	A ₁ x 34.6 + A	A _P x 0.54)				
where:	$A_c = Total$ $A_t = Impe$ $A_p = Pervi$ $L_R = TSS$ $A_c =$	I On-Site rvious a ious are Load re 1.68	e drainage a rea propose a remaining moved from acres	area in the I ed in the BM I in the BMI I this catchr	BMP catchme AP catchmen a catchment a nent area by	ent area t area area the prop	osed BMP		

A₁ ≃	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 _{M THIS BASIN} =	513	lbs.			
F =	0.95				
6. Calculate Capture Volume required by the BMP Type for this drainage bas	sin / outfall ar	ea.	Calculations from RG-3	48	Pages 3-34 to 3-36
Rainfall Depth = Post Development Runoff Coefficient = On-site Water Quality Volume =	2.60 0.28 4411	inches cubic feet			
	Calculations	from RG-348	Pages 3-36 to 3-37		
Off-site area draining to BMP = Off-site impervious cover draining to BMP = Impervious fraction of off-site area = Off-site Runoff Coefficient = Off-site Water Quality Volume =	0.00 0.00 0.00 0	acres acres cubic feet			
Storage for Sediment = Total Capture Volume (required water quality volume(s) x 1.20) = The following sections are used to calculate the required water quality volu The values for BMP Types not selected in cell C45 will show NA.	882 5293 me(s) for the	cubic feet selected BMP.			
7. Retention/Irrigation System	Designed as	Required in RG	i-348	Pages 3-42 to	3-46
Required Water Quality Volume for retention basin =	NA	cubic feet			
Irrigation Area Calculations:					
Soil infiltration/permeability rate = Irrigation area =	0.1 NA NA	in/hr square feet acres	Enter determined per	meability rate	or assumed value of 0.1
8. Extended Detention Basin System	Designed as	Required in RG	à-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	i-348	Pages 3-58 to	3-63
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System	Designed as	Required in RG	3-348	Pages 3-58 to	3-63
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin =	Designed as	Required in RC	3-348	Pages 3-58 to	3-63
<u>9. Filter area for Sand Filters</u> <u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basin = Minimum filter basin area =	Designed as NA NA	Required in RC cubic feet square feet	5-348	Pages 3-58 to	3-63
<u>9. Filter area for Sand Filters</u> <u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basin = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area =	Designed as NA NA NA NA	Required in RC cubic feet square feet square feet square feet	5-348 For minimum water d For maximum water t	Pages 3-58 to lepth of 2 feet depth of 8 fee	3-63
<u>9. Filter area for Sand Filters</u> <u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basin = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area =	Designed as NA NA NA NA	Required in RC cubic feet square feet square feet square feet	5-348 For minimum water d For maximum water t	Pages 3-58 to lepth of 2 feet depth of 8 fee	3-63
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basins =	Designed as NA NA NA NA	Required in RC cubic feet square feet square feet square feet cubic feet	5-348 For minimum water d For maximum water d	Pages 3-58 to lepth of 2 feet depth of 8 feet sf at 4' of dep	3-63
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin = Minimum filter basin area = Minimum sedimentation basin area = 9B. Partial Sedimentation and Filtration System Water Quality Volume for combined basins = Minimum filter basin area =	Designed as NA NA NA NA NA NA	Required in RC cubic feet square feet square feet square feet cubic feet square feet	5-348 For minimum water d For maximum water o #VALUE!	Pages 3-58 to lepth of 2 feet depth of 8 fee sf at 4' of dep	3-63 1
9. Filter area for Sand Filters 9. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = Mater Quality Volume for combined basins = Minimum filter basin area = Minimum filter basin area = Minimum sedimentation basin area = Maximum sedimentation basin area =	Designed as NA NA NA NA NA NA	Required in RC cubic feet square feet square feet square feet square feet square feet	5-348 For minimum water d For maximum water o #VALUE! For minimum water d For maximum water d	Pages 3-58 to lepth of 2 feet depth of 8 fee sf at 4' of dep lepth of 2 feet depth of 8 fee	3-63 h
 <u>9. Filter area for Sand Filters</u> <u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basin = Minimum filter basin area = Maximum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Mater Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = 	Designed as NA NA NA NA NA NA NA Designed as	Required in RC cubic feet square feet square feet cubic feet square feet square feet square feet square feet	5-348 For minimum water d For maximum water d #VALUE! For minimum water d For maximum water d	Pages 3-58 to lepth of 2 feel depth of 8 fee sf at 4' of depth depth of 2 feel depth of 2 feel Pages 3-63 to	3-63 h 1 3-65
9. Filter area for Sand Filters 9. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin area = Minimum filter basin area = Minimum sedimentation basin area = 9. Partial Sedimentation and Filtration System Water Quality Volume for combined basins = Minimum filter basin area = Minimum sedimentation basin area = M	Designed as NA NA NA NA NA NA NA NA NA	Required in RC cubic feet square feet square feet cubic feet square feet square feet square feet square feet Required in RC cubic feet	5-348 For minimum water d For maximum water o #VALUE! For minimum water o For maximum water o 3-348	Pages 3-58 to lepth of 2 feel depth of 8 fee st at 4' of depth depth of 2 feel depth of 8 fee Pages 3-63 to	3-63 h 3-65
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin area = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = Mater Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Minimum filter basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Minimum filter basin area = Maximum sedimentation basin area = Minimum se	Designed as NA NA NA NA NA NA Designed as NA Designed as	Required in RC cubic feet square feet square feet cubic feet square feet square feet square feet Required in RC cubic feet Required in RC	5-348 For minimum water d For maximum water d #VALUE! For minimum water d 5-348	Pages 3-58 to lepth of 2 feet depth of 8 feet sf at 4' of dept depth of 8 feet Pages 3-63 to Pages 3-66 to	3-63 h 3-65 3-71
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin area = Minimum filter basin area = Maximum sedimentation basin area = Minimum filter basin area = Maximum sedimentation basin area = Maximum filter basin area = Minimum filter basin area = Maximum sedimentation basin area = Maximum sedimentat	Designed as NA NA NA NA NA Designed as NA Designed as NA	Required in RC cubic feet square feet square feet cubic feet square feet square feet square feet Required in RC cubic feet cubic feet cubic feet	5-348 For minimum water d For maximum water d #VALUE! For minimum water d For maximum water d 3-348 3-348 Permanent Pool Capi Total Capacity shoul plus a second WQV.	Pages 3-58 to lepth of 2 feet depth of 8 fee sf at 4' of dept depth of 8 fee Pages 3-63 to Pages 3-66 to acity is 1.20 t d be the Perm	3-63 h h 3-65 3-71 imes the WQV hanent Pool Capacity
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Minimum filter basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Minimum filter basin area = Minimum filter basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Minimum filter basin area = Maximum sedimentation basin area = Minimum filter basin area = Maximum sedimentation bas	Designed as NA NA NA NA NA Designed as NA Designed as NA NA	Required in RC cubic feet square feet square feet cubic feet square feet square feet square feet Required in RC cubic feet cubic feet cubic feet cubic feet	5-348 For minimum water of For maximum water of #VALUE! For minimum water of 3-348 3-348 Permanent Pool Capi Total Capacity shoul plus a second WQV. 3-348	Pages 3-58 to lepth of 2 feet depth of 8 feet sf at 4' of dept depth of 8 feet Pages 3-63 to Pages 3-66 to acity is 1.20 t d be the Perm Pages 3-71 to	3-63 h h 3-65
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin area = Minimum sedimentation basin area = Maximum sedimentation basin area = Minimum filter basin area = Minimum sedimentation basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Minimum sedimentat	Designed as NA NA NA NA NA Designed as NA Designed as NA	Required in RC cubic feet square feet square feet cubic feet square feet square feet square feet square feet square feet Required in RC cubic feet cubic feet cubic feet cubic feet cubic feet	5-348 For minimum water of For maximum water of #VALUE! For minimum water of For maximum water of 3-348 S-348 Permanent Pool Capit Total Capacity shoul plus a second WQV. 3-348	Pages 3-58 to lepth of 2 feel depth of 8 fee sf at 4' of depth depth of 2 feel depth of 2 feel depth of 8 fee Pages 3-63 to Pages 3-66 to acity is 1.20 t d be the Perm Pages 3-71 to	3-63 h h 3-65 3-71 imes the WQV hanent Pool Capacity 3-73

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) ⇒	NA NA NA	cubic feet cartridges 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 REMOVA	ALS ARE BASE	D UPON FLOW RA	TES - NOT CALC	ULATED WATER QUALITY VOLUMES
15. Grassy Swales	Designed as R	equired in RG-348	Pa	ages 3-51 to 3-54
Design parameters for the swale:				
Drainage Area to be Treated by the Swate = A = Impervious Cover in Drainage Area = Rainfall intensity = 1 = Swale Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	0.00 0.00 1.1 3 0.33 #DIV/0!	acres acres in/hr ft/ft t		
A_{cs} = cross-sectional area of flow in Swale =	#DIV/01	sf		
P _w = Wetted Perimeter =	#DIV/01	feet		
R_{H} = hydraulic radius of flow cross-section = A_{CS}/P_{W} = n = Manning's roughness coefficient =	#D1V/01 0.2	teet		
15A. Using the Method Described in the RG-348				
Manning's Equation: $Q = 1.49 A_{CS} R_{H}^{23} S^{0.5}$ n				
$b = 0.134 \times Q$ - zy = $y^{167} S^{05}$	#DIV/01	feet		
Q = CiA =	#DIV/01	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/01	feet		
If any of the resulting values do not meet the design requiremen	it set forth in R(G-348. the design pa	rameters must be	modified and the solver rerun.
15B. Alternative Method using Excel Solver				
Design Q = CiA =	#DIV/01	cfs		
Manning's Equation Q = Swale Width=	0 76 6 00	6 cfs D ft	Error 1 =	#DIV/0!
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	#DIV/0! #DIV/0!	ft∕s ft		
Instructions are provided to the right (blue comments).				
Design Width = Design Discharge = Design Depth = Flow Velocity = Minimum Length =	: 0.71 : 0.33 = 0.3; = 97.4;	6 ft 6 cfs 3 ft 2 cfs 8 ft	Error 2 =	#DIV/0!
in any or the resulting values do not meet the design requirement set forth i	11 HG-348, the	uesign parameters	may be modified	and the solver rerun.

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 reru-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

17. Wet Vaults	Desig	gned as R	equired in RG	-348	Pages 3-30 to 3-32 & 3-79
Required Load Removal Based upon Equation 3.3	2	NA	lbs		
First calculate the load removal at 1.1 in/hour					
RG-348 Page 3-30 Equation 3.4: $Q = Ci$	iA				
C = runoff coefficient for the drainage area i = design rainfall intensity A = drainage area in acres	= =	0.20 1.1 1	in/hour acres	C = Runoff Coefficie	nt = 0.546 (IC) ² + 0.328 (IC) + 0.03
Q = flow rate in cubic feet per second	=	0.23	cubic feet/se	c	
RG-348 Page 3-31 Equation 3.5 [.] V _{OR} = Q	/A				
Q = Runoff rate calculated above A = Water surface area in the wet vault	=	0 23	cubic feet/se square feet	c	
V _{OR} = Overflow Rate	=	0.00	teet/sec		
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31)	5	53	percent		
Load removed by Wet Vault	t = #∖	ALUE	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	5 =	0.6	in/hour		
Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 Efficiency Reduction for Actual Rainfall Intensity	2 = / =	0.75	percent percent		
Resultant TSS Load removed by Wet Vault	t = #\	VALUE!	lbs		
18. Permeable Concrete	Desig	gned as P	lequired in RG	3-348	Pages 3-79 to 3-83
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING	ZONE				
19. BMPs Installed in a Series	Desi	gned as P	Required in RG	3-348	Pages 3-32
Michael E. Barrett, Ph.D., P.E. recommended that the coef	ficient f	for E ₂ be	changed from	n 0.5 to 0.65 on May 3	3, 2006
$E_{TOT} = \{1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))\} \times 100$) =	94.01	1 percent	NET EFFICIENCY O	F 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 =	0.04	percent		
THEREFORE, THE NET LOAD REMOVAL WOULD BE. (A; AND AP VALUES ARE FROM SECTION 3 ABOVE)					
L _B = E _{TOT} X P X (A, X 34.6 X A _P X0.54)) =	632 1	2 lbs		
20. Stormceptor Required TSS Removal in BMP Drainage Are Impervious Cover Overtreatmer TSS Removal for Uncaptured Area BMP Sizing Effective Area Calculated Model Size(s Actual Model Size (if multiple values provided in Calculated Model Size (if multiple values provided in Calculated Model Size (if multiple values pro	ha= nt= (a = a =) = ted	NA 0.0000 0.00 NA #N/A	lbs ac lbs EA		
Model Size or if you are choosing a larger model size Surface Area Overflow Rate Rounded Overflow Rate BMP Efficiency % L _R Value)= a= e= # e= # %= #	#N/A VALUE! VALUE! VALUE! VALUE!	model Size ft ² V₀ V₀ % Ibs		

	TSS Load Credit =	#VALUE!	lbs
Is	Sufficient Treatment Available? (TSS Credit > TSS Uncapt.)	#VALUE!	
	TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	
21. Vortech	Populated TSS Removal in BMP Drainage Area-	NA	lbc
	mequiled 155 Removal III Bivir Drainage Area=	0.0000	105
	TSS Berroval for Lincentured Area -	0.000	ibs
BM	P Sizing	0.00	100
	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 _{or}
	Rounded Overflow Rate =	#VALUE!	Var
	BMP Efficiency % =	#VALUE!	%
	L _a Value =	#VALUE!	lbs
	TSS Load Credit =	#VALUE!	lbs
ls	Sufficient Treatment Available? (TSS Credit > TSS Uncapt.)	#VALUE!	
	TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

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Texas Commission on Environmental Quality									
TSS Removal Calculations 04-20-2009				Projec Date Pr	t Name: repared:	Manor 6/1/2	Creek 2015	Unit 6	
Additional information is provided for cells with a red triang Text shown in blue indicate location of instructions in the Technic Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Cha	le in the cal Guid inges to	e upper ance Mar these fi	right corn nual - RG- elds will i	er. Place th 348. remove the	ne curso equatio	or over	the ce	e sprea	dsheet.
1. The Required Load Reduction for the total project:	Calc	ulations fro	m RG-348			Pages 3	-27 to 3-	30	
Page 3-29 Equation 3.3.	L _M = 27.2	(A _N x P)							
where: L _{M TOTAL PROJE}	_{ct} = Requ A _N = Neti P = Aver	uired TSS ncrease in age annua	emoval resu impervious I precipitatio	ulting from the area for the pr on, inches	proposed oject	develop	ment = 8	10% of inc	reased load
Site Data: Determine Required Load Removal Based on the Entire Pro	oject								
Coun Total project area included in plan Predevelopment impervious area within the limits of the plar Total post-development impervious area within the limits of the pla Total post-development impervious cover fraction	n' = n' = n' = P =	Comal 40.55 0.00 10.47 0.26 33	acres acres acres inches	Lots	51	Streets SF/Lot	,225	138,758 317 475	3.19 7.29 10.47
LM TOTAL PROJE	ст =	9401	lbs.						
* The values entered in these fields should be for the total project area.									
Number of drainage basins / outfalls areas leaving the plan are	ea =	6							
2. Drainage Basin Parameters (This information should be provided for	each bas	sin):							
Drainage Basin/Outfall Area N	lo. =	A 6-4							
Total drainage basin/outfall ar Predevelopment impervious area within drainage basin/outfall ar Post-development impervious area within drainage basin/outfall ar Post-development impervious fraction within drainage basin/outfalt ar L _{M THIS BA}	ea = ea = ea = ea =	1.91 0.00 0.86 0.45 770	acres acres acres lbs	# of Lots	6	SF/Lot	6225 0	0.86	acres of IC for lots acres of street
3. Indicate the proposed BMP Code for this basin.									
Proposed Bh	MP = Veg	etated Filt	er Strips						
	ucy =	80	percent			Aqualog Bioreter Contect Constru Extende Grassy Relentio Stormoo Vegetal Vortech Wet Ba Wet Va	gic Cartri ntion n StormF icted We ed Deten Swale on / Irriga ilter eptor ed Filter is sin ult	idge Filter itland ition ation Strips	
4. Calculate maximum 1 SS Load Removed (L _R) for this brainage Basin	by the se		ip Type.	246	54)				
Horsee Hage siss Equation 3.7:		- enicienc	y) x r x (A ₁)	ς 34.0 + Αρ X U.	54)				
where:	$A_{c} = Tota$ $A_{i} = Imperior A_{P} = PeriorL_{R} = TSS$	al On-Site (prvious are vious area 6 Load rem	trainage are a proposed remaining ir oved from th	ea in the BMP ca In the BMP ca In the BMP catc his catchment a	catchment tchment a hment are area by th	area Irea ea e propos	ed BMP		
	A _C = A _I = A _P = L _R =	1.91 0.86 1.05 798	acres acres acres ibs	# of Lots	e	SF/Lot	6225 0	0.8	16 acres of IC for lots 0 acres of street

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

Desired L _{M THIS BASIN} =	770	lbs		
F =	0.96			
6. Calculate Capture Volume required by the BMP Type for this drainage bas	in / outfall a	rea.	Calculations from RG-3	348 Pages 3-34 to 3-36
Rainfall Depth = Post Development Runoff Coefficient = On-site Water Quality Volume =	2.80 0.33 6421	inches cubic feet		
	Calculations	from HG-348	Pages 3-36 to 3-37	
Off-site area draining to BMP = Off-site Impervious cover draining to BMP = Impervious fraction of off-site area = Off-site Runoff Coefficient = Off-site Water Quality Volume =	0.00 0 0.00 0	acres acres		
	1004			
Total Capture Volume (required water quality volume(s) x 1.20) = The following sections are used to calculate the required water quality volu The values for BMP Types not selected in cell C45 will show NA.	7706 me(s) for the	cubic feet selected BMP		
7. Retention/Irrigation System	Designed as	Required in RG	i-348	Pages 3-42 to 3-46
Required Water Quality Volume for retention basin =	NA	cubic feet		
Irrigation Area Calculations:				
Soil infiltration/permeability rate = Irrigation area =	0.1 NA NA	in/hr square feet acres	Enter determined per	meability rate or assumed value of 0.
8. Extended Detention Basin System	Designed as	Required in RG	3-348	Pages 3-46 to 3-51
Required Water Quality Volume for extended detention basin \approx	NA	cubic feet		
9. Filter area for Sand Filters	Designed as	Required in RC	3-348	Pages 3-58 to 3-63
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System	Designed as	Required in RC	3-348	Pages 3-58 to 3-63
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin =	Designed as	Required in RC	3-348	Pages 3-58 to 3-63
<u>9. Filter area for Sand Filters</u> <u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basin = Minimum filter basin area =	Designed as NA NA	Required in RC cubic feet square feet	3-348	Pages 3-58 to 3-63
<u>9. Filter area for Sand Filters</u> <u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basin == Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area =	Designed as NA NA NA NA	Required in RC cubic feet square feet square feet square feet	3-348 For minimum water d For maximum water (Pages 3-58 to 3-63 lepth of 2 feet depth of 8 feet
<u>9. Filter area for Sand Filters</u> <u>9A. Full Sedimentation and Filtration System</u> Water Quality Volume for sedimentation basin == Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area =	Designed as NA NA NA NA	Required in RC cubic feet square feet square feet square feet	3-348 For minimum water d For maximum water (Pages 3-58 to 3-63 Septh of 2 feet depth of 8 feet
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Image: System Water Quality Volume for sedimentation basin area Image: System Maximum sedimentation basin area Image: System 9B. Partial Sedimentation and Filtration System Image: System Water Quality Volume for combined basins Image: System	Designed as NA NA NA NA	Required in RC cubic feet square feet square feet square feet cubic feet	3-348 For minimum water o For maximum water o ¢VALUE!	Pages 3-58 to 3-63 lepth of 2 feet depth of 8 feet
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin area = Minimum filter basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = Minimum filter basin area = Minimum filter basin area = Minimum filter basin area =	Designed as NA NA NA NA NA NA	Required in RC cubic feet square feet square feet square feet cubic feet square feet	3-348 For minimum water o For maximum water o #VALUE!	Pages 3-58 to 3-63 lepth of 2 feet depth of 8 feet sf at 4' of depth
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Image: System Water Quality Volume for sedimentation basin area Image: System Maximum sedimentation basin area Image: System 9B. Partial Sedimentation and Filtration System Image: System Water Quality Volume for combined basins Image: System Mater Quality Volume for combined basins Image: System Maximum sedimentation basin area Image: System	Designed as NA NA NA NA NA NA	Required in RC cubic feet square feet square feet cubic feet square feet square feet	3-348 For minimum water of For maximum water of #VALUE! For minimum water of For maximum water of	Pages 3-58 to 3-63 lepth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 8 feet
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin area = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Minimum filter basin area = Minimum sedimentation basin area =	Designed as NA NA NA NA NA NA NA NA Designed as	Required in RC cubic feet square feet square feet square feet square feet square feet square feet square feet	3-348 For minimum water of For maximum water of eVALUE! For minimum water of For maximum water of 3-348	Pages 3-58 to 3-63 lepth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 3 feet Pages 3-63 to 3-65
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Image: System Water Quality Volume for sedimentation basin area Image: System Maximum sedimentation basin area Image: System 9B. Partial Sedimentation and Filtration System Image: System Water Quality Volume for combined basins Image: System Maximum sedimentation basin area Image: System Maximum Sedimentation System Image: System Maximum sedimentation basin area Image: System Maximum Sedimentation System Image: System Maximum Sedimentation Sy	Designed as NA NA NA NA NA NA NA NA NA NA	Required in RC cubic feet square feet square feet cubic feet square feet square feet square feet square feet square feet cubic feet	3-348 For minimum water o For maximum water o #VALUE! For minimum water o For maximum water o 3-348	Pages 3-58 to 3-63 lepth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 2 feet depth of 8 feet Pages 3-63 to 3-65
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Image: System Water Quality Volume for sedimentation basin area Image: System Maximum sedimentation basin area Image: System 9B. Partial Sedimentation and Filtration System Image: System Water Quality Volume for combined basins area Image: System Maximum sedimentation basin area Image: System Maximum sedimentation basin area Image: System Intervention System Image: System Mater Quality Volume for Bioretention Basin area Image: System Int. Wet Basins Image: System	Designed as NA NA NA NA NA NA NA NA Designed as NA	Required in RC cubic feet square feet square feet cubic feet square feet square feet square feet square feet square feet square feet	3-348 For minimum water o For maximum water o eVALUE! For minimum water o 3-348 3-348	Pages 3-58 to 3-63 lepth of 2 feet depth of 8 feet si at 4' of depth depth of 2 feet depth of 8 feet Pages 3-63 to 3-65 Pages 3-66 to 3-71
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin area Minimum filter basin area Maximum sedimentation basin area Minimum sedimentation basin area Minimum sedimentation basin area Minimum sedimentation basin area Minimum sedimentation basin area Maxer Quality Volume for combined basins Minimum filter basin area Minimum filter basin area Minimum sedimentation basin area Maximum sedimentation basin area Minimum sedimentation basin area	Designed as NA NA NA NA NA Designed as NA Designed as NA	Required in RC cubic feet square feet	3-348 For minimum water of For maximum water of eVALUE! For minimum water of For maximum water of 3-348 3-348 S-348 Permanent Pool Cap Total Capacity shoul plus a second WQV.	Pages 3-58 to 3-63 lepth of 2 feet depth of 8 feet si at 4' of depth depth of 2 feet depth of 2 feet depth of 8 feet Pages 3-63 to 3-65 Pages 3-66 to 3-71 acity is 1.20 times the WOV id be the Permanent Pool Capacity
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin area = Minimum filter basin area = Maximum sedimentation basin area = Minimum filter basin area = Maximum sedimentation basin area = Minimum filter basin area = Maximum sedimentation basin area =	Designed as NA NA NA NA NA NA Designed as NA Designed as	Required in RC cubic feet square feet squa	3-348 For minimum water of For maximum water of eVALUE! For minimum water of For maximum water of 3-348 3-348 Permanent Pool Cap Total Capacity shoul plus a second WQV. 3-348	Pages 3-58 to 3-63 lepth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 2 feet depth of 2 feet depth of 3 feet Pages 3-63 to 3-65 Pages 3-66 to 3-71 acity is 1.20 times the WOV id be the Permanent Pool Capacity Pages 3-71 to 3-73
9. Filter area for Sand Filters 9A. Full Sedimentation and Filtration System Water Quality Volume for sedimentation basin area Minimum filter basin area Maximum sedimentation basin area Minimum sedimentation basin area Minimum sedimentation basin area Minimum sedimentation basin area Minimum filter basin area Minimum filter basin area Maximum sedimentation basin area Minimum filter basin area Minimum filter basin area Maximum sedimentation basin area Maximum sedimentation basin area Minimum filter basin area Minimum filter basin area Maximum sedimentation basin area Maximum sedimentation basin area Maximum sedimentation basin area Minimum filter basin area Maximum sedimentation basin area<	Designed as NA NA NA NA NA NA Designed as NA Designed as NA	Required in RC cubic feet square feet squa	3-348 For minimum water of For maximum water of #VALUE! For minimum water of For maximum water of 3-348 3-348 Permanent Pool Cap Total Capacity shoul plus a second WQV. 3-348	Pages 3-58 to 3-63 lepth of 2 feet depth of 8 feet sf at 4' of depth depth of 2 feet depth of 2 feet depth of 2 feet Pages 3-63 to 3-65 Pages 3-66 to 3-71 acity is 1.20 times the WOV id be the Permanent Pool Capacity Pages 3-71 to 3-73

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 REMOVAL	S ARE BASI	ED UPON FL	OW RATES - N	OT CALCL	JLATED WATER QUALITY VOLUMES
15. Grassy Swales De	esigned as P	lequired in R	G-348	Pa	ges 3-51 to 3-54
Design parameters for the swale:					
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfall intensity = i = Swale Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	0.00 0.00 1.1 0.01 3 0.30 #DIV/0!) acres) acres I in/hr I ft/ft 3 ft			
Ans = 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			
	0.4	2			
15A. Using the Method Described in the HG-348					
Manning's Equation: $Q = 1.49 A_{CS} R_{H}^{2/3} S^{0.5}$ n					
$b = \frac{0.134 \text{ x } \Omega}{y^{1.67} \text{ S}^{0.5}} - zy =$	#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 s	set forth in R	G-348, the d	esign parameter	s must be r	nodified and the solver rerun.
15B. Alternative Method using Excel Solver					
Design Q = CiA =	#DIV/0!	cfs			
Manning's Equation Q = Swale Width=	0.7 6.0	6 cfs 0 ft	E	Error 1 =	#DIV/0!
Instructions are provided to the right (green comments).					
Flow Velocity Minimum Length #	#DIV/0' #DIV/0'	ft/s ft			
Instructions are provided to the right (blue comments).					
Design Width = Design Discharge = Design Depth = Flow Velocity = Minimum Length =	0.7 0.3 0.3 97.4	6 ft 6 cfs 3 ft 2 cfs 8 ft	amelare meu ho	Error 2 =	#DIV/0!

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

17. Wet Vaults	Designed as	Required in RG	-348 Pa	iges 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	29	C = Runoff Coefficient =	= 0.546 (IC) ² + 0.328 (IC) + 0.03
i = design raintali intensity = A = drainage area in acres ≂		1.1 in/hour 1 acres		
Q = flow rate in cubic feet per second =	0	.32 cubic feet/se	C	
RG-348 Page 3-31 Equation 3 5: V _{OR} = Q/A				
Q = Runoff rate calculated above = A = Water surface area in the wet vault =	0	.32 cubic feet/se 150 square feet	c	
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 = Efficiency Reduction for Actual Rainfall Intensity ≈	C	75 percent .83 percent		
Resultant TSS Load removed by Wet Vault =	#VALUE	! Ibs		
18. Permeable Concrete	Designed a	s Required in R(-348 Pa	ages 3-79 to 3-83
PERMEARI E CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING 70	WE			
19. BMPs Installed in a Series	Designed a	s Required in R(i-348 Pa	ages 3-32
Michael E Barrett, Ph.D., P.E. recommended that the coeffic	ient for E.	e changed from	0.5 to 0.65 on May 3. 2	006
$E_{TOT} = (1 - ((1 - E_1) \times (1 - 0.05E_2) \times (1 - 0.25E_3)) \times 100 =$	94	or percent	NET EFFICIENCY OF I	HE DIVIES 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 = $E_3 =$. (00 percent		
THEREFORE, THE NET LOAD REMOVAL WOULD BE: (A, AND A, VALUES ARE FROM SECTION 3 ABOVE)				
L _R = E _{TOT} X P X (A ₁ X 34.6 X A _P X0.54) =	937	.96 lbs		
20. Starmontor				
Required TSS Removal in BMP Drainage Area=	NA	ibs		
TSS Removal for Uncaptured Area =	0.00	lbs		
EMP 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		
Surtana Araa -	± #N/∆	ft ²		
Overflow Rate =	= #VALUE	U Va		
Rounded Overflow Rate =	#VALUE	V _a		
BMP Efficiency % =	#VALUE	! %		
L _A Value =	#VALUE	l lbs		

		TSS Load Credit =	#VALUE!	lbs
	Is Sufficient Treatment Availa	ble? (TSS Credit <u>></u> TSS Uncapt.)	#VALUE!	
	TSS Treatme	nt by BMP (LM + TSS Uncapt.) =	#VALUE!	
21 Verteeb				
21. Vortech	Required TSS	Removal in BMP Drainage Area=	NA	lbs
	TSS	Removal for Uncaptured Area =	0.00	lbs
	BMP Sizing	Ellesting Area		54
		Calculated Model Size(s) =	#N/A	EA
	Actual Model Size	(if choosing larger model size) =	Vx1000	Pick Model Size
		Surface Area =	7.10	ft²
		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 Availa	ble? (TSS Credit > TSS Uncapt.)	#VALUE!	

Texas Commission on Environmental Quality									
TSS Removal Calculations 04-20-2009				Project Date Pre	Name: epared:	Manor 6/1/2	Creek 2015	Unit 6	
Additional information is provided for cells with a red triang Text shown in blue indicate location of instructions in the Techni Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Cha	gle in t ical Gui anges	he upper idance M to these	r <mark>right cor</mark> r anual - RG fields will	ner. Place th -348. remove the e	e curs equation	or over	the ce	II. e spread	sheet.
1. The Required Load Reduction for the total project:	Ca	culations f	rom RG-348			Pages 3	-27 to 3-	30	
Page 3-29 Equation 3 3:	L _M = 27	.2(A _N x P)							
where: L _{M TOTAL PROJ}	_{ECT} = Re A _N = Ne P = Av	equired TSS et increase erage anni	S removal res in impervious ual precipitati	sulting from the p s area for the pro ion, inches	ropose ject	d develop	oment = 8	0% of incre	eased load
Site Data: Determine Required Load Removal Based on the Entire Pr Cou Total project area included in plar Predevelopment impervious area within the limits of the pla Total post-development impervious area within the limits of the pla Total post-development impervious cover fractio	oject nty = n * = an* = P =	Comal 40.55 0.00 10.47 0.26 33	acres acres acres inches	Lots	51	Streets SF/Lot	3,225	138,758 317,475	3.19 7.29 10.47
LM TOTAL PROV * The values entered in these fields should be for the total project area	EGT = 1.	9401	lbs.						
Number of drainage basins / outfalls areas leaving the plan a	rea =	6							
2. Drainage Basin Parameters (This information should be provided for Drainage Basin/Outfall Area I	reach b	aşin): A 6-5							
Total drainage basin/outfall a Predevelopment impervious area within drainage basin/outfall a Post-development impervious area within drainage basin/outfall a Post-development impervious fraction within drainage basin/outfall a Lutrista	rea = rea = rea = rea = rea =	2.24 0.00 0.86 0.38 770	acres acres acres ibs.	# of Lots	1	SF/Lot	6225 0	0.86	acres of IC for lots acres of street
3. Indicate the proposed BMP Code for this basin.									
Proposed B	MP = Ve	egetated F	ilter Strips						
			percent			Aqualo Biorete Contec Constru Extend Grassy Retenti Sand F Stormc Vegeta Vortech Wet Ba Wet Va	gic Cartri ntion h StormF Jocted We ed Deten Swale on / Irriga ilter eptor ted Filter as ut	dge Fifter filter itland tion ation Strips	
4. Calculate Maximum TSS Load Removed (L _R) for this Drainage Basin	by the	selected E	MP Type.						
RG-348 Page 3-33 Equation 3.7;	L _A = (8	MP efficier	ncy) x P x (A _l	x 34.6 + A _P x 0.5	54)				
where:	$A_c = Tc$ $A_t = Irr$ $A_P = Pc$ $L_R = Ts$	otal On-Site opervious a ervious are SS Load re	e drainage ar area proposed a remaining moved from 1	ea in the BMP ca d in the BMP cate in the BMP catch this catchment a	atchmer chment iment a rea by t	nt area area rea ne propos	sed BMP		
	A _C = A _I = A _P =	2.24 0.86 1.38	acres acres acres	# of Lots		SF/Lot	6225	0.8	5 acres of IC for lots

L_R = 803

lbs

0

0 acres of street

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

Desired L _{M THIS} BASIN =	770	lbs.			
F =	0.96				
6. Calculate Capture Volume required by the BMP Type for this drainage bas	sin / outfall a	rea.	Calculations from RG-	348 Pages 3-34 to	3-36
Beinfall Depth	2.80	inches			
Post Development Runoff Coefficient =	0.30	incres			
Un-site Water Quality Volume =	P144	CUDIC TEET			
	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 = Impervious fraction of off-site area =	0.00	acres			
Off-site Runoff Coefficient =	0.00	outric foot			
On-she water Quality Volume =	U	cubic leet			
Storage for Sediment =	1360	10.10 544			
Total Capture Volume (required water quality volume(s) x 1.20) = The following sections are used to calculate the required water quality volu	8159 me(s) for the	cubic feet selected BMP	6		
The values for BMP Types not selected in cell C45 will show NA.	Decisered as	Deputed in DC	240	Dana 2 40 to 2 40	
7. Retention/inquition System	Designed as	nequired in no		rages 3-42 to 3-40	
Required Water Quality Volume for retention basin =	NA	cubic feet			
Irrigation Area Calculations:					
Soil infiltration/permeability rate =	0.1	in/hr	Enter determined per	meability rate or assumed	value of 0.1
Irrigation area =	NA NA	square feet			
8. Extended Detention Basin System	Designed as	Required in RG	3-348	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 RC	3-348	Pages 3-58 to 3-63	
0.0 Eull Sedimentation and Eiltration System					
<u>SA. Full Sedimentation and Finfation System</u>		and in faces			
water Quality volume for sedimentation basin =	NA	cubic feet			
	NA	Square reet	For all the second second	louth of D foot	
Minimum sedimentation basin area = 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	
	Designed	Regulard in Di	2.010	Dages 2 62 to 2 65	
10. Bioretention System	Lifesigned as	nequired in Hu	3-340	Pages 3-03 to 3-05	
Required Water Quality Volume for Bioretention Basin =	NA NA	cubic feet			
11. Wet Basins	Designed as	Required in R	G-348	Pages 3-66 to 3-71	
Required capacity of Permanent Pool =	NA	cubic feet	Permanent Pool Cap	acity is 1.20 times the WC	V
Required capacity of Permanent Pool = Required capacity at WQV Elevation =	NA NA	cubic feet cubic feet	Permanent Pool Cap Total Capacity shou plus a second WQV.	acity is 1.20 times the WC Id be the Permanent Pool	V Capacity
Required capacity of Permanent Pool = Required capacity at WQV Elevation = <u>12. Constructed Wetlands</u>	NA NA Designed as	cubic feet cubic feet	Permanent Pool Cap Total Capacity shou plus a second WQV. 3-348	acity is 1.20 times the WC Id be the Permanent Pool Pages 3-71 to 3-73	V Capacity
Required capacity of Permanent Pool = Required capacity at WQV Elevation = 12. Constructed Wetlands	NA NA Designed as	cubic feet cubic feet Required in R(Permanent Pool Cap Total Capacity shou plus a second WQV. 3-348	acity is 1.20 times the WC Id be the Permanent Pool Pages 3-71 to 3-73	W Capacity
Required capacity of Permanent Pool = Required capacity at WQV Elevation = <u>12. Constructed Wetlands</u> Required Water Quality Volume for Constructed Wetlands =	NA NA Designed as	cubic feet cubic feet Required in R(cubic feet	Permanent Pool Cap Total Capacity shou plus a second WQV. 3-348	acity is 1.20 times the WC Id be the Permanent Pool Pages 3-71 to 3-73	IV Capacity
Required capacity of Permanent Pool = Required capacity at WQV Elevation = <u>12. Constructed Wetlands</u> Required Water Quality Volume for Constructed Wetlands = 13. Aqual ogic TM Cadridge System	NA NA Designed as	cubic feet cubic feet Required in Ro cubic feet	Permanent Pool Cap Total Capacity shou plus a second WQV. 3-348	Pages 3-74 to 3-78	W Capacity

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 REMOVAL	S ARE BAS	ED UPON FLO	W RATES - NOT CAL	CULATED WATER QUALITY VOLUMES
15. Grassy Swales	lesigned as F	Required in RG	-348	Pages 3-51 to 3-54
Design parameters for the swale:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfall intensity = i = Swale Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	0.0 0.0 1. 0.0 0.3 #DIV/0!	0 acres 0 acres 1 in/hr 1 ft/ft 3 3 ft		
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} = n = Manning's roughness coefficient =	#DIV/0! 0.	feet 2		
15A. Using the Method Described in the RG-348				
Manning's Equation: Q = <u>1.49</u> A _{CS} R _H ²³ S ⁰⁵ n				
$b = 0.134 \times Q$ - zy = $y^{1.67} S^{0.5}$	#DIV/01	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 R	G-348. the des	ion parameters must be	e modified and the solver rerun.
15B. Alternative Method using Excel Solver				
Design Q = CiA =	#DIV/0	cts		
	#D10/0	Cio	Error 1 –	
Swale Width=	6.0	0 ft		
Instructions are provided to the right (green comments).				
Fłow Velocity Minimum Length =	#DIV/01 #DIV/01	ft/s ft		
Instructions are provided to the right (blue comments).				
Design Width = Design Discharge = Design Depth = Flow Velocity = Minimum Length =	0.7 0.3 0.2 97.4	6 ft 76 cfs 33 ft 32 cfs 18 ft	Error 2 =	#DIV/01

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 reru 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

17. Wet Vaults	Designed as	Required in R	3-348 P	ages 3-30 to 3-32 & 3-79
Required Load Removal Based upon Equation 3.3	s = NA	lbs		
First calculate the load removal at 1.1 in/hour				
RG-348 Page 3-30 Equation 3.4: Q = C	ыA			
C = runoff coefficient for the drainage area i = design rainfall intensity A = drainage area in acres	1 = 0 / = 5 =	24 1.1 in/hour 1 acres	C = Runoff Coefficient	= 0.546 (IC) ² + 0.328 (IC) + 0.03
Q = flow rate in cubic feet per second	d = 0	26 cubic feet/s	ec	
RG-348 Page 3-31 Equation 3.5: V _{OR} = C)/A			
Q = Runoff rate calculated above A = Water surface area in the wet vaul	e = 0 t =	26 cubic feet/s 50 square feet	ec	
V _{OR} = Overflow Rate	e = C	00 feet/sec		
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	53 percent		
Load removed by Wet Vau	t = #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 Occur	S =	0.5 in/hour		
Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-3 Efficiency Reduction for Actual Rainfall Intensit	2 = 0 y = 0	75 percent .83 percent		
Resultant TSS Load removed by Wet Vau	it = #VALUE	lbs		
18. Permeable Concrete	Designed a	s Required in R	G-348 P	ages 3-79 to 3-83
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING	ZONE			
19. BMPs Installed in a Series	Designed a	s Required in R	G-348 P	ages 3-32
Michael E. Barrett, Ph.D., P.E. recommended that the coe	fficient for E ₂ I	e changed fro	n 0.5 to 0.65 on May 3, 2	2006
$E_{TOT} = [1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 10$	0 = 94	01 percent	NET EFFICIENCY OF 1	THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E	, = 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 = (00 percent		
THEREFORE, THE NET LOAD REMOVAL WOULD BE: (A, AND A, VALUES ARE FROM SECTION 3 ABOVE)				
L _R = E _{TOT} X P X (A ₁ X 34.6 X A _P X0.54	943	.49 lbs		
20. Stormceptor Required TSS Removal in BMP Drainage Ard Impervious Cover Overtreatme TSS Removal for Uncaptured Are BMP Sizing Effective Are Calculated Model Size(ea= NA nt= 0.0000 a = 0.00 a = NA	lbs ac Ibs EA		
Actual Model Size (if multiple values provided in Calcula Model Size or if you are choosing a larger model size	ted e) = 0	Model Size		
Surface Are Overflow Rat Rounded Overflow Rat BMP Efficiency ⁶ L _R Valu	a = #N/A e = #VALUE e = #VALUE % = #VALUE e = #VALUE	t ² ! V _α ! V _α ! % ! Ibs		

		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
	B科P Sizing			
		Effective Area =	NA	EA
		Calculated Model Size(s) =	#N/A	
	Ļ	Actual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
	Ļ	<pre>\ctual Model Size (if choosing larger model size) = Surface Area =</pre>	Vx1000 7 10	Pick Model Size
	Å	ctual Model Size (if choosing larger model size) = Surface Area = Overflow Rate =	Vx1000 7 10 #VALUE!	Pick Model Size ft ² Vα
	¥	totual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate =	Vx1000 7 10 #VALUE! #VALUE!	Pick Model Size ft ² V _a V _a
	Å	ctual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % =	7 10 #VALUE! #VALUE! #VALUE!	Pick Model Size ft ² V _o V _o
	,	totual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % = L _R Value =	7 10 #VALUE! #VALUE! #VALUE! #VALUE!	Pick Model Size ft ² V _o % Ibs
	£	Actual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % = L _R Value = TSS Load Credit =	Vx1000 7 10 #VALUE! #VALUE! #VALUE! #VALUE!	Pick Model Size ft ² V ₀ V ₀ bs Ibs
	is Sufficient	totual Model Size (if choosing larger model size) = Surface Area = Overflow Rate = Rounded Overflow Rate = BMP Efficiency % = L _R Value = TSS Load Credit = Treatment Available? (TSS Credit ≥ TSS Uncapt.)	Vx1000 7 10 #VALUE! #VALUE! #VALUE! #VALUE! #VALUE!	Pick Model Size tt ² V _α V _α k Ibs

Texas Commission on Environmental Quality								
TSS Removal Calculations 04-20-2009					Project Name Date Prepared	Manor Creek U 6/1/2015	nit 6	
Additional information is provided for cells with a red triang Text shown in blue indicate location of instructions in the Technic Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Cha	le in t cal Gui nges f	he upper idance M to these	right cor anual - RC fields wil	rner. P 3-348. I remov	lace the curr re the equati	sor over the cell. ons used in the	spreadsheet	
1. The Required Load Reduction for the total project:	Ca	culations f	rom RG-348	8		Pages 3-27 to 3-30	F.	
Page 3-29 Equation 3.3: L	- _M = 27	2(A _N x P)						
where:	_{ct} = Re A _N = Ne P = Avi	quired TSS t increase erage annu	S removal re In imperviou Ial precipital	esulting fr us area fo ition, inch	om the propose r the project es	d development = 80°	% of increased lo	Jad
Site Data: Determine Required Load Removal Based on the Entire Pro Coun Total project area included in plan Predevelopment impervious area within the limits of the plan Total post-development impervious area within the limits of the plan Total post-development impervious cover fraction	iject ity = n° = n° = P =	Comal 40.55 0.00 10.47 0.26 33	acres acres acres inches	Lois	51	Streets SF/Lot 6.225	138,758 317,475	3.19 7.29 10.47
LM TOTAL PROJE * The values entered in these fields should be for the total project area.	ct =	9401	lbs.					
Number of drainage basins / outfalls areas leaving the plan are	ea =	6						
2. Drainage Basin Parameters (This information should be provided for	each b	asin):						
Drainage Basin/Outfall Area N	0. =	A 6-6						
Total drainage basin/outfall are Predevelopment impervious area within drainage basin/outfall are Post-development impervious area within drainage basin/outfall are Post-development impervious fraction within drainage basin/outfall are L _{M THES BAT}	ea = ea = ea = ea = sin =	1.55 0.00 0.57 0.37 513	acres acres acres Ibs	# of l	_ots	SF/Lot 4 6225 0	0.57 a 0.00 a 0.57 T	cres of IC cres of str otal IC (a
3. Indicate the proposed BMP Code for this basin.								
Removal efficien 4. Calculate Maximum TSS Load Removed (L _R) for this Drainage Basin 1	cy ≕ by the s	80 selected B	percent MP Type.			Aqualogic Cartridg Bioretention Contech StormFilt Constructed Wetla Extended Detentio Grassy Swale Retention / Irrigatii Sand Filter Stormceptor Vegetated Filter S Vortechs Wet Basin Wet Vault	je Filter er ind in on trips	
RG-348 Page 3-33 Equation 3.7:	L _R = (B	MP efficier	icy) x P x (A	4; x 34.6 +	А _Р х 0.54)			
where:	$A_{c} = Tc$ $A_{l} = Im$ $A_{p} = Pe$ $L_{R} = TS$ $A_{r} = TS$	otal On-Site apervious a ervious are SS Load re	e drainage a rea propose a remaining moved from	area in the ed in the f in the BM this catcl	BMP catchme BMP catchment MP catchment a hment area by t	nt area area rea he proposed BMP		
	· · C · ·	1.00	acres	# UT	LU(3	3F/LUI		

A, =	0.57	acres	4	6225	0.57 acres of IC
Ap =	0.98	acres		0	0.00 acres of str
L _R =	536	lbs		0	0.57 Total IC (a

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

Desired L _{M THIS BASIN} =	513	lbs.					
F =	0.96						
6. Calculate Capture Volume required by the BMP Type for this drainage bas	sin / outfall ar	ea.	Calculations from RG-	348 P	ages 3-34 to 3	-36	
Painfall Depth -	2 80	inches					
Post Development Runoff Coefficient =	0.29	cubic feet					
	4599	CODIC IEEI					
	Calculations fi	rom RG-348	Pages 3-36 to 3-37				
Off-site area draining to BMP =	0.00	acres					
Off-site Impervious cover draining to BMP = Impervious fraction of off-site area =	0.00	acres					
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 volu	me(s) for the	selected BMP					
7. Retention/Irrigation System	Designed as I	Required in RG	3-348	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 pe	rmenhility rate	or assumed v	alue of 0	1
Irrigation area =	NA	square feet	annar jastannina pa	,,			
	NA	acres					
	2						
8. Extended Detention Basin System	Designed as i	Required in RC	5-348	Pages 3-46 to 3	3-51		
Required Water Quality Volume for extended detention basin =	NA	cubic feet					
9. Filter area for Sand Filters	Designed as I	Required in RG	3-348	Pages 3-58 to 3	3-63		
9A. Full Sedimentation and Filtration System							
Water Quality Volume for sedimentation basin =	NA	cubic feet					
Minimum filter basin area =	NA	square feet					
Minimum filter basin area = Maximum sedimentation basin area =	NA	square leet square leet	For minimum water	depth of 2 feet			
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area =	NA NA NA	square leet square leet square leet	For minimum water For maximum water	depth of 2 feet depth of 8 feet			
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 9B. Partial Sedimentation and Filtration System	NA NA NA	square feet square feet square feet	For minimum water For maximum water	depth of 2 feet depth of 8 feet			
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins =	NA NA NA	square feet square feet square feet cubic feet	For minimum water For maximum water SF @ Given Depth eVALUE!	depth of 2 feet depth of 8 feet	Siven Depth	Width	60
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area =	NA NA NA NA	square leet square leet square leet cubic leet square leet	For minimum water For maximum water SF @ Given Depth ¢VALUE!	depth of 2 feet depth of 8 feet G	Siven Depth	Width 5	60 60
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area =	NA NA NA NA NA	square leet square leet square leet cubic leet square leet square leet	For minimum water For maximum water SF @ Given Depth @VALUE!	depth of 2 feet depth of 8 feet G depth of 2 feet	Siven Depth	Width 5	60 60 60
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area =	NA NA NA NA NA	square feet square feet square feet cubic feet square feet square feet square feet	For minimum water For maximum water SF @ Given Depth eVALUE! For minimum water For Given water dep	depth of 2 feet depth of 8 feet depth of 2 feet th	Siven Depth	Width 5	60 60 60
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 9 <u>B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area =	NA NA NA NA NA NA	square feet square feet square feet cubic feet square feet square feet square feet square feet	For minimum water For maximum water SF @ Given Depth eVALUE! For minimum water For Given water dep For maximum water	depth of 2 feet depth of 8 feet depth of 2 feet th depth of 8 feet	Siven Depth	Width 5	60 60 60 60 60
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area =	NA NA NA NA NA NA	square leet square leet square leet cubic feet square leet square leet square feet square feet	For minimum water For maximum water SF @ Given Depth «VALUE! For minimum water For Given water dep For maximum water	depth of 2 feet depth of 8 feet depth of 2 feet th depth of 8 feet	Siven Depth	Width 5	60 60 60 60 60
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 9 <u>B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = <u>Minimum sedimentation basin area =</u>	NA NA NA NA NA NA NA Designed as	square leet square leet square leet cubic feet square leet square leet square feet square feet	For minimum water For maximum water SF @ Given Depth «VALUE! For minimum water For Given water dep For maximum water 3-348	depth of 2 feet depth of 8 feet depth of 2 feet th depth of 8 feet Pages 3-63 to 3	Siven Depth	Width 5	60 60 60 60
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = <u>10. Bioretention System</u> Required Water Quality Volume for Bioretention Basin =	NA NA NA NA NA NA Designed as NA	square feet square feet square feet cubic feet square feet square feet square feet square feet square feet cubic feet	For minimum water For maximum water SF @ Given Depth eVALUE! For minimum water For Given water dep For maximum water 3-348	depth of 2 feet depth of 8 feet depth of 2 feet th depth of 8 feet Pages 3-63 to 3	Siven Depth	Width 5	60 60 60 60
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = <u>Minimum sedimentation basin area =</u> <u>10. Bioretention System</u> Required Water Quality Volume for Bioretention Basin =	NA NA NA NA NA NA Designed as NA Designed as	square leet square leet square leet cubic feet square leet square leet square leet square feet Required in RC cubic feet	For minimum water For maximum water SF & Given Depth eVALUE! For minimum water For Given water dep For maximum water 3-348	depth of 2 feet depth of 8 feet depth of 2 feet th depth of 8 feet Pages 3-63 to 3 Pages 3-66 to 3	Siven Depth 3-65 3-71	Width 5	60 60 60 60
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = <u>Minimum sedimentation basin area =</u> <u>10. Bioretention System</u> Required Water Quality Volume for Bioretention Basin = <u>11. Wet Basins</u>	NA NA NA NA NA NA Designed as NA	square leet square leet square leet cubic feet square leet square leet square leet square feet Required in RC cubic feet	For minimum water For maximum water SF & Given Depth eVALUE! For minimum water For Given water dep For maximum water 3-348	depth of 2 feet depth of 8 feet depth of 2 feet th depth of 8 feet Pages 3-63 to 3 Pages 3-66 to 3	Siven Depth 3-65 3-71	Width 5	60 60 60 60
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 10. Bioretention System Required Water Quality Volume for Bioretention Basin = 11. Wet Basins Required capacity of Permanent Pool = Required capacity of Permanent Pool = Required capacity at WQV Elevation =	NA NA NA NA NA Designed as NA Designed as NA	square feet square feet square feet cubic feet square feet square feet square feet square feet cubic feet Required in RC cubic feet cubic feet	For minimum water For maximum water SF @ Given Depth eVALUE! For minimum water For Given water dep For maximum water 3-348 9-348 9-348	depth of 2 feet depth of 8 feet th depth of 2 feet th Pages 3-63 to 3 Pages 3-66 to 3 nacity is 1.20 tin Id be the Perma	Siven Depth 3-65 3-71 mes the WQV anent Pool Ca	Width 5	60 60 60 60
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = <u>Minimum sedimentation basin area =</u> <u>Minimum filter basin area =</u> <u>Minimum sedimentation basin area =</u>	NA NA NA NA NA Designed as NA Designed as NA	square feet square feet square feet square feet square feet square feet square feet cubic feet cubic feet cubic feet	For minimum water For maximum water SF & Given Depth eVALUE! For minimum water For Given water dep For maximum water 3-348 3-348 Permanent Pool Cap Total Capacity shou plus a second WQV.	depth of 2 feet depth of 8 feet depth of 2 feet th depth of 8 feet Pages 3-63 to 3 Pages 3-66 to 3 pacity is 1.20 tim Id be the Perma	Siven Depth 3-65 3-71 nes the WQV anent Pool Ca	Width 5	60 60 60 60
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = <u>Minimum sedimentation basin area =</u> Minimum sedimentation basin area = <u>10. Bioretention System</u> Required Water Quality Volume for Bioretention Basin = <u>11. Wet Basins</u> Required capacity of Permanent Pool = Required capacity at WQV Elevation = <u>12. Constructed Wetlands</u>	NA NA NA NA NA Designed as NA Designed as	square feet square feet square feet square feet square feet square feet square feet square feet cubic feet Required in RC cubic feet cubic feet	For minimum water For maximum water SF @ Given Depth eVALUE! For minimum water For Given water dep For maximum water 3-348 9-348 Permanent Pool Cap Total Capacity shou plus a second WQV. G-348	depth of 2 feet depth of 8 feet depth of 2 feet th depth of 8 feet Pages 3-63 to 3 Pages 3-66 to 3 pacity is 1.20 tin Id be the Perma Pages 3-71 to 3	Siven Depth 3-65 3-71 nes the WQV anent Pool Ca 3-73	Width 5	60 60 60 60
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = <u>9B. Partial Sedimentation and Filtration System</u> Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = <u>Minimum sedimentation basin area =</u> <u>Minimum sedimentation basin area =</u> <u>Mi</u>	NA NA NA NA NA Designed as NA Designed as NA NA	square feet square feet square feet cubic feet square feet square feet square feet square feet square feet cubic feet Required in RC cubic feet cubic feet Required in RC cubic feet	For minimum water For maximum water SF @ Given Depth eVALUE! For minimum water For Given water dep For maximum water 3-348 3-348 9-and Capacity shou plus a second WQV. 3-348	depth of 2 feet depth of 8 feet depth of 2 feet th depth of 8 feet Pages 3-63 to 3 Pages 3-66 to 3 nacity is 1.20 tin Id be the Perma Pages 3-71 to 3	Siven Depth 3-65 3-71 mes the WQV anent Pool Ca 3-73	Width 5	60 60 60 60
Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = 98. Partial Sedimentation and Filtration System Water Quality Volume for combined basins = Minimum filter basin area = Maximum sedimentation basin area = Minimum sedimentation basin area = Minimum sedimentation basin area = 10. Bioretention System Required Water Quality Volume for Bioretention Basin = 11. Wet Basins Required capacity of Permanent Pool = Required capacity of Permanent Pool = Required capacity at WQV Elevation = 12. Constructed Wetlands	NA NA NA NA NA NA Designed as NA Designed as NA NA	square feet square feet square feet square feet square feet square feet square feet square feet cubic feet Required in RC cubic feet Required in RC cubic feet cubic feet cubic feet	For minimum water For maximum water SF & Given Depth eVALUE! For minimum water For Given water dep For maximum water 3-348 G-348 Permanent Pool Cap Total Copacity shou plus a second WQV. G-348	depth of 2 feet depth of 8 feet depth of 2 feet th depth of 8 feet Pages 3-63 to 3 Pages 3-66 to 3 pacity is 1.20 tim Id be the Perma Pages 3-71 to 3	Siven Depth 3-65 3-71 nes the WQV anent Pool Ca 3-73	Width 5	60 60 60 60

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 REMOV/	ALS ARE BASE	D UPON FLOW RA	TES - NOT CALCU	JLATED WATER QUALITY VOLUMES
15. Grassy Swales	Designed as R	equired in RG-348	Pa	ges 3-51 to 3-54
Design parameters for the swale:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfall intensity = i = Swale Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	0.00 0.00 1.1 0.01 3 0.33 #DIV/0!	acres acres in/hr ft/ft ft		
A_{cs} = cross-sectional area of flow in Swale =	#DIV/0!	st		
P _w = Wetted Perimeter =	#DIV/0!	feet		
R_{H} = hydraulic radius of flow cross-section = A_{cs}/P_{W} = n = Manning's roughness coefficient =	#DIV/01 0.2	feet 2		
15A. Using the Method Described in the RG-348				
Manning's Equation: $Q = 1.49 A_{CS} R_{H}^{2/3} S^{0.5}$ n				
b = <u>0.134 x Q</u> - zy = y ¹⁶⁷ S ⁰⁵	#DIV/0!	feet		
Q = CiA =	#DIV/01	cfs		
To calculate the flow velocity in the swale:				
V (Velocity of Flow in the swate) = Q/A_{CS} =	#DIV/0!	ft/sec		
To calculate the resulting swale length:				
$L \simeq Minimum Swale Length = V (ft/sec) * 300 (sec) =$	#DIV/01	feet		
If any of the resulting values do not meet the design requirement	nt set forth in RC	G-348, the design pa	arameters must be n	nodified and the solver rerun.
15B. Alternative Method using Excel Solver				
Design Q = CiA =	#DIV/0!	cfs		
Manning's Equation Q = Swale Width=	= 0.76 = 6.00	6 cfs 0 ft	Error 1 =	#DIV/0!
Instructions are provided to the right (green comments).				
- Flow Velocity Minimum Length =	#DIV/01 = #DIV/01	ft/s ft		
Instructions are provided to the right (blue comments).				
Design Width =	- 07	6 ft 6 cfs	Error 2 -	#DIV/0
Design Discharge = Design Depth =	≈ 070 = 0.33	3 ft	Flor 5 =	
Flow Velocity = Minimum Length =	= 0.3 = 97.4	2 cfs 8 lt		
If any of the resulting values do not meet the design requirement set forth If any of the resulting values still do not meet the design requirement set for	in RG-348, the orth in RG-348.	design parameters widening the swal	a may be modified le bottom value ma	and the solver rerun. ay not be possible.

16. Vegetated Filter Strips

Designed as Required in RG-348

Pages 3-55 to 3-57

17. Wet Vaults	Desig	esigned as Required in RG-348		3-348	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 = runolf coefficient for the drainage are i = design rainfall intensii A = drainage area in acre	ea = ty = es =	0.23 1.1 1	in/hour acres	C = Runoff Coefficie	nt = 0.546 (IC) ² + 0.328 (IC) + 0.03
Q = flow rate in cubic feet per secon	nd =	0.25	cubic feet/se	ec	
RG-348 Page 3-31 Equation 3.5: Von = 0	Q/A				
Q = Runoff rate calculated abov A = Water surface area in the wet value	ve = ult =	0.25 150	cubic feet/se square feet	ec	
V _{CR} = Overflow Ra	te =	0.00	feet/sec		
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-3	1) =	53	percent		
Load removed by Wet Vac	u!t = #\	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 Occu	rs =	0.5	in/hour		
Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-3 Efficiency Reduction for Actual Rainfall Intensi	32 = ity =	0.75	percent percent		
Resultant TSS Load removed by Wet Vac	ult = #\	VALUE!	lbs		
18. Permeable Concrete	Desi	gned as R	equired in R(3-348	Pages 3-79 to 3-83
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING	ZONE				
19. BMPs Installed in a Series	Desi	gned as F	lequired in R	3-348	Pages 3-32
Michael E. Barrett, Ph.D., P.E. recommended that the co	efficient I	for E ₂ be	changed from	n 0.5 to 0.65 on May 3	3, 2006
$E_{TOT} = [1 - ((1 - E_1) \times (1 - 0.65E_2) \times (1 - 0.25E_3))] \times 10^{-10}$	00 =	94.01	percent	NET EFFICIENCY O	F THE BMPS IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES =	E,=	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, VALUES ARE FROM SECTION 3 ABOVE)					
L _R = E _{TOT} X P X (A ₁ X 34.6 X A _P X0.5	(4) =	629.94	t ibs		
20. Stormceptor Required TSS Removal in BMP Drainage Ar Impervious Cover Overtreatmu TSS Removal for Uncaptured Ar BMP Sizing	rea= ent= ea = ea =	NA 0.0000 0.00	lbs ac ibs EA		
Catculated Model Size Actual Model Size (if multiple values provided in Calcul Model Size or if you are choosing a larger model siz	(s) = ated ze) =	#N/A 0	Model Size		
Surface Are	ea =	#N/A	ft ²		
Overflow Ra	ate = #	VALUE!	V _{or}		
Rounded Overflow Ra BMP Efficiency	ate = # % = #	VALUE! VALUE!	V ₀₁ %		

.

		L _R Value =	#VALUE!	lbs
		TSS Load Credit =	#VALUE!	Ibs
	Is Sufficient T	reatment Available? (TSS Credit \geq TSS Uncapl.)	#VALUE!	
		TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	
21. Vortech				
211 001000		Required TSS Removal in BMP Drainage Area=	NA	lbs
		Impervicus 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	
	Ar	tual Model Size (if choosing larger model size) =	Vx1000	Pick Model Size
		Surface Area =	7,10	ft ²
		Overflow Rate =	#VALUE!	Vø
		Rounded Overflow Rate =	#VALUE!	Va
		BMP Efficiency % =	#VALUE!	%
		L _R Value =	#VALUE!	lbs
		TSS Load Credit =	#VALUE!	lbs
	Is Sufficient 7	reatment Available? (TSS Credit \geq TSS Uncapt.)	#VALUE!	
		TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE	

Texas Commission on Environmental Quality								
TSS Removal Calculations 04-20-2009				Project Date Pro	Name: Ma epared:	nor Creek 6/1/2015	Unit 6	
Additional information is provided for cells with a red triang Text shown in blue indicate location of instructions in the Technic Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated fields. Characters shown in black (Bold)	gle in t cal Gui anges	he uppe idance M to these	r right con Ianual - RG fields will	ner. Place th -348. remove the e	e cursor (equations	over the cel used in the	ll. e spreadshe	eet.
1. The Required Load Reduction for the total project:	Ca	lculations	from RG-348		Pa	ges 3-27 to 3-3	30	
Page 3-29 Equation 3.3:	L _N = 27.	2(A _N x P)						
where: L _{M TOTAL PROJE}	_{ECT} = Re A _N = Ne P = Av	quired TS I increase erage ann	S removal res in impervious ual precipitati	sulting from the p s area for the pro ion, inches	roposed dev ject	velopment = 8	0% of increase	d load
Site Data: Determine Required Load Removal Based on the Entire Pro	oject							
Cour Total project area included in plan Predevelopment impervious area within the limits of the pla Total post-development impervious area within the limits of the pla Total post-development impervious cover fraction	nty = n * = an * = n * = P =	Comal 40.55 0.00 10.47 0.26 33	acres acres acres inches	Lots	Str SF 51	eets /Lot 6.225	138,758 317,475	3.185 7.288 10 47
LM TOTAL PROF. * The values entered in these fields should be for the total project area	ECT =	9401	lbs.					
Number of drainage basins / outfalls areas leaving the plan ar	rea =	6						
2. Drainage Basin Parameters (This information should be provided for Drainage Basin/Outfall Area N Total drainage basin/outfall ar Predevelopment impervious area within drainage basin/outfall ar Post-development impervious area within drainage basin/outfall ar Post-development impervious fraction within drainage basin/outfall ar L _{M THIS BA}	r each b No. = rea = rea = rea = rea = rea =	A 6-12 0.22 0.00 0.15 0.66 131	acres acres acres lbs.	# of Lots	SF 0	/Lot 6225 6344 5158	0.00 / 0.15 / 0.15 /	acres of IC for lots acres of street Total IC (acres)
3. Indicate the proposed BMP Code for this basin.								
Proposed B/ Removat efficier	MP = Na	one: O	percent		Aq Bid Co Co Co Ex Gr Re Sa Sto Ve Vo Vo WW	ualogic Cartrico pretention intech StormFi instructed Wel tended Detent sasy Swale itention / Irriga ind Filter primceptor igetated Filter ridechs et Basin et Vault	dge Filter Iland ion tion Strips	
4. Calculate Maximum TSS Load Removed (L_n) for this Drainage Basin	by the	selected E	BMP Type.					
RG-348 Page 3-33 Equation 3.7:	L _A = (B	MP efficier	ncy) x P x (A _f	x 34.6 + A _P x 0.5	54)			
where:	$A_{c} = Tc$ $A_{i} = Im$ $A_{p} = Pe$ $L_{R} = TS$	otal On-Site npervious a ervious are SS Load re	e drainage ar area proposed ea remaining i emoved from t	ea in the BMP cat d in the BMP cate in the BMP catch this catchment an	atchment area chment area ment area ea by the pr	ea roposed BMP		
	A _C = A _I = A _P = L _R =	0.22 0.15 0.07 0	acres acres acres Ibs	# of Lots	SF 0	-/Lot 6225 6344.5158	0.00 0.15	acres of IC for lots 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 bas	in / outfall are	a.	Calculations from RG-	348 1	Pages 3-34 to	3-36		
Rainfall Depth =	#DIV/0!	inches						
On-site Water Quality Volume =	#DIV/0!	cubic feet						
	Calculations fro	om 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 = Off-site Bunoff 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 volur.	me(s) for the s	elected BMP						
7. Retention/Irrigation System	Designed as R	lequired in RC	3-348	Pages 3-42 to	3-46			
Bequired Water Quality Volume for releation basin -	NA	cubic feet						
Required water cloarky volume for recention basin -	NA	cubic leet						
Irrigation Area Calculations:								
Soil infiltration/permeability rate =	0.1	in/hr	Enter determined pe	rmeability rate	or assumed	value of ().1	
Irrigation area =	NA	square feet						
	114	40103						
8. Extended Detention Basin System	Designed as R	lequired in RC	3-348	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 P	Required in RC	3-348	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 = Minimum sedimentation basin area =	NA NA	square feet square feet	For minimum water For maximum water	depth of 2 feet depth of 8 fee	t			
9B. Partial Sedimentation and Filtration System			SE @ Given Death		Given Denth	Width	ĩ	ength
Water Quality Volume for combined basins =	NA	cubic feet	#VALUE!		enten sepan	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 90	#VALUE!
Minimum sedimentation basin area =	NA	square leet	For maximum water	depth of 8 fee	t		90	#VALUE!
10. Bioretention System	Designed as F	Required in R	G-348	Pages 3-63 to	3-65			
Required Water Quality Volume for Bioretention Basin =	NA	cubic feet						
11. Wet Basins	Designed as F	Required in R	G-348	Pages 3-66 to	3-71			
Required canacity of Permanent Pool =	NA	cubic feet	Permanent Pool Car	pacity is 1 20 ti	mes the WO	u l		
Required capacity at WQV Elevation =	NA	cubic feet	Total Capacity shou	Id be the Perm	nanent Pool C	apacity		
			plus a second WQV	*				
12. Constructed Wetlands	Designed as F	Required in R	G-348	Pages 3-71 to	3-73			
Required Water Quality Volume for Constructed Wetlands =	NA	cubic feet						
13. AquaLoqic [™] Cartridge System	Designed as f	Required in RI	G-348	Pages 3-74 to	3-78			

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 REMOVA	LS ARE BAS	SED UPON FLOW BAT	TES - NOT CALC	ULATED WATER QUALITY VOLUMES
15. Grassy Swales	Designed as	Required in RG-348	Pa	ages 3-51 to 3-54
Design parameters for the swale:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfall intensity = i = Swale Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	0.0 0.0 1 0.0 0.: #D1V/0!	00 acres 00 acres 1 in/hr 25 ft/ft 3 33 ft		
A_{cs} = cross-sectional area of flow in Swale = P_w = Wetted Perimeter = R_H = hydraulic radius of flow cross-section = A_{cs}/P_w = n = Manning's roughness coefficient =	#DIV/0! #DIV/0! #DIV/0! C	st feet feet 0.2		
15A. Using the Method Described in the RG-348				
Manning's Equation. Q = $149 A_{CS} B_{H}^{23} S^{0.5}$ n				
$b = .0.134 \times Q$ - zy \approx y ^{1 a7} S ^{0 5}	#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!	leet		
If any of the resulting values do not meet the design requirement	it set forth in F	RG-348, the design par	ameters must be	modified and the solver rerun.
15B. Alternative Method using Excel Solver				
Design Q = CiA =	#DIV/0!	cfs		
Manning's Equation Q = Swale Width=	: 6. : 36.	90 cfs 91 ft	Error 1 =	5.82
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	#DIV/0! #DIV/0!	ft/s ft		
Instructions are provided to the right (blue comments).				
Design Width = Design Discharge = Design Depth = Flow Velocity = Minimum Length =	: 1. : 0. : 0. : 0.	6 ft 20 cts .33 ft .51 cts .12 ft	Error 2 =	#DIV/0!
If any of the resulting values do not meet the design requirement set forth i If any of the resulting values still do not meet the design requirement set for	in RG-348, the orth in RG-34	e design parameters 8, widening the swale	may be modified bottom value m	and the solver rerun. ay not be possible.
16. Vegetated Filter Strips	Designed as	s Required in RG-348	F	Pages 3-55 to 3-57

16. Vegetated Filter Strips

If vegetative fitter 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 RC	3-348 Pages 3-30 to 3-32 & 3-79
P	equired 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 = i = design ramfall intensity = A = drainage area in acres =		0	49 .1 in/hour 1 acres	C = Flunoff Coefficient = 0.546 $(IC)^2$ + 0.328 (IC) + 0.03
	Q = flow rate in cubic feet per second =	0.	54 cubic feet/se	ec
RG-348 Page 3-31 Equation 3.5: V _{OR} = Q/A				
Q = Runoff rate calculated above = A = Water surface area in the wet vault =		0. 1	0.54 cubic feet/sec 150 square feet	
V _{OR} = Overflow Rate =		0	0.00 feet/sec	
Percent T	SS 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 rain Calculate the efficiency red	fall intensity of less than 1.1 in/hours uction for the actual rainfall intensity rate			
Actual Rainfall Intensity at which Wet Vault bypass Occurs =).5 in/hour	
Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = Efficiency Reduction for Actual Rainfall Intensity =		0	75 percent 83 percent	
	Resultant TSS Load removed by Wet Vault =	#VALUE!	lbs	
18. Permeable Concrete		Designed as	Required in R	G-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 RO	G-348 Pages 3-32
Michael E. Barrett, Ph.D., P.E. recommended that the coefficient for E2 be changed from 0.5 to 0.65 on May 3, 2006				m 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
E	FFICIENCY OF FIRST BMP IN THE SERIES = $E_1 =$	89.00 percent		
EFFICIEN	ICY 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 ₂ VALUES ARE FROM SECTION 3 ABOVE)				
$L_{R} = E_{TOT} X P X (A_{i} X 34.6 X A_{P} X0.54) =$		157.58 lbs		
20. Stormceptor BMP Sizing Actual I Moc	Required TSS Removal in BMP Drainage Area= Impervious Cover Overtreatment= TSS Removal for Uncaptured Area = Effective Area = Calculated Model Size(s) = Model Size (if multiple values provided in Calculated lel Size or if you are choosing a larger model size) = Surface Area =	NA 0.000 0.00 NA #N/A 0	lbs ac Ibs EA Model Size # ²	
	Overflow Rate =	= #VALUË	V _{or}	
	Rounded Overflow Rate = BMP Efficiency % =	#VALUE #VALUE	V _α %	

•
		L _R Value =	#VALUE	lbs
		TSS Load Credit =	#VALUE!	lbs
	1s Sufficient	Treatment Available? (TSS Credit ≥ TSS Uncapi.)	#VALUE!	
		TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	
21 Vortech				
ZI. VOIICCI		Required TSS Removal in BMP Drainage Area=	NA	íbs
		Impervious Cover Overtreatment=	G.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	łt ²
		Overflow Rate =	#VALUE!	Var
		Rounded Overflow Rate =	#VALUE!	V.
		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 Date Pre	Name: Manor Creek Unit 6 pared: 6/1/2015	
Additional information is provided for cells with a re Text shown in blue indicate location of instructions in the Characters shown in red are data entry fields. Characters shown in black (Bold) are calculated field	d triangle in Technical Gu ds. Changes	the uppe uidance M to these	r right cor Ianual - RG fields will	ner. Place the 3-348. I remove the e	e cursor over the cell. quations used in the spread	dsheet.
1. The Required Load Reduction for the total project:	C	alculations	from RG-346	C.	Pages 3-27 to 3-30	
Page 3-29 Equa	tion 3 3 1 - 2	7 2/A V P)				
where.	OTAL PROJECT = R_i $A_N \approx N$ $P = A_i$	equired TS et increase verage ann	S removal re in imperviou ual precipitat	sulting from the pros s area for the pros ion, inches	oposed development = 80% of inc ect	reased load
Site Data: Determine Required Load Removal Based on the Total project area includ Predevelopment impervious area within the limits Total post-development impervious area within the limits Total post-development impervious cov	Entire Project County = ed in plan * = of the plan * = of the plan * = er fraction * = P =	Comal 40.55 0.00 10.47 0.26 33	acres acres acres inches	Lots	Streets SF/Lot 51 6.225 317,4	*58 3.185 175 7.288 10 47
 The values entered in these fields should be for the total pro 	OTAL PROJECT =	9401	lbs.			
Number of drainage basins / outfalls areas leaving the	ne plan area =	6				
2. Drainage Basin Parameters (This information should be pro	vided for each l	oasin):				
Drainage Basin/Outfa	all Area No. ≠	A 6-12				
Total drainage basin Predevelopment impervious area within drainage basin Post-development impervious area within drainage basin Post-development impervious fraction within drainage basin	/outfall area = /outfall area = /outfall area = /outfall area = L _{M THIS BASIN} =	0.30 0.00 0.20 0.68 183	acres acres acres lbs	# of Lots	SF/Lot 0 6225 (8875 7696 (0.00 acres of IC for lots 0.20 acres of street 0.20 Total IC (acres)
3. Indicate the proposed BMP Code for this basin.						
<u>o, marcate ine proposed bim, odde for tins basin.</u> Pro Remov	posed BMP = N at efficiency =	one 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 _B) for this Drainad	ge Basin by the	selected E	MP Typę.			
RG-348 Page 3-33 Equa	tion 3.7: L _θ ≈ (I	3MP efficier	псу) х Р х (А	x 34.6 + A _P x 0.5	4)	
where:	$A_{C} = T$ $A_{i} = Ir$ $A_{P} = P$ $L_{R} = T$	otal On-Site npervious a 'ervious are SS Load re	e drainage a trea propose a remaining moved from	rea in the BMP ca d in the BMP catc in the BMP catchi this catchment an	tchment area hment area nent area aa by the proposed BMP	
	A _C =	0.30	acres			
	Α ₁ =	0.20	acres	# of Lots	SF/Lot	0.00 acres of IC for lots
	L _H =	0.10	lbs		8875,7696	0.20 acres of street

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

Desired L _{M THIS BASIN} =	0	łbs.			
F =	#DIV/0!				
6. Calculate Capture Volume required by the BMP Type for this drainage bas	sin / outfall are	<u>a.</u>	Calculations from RG-348	Pages 3-34 to 3-36	
Bainfall Deoth =	#DIV/0!	inches			
Post Development Runoff Coefficient =	0.49	aubia faat			
On-site water Quality Volume =	#DIV/U	cubic feet			
	Calculations fr	om RG-348	Pages 3-36 to 3-37		
Off-site area draining to BMP =	0.00	acres			
Impervious fraction of off-site area =	0.00	acres			
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 values for BMP Types not selected in cell C45 will show NA.	ine(a) for the a	Senected Dim-	•		
7. Retention/Irrigation System	Designed as F	Required in RC	i-348 Page	es 3-42 to 3-46	
Required Water Quality Volume for retention basin =	NA	cubic feet			
Irrigation Area Calculations:					
					2
Soil infiltration/permeability rate = Irrigation area =	0.1 NA	in/hr square feet	Enter determined permea	bility rate or assumed value of 0.	1
	NA	acres			
8. Extended Detention Basin System	Designed as F	Required in RC	3-348 Page	es 3-46 to 3-51	
Required Water Quality Volume for extended dataption basin -	NA	cubic foot			
	NA NA	cubic leet			
9. Filter area for Sand Filters	Designed as F	Required in R	3-348 Page	es 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 = Minimum sedimentation basin area =	NA ■ NA	square feet square feet	For minimum water depth For maximum water depth	n of 2 feet In of 8 feet	
9B. Partial Sedimentation and Filtration System					
Water Quality Volume for combined basins =	NA	cubic feet	SF @ Given Depth #VALUE!	Given Depth Width 5	Length 90 #VALUE!
- Mınimum filter basin area =	= NA	square feet		,	90 #VALUE!
Maximum sedimentation basin area =	- NA	square feet	For minimum water depth	h of 2 feet	90 #VALUE!
Minimum sedimentation basin area -	NA - NA	square feet	For Given water depth	th of 8 feet	90 #VALUE!
Minindin Sedimentation basin area -	- 10	Square reet	r of maximum mater dept	n or o reek	SO WWEDE.
10. Bioretention System	Designed as I	Required in R	3-348 Pag	es 3-63 to 3-65	
Required water Quality Volume for Bioretention Basin =	= NA	cubic feet			
11. Wet Basins	Designed as I	Required in R	3-348 Pag	es 3-66 to 3-71	
Required capacity of Permanent Pool = Required capacity at WQV Elevation =	NA	cubic feet cubic feet	Permanent Pool Capacity Total Capacity should be plus a second WGV.) is 1.20 times the WOV the Permanent Pool Capacity	
12. Constructed Wetlands	Designed as I	Required in R	G-348 Pag	es 3-71 to 3-73	
Required Water Quality Volume for Constructed Wetlands =	= NA	cubic feet			
12 Acust acis TM Castridae Sustan	Decidered	Paguired in D	0.949	100 2 74 10 2 78	
15. Aquacodic Cannode System	mesigned as	nedmed in H	araro Pag	03 3-14 10 3-10	

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

Required Sedimentation chamber capacity = Filter canisters (FCs) to treat WQV = Filter basin area (RIA _F) =	NA NA NA	cubic feet cartridges 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 REMOVAL	LS ARE BAS	ED UPON FLOW RATE	S - NOT CALC	ULATED WATER QUALITY VOLUMES
15. Grassy Swales	Designed as F	Required in RG-348	P	ages 3-51 to 3-54
Design parameters for the swale:				
Drainage Area to be Treated by the Swale = A = Impervious Cover in Drainage Area = Rainfall intensity = i = Swale Slope = Side Slope (z) = Design Water Depth = y = Weighted Runoff Coefficient = C =	0.0 1. 0.02 0.3 #DIV/0!	0 acres 0 acres 1 in/hr 5 ft/ft 3 ft		
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 = n = Manning's roughness coefficient =	#DIV/0! 0.	feet 2		
15A. Using the Method Described in the RG-348				
Manning's Equation: Q ≈ <u>1.49</u> A _{CS} R _H ²³ S ⁰⁶ n				
$b = \frac{0.134 \text{ x Q}}{\text{y}^{167}} - \text{zy} = 1000000000000000000000000000000000000$	#DIV/0!	feet		
Q = CiA =	#DIV/01	cfs		
To calculate the flow velocity in the swale:				
V (Velocity of Flow in the swale) = Q/A_{CS} =	#D!V/0'	/t/sec		
To calculate the resulting swale length:				
L = Minimum Swale Length = V (ft/sec) * 300 (sec) =	#DIV/01	feet		
If any of the resulting values do not meet the design requirement	set forth in R	G-348, the design paran	neters must be	modified and the solver rerun,
15B. Alternative Method using Excel Solver				
Design Q = CiA =	#DIV/01	cis		
	6(0. cfs	Error 1 -	5.92
Swale Width=	36.9	91 ft	End 1	5.02
Instructions are provided to the right (green comments).				
Flow Velocity Minimum Length =	#DIV/0! #DIV/0!	ft/s ft		
Instructions are provided to the right (blue comments).				
Design Width = Design Discharge = Design Depth = Flow Velocity = Minimum Length =	1.2 0.3 0.5 154.	6 tt 20 cfs 33 tt 51 cfs 12 tt	Error 2 =	#DIV/01
If any of the resulting values do not meet the design requirement set forth in If any of the resulting values still do not meet the design requirement set for	rth in RG-348, the	design parameters ma , widening the swale b	ty be modified ottom value m	and the solver rerun.
16. Vegetated Filter Strips	Designed as	Required in RG-348	1	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		Required in RC	3-348 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 =	0.5	50 1 vo/bour	C = Runoff Coefficient = 0.546 $(IC)^2$ + 0.328 (IC) + 0.03		
A = drainage area in acres =	1	1 acres			
Q = flow rate in cubic feet per second =	0.5	56 cubic feet/se	20		
RG-348 Page 3-31 Equation 3 5: $V_{OR} \approx Q/A$					
Q = Runoff rate calculated above = A = Water surface area in the wet vault =	0.5	66 cubic feet/se 50 square feet	20		
V _{CR} = Overflow Rate =	0.0	00 feet/sec			
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =		3 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 =	C	5 in/hour			
Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = Efficiency Reduction for Actual Rainfall Intensity =	0.1	75 percent 33 percent			
Resultant TSS Load removed by Wet Vault =	#VALUE!	lbs			
18. Permeable Concrete	Designed as	Required in RO	3-348 Pages 3-79 to 3-83		
PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZO	ONE				
19. BMPs Installed in a Series	Designed as	Required in R	3-348 Pages 3-32		
Michael E. Barrett, Ph.D., P.E. recommended that the coeffic	cient for E ₂ be	changed from	n 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, =	89.	00 percent			
EFFICIENCY OF THE SECOND BMP IN THE SERIES = ${\rm E_{z}}$ =	70.	00 percent			
EFFICIENCY OF THE THIRD BMP IN THE SERIES = ${\rm E_3}$ =	0	00 percent			
THEREFORE, THE NET LOAD REMOVAL WOULD BE: $(A_f \text{ AND } A_P \text{ VALUES ARE FROM SECTION 3 ABOVE})$					
L _R = E _{TOT} X P X (A ₁ X 34.6 X A _P X0.54) =	220.	32 lbs			
20. Stormceptor					
Required TSS Removal in BMP Drainage Area= Impervious Cover Overtreatment=	0.0000	lbs ac			
TSS Removal for Uncaptured Area = BMP Sizing	0.00	lbs			
Effective Area =	NA #N/A	EA			
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) =	1 0	Model Size			
Surface Area =	= #N/A	ft²			
Overflow Rate =	#VALUE!	V _{or}			
Rounded Overflow Rate =	= #VALUE!	V _{or} %			
Biver Emcleticy /a=	- "VALUE!				

		L _P 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 Vortoch				
zi. vonech		Required TSS Removal in BMP Draipage Area-	NA	lbs
		Impervious Cover Overtreatment=	0.0000	ac
		TSS Removal for Uncaptured Area =	0.00	ibs
	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!	Vor
		Rounded Overflow Rate =	#VALUE!	Vax
		BMP Efficiency % =	#VALUE!	%
		L _a Value =	#VALUEI	lbs
		TSS Load Credit =	#VALUE!	lbs
	Is Sufficient	Treatment Available? (TSS Credit > TSS Uncapt.)	#VALUE!	
		TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	



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	4.66	4.67	2.38	51.0%	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	
				17.40	0.44	50.0%	8.046	7 544	7 580
Total			18.47	17.10	6.41	50.0%	0,040	7,544	1,000
							Required T	SS Removal	7,544



WATER QL	JALITY
BASIN A4-1	DETAILS
ITEM	QUANTITY
WQ VOLUME REQUIRED	12,542 CF
WQ VOLUME PROVIDED	20,432 CF
SEDIMENTATION AREA REQUIRED	1,045 SF
SEDIMENTATION AREA PROVIDED	1,050 SF
FILTER AREA REQUIRED	1,045 SF
FILTER AREA PROVIDED	1,050 SF
WQ STORAGE DEPTH	5.21 FEET
TSS REMOVED	2,202 LBS















	A STATE OF A	Theore							
Subbasin Data	Area Treated	Treatment Method	Total Area (acres)	Acreage Treated	Impervious Area (acres)	Imp %	LR (lbs)	LM (lbs)	Uesired LIM (Ibs)
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%	377	610	377
A 5 3	DA 54	Vegetated Filter Strips	0.28	0.28	0.07	25.5%	68	64	64
A 5-5	DA 5.6	Vegetated Filter Strips	5.24	5.24	0.71	13.6%	717	641	641
A 5-4	DA 5.11	Vegetated Filter Strips	0.83	0.83	0.29	34.4%	269	257	257
A 5-5		Sand Filter	14.39	14.09	6.66	46.3%	7033	5982	6294
A 5-6	DA 5.9A +DA 5.9B+DA 5.9C	Vegetated Filter Strips	3.96	3.96	1.43	36.1%	1341	1283	1283
A 5-7	DA 5.16	Vegetated Filter Strips	2.88	2.88	0.57	19.8%	555	513	513
A 5-8	DA 5.13	Vogetated Filter Strips	26	26	0.57	22.0%	551	513	513
A 5-9	DA 5.10	vegetated Filter Strips	0.2	0.3	0.20	68.1%	0	183	0
A 5-12	DA 5.12	Untreated Release	0.3	0.3	0.20	00.0%		450	
A 5-4A	DA 5.4A	Untreated Release	0.28	0.28	0.17	60.6%	0	152	0
		2	44.06	43.60	16.97	38.8%	16888	15383	15383



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-	Manor Creek	o Permanent B	WP Summary	lable				
ated	Treatment Method	Total Area (acres)	Acreage Treated	Impervious Area (acres)	Imp %	LR (lbs)	LM (lbs)	Desired LM (lbs)
.6	Sand Filter	15.59	15.07	6.695	42.9%	6936	6009	6323
	Vegetated Filter Strips	1.56	1.56	0.572	36.6%	536	513	513
	Vegetated Filter Strips	1.68	1.68	0.572	34.0%	538	513	513
	Vegetated Filter Strips	1.91	1.91	0.857	44.9%	798	770	770
	Vegetated Filter Strips	2.24	2.24	0.857	38.3%	803	770	770
A Start	Vegetated Filter Strips	1.55	1.55	0.572	36.9%	536	513	513
	Untreated Release	0.22	0.22	0.15	66.2%	-	131	-
	Untreated Release	0.30	0.30	0.20	67.9%	· -	183	-
		25.05	24.53	10.47	46.0%	10147	9401	9402





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