TCEQ Core Data Form

TCEQ Use Only

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

SECTION I: General Information

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

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

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

2. Customer Reference Number *(if issued)*	Follow this link to search for CN or RN numbers in Central Registry**	3. Regulated Entity Reference Number *(if issued)*
CN 600130652		RN

SECTION II: Customer Information

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

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

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

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

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

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

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

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

12. Number of Employees

☐ 0-20 ☐ 21-100 ☐ 101-250 ☐ 251-500 ☐ 501 and higher

13. Independently Owned and Operated?

☐ **Yes** ☐ **No**

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

☐ Owner ☐ Operator ☐ Owner & Operator

☐ Occupational Licensee ☐ Responsible Party ☐ Voluntary Cleanup Applicant ☐ Other:

15. Mailing Address:							
	City		**State**		**ZIP**	**ZIP + 4**	

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

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

SECTION III: Regulated Entity Information

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

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

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

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

CoSA Arrowhead Subdivision Phase 2 Sidewalk Project

23. Street Address of the Regulated Entity: *(No PO Boxes)*	Not Applicable						
	City		**State**		**ZIP**		**ZIP + 4**
24. County	Bexar						

Enter Physical Location Description if no street address is provided.

25. Description to Physical Location:	Within the Arrowhead Subdivision along Flaming Arrow, Arrow Ridge and Crooked Arrow.

26. Nearest City	**State**	**Nearest ZIP Code**
San Antonio	TX	78258

27. Latitude (N) In Decimal:	29.644957	**28. Longitude (W) In Decimal:**	-98.4947325

Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
29	38	41.9	-98	29	41.0

29. Primary SIC Code (4 digits)	**30. Secondary SIC Code** (4 digits)	**31. Primary NAICS Code** (5 or 6 digits)	**32. Secondary NAICS Code** (5 or 6 digits)
1611	1629	237310	238990

33. What is the Primary Business of this entity? *(Do not repeat the SIC or NAICS description.)*

Sidewalk Improvements

34. Mailing Address:	**100 W. Houston Street, 15th Floor**							
	City	**San Antonio**	**State**	**TX**	**ZIP**	**78283**	**ZIP + 4**	**3966**

35. E-Mail Address:	**Justin.Gawlik@sanantonio.gov**

36. Telephone Number	**37. Extension or Code**	**38. Fax Number** *(if applicable)*
(210) 207-0614		**(210) 366-1980**

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

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

SECTION IV: Preparer Information

40. Name:	Elvis Treviño	**41. Title:**	Project Manager

42. Telephone Number	**43. Ext./Code**	**44. Fax Number**	**45. E-Mail Address**
(210) 366-1988	8114	(210) 366-1980	etrevino@maesce.com

SECTION V: Authorized Signature

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

Company:	Maestas & Associates, LLC	**Job Title:**	Project Manager
Name *(In Print):*	Elvis Treviño	**Phone:**	(210) 366- **1988**
Signature:	Elvis Treviño	**Date:**	6/26/2025

CoSA Arrowhead Subdivision Phase 2

Sidewalk Project

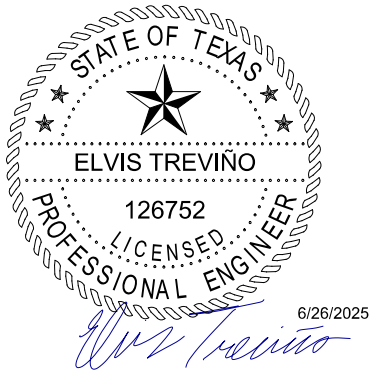
WPAP Application

June 2025

Prepared for:

City of San Antonio

Public Works Department



Prepared by:

MAESTAS

Texas Commission on Environmental Quality

Edwards Aquifer Application Cover Page

Our Review of Your Application

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

Administrative Review

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

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

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

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

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

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

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

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

Technical Review

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

2. A site assessment is usually conducted as part of the technical review, to evaluate the geologic assessment and observe existing site conditions. The site must be accessible to our staff. The site boundaries should be

clearly marked, features identified in the geologic assessment should be flagged, roadways marked and the alignment of the Sewage Collection System and manholes should be staked at the time the application is submitted. If the site is not marked the application may be returned.

3. We evaluate the application for technical completeness and contact the applicant and agent via Notice of Deficiency (NOD) to request additional information and identify technical deficiencies. There are two deficiency response periods available to the applicant. There are 14 days to resolve deficiencies noted in the first NOD. If a second NOD is issued, there is an additional 14 days to resolve deficiencies. If the response to the second notice is not received, is incomplete or inadequate, or provides new information that is incomplete or inadequate, the application must be withdrawn or will be denied. Please note that because the technical review is underway, whether the application is withdrawn or denied **the application fee will be forfeited**.
4. The program has 90 calendar days to complete the technical review of the application. If the application is technically adequate, such that it complies with the Edwards Aquifer rules, and is protective of the Edwards Aquifer during and after construction, an approval letter will be issued. Construction or other regulated activity may not begin until an approval is issued.

Mid-Review Modifications

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

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

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

- If the technical review has begun your application can be denied/withdrawn, your fees will be forfeited, and the plan will have to be resubmitted.
- TCEQ can continue the technical review of the application as it was submitted, and a modification application can be submitted at a later time.

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

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

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

1. Regulated Entity Name: CoSA Arrowhead Subdivision Phase 2 Sidewalk Project						**2. Regulated Entity No.:**			
3. Customer Name: City of San Antonio						**4. Customer No.:** CN 600130652			
5. Project Type: **(Please circle/check one)**	New		Modification			Extension		Exception	
6. Plan Type: **(Please circle/check one)**	WPAP	CZP	SCS	UST	AST	EXP	EXT	Technical Clarification	Optional Enhanced Measures
7. Land Use: **(Please circle/check one)**	Residential		Non-residential			**8. Site (acres):**		0.48	
9. Application Fee:	$500		**10. Permanent BMP(s):**			Shared Use Path Vegetative Filter Strip			
11. SCS (Linear Ft.):	-		**12. AST/UST (No. Tanks):**						
13. County:	Bexar		**14. Watershed:**			Salado Creek			

Application Distribution

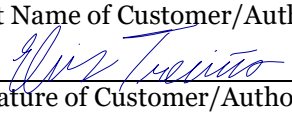
Instructions: Use the table below to determine the number of applications required. One original and one copy of the application, plus additional copies (as needed) for each affected incorporated city, county, and groundwater conservation district are required. Linear projects or large projects, which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

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

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

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

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

I certify that to the best of my knowledge, that the application is complete and accurate. This application is hereby submitted to TCEQ for administrative review and technical review. Elvis Treviño, PE
Print Name of Customer/Authorized Agent
 6/26/2025 Signature of Customer/Authorized Agent Date

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

General Information Form

Texas Commission on Environmental Quality

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

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

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

Signature

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

Print Name of Customer/Agent: Elvis Treviño, PE

Date: 06/26/2025

Signature of Customer/Agent:

Project Information

1. Regulated Entity Name: CoSA Arrowhead Subdivision Phase 2 Sidewalk Project
2. County: Bexar
3. Stream Basin: San Antonio River Basin
4. Groundwater Conservation District (If applicable): N/A
5. Edwards Aquifer Zone:

   ☒ Recharge Zone
   ☐ Transition Zone

6. Plan Type:

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

7. Customer (Applicant):

   Contact Person: Justin Gawlik, PE
   Entity: City of San Antonio
   Mailing Address: 100 W. Houston St., 15th Floor
   City, State: San Antonio, Texas Zip: 78205
   Telephone: 210-207-0614 FAX: 210-207-4406
   Email Address: justin.gawlik@sanantonio.gov

8. Agent/Representative (If any):

   Contact Person: Elvis Treviño, PE
   Entity: Maestas & Associates, LLC.
   Mailing Address: 8122 Datapoint Drive, Suite 840
   City, State: San Antonio, Texas Zip: 78229
   Telephone: 210-366-1988 FAX: 210-366-1980
   Email Address: etrevino@maesce.com

9. Project Location:

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

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

    Within the Arrowhead Subdivision along Flaming Arrow, Arrow Ridge and Crooked Arrow.

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

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

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

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

☒ Survey staking will be completed by this date: 10-27-2025

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

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

15. Existing project site conditions are noted below:

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

Prohibited Activities

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

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

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

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

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

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

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

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

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

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

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

Administrative Information

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

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

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

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

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

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

GENERAL INFORMATION FORM ATTACHMENTS

ATTACHMENT A – ROAD MAP

Attached.

ATTACHMENT B – USGS/EDWARDS AQUIFER RECHARGE ZONE MAP

Attached.

ATTACHMENT C - PROJECT DESCRIPTION

The City of San Antonio is placing sidewalks in a residential area to provide continuous sidewalks within the Arrowhead Subdivision along the following project limits:

- Installation of the following segment of sidewalk along Flaming Arrow ~30 LF south of Crescent Oaks to Flying Arrow:
    - 70 LF of 3.5-foot sidewalk with a 2.1-foot (minimum) shared use path natural vegetative filter strip on the east side of the sidewalk, which transitions to 41 LF of married 3.5-foot sidewalk and ties into the existing sidewalk.
- Installation of the following segments of sidewalks along the west side of Flaming Arrow from ~21 LF south of Flying Arrow to ~47 LF north of Lost Arrow:
    - 4 LF of existing 3-foot sidewalk to be replaced, which transitions to 17 LF of 3.5-foot divorced 3.5-foot sidewalk with a 3.5-foot (minimum) shared use path natural vegetative filter strip on the east side of the sidewalk, then ties into a proposed driveway, then 45 LF of 3.5-foot sidewalk with a 3.5-foot (minimum) shared use path natural vegetative filter strip on the east side of the sidewalk, which transitions to 9 LF of married 3.5-foot sidewalk tied into an existing concrete pad, then 8 LF of married 3.5-foot sidewalk, which transitions to 55 LF of 4-foot divorced 3.5-foot sidewalk with a 4-foot (minimum) shared use path natural vegetative filter strip on the east side of the sidewalk, and then transitions to 4 LF of married 3-foot sidewalk which ties in to an existing driveway.
- Installation of the following segments of sidewalks along the west side of Flaming Arrow from ~117 LF south of Lost Arrow to Hidden Arrow:
    - 10 LF of married 3-foot sidewalk, which transitions to 102 LF of 4-foot divorced 3.5-foot sidewalk with a 4-foot (minimum) shared use path natural vegetative filter strip on the east side of the sidewalk, and then transitions to 37 LF of married 3.5-foot sidewalk by replacing 16 LF of the existing 3-foot sidewalk, and then transitions to 3 LF of married 3-foot sidewalk to tie into an existing sidewalk.
- Installation of the following segments of sidewalks along the west side of Flaming Arrow from ~137 LF south of Hidden Arrow to Straight Arrow:
    - 4 LF married 3-foot sidewalk, which transitions to 27 LF of 4-foot divorced 3.5-foot sidewalk with a 4-foot (minimum) shared use path natural vegetative filter strip on the east side of the sidewalk, then ties into a proposed driveway, and then 77 LF of 3.5-foot sidewalk with a 4-foot (minimum) shared use path natural vegetative filter strip on

the east side of the sidewalk, which transitions to 29 LF of married 4-foot sidewalk and then ties into an existing sidewalk.

- Installation of the following segments of sidewalks along west side of Flaming Arrow from Straight Arrow to ~46 LF north of Crooked Arrow:

    - 27 LF of married 4-foot sidewalk, which transitions to 121 LF of 3.5-foot divorced 3.5-foot sidewalk with a 3.5-foot (minimum) shared use path natural vegetative filter strip on the east side of the sidewalk, and then transitions to 11 LF of married 3.5-foot sidewalk tied into an existing concrete pad, then 4 LF of married 3.5-foot sidewalk, which transitions to 49 LF of 3.5-foot divorced 3.5-foot sidewalk with a 3.5-foot (minimum) shared use path natural vegetative filter strip on the east side of the sidewalk, and then transitions to 27 LF of 2.1-foot divorced 3.5-foot sidewalk with a 2.1-foot (minimum) shared use path natural vegetative filter strip on the east side of the sidewalk, and then transitions to 4 LF of married 3.5-foot sidewalk, which ties into the existing curb inlet.

- Installation of the following segments of sidewalks along the west side of Arrow Ridge from ~113 LF south of Lost Arrow to Cul-de-Sac:

    - 4 LF of married 3-foot sidewalk, which transitions to 32 LF of 3.5-foot divorced 3.5-foot sidewalk with a 3.5-foot (minimum) shared use path natural vegetative filter strip on the east side of the sidewalk, then ties into a proposed driveway, and then 81 LF of 3.5-foot sidewalk with a 3.5-foot (minimum) shared use path natural vegetative filter strip on the east side of the sidewalk and with a 40 LF of retaining wall on the west side of the sidewalk beginning approximately 15 LF south of the proposed driveway, which transitions to 18 LF of married 3.5-foot sidewalk replacing 23 LF of 3-foot sidewalk, and then transitions to married 3-foot sidewalk to tie into an existing sidewalk.

- Installation of the following segments of sidewalks along the east side of Arrow Ridge from ~131 LF south of Lost Arrow to Hidden Arrow:

    - 8 LF of existing 3-foot sidewalk to be replaced, then transitions to a 3.5-foot sidewalk, then ties into a proposed driveway, then 4 LF of married 3.5-foot sidewalk which transitions to 49 LF of 2.1-foot divorced 3.5-foot sidewalk with a 2.1-foot (minimum) shared use path natural vegetative filter strip on the west side of the sidewalk, and then transitions to 39 LF of married 3.5-foot sidewalk, which transitions to 3-foot sidewalk to tie into an existing sidewalk.

- Installation of the following segments of sidewalks along the west side of Arrow Ridge from Cul-de-Sac to ~ 125 LF north of Crooked Arrow:

    - Removal of 15 LF of the existing 3-foot sidewalk and transition to a 3.5-foot sidewalk, then 27 LF of married 3.5-foot sidewalk, which transitions to 74 LF of 5-foot divorced 3.5-foot sidewalk with a 5-foot (minimum) shared use path natural vegetative filter strip on the east side of the sidewalk, then ties into the existing driveway, and then 10 LF of 3.5-foot sidewalk with a 5-foot (minimum) shared use path natural vegetative filter strip on the east side of the sidewalk, then ties into the existing driveway, and then 53 LF of 3.5-foot sidewalk with a 5-foot (minimum) shared use path natural vegetative filter strip on the east side of the sidewalk, which transitions to 4 LF of married 3-foot sidewalk to tie into an existing sidewalk.

- Installation of the following segments of sidewalks along the east side of Arrow Ridge from ~55 LF south of Hidden Arrow to Straight Arrow:

    - 4 LF of married 3-foot sidewalk, which transitions to 110 LF of 4.5-foot divorced 3.5-foot sidewalk with a 3.5-foot (minimum) shared use path natural vegetative filter strip on the west side of the sidewalk, then transitions to 14 LF of 2.1-foot divorced 3.5-foot sidewalk with a 2.1-foot (minimum) shared use path natural vegetative filter strip on west side of sidewalk and with a 12 LF retaining wall on east side of sidewalk at the proposed driveway, then ties into a proposed driveway, and then 4 LF of 3.5-foot sidewalk with a 2.1-foot (minimum) shared use path natural vegetative filter strip on the west side of the sidewalk, which transitions to 20 LF of 4-foot divorced 3.5-foot sidewalk with a 4-foot (minimum) shared use path natural vegetative filter strip on the west side of the sidewalk, and then transitions to 23 LF of married 3.5-foot sidewalk, which transitions to 4 LF of married 3-foot sidewalk to tie into an existing sidewalk.

- Installation of the following segments of sidewalks along the north side of Crooked Arrow from ~324 LF east of Lost Arrow to Arrow Ridge:

    - 10 LF of married 3.5-foot sidewalk, which transitions from a 3-foot sidewalk ties into a proposed driveway, and then 4 LF of married 3.5-foot sidewalk, which transitions to 50 LF of 4-foot divorced 4-foot sidewalk with a 4-foot (minimum) shared use path natural vegetative filter strip on the south side of the sidewalk and with 50 LF of retaining wall on the north side of the sidewalk beginning at the proposed driveway, and then transitions to 59 LF of married 3.5-foot sidewalk, which transitions to a 3-foot sidewalk to tie into an existing sidewalk.

- Installation of the following segments of sidewalks along the south side of Crooked Arrow from ~330 LF east of Lost Arrow to Arrow Ridge:

    - 14 LF of married 3-foot sidewalk, which transitions to 87 LF of 4-foot divorced 3.5-foot sidewalk with a 4-foot (minimum) shared use path natural vegetative filter strip on the north side of the sidewalk, and then transitions to 53 LF of married 3.5-foot sidewalk and then transitions to a 3-foot sidewalk to tie into an existing sidewalk.

- Installation of the following segments of sidewalks along the south side of Crooked Arrow from Arrow Ridge to ~118 LF west of Burnt Arrow:

    - 9 LF of existing 3-foot sidewalk to be replaced and transitions to a 3.5-foot sidewalk, then ties into an existing driveway, and then 40 LF of married 3.5-foot sidewalk, which transitions to 95 LF of 4.5-foot divorced 3.5-foot sidewalk with a 4.5-foot (minimum) shared use path natural vegetative filter strip on the north side of the sidewalk, and then transitions to 6 LF of married 3-foot sidewalk to tie into an existing driveway.

- Installation of the following segments of sidewalks along the south side of Crooked Arrow from ~22 LF east of Flying Arrow to ~114 LF west of Lost Arrow:

    - 4 LF of married 3-foot sidewalk, which transitions to 90 LF of 4-foot divorced 3.5-foot sidewalk with a 4-foot (minimum) shared use path natural vegetative filter strip on the north side of the sidewalk, and then transitions to 4 LF of married 3-foot sidewalk to tie into an existing sidewalk.

The 1,892 LF of the proposed sidewalk will connect to the existing sidewalks along the project limits. The purpose of the project is to provide continuous sidewalk access in the area and provide ADA compliant sidewalks along the project limits.

The project area within the Recharge Zone is 0.48 acres; 1892 linear feet of sidewalk and shared use path natural vegetative filter strip combination. All elements of the improvements drain to Unnamed stream and to Unnamed Tributary 1 to Panther Springs Creek and then into Panther Springs Creek.

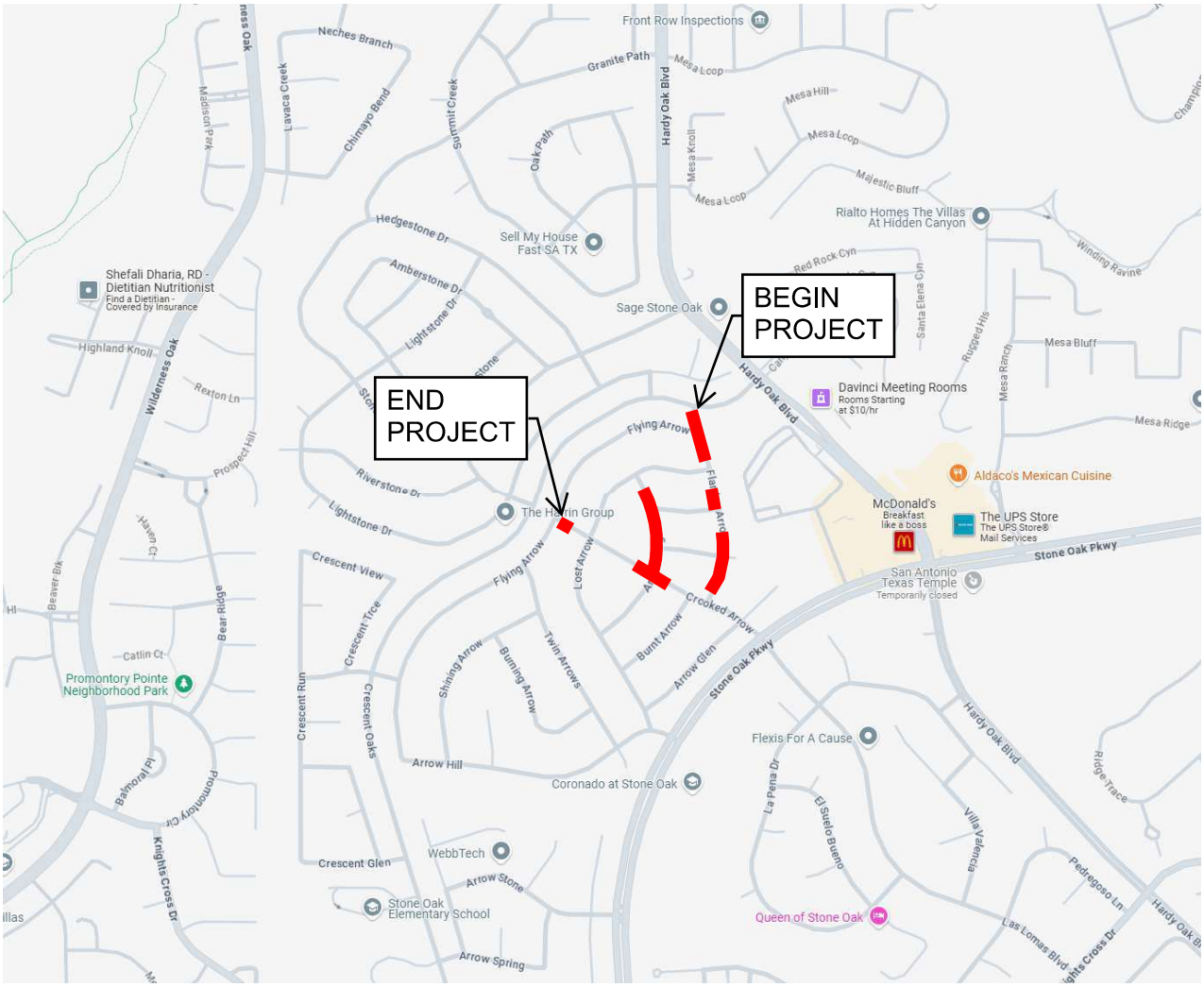
The proposed BMP is 4758 square feet of shared use path natural vegetative filter strip along the proposed sidewalk segments.

The existing curb along the proposed sidewalk will prevent off-site runoff from affecting the new impervious cover and natural vegetative filter strip. There is no concentration of flow within the shared use path natural VFS treatment area.

The total project area draining into the Recharge Zone is 0.48 acres, 0 acres of which is existing impervious cover (0% impervious cover) for predevelopment conditions. New impervious cover totaling 8804 square feet will be added resulting in 0.24 acres of total impervious cover yielding a post development percent impervious cover equal to 50%.

The sidewalk will be constructed in the City of San Antonio right-of-way. The property adjacent to the project was originally platted on June 13th, 1985, recorded in Volume 9511 Page 118 of the Bexar County Records.

CoSA ARROWHEAD SUBDIVISION PHASE 2 SIDEWALK PROJECT



LEGEND

WPAP PROJECT SITE

ATTACHMENT A

PROJECT LOCATION

EDWARDS AQUIFER RECHARGE ZONE

PROJECT LOCATION

FLOW PATH

SAN ANT

EDWARDS AQUIFER RECHARGE ZONE

Classen Cem

Hollywood

Hollywood Park

Kentwoo Manor

MATCHLINE A-A

STATE OF TEXAS
ELVIS TREVIÑO
126752
LICENSED
PROFESSIONAL ENGINEER
6/26/2025

LEGEND

FLOW PATH FROM PROJECT TO END OF TRANSITION ZONE

SCALE: 1" = 2000'

USGS QUADRANGLE:

CAMP BULLIS
BULVERDE
CASTLE HILLS
LONGHORN

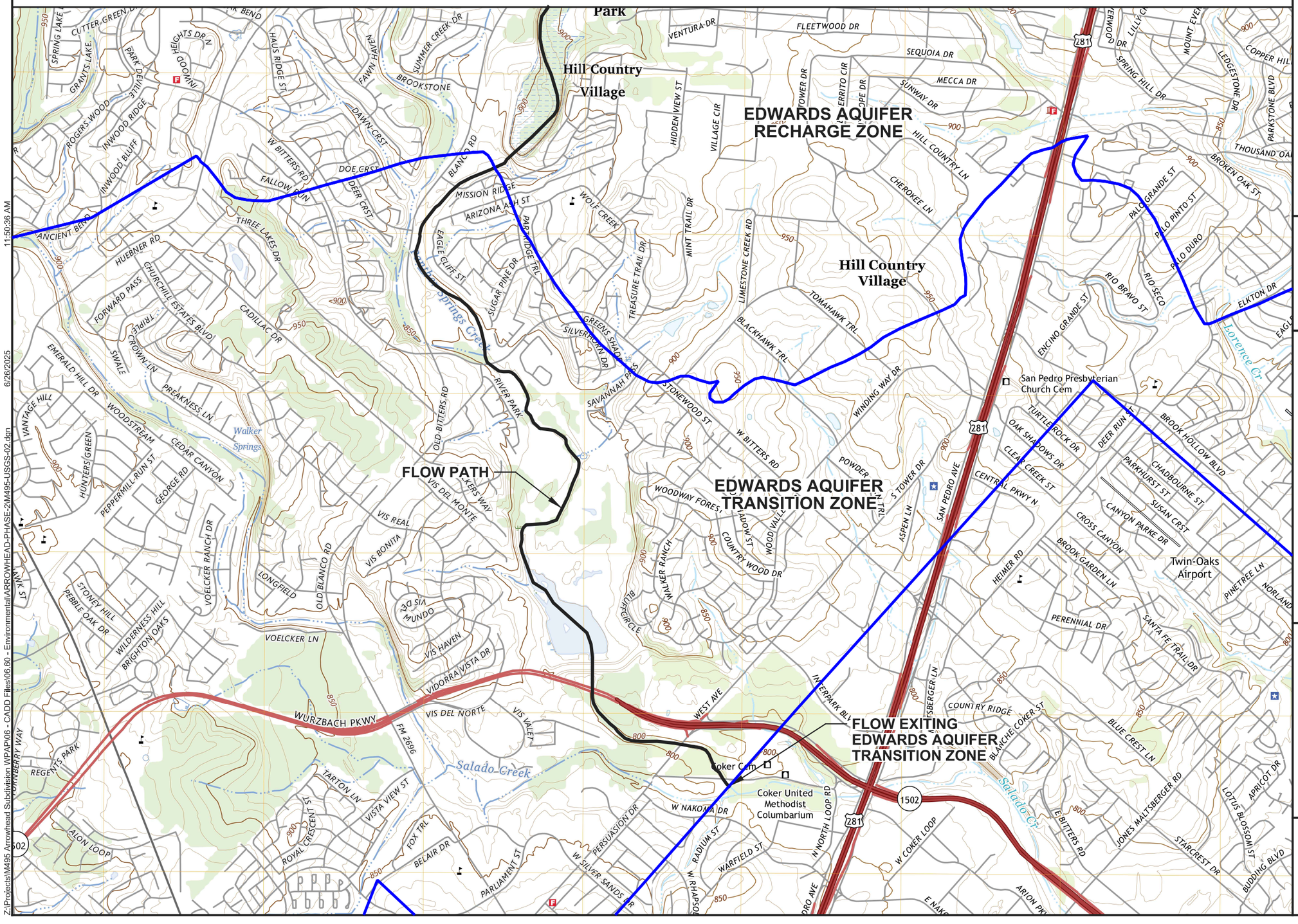
ATTACHMENT B

COSA Arrowhead Phase 2
Sidewalk Project
Arrowhead Townhouse UT-1 South

Sheet 1 of 2

11:45:31 AM 6/26/2025 Z:\Projects\M495 Arrowhead Subdivision WPAP\06 - CADD Files\06.60 - Environmental\ARROWHEAD-PHASE-2\M495-USGS-01.dgn

MATCHLINE A-A



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STATE OF TEXAS
ELVIS TREVIÑO
126752
LICENSED
PROFESSIONAL ENGINEER
6/26/2025

LEGEND

FLOW PATH FROM PROJECT TO END OF TRANSITION ZONE

SCALE: 1" = 2000'

USGS QUADRANGLE:

CAMP BULLIS
BULVERDE
CASTLE HILLS
LONGHORN

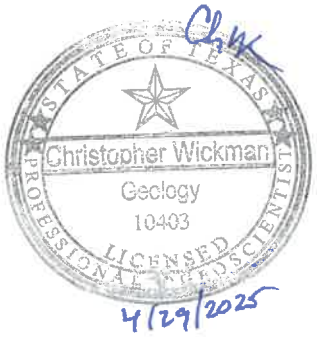
ATTACHMENT B

COSA Arrowhead Phase 2
Sidewalk Project
Arrowhead Townhouse UT-1 South

Sheet 2 of 2

GEOLOGIC ASSESSMENT

CoSA Arrowhead Subdivision Phase 2
San Antonio, Bexar County, Texas
April 29, 2025 | Terracon Project No. 90257093



Prepared for:
Maestas & Associates, LLC
8122 Datapoint Drive, Suite 840
San Antonio, Texas

Prepared by:
Terracon Consultants, Inc.
6000 Northwest Parkway, Suite 100
San Antonio, Texas

Terracon
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6000 Northwest Parkway, Suite 100
San Antonio, Texas 78249
P 210.641.2112
F 210.641.2124
Texas Professional Engineers No. 3272
Texas Professional Geoscience Firm Registration No. 50058
Terracon.com

April 29, 2025

Maestas & Associates, LLC
8122 Datapoint Drive, Suite 840
San Antonio, Texas 78229

Attn: Mr. Carlos Luna III, PE, CFM, Vice President
P: (210) 366-1988
E: cluna@maesce.com

Re: Geologic Assessment
CoSA Arrowhead Subdivision Phase 2
San Antonio, Bexar County, Texas
Terracon Project No. 90257093
Maestas Project No. M495

Dear Mr. Luna:

Terracon Consultants, Inc. (Terracon) is pleased to submit the enclosed Geologic Assessment (GA) report for the above-referenced site. This assessment was performed in accordance with the Maestas & Associates, LLC Subconsultant Work Authorization No. 3 dated March 24, 2025.

We appreciate the opportunity to be of service to you on this project. In addition to the GA services, our professionals provide other environmental, geotechnical, construction materials testing, and facilities services on a wide variety of projects locally, regionally, and nationally. For more detailed information on Terracon's services, please visit our website at www.terracon.com. If there are any questions regarding this report or if we may be of further assistance, please do not hesitate to contact us.

Sincerely,
Terracon Consultants, Inc.

Christopher Wickman, P.G.
Senior Staff Scientist

Kevin Bryant, P.G.
Senior Project Manager

Attachments:
Geologic Assessment Form
Geologic Assessment Narrative Text
Geologic Assessment Table
Stratigraphic Column
Site Photographs
Exhibits 1 – 10: Geologic Map

cc: Maestas & Associates, LLC (1 digital [PDF])

Geologic Assessment

Texas Commission on Environmental Quality

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

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

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

Signature

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

Print Name of Geologist: Chris Wickman

Telephone: 210-641-2112

Date: April 29, 2025

Fax: 210-641-2124

Representing: Terracon Consultants, Inc. (TBPG No. 50058) (Name of Company and TBPG or TBPE registration number)

Signature of Geologist:

4/29/2025

STATE OF TEXAS
Christopher Wickman
Geology
10403
LICENSED
PROFESSIONAL GEOSCIENTIST

Regulated Entity Name: CoSA Arrowhead Subdivision Phase 2

Project Information

1. Date(s) Geologic Assessment was performed: April 1, 2025
2. Type of Project:
   - ☒ WPAP
   - ☐ SCS
   - ☐ AST
   - ☐ UST
3. Location of Project:
   - ☒ Recharge Zone
   - ☐ Transition Zone
   - ☐ Contributing Zone within the Transition Zone

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

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

Table 1 - Soil Units, Infiltration Characteristics and Thickness

Soil Name	Group*	Thickness(feet)
TaD	D	0-2

** Soil Group Definitions (Abbreviated)*

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

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

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

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

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

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

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

   Applicant's Site Plan Scale: 1" = 40'
   Site Geologic Map Scale: 1" = 40'
   Site Soils Map Scale (if more than 1 soil type): 1" = _____'

9. Method of collecting positional data:

   ☒ Global Positioning System (GPS) technology.
   ☐ Other method(s). Please describe method of data collection: _____

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

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

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

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

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

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

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

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

Administrative Information

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

CoSA Arrowhead Subdivision Phase 2
San Antonio, Bexar County, Texas
Terracon Project No. 90257093
Maestas Project No. M475

INTRODUCTION

Maestas and Associates, LLC (Client) retained Terracon Consultants, Inc. (Terracon) to conduct a Geologic Assessment (GA) where the following proposed sidewalks are to be installed. The sidewalks are to be installed along the west side of Flaming Arrow beginning approximately 20 feet south of Flying Arrow and terminating approximately 40 feet north of Lost Arrow; the west side of Flaming Arrow beginning approximately 115 feet north of Hidden Arrow and ending at Hidden Arrow; the west side of Flaming Arrow beginning approximately 120 feet north of Straight Arrow and ending at Crooked Arrow; the south side of Crooked Arrow beginning approximately 115 east of Arrow Ridge to 135 feet west of Arrow Ridge; the south side of Crooked Arrow beginning approximately 110 east of Flying Arrow to Flying Arrow; the west side of Arrow Ridge from approximately 130 feet north of Straight Arrow to 90 feet west of Arrow Ridge on the north side of Crooked Arrow; the east side of Arrow Ridge from approximately 60 feet south of Hidden Arrow to Straight Arrow; the east side of Arrow Ridge from approximately 60 feet north of Hidden Arrow to Hidden Arrow; and the west side of Arrow Ridge from Hidden Arrow to approximately 100 feet north of Hidden Arrow in San Antonio, Bexar County, Texas (site). According to the *Edwards Aquifer Map Viewer*, accessible from the Texas Commission on Environmental Quality (TCEQ) website, the site is located within the designated Edwards Aquifer Recharge Zone (EARZ).

EXPLANATION OF ASSESSMENT

This assessment follows general guidelines contained in the TCEQ *Instructions to Geologists for Geologic Assessments on the Edwards Aquifer Recharge/Transition Zones* (TCEQ Guidance 0585, dated October 4, 2004). The EARZ and Edwards Aquifer Transition Zone (EATZ) are known to contain karst features formed by selective dissolving of carbonate minerals by water. Karst features may be formed and be visible at the ground surface but more commonly tend to be smaller at the surface and develop with depth. Because of the site's location, future development of the site must comply with the TCEQ Edwards Aquifer Protection Program Rules specified in Title 30 of the Texas Administrative Code, Section 213 (30 TAC§ 213).

The assessment consisted of a pedestrian survey of the subject property and non-intrusive visual observations of readily accessible and visible surface conditions to identify the presence of geologic and manmade features. Geologic or manmade features, for the purposes of this assessment, are those features that are visible at the ground surface or have been mapped within the EARZ/EATZ which have a potential for hydraulic interconnectedness between the surface and the Edwards Aquifer. In accordance with the GA guidelines, intrusive subsurface testing such as excavation, cave mapping, infiltrometer

testing, geophysical studies, or tracer studies was not required or conducted for the GA of any feature identified at the site.

The GA was supervised by Mr. Chris Wickman, a Professional Geoscientist (P.G.), and the field assessment was performed by Mr. Wickman on April 1, 2025. Technical review of the GA was conducted by Mr. Kevin K. Bryant, P.G.

GENERAL SITE DESCRIPTION

The site is located in the public right-of-way (ROW) along the west side of Flaming Arrow beginning approximately 20 feet south of Flying Arrow and terminating approximately 40 feet north of Lost Arrow; the west side of Flaming Arrow beginning approximately 115 feet north of Hidden Arrow and ending at Hidden Arrow; the west side of Flaming Arrow beginning approximately 120 feet north of Straight Arrow and ending at Crooked Arrow; the south side of Crooked Arrow beginning approximately 115 east of Arrow Ridge to 135 feet west of Arrow Ridge; the south side of Crooked Arrow beginning approximately 110 east of Flying Arrow to Flying Arrow; the west side of Arrow Ridge from approximately 130 feet north of Straight Arrow to 90 feet west of Arrow Ridge on the north side of Crooked Arrow; the east side of Arrow Ridge from approximately 60 feet south of Hidden Arrow to Straight Arrow; the east side of Arrow Ridge from approximately 60 feet north of Hidden Arrow to Hidden Arrow; and the west side of Arrow Ridge from Hidden Arrow to approximately 100 feet north of Hidden Arrow and drains into unnamed tributary 1 of Panther Springs Creek. Sidewalks are proposed to be installed at the site which requires a Water Pollution Abatement Plan (WPAP).

According to light detection and ranging (LIDAR) elevation data obtained from the Texas Natural Resources Information System (TNRIS), the topography of the site ranges from approximately 1142 feet above mean sea level (amsl) in the southern portion of the site to approximately 1231 feet amsl in the northern portion of the site.

Historical aerial photographs available through Google Earth Pro software were reviewed during this assessment. According to the aerial photographs, the site is relatively unchanged between the 1995 and 2024 aerial photographs.

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) 48029C0140G (dated September 29, 2010), the site is not zoned for potential flood hazards.

According to the Texas Water Development Board's (TWDB) website, there are no registered water wells mapped within the boundaries of the project site.

SOIL DESCRIPTION

Based on a review of the United States Department of Agriculture (USDA) *Web Soil Survey*, the soil type mapped at the site is the Eckrant – Rock outcrop association, 8 to 30 percent slopes (TaD).

The TaD soils are mapped throughout the site. The typical profile for TaD soils consist of very to extremely cobbly clay overlaying bedrock. The TaD soils are well drained, runoff is high, and capacity of the most limiting layer to transmit water is moderately low to moderately high (Saturated Hydraulic Conductivity [Ksat] 0.06 to 0.57 inches per hour). Accordingly, these soils are classified as Hydrologic Soil Group D, having a very slow infiltration rate when thoroughly wetted.

NARRATIVE DESCRIPTION OF SITE GEOLOGY

Several published sources were reviewed to assist in identifying the underlying geology of the site, including maps from the U.S. Geological Survey (USGS) and the Bureau of Economic Geology (BEG). The following documents were reviewed as part of this GA:

- *Geologic Atlas of Texas, San Antonio Sheet (Barnes, 1983);*
- *Geologic Map of the Edwards Aquifer Recharge Zone, South-Central Texas (Blome and others, 2005);*
- *Miscellaneous Map No. 39, Geologic Map of the New Braunfels, Texas, 30 x 60 Minute Quadrangle (Collins, 2000);*
- *Geologic Map of the Bulverde Quadrangle, Texas (Collins, 1993)*; and
- *Geologic Framework and Hydrogeologic Characteristics of the Edwards Aquifer Recharge Zone, Bexar County, Texas (Small and Hanson, 1995).*

The Geologic Map of the Edwards Aquifer Recharge Zone depicts the site located on the Kirschberg Evaporite (Kkke) and Dolomitic (Kkd) members of the Edwards Kainer formation. The New Braunfels geologic map depicts Edwards Kainer formation (Kk) at the site. Based on a review of the above-referenced documents and observations made in the field, the northern portion of the site most likely is located on the Kkke and the southern portion of the site is underlain by Kkd.

Regionally, the Kkke consists of highly altered crystalline limestone, chalky mudstone, and chert with few fossils. The Kkke is characterized by box-work voids with neospar and travertine framing. Extensive cavern development throughout this member makes the Kkke one of the most porous (majority fabric selective) and permeable members of the Edwards Limestone. Regionally, the average thickness of this member is 50-feet to 60-feet in Bexar County.

The Kkd consists of mudstone to grainstone with crystalline limestone and chert. This member is massively bedded and light gray with abundant fossils of *Toucasia*. Cavern

development is related to structural features, such as faults, fractures, and bedding planes, and would be considered nonfabric-selective porosity. However, fabric-selective porosity would occur where solution along bedding planes yields water. Overall thickness ranges from 110 to 130 feet.

Review of *The Caves and Karst of Texas* (Veni and Elliott, 1994) and *The Caves of Bexar County* (Veni, 1988) indicates that caves have not been mapped on the project site.

SITE-SPECIFIC GEOLOGIC FEATURE DESCRIPTIONS

The following is a description of the features identified during literature research and observations made during the field reconnaissance at the site. Field observations were made to identify features such as caves, solution cavities, solution-enlarged fractures, faults, other natural bedrock features, manmade features in bedrock, swallow holes, sinkholes, non-karst closed depressions, and zone/clustered/aligned features, using the survey guidance from the TCEQ *Instructions to Geologists for Geologic Assessments* as revised October 1, 2004. Features identified at the site are listed in the following subsections. If geologic features were identified, the sidewalls and floors of the features were probed (if possible) by hand using a 4-foot long, 3/8-inch diameter metal soil probe.

Initially, a number of potential recharge features were identified during the site reconnaissance. However, upon further evaluation, some of these identified areas were either beyond the boundaries of the project site or did not meet the criteria for potential recharge features and have, therefore, been removed from this report. The numbering system of the individual features discussed below has been maintained to be consistent with field markings such as stakes and flagging that were used to mark potential recharge features at the site.

For the purposes of completing the GA forms and associated table included in this report, each feature has been assigned a point value where higher values indicate an increased probability for rapid infiltration into the subsurface. As required by the TCEQ survey guidance documents, some features not readily identifiable in the field, such as mapped faults, have also been included in this section, if applicable. Exhibit 1-10, attached at the end of this report, depict the locations of the geologic and manmade features discussed below.

Feature Assessment

S-6 Man-Made Boring in Bedrock: This feature is a mapped water line owned and operated by the San Antonio Water System (SAWS). The water line is mapped crossing the Kkd and Kkke. The mapped water line was not observed in the field with the exception of a fire hydrant observed on the southern portion of the site on the westside of Flaming Arrow, north of Hidden Arrow and a 6-inch diameter water valve

cover observed on the southern portion of the site in the northwest corner of the intersection of Arrow Ridge and Crooked Arrow. The depth of the water line is unknown. However, according to the SAWS Water Block Maps #158658, 160656, and #160658 (dated August 3, 2024), the water line is a 8 to 12-inch diameter pipe and crosses through the various sections of proposed sidewalk area for approximately 944 feet. The catchment area of the water line is believed to be greater than 1.6 acres. Detectable voids, depressions, and conduits were not noted in the vicinity of the mapped water line. Sunken soil, differential vegetation patterns, or other visual indicators of concentrated subsurface drainage were not noted in the vicinity of the mapped water line. The water line at the site is located on a hilltop topography. Typically, water lines are installed into trenches excavated into near surface soils and shallow bedrock. Once the water lines have been installed, select fill materials, such as sand or pea-gravel, are typically used to backfill around the utility lines although backfilling using excavated materials removed during the trench excavation is also common. Given the lack of evidence regarding concentrated flow in the subsurface along the mapped water line, the lack of subsided soil or other depressions in the vicinity of the mapped water line, the potential recharge into the feature to the Edwards Aquifer is believed to be low – scoring 37 points on the Geological Assessment Table. Therefore, this feature would not be considered sensitive.

S-7 Man-Made Boring in Bedrock: This feature is a series of storm water inlets. The storm water inlets are mapped on the Kkd. The storm water inlets were observed in the field along the eastern boundary of the site along the west side of Flaming Arrow, northwest of the intersection of Flaming Arrow and Straight Arrow. The length of the storm water inlets was measured to be approximately 35 feet. However, the total length, width, and depth of the storm water lines crossing the site are unknown. The catchment area of the water line is believed to be greater than 1.6 acres. Detectable voids, depressions, and conduits were not noted in the vicinity of the storm water inlets. Typically, storm water lines are installed into trenches excavated into near surface soils and shallow bedrock. Once the storm water lines have been installed, select fill materials, such as sand or pea-gravel, are typically used to backfill around the concrete pipe culverts although backfilling using excavated materials removed during the trench excavation is also common. Given the lack of evidence regarding concentrated flow in the subsurface along the storm water inlets, the lack of subsided soil or other depressions in the vicinity of the storm water inlets, the potential recharge into the feature to the Edwards Aquifer is believed to be low – scoring 38 points on the Geological Assessment Table. Therefore, this feature would not be considered sensitive.

S-9 Man-Made Boring in Bedrock: This feature is an apparent CATV utility vault with secured cover. The observed CATV utility vault is approximately 1-foot wide by 2-feet long and was approximately 2 feet in height. The CATV utility vault was located on the Kkd. The depth, diameter, and distance of the CATV utility lines traveling

across the site are unknown. However, the catchment area of the CATV utility lines is believed to be greater than 1.6 acres. Detectable voids, conduits, or depressions were not noted in the vicinity of the CATV utility vault. Sunken soil, differential vegetation patterns, or other visual indicators of concentrated subsurface drainage were not noted in the vicinity of the CATV utility vault. The utility lines at the site are located on a hilltop topography. Typically, CATV utility lines are installed into trenches excavated into near surface soils and shallow bedrock. Once the utility lines have been installed, select fill materials, such as sand or pea-gravel, are typically used to backfill around the utility lines although backfilling using excavated materials removed during the trench excavation is also common. Given the lack of evidence regarding concentrated flow in the subsurface in the vicinity of the CATV utility vault, and the lack of subsided soil or other depressions in the vicinity of the CATV utility vault, the potential recharge into the feature to the Edwards Aquifer is believed to be low – scoring 36 points on the Geological Assessment Table. Therefore, this feature would not be considered sensitive.

COMMENTS AND OBSERVATIONS

Slight modification of the site topography or surface-water flow during construction is anticipated. Within the Edwards Aquifer Recharge/Transition Zone, potential recharge features lacking visible surface expression (such as subsurface solution enlarged fractures, caves, cavities, and other karst features) are often present which would not be identifiable during the site inspection. Accordingly, this assessment does not address the possible presence of subsurface conditions that may be exposed during excavation or other construction activities. Should solution features or conditions be exposed during construction, construction should be halted and the TCEQ Edwards Aquifer Protection Program should be contacted and notified of the site conditions immediately in accordance with 30 TAC §213.5(f)(2).

REFERENCES

- Barnes, V.E., 1983, *Geologic Atlas of Texas, San Antonio Sheet: Bureau of Economic Geology, Scale 1:250,000.*
- Blome, C.D., Faith, J.R., Pedraza, D.E., Ozuna, G.B., Cole, J.C., Clark, A.K., Small, T.A., and Morris, R.R., 2005, *Geologic Map of the Edwards Aquifer Recharge Zone, South-Central Texas: U.S. Geological Survey Scientific Investigations Map 2873, Version 1.1, 1 pl., scale 1:200,000.*
- Collins, E., 2000, *Miscellaneous Map No. 39, Geologic Map of the New Braunfels, Texas, 30 x 60 Minute Quadrangle: Geologic Framework of an Urban-Growth Corridor along the Edwards Aquifer, South-Central Texas. The University of Texas at Austin, Bureau of Economic Geology.*
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- Veni and Elliot, 1994 *The Caves and Karst of Texas, 1994 NSS Convention Guidebook.*
- Veni, 1988, *The Caves of Bexar County, Second Edition, Texas Memorial Museum Speleological Monographs, 2.*

GEOLOGIC ASSESSMENT TABLE

PROJECT NAME: CoSA Arrowhead Subdivision Phase 2 (COSA FY25) (Terracon Project No. 90257093)

LOCATION			FEATURE CHARACTERISTICS												EVALUATION			PHYSICAL SETTING		
1A	1B *	1C*	2A	2B	3	4			5	5A	8	7	8A	8B	9	10		11		12
FEATURE ID	LATITUDE	LONGITUDE	FEATURE TYPE	POINTS	FORMATION	DIMENSIONS (FEET)			TREND (DEGREES)	MOD 10	DENSITY (NO/FT)	APERTURE (FEET)	INFILL	RELATIVE INFILTRATION RATE	TOTAL	SENSITIVITY		CATCHMENT AREA (ACRES)		TOPOGRAPHY
						X	Y	Z		10						<40	>40	<1.6	>1.6	
S-6	29° 38' 42.17"	98° 29' 40.27"	MB	30	Kkd	0.67-10	~944	?					X	7	37	X			X	HILLTOP
S-7	29° 38' 33.14"	98° 29' 32.27"	MB	30	Kkd	?	?	?					X	8	38	X			X	HILLTOP
S-9	29° 38' 31.63"	98° 29' 43.80"	MB	30	Kkd	?	?	?					X	6	36	X			X	HILLTOP

* DATUM: NAD 83

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

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

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

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

4/29/2025

Chris Wickman P.G.

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Christopher Wickman
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LICENSED PROFESSIONAL GEOSCIENTIST

Date: April 29, 2025

Sheet 1 of 1

TCEQ-0585-Table (Rev. 10-01-04)

STRATIGRAPHIC COLUMN

CoSA Arrowhead Subdivision Phase 2
San Antonio, Bexar County, Texas
Terracon Project No. 90257093
Maestas Project No. M495

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

Based on information provided in the *Geologic Framework and Hydrogeologic Characteristics of the Outcrops of the Edwards Aquifer Recharge Zone, Bexar County, Texas* (USGS, 1995). The geologic unit outlined in red is believed to be present at the site.

Photo #1: View of the northern portion of the Site along the west side of Flaming Arrow, looking north.

Photo #2: View of the northern portion of the site on the west side of Flaming Arrow, looking south.

Photo #3: View of the northern portion of the site on the west side Flaming Arrow, looking south.

Photo #4: View of the central portion of site on the west side of Flaming Arrow, looking north.

Photo #5: View of fire hydrant associated with feature S-6, a San Antonio Water Systems water line, in the vicinity of the southern portion of site on the west side of Flaming Arrow, north of Hidden Arrow.

Photo #6: View of the southern portion of the site with feature S-7, storm water drains, located on the west side of Flaming Arrow, north of Hidden Arrow.

Photo #7: View of the southern portion of the site on the west side of Flaming Arrow between Hidden Arrow and Crooked Arrow.

Photo #8: View of the southern portion of the site on the south side of Crooked Arrow looking southeast.

Photo #9: View of the southern portion of the site on the north side of Crooked Arrow looking northwest, northwest of Arrow Ridge.

Photo #10: View of the southern portion of the site on the south side of Crooked Arrow looking southwest, northwest of Arrow Ridge.

Photo #11: View of an apparent CATV utility vault associated with feature S-9 in the vicinity of the southern portion of site on the south side of Crooked Arrow, southwest of the intersection of Crooked Arrow and Arrow Ridge.

Photo #12: Another view of marked valve cover associated with feature S-6 in the vicinity of the southern portion on the site, north of the intersection of Crooked Arrow and Arrow Ridge.

Photo #13: View of the western portion of the site on the south side of Crooked Arrow looking northeast, southeast of Flying Arrow.

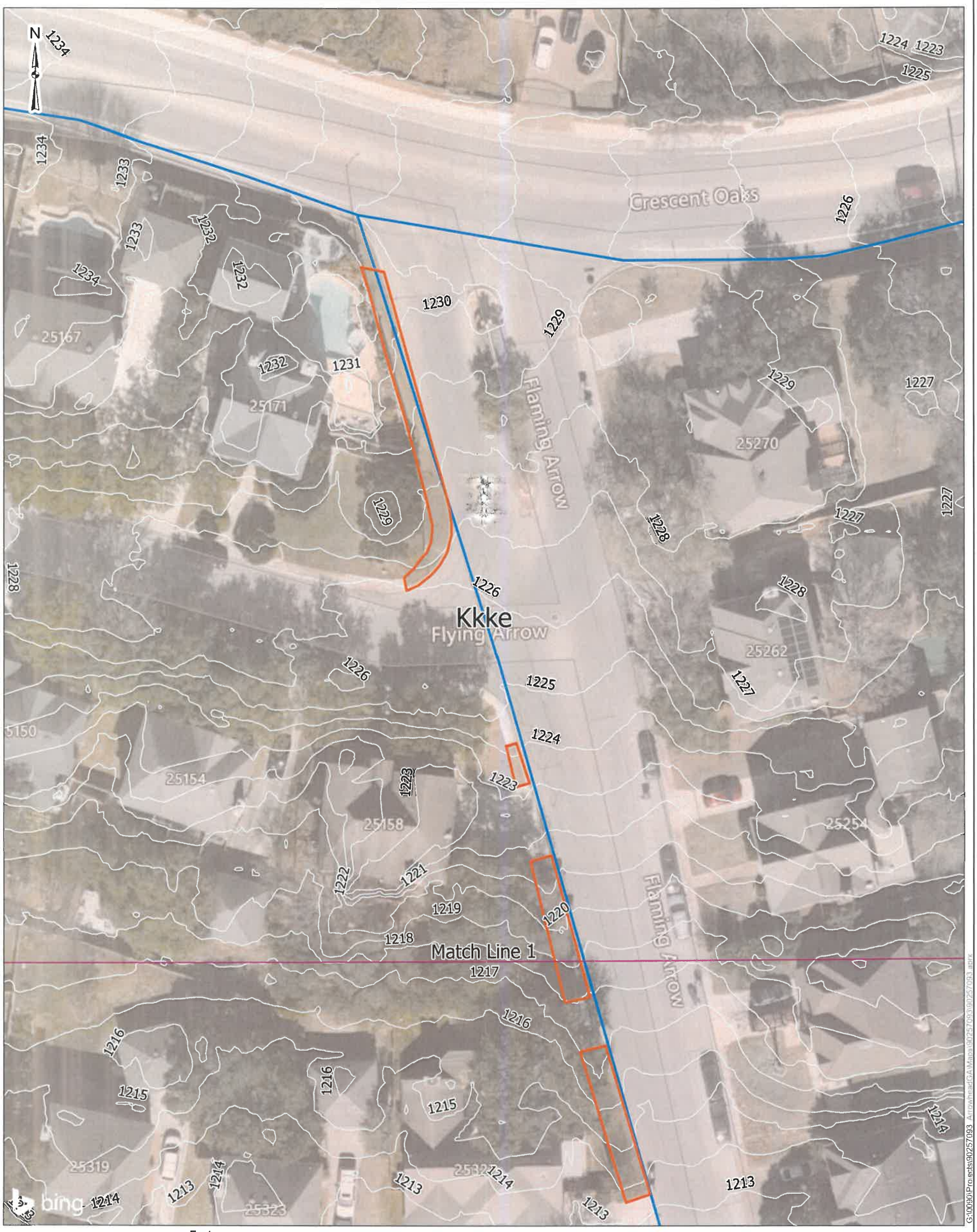
Photo #14: View of the central portion of the site on the east side of Arrow Ridge, looking south.

Photo #15: View of the central portion of the site on the west side of Arrow Ridge, looking south.

Photo #16: View of the central portion of the site on the west side of Arrow Ridge, looking south.

Photo #17: View of the central portion of the site on the east side of Arrow Ridge, looking south.

Photo #18: View of disturbed soil in the central portion of the site on the west side of Arrow Ridge, looking south.



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1 inch = 40 feet

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- Match Line
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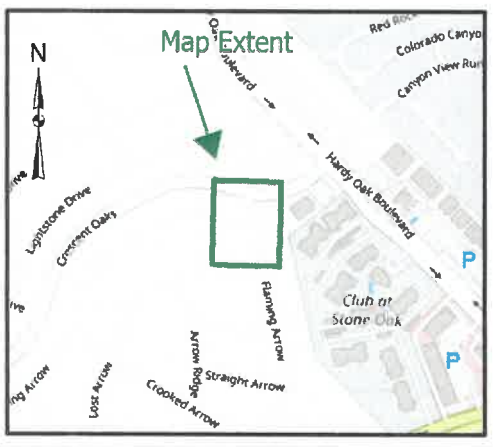

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Reviewed By:	KKB

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Geologic Map	Exhibit
CoSA Arrowhead Subdivision Phase 2 San Antonio, Texas	1

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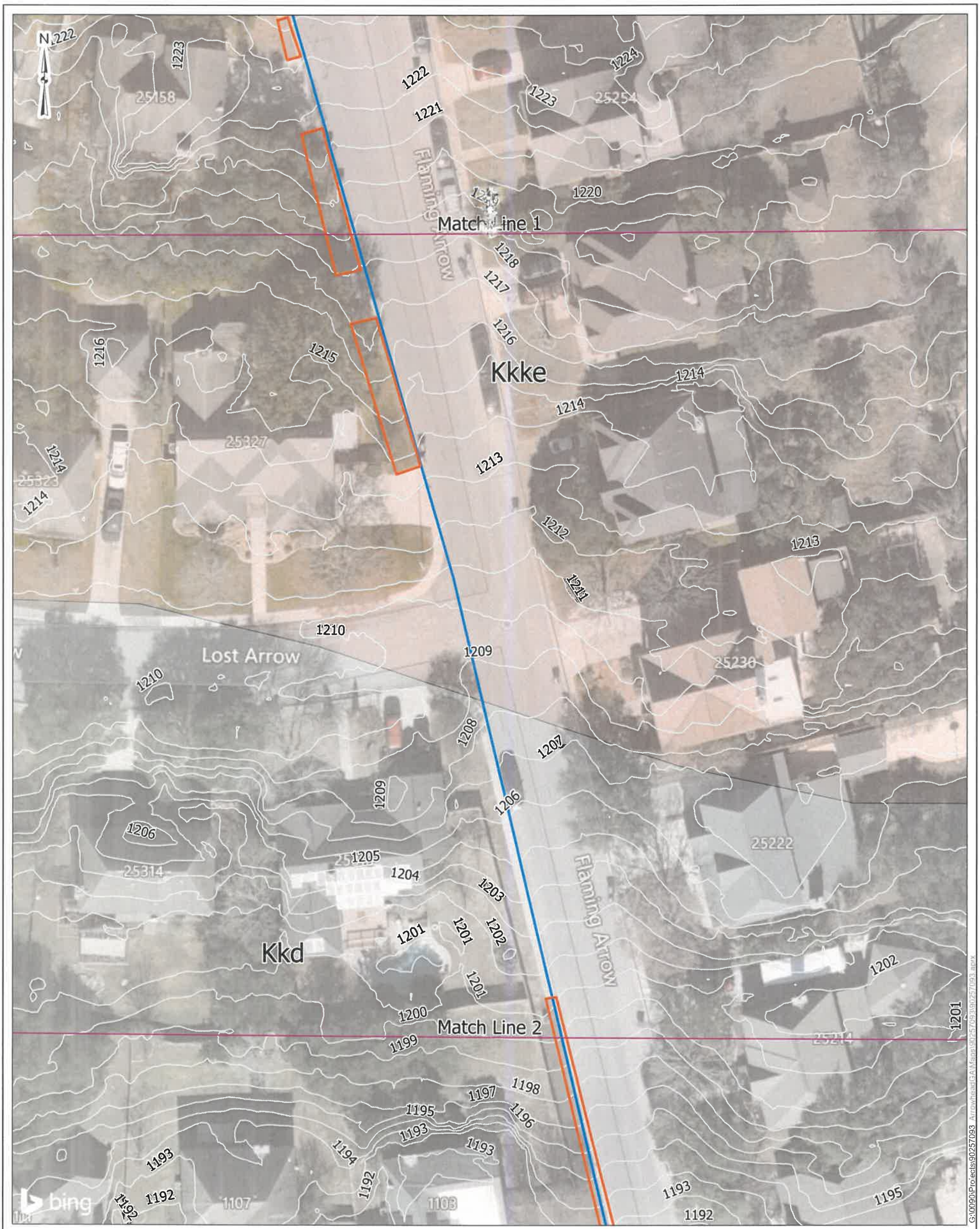

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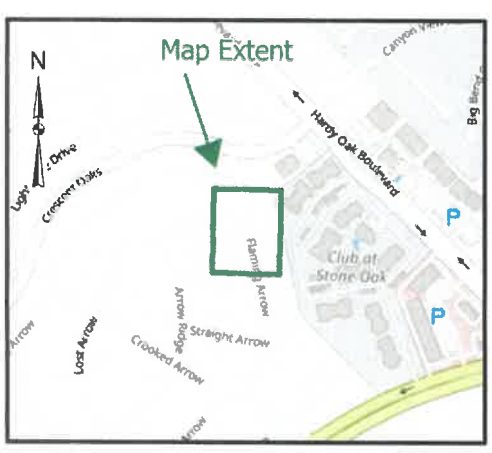

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Exhibit

2

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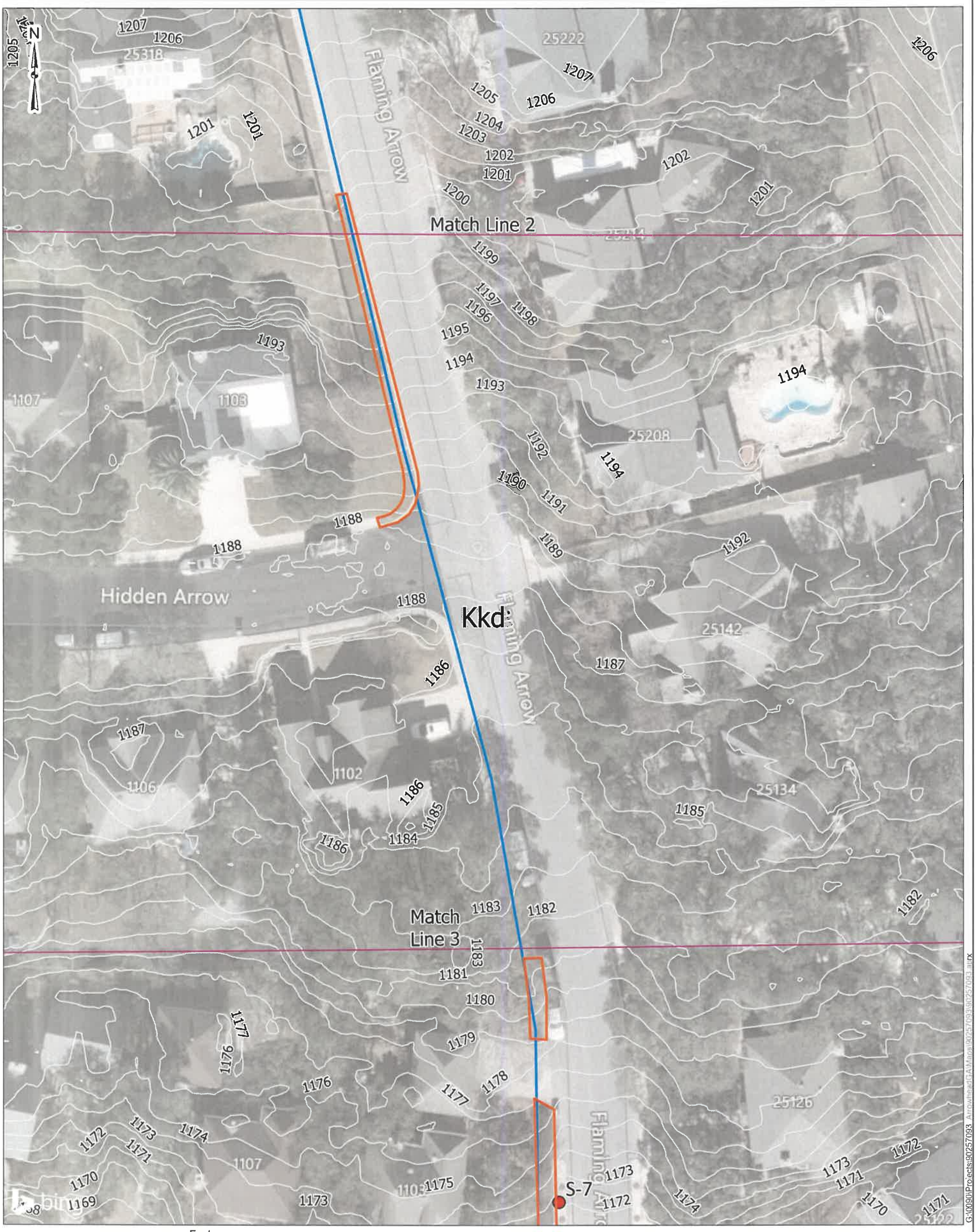

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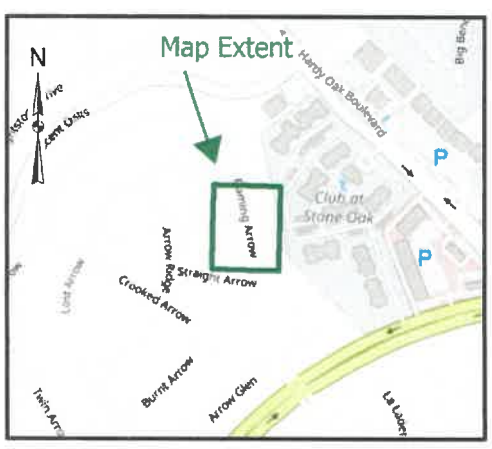

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3

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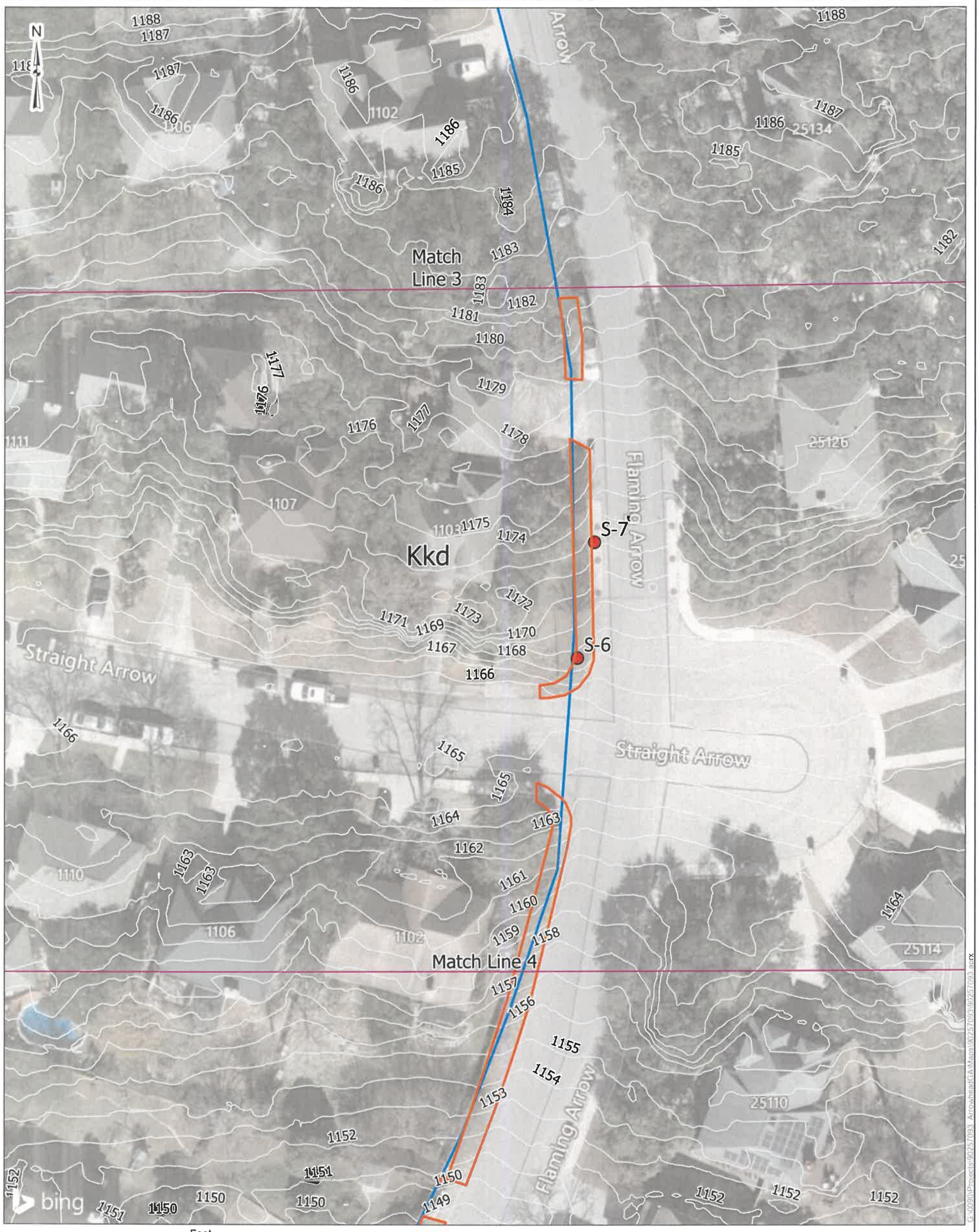

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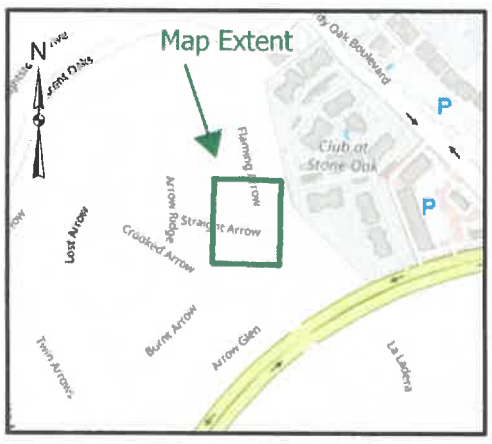

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4

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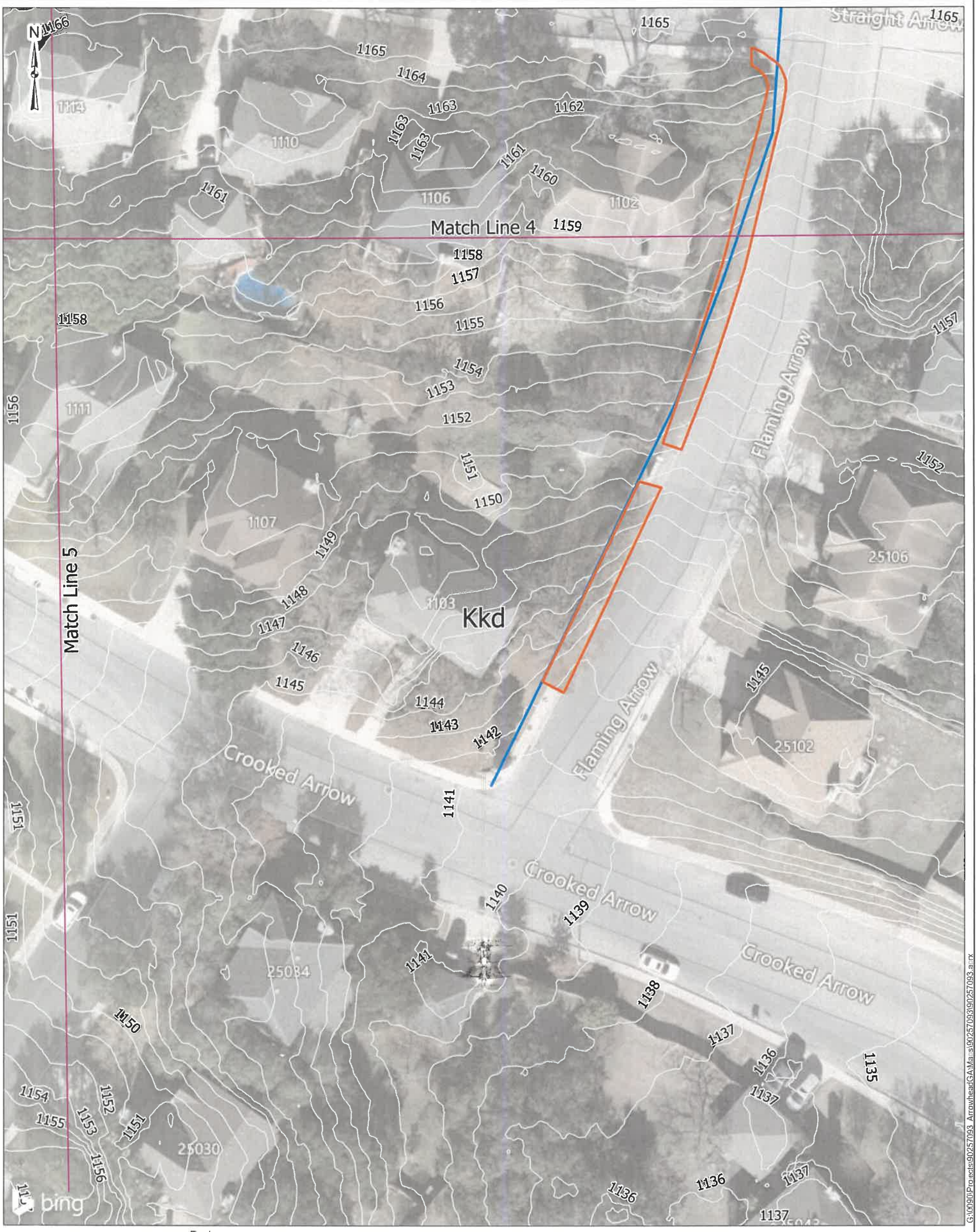

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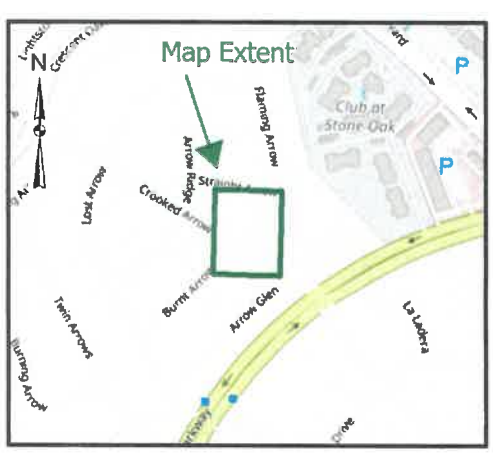

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5

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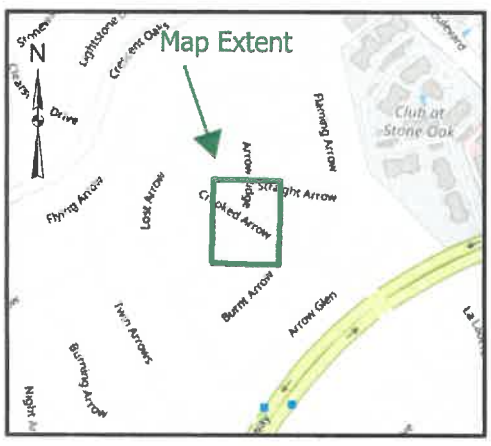

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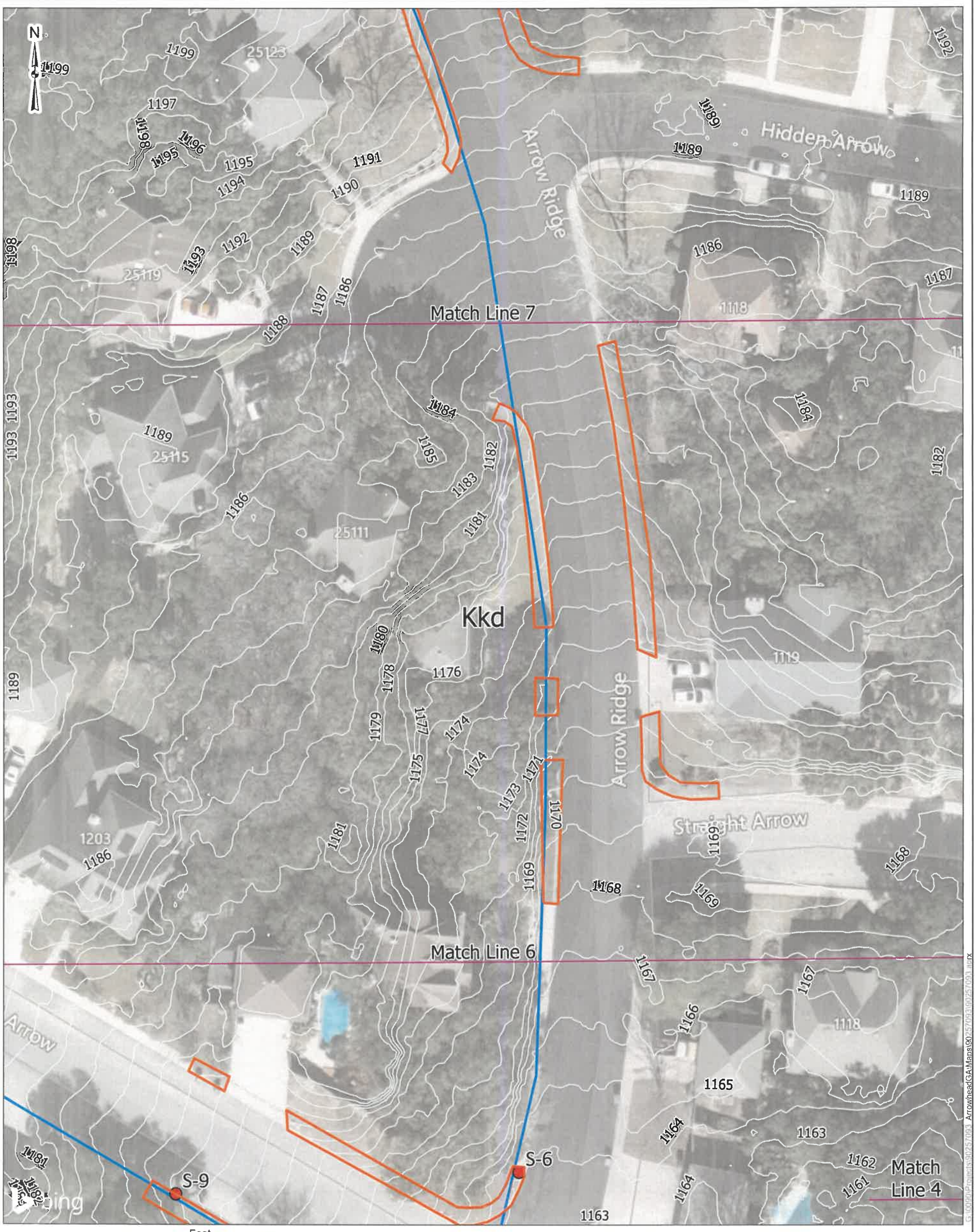

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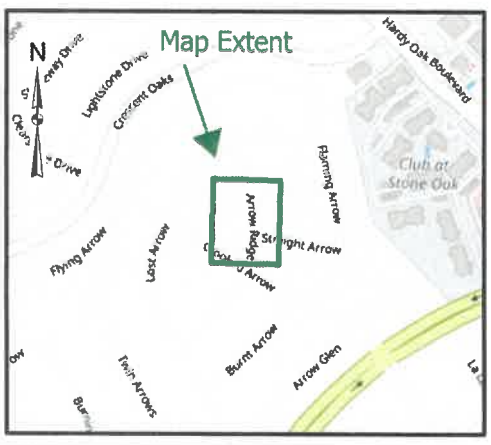

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7

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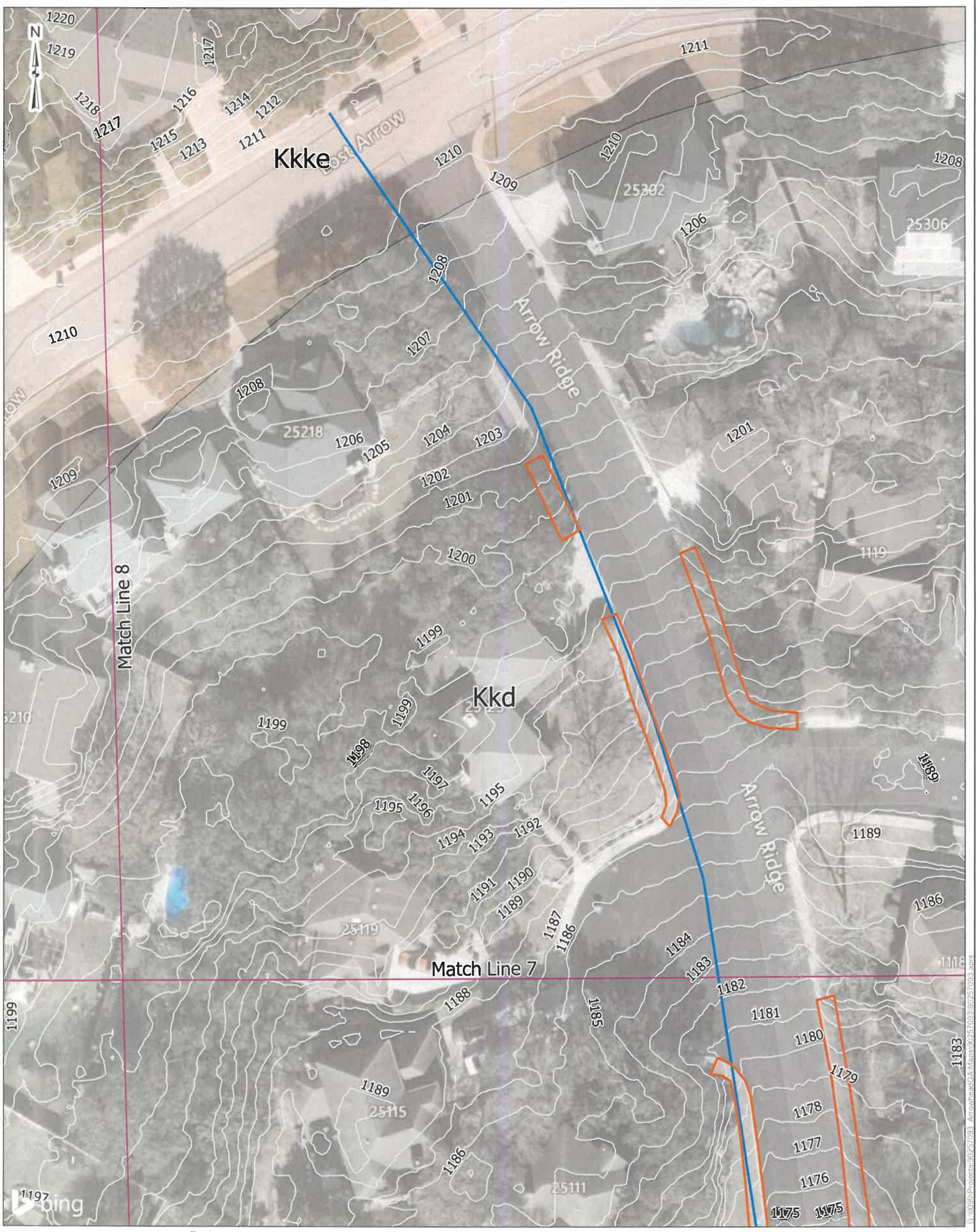

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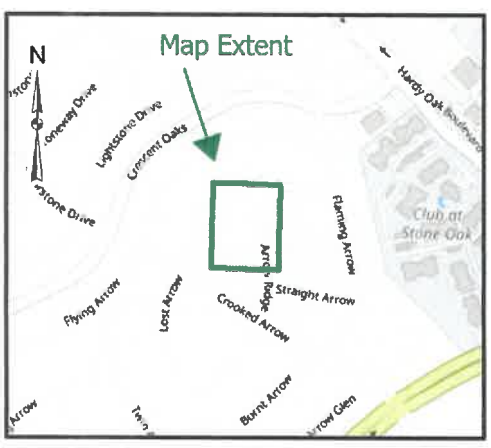

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Geologic Map

CoSA Arrowhead Subdivision Phase 2

San Antonio, Texas

Exhibit

8

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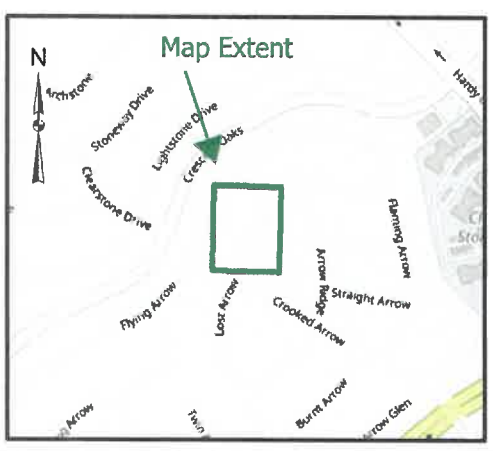

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Geologic Map

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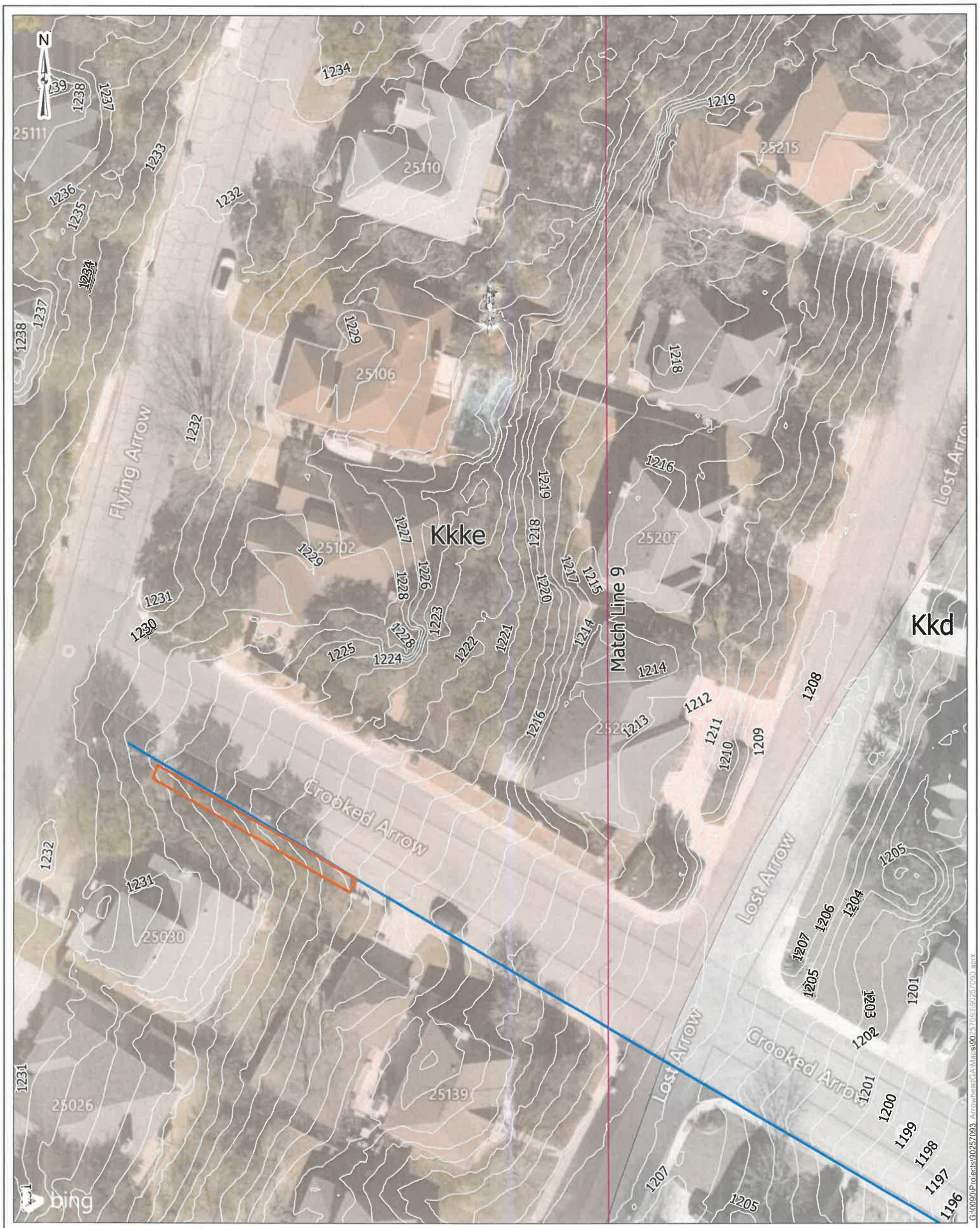
San Antonio, Texas

Exhibit

9



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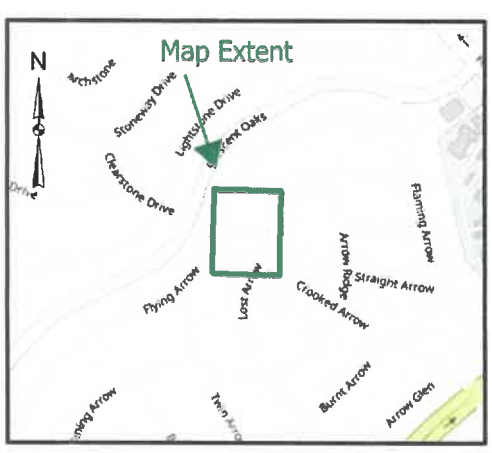

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Exhibit

10

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Recharge and Transition Zone Exception Request Form

Texas Commission on Environmental Quality
30 TAC §213.9 Effective June 1, 1999

To ensure that the application is administratively complete, confirm that all fields in the form are complete, verify that all requested information is provided, consistently reference the same site and contact person in all forms in the application, and ensure forms are signed by the appropriate party.
Note: Including all the information requested in the form and attachments contributes to more streamlined technical reviews.

Signature

To the best of my knowledge, the responses to this form accurately reflect all information requested concerning the proposed regulated activities and methods to protect the Edwards Aquifer. This **Recharge and Transition Zone Exception Request Form** is hereby submitted for TCEQ review and executive director approval. The request was prepared by:

Print Name of Customer/Agent: Elvis Treviño, PE
Date: 06/26/2025
Signature of Customer/Agent:

Regulated Entity Name: CoSA Arrowhead Subdivision Phase 2 Sidewalk Project

Exception Request

1. ☒ **Attachment A - Nature of Exception**. A narrative description of the nature of each exception requested is attached. All provisions of 30 TAC §213 Subchapter A for which an exception is being requested have been identified in the description.
2. ☒ **Attachment B - Documentation of Equivalent Water Quality Protection**. Documentation demonstrating equivalent water quality protection for the Edwards Aquifer is attached.

Administrative Information

3. ☒ Submit one (1) original and one (1) copy of the application, plus additional copies as needed for each affected incorporated city, groundwater conservation district, and county in which the project will be located. The TCEQ will distribute the additional copies to these jurisdictions. The copies must be submitted to the appropriate regional office.
4. ☒ The applicant understands that no exception will be granted for a prohibited activity in Chapter 213.
5. ☒ The applicant understands that prior approval under this section must be obtained from the executive director for the exception to be authorized.

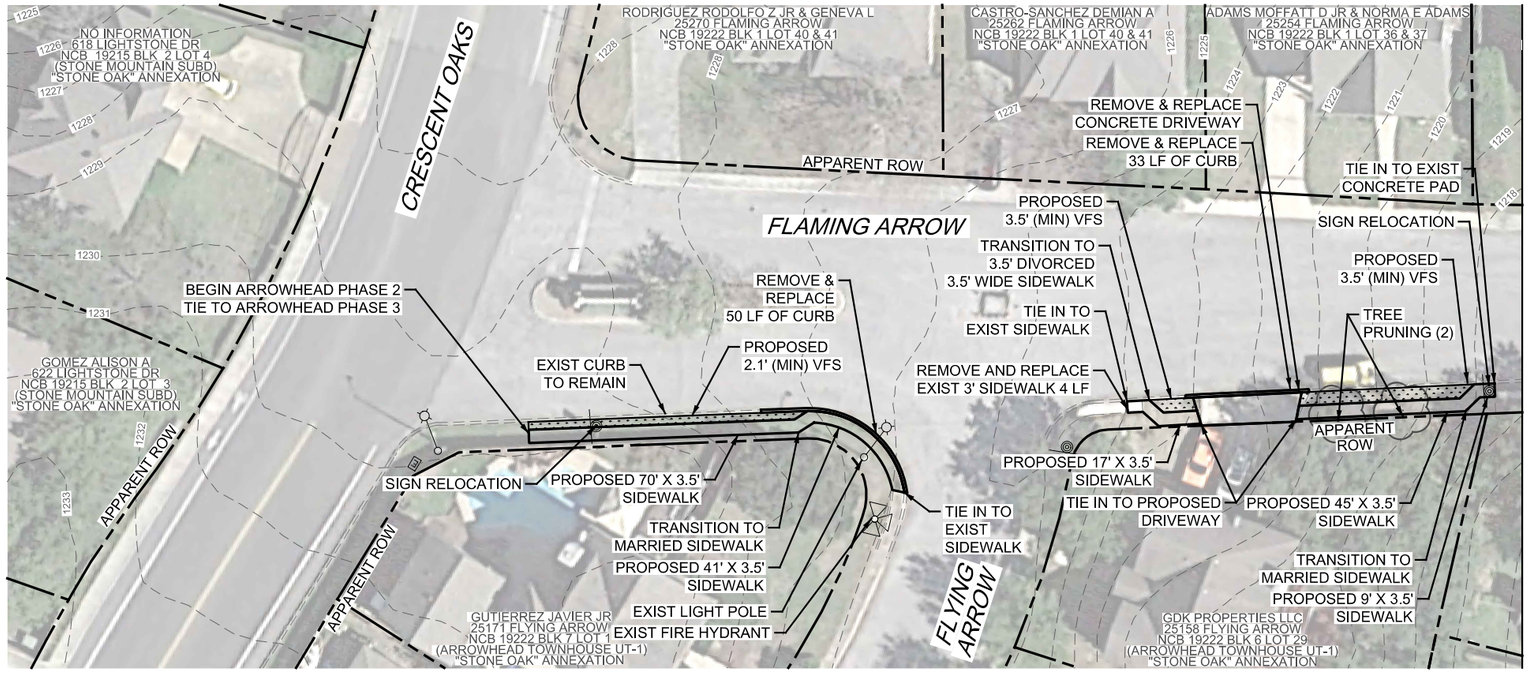
RECHARGE AND TRANSITION ZONE EXCEPTION REQUEST ATTACHMENTS

ATTACHMENT A – Nature of Exception

In accordance with the provisions of 30 TAC 213.9, the City of San Antonio requests an exception to being classified as a regulated activity under 30 TAC 213.3(28). Regulated activity is defined in 30 TAC 213.3(28) as any construction-related or post construction activity on the recharge zone of the Edwards Aquifer having the potential for polluting the Edwards Aquifer and hydrologically connected surface streams. The project area within the Recharge Zone is 0.48 acres and all elements of the improvements drain to Unnamed Tributary 1 to Panther Springs Creek. The City of San Antonio is proposing to install approximately 1892 linear feet of sidewalk and shared use path natural vegetative filter strip combination along west side of Flaming Arrow between Crescent Oaks and Crooked Arrow, along east and west sides of Arrow Ridge in between Lost Arrow and Straight Arrow and along north and south sides of Crooked Arrow in between Flying Arrow and Burnt Arrow. The exception request demonstrates equivalent water quality protection for the Edwards Aquifer. The activities proposed will be implemented with a minimum disturbance area requiring permanent and temporary stabilization measures.

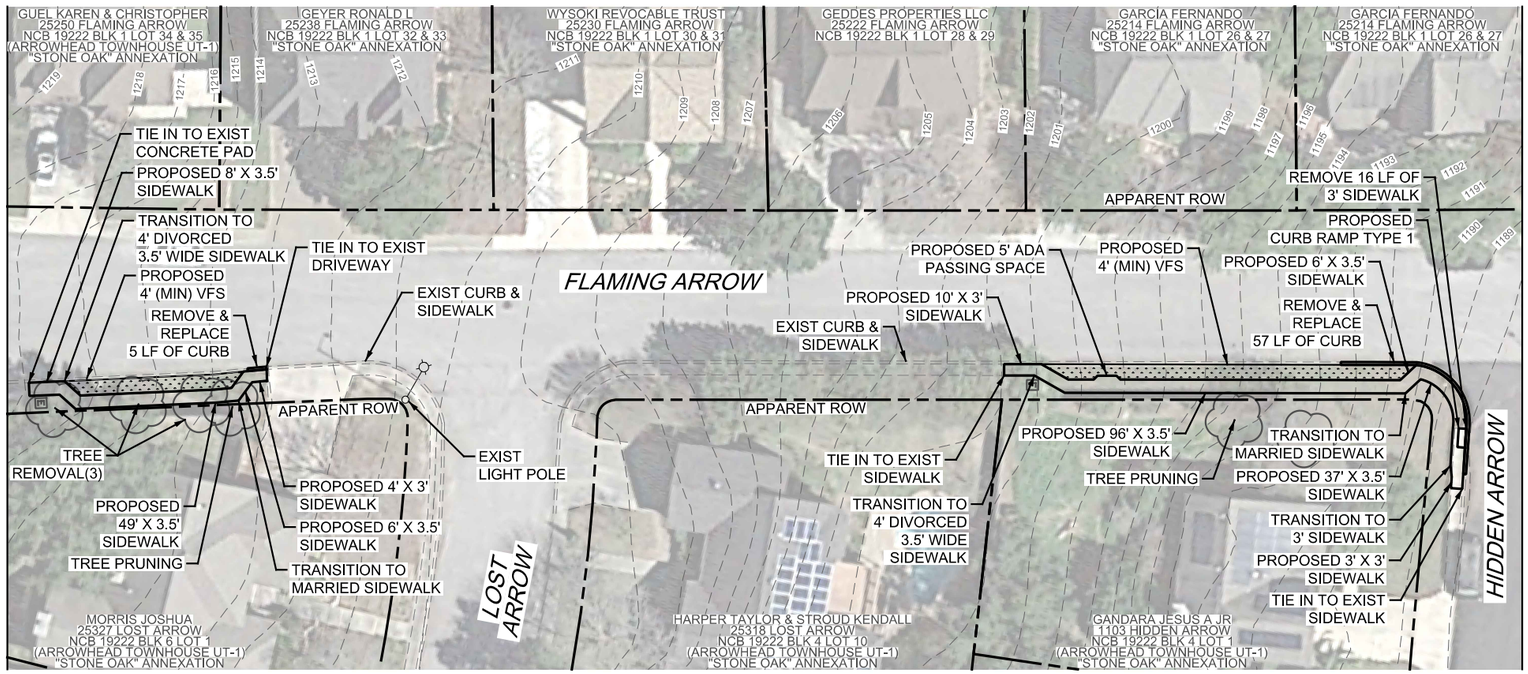
ATTACHMENT B – Documentation of Equivalent Water Quality Protection

This project will increase the impervious cover, soil disturbance is limited, and temporary stormwater controls will be implemented until sufficient soil stabilization has been established. This project proposes a total of 0.24 acres of new impervious cover to be treated by a shared use path natural vegetative filter strip. Furthermore, by proposing a shared use path natural vegetative filter strip this project will provide an equivalent water quality protection.



MATCHLINE - SHEET A-A

MATCHLINE - SHEET A-A



MATCHLINE - SHEET B-B

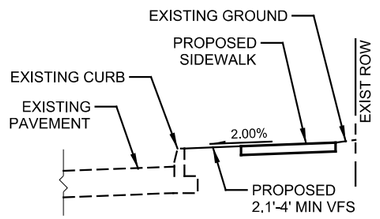
PLAN VIEW LEGEND

- EXISTING CONTOURS
- APPARENT RIGHT OF WAY
- PROP SIDEWALK
- VEGETATIVE FILTER STRIP
- FLOW ARROW
- EXIST LIGHT POLE
- EXIST SIGN
- EXIST FIRE HYDRANT
- EXIST WATER VALVE
- EXIST SPRINKLER HEAD
- EXIST ELECTRIC/TELECOM BOX
- EXIST TREE

NOTES:

1. NO PART OF THE PROJECT SITE IS LOCATED WITHIN THE 100-YEAR FLOODPLAIN.
2. THERE ARE NO KNOWN WELLS OR TEST HOLES PRESENT ON THIS PROJECT SITE.
3. THERE ARE NO KNOWN GEOLOGIC OR MANMADE FEATURES ON THIS SITE.
4. THERE ARE NO KNOWN SURFACE WATERS ON THIS SITE.
5. THERE WILL BE NO DISCHARGES TO SURFACE WATER OR SENSITIVE FEATURES.
6. AREAS OF SOIL DISTURBANCE WILL BE FROM BACK OF CURB TO RIGHT-OF-WAY.
7. DIMENSIONS SHOWN TO BE USED FOR REFERENCE. CONTRACTOR TO FIELD VERIFY ALL DIMENSIONS.
8. CONTRACTOR TO GRADE EXISTING GROUND AWAY FROM BACK OF SIDEWALK AS NEEDED IN LIEU OF CONSTRUCTING RETAINING WALL (NSPI).
9. CONTRACTOR TO PROTECT RESIDENTS IRRIGATION SYSTEM

STATE OF TEXAS
ELVIS TREVIÑO
126752
LICENSED
PROFESSIONAL ENGINEER
6/26/2025



PROPOSED TYPICAL SECTION
2.1'-4' DIVORCED SIDEWALK
NOT TO SCALE

SCALE
HORZ: 1" = 40'

MAESTAS
8122 DATAPOINT DR, STE 840
SAN ANTONIO, TX 78229
(210) 366-1188
TBPE No. 13183
TBPLS No. 10194506

OVERALL SITE PLAN
SHEET 1 OF 5
COSA ARROWHEAD SUBDIVISION PHASE 2 SIDEWALK PROJECT

SHEET 1
OF 7

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6/27/2025
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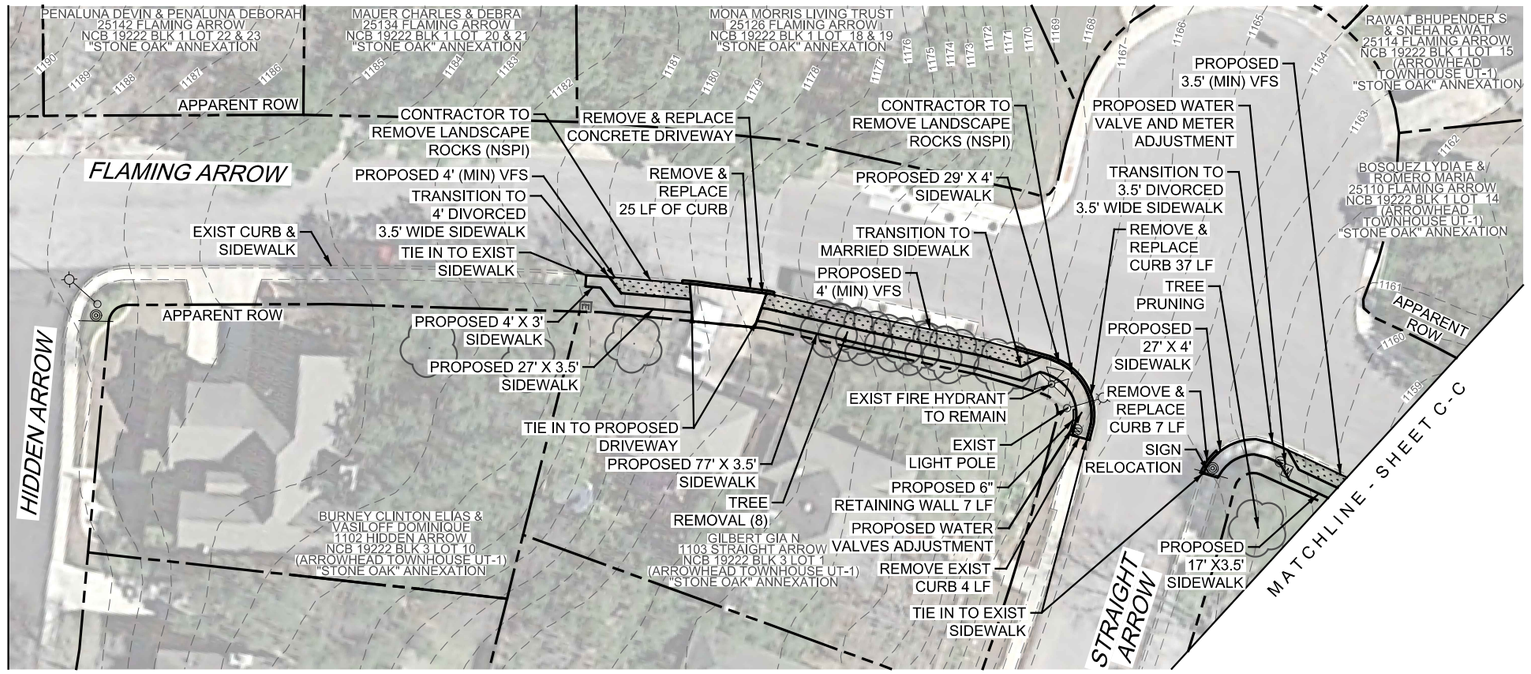

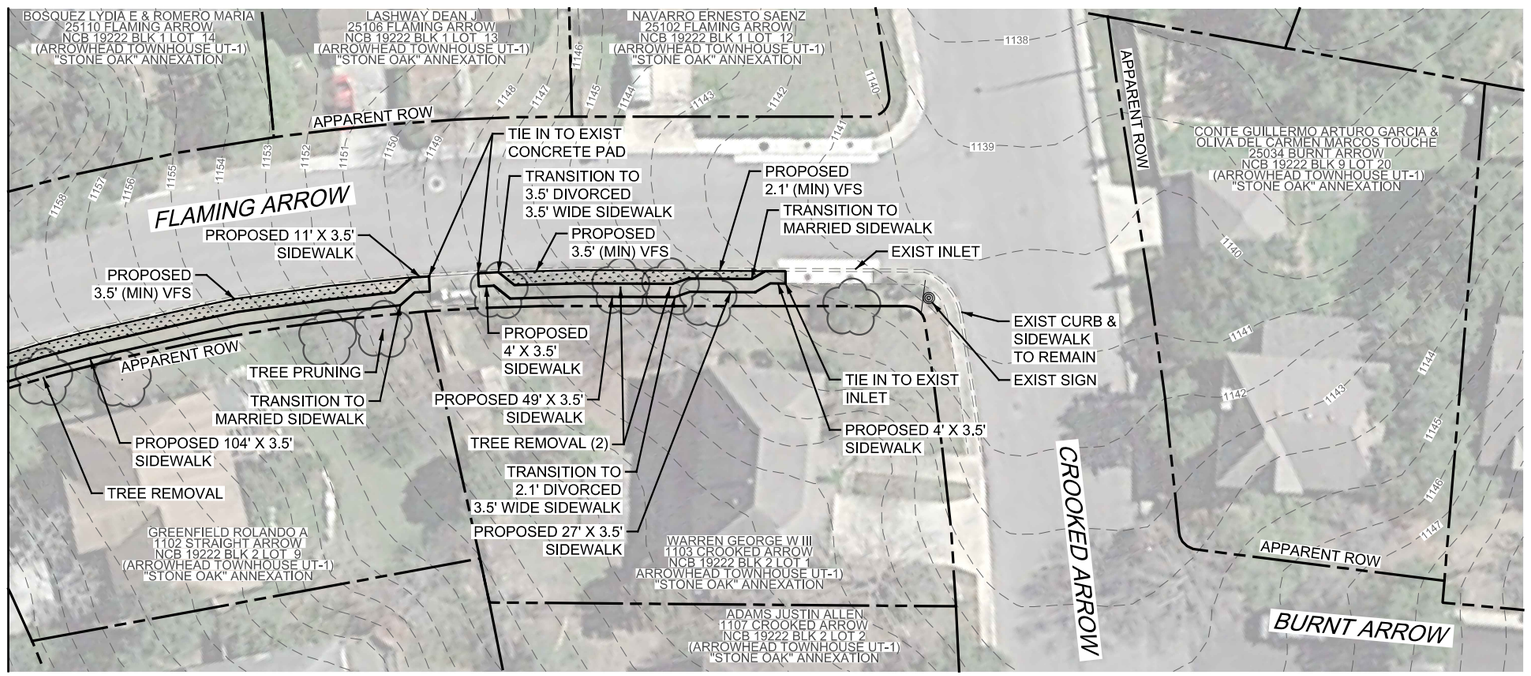

PLAN VIEW LEGEND

- EXISTING CONTOURS
- APPARENT RIGHT OF WAY
- PROP SIDEWALK
- VEGETATIVE FILTER STRIP
- FLOW ARROW
- EXIST LIGHT POLE
- EXIST SIGN
- EXIST FIRE HYDRANT
- EXIST WATER VALVE
- EXIST SPRINKLER HEAD
- EXIST ELECTRIC/TELECOM BOX
- EXIST TREE

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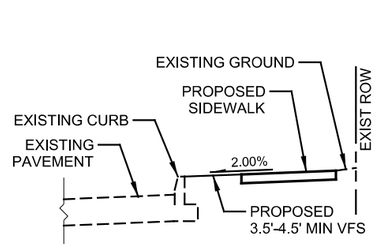
9. CONTRACTOR TO PROTECT RESIDENTS IRRIGATION SYSTEM



PROPOSED TYPICAL SECTION
3.5'-4.5' DIVORCED SIDEWALK
NOT TO SCALE

STATE OF TEXAS
ELVIS TREVIÑO
126752
LICENSED PROFESSIONAL ENGINEER
6/26/2025

SCALE
HORZ: 1" = 40'

MAESTAS
8122 DATAPOINT DR, STE 800
SAN ANTONIO, TX 78229
(210) 366-1188
(210) 366-1133
TBPLS No. 10194506

OVERALL SITE PLAN
SHEET 2 OF 5

COSA ARROWHEAD SUBDIVISION PHASE 2
SIDEWALK PROJECT

SHEET 2
OF 7

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6/27/2025
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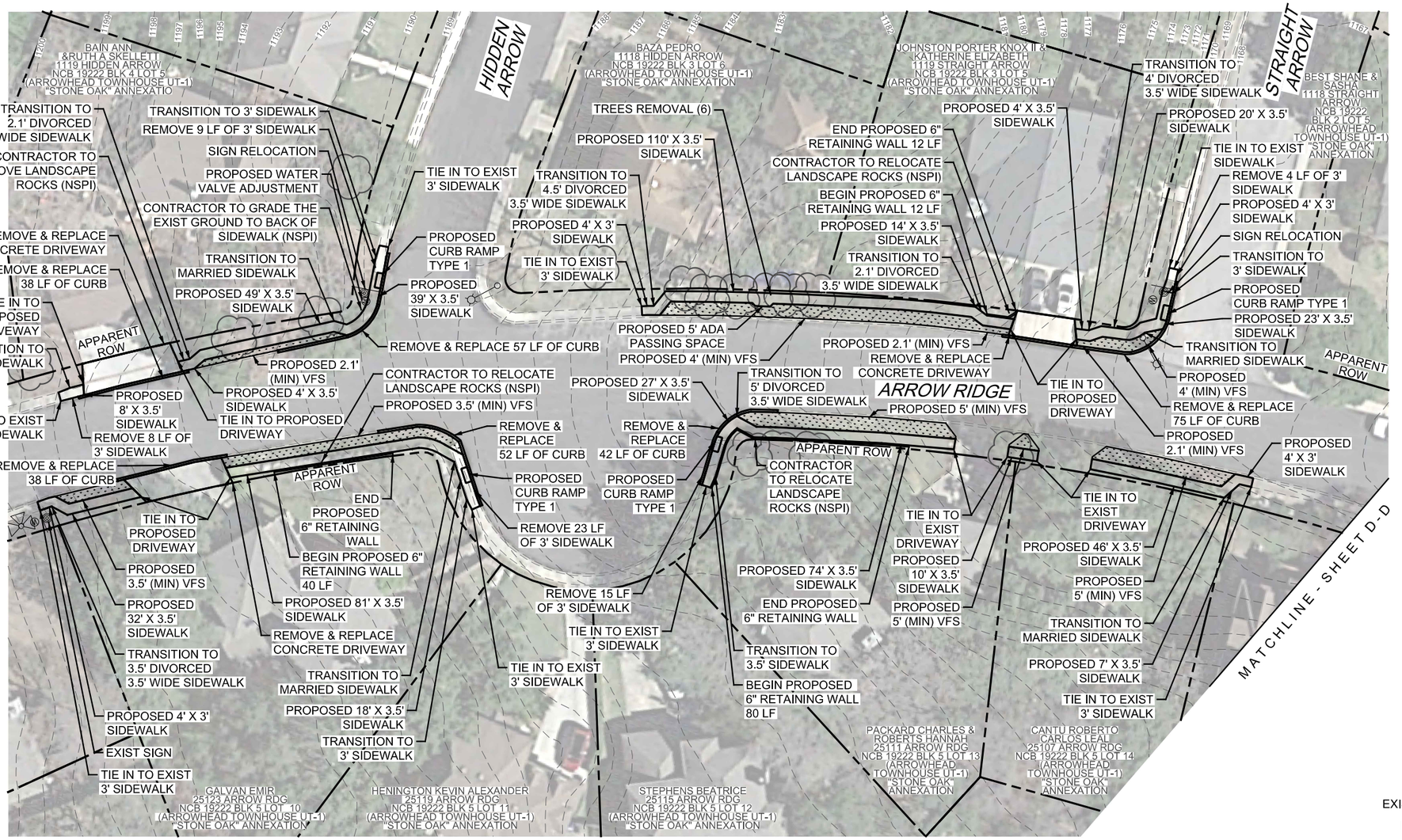

PLAN VIEW LEGEND

- EXISTING CONTOURS
- APPARENT RIGHT OF WAY
- PROP SIDEWALK
- VEGETATIVE FILTER STRIP
- FLOW ARROW
- EXIST LIGHT POLE
- EXIST SIGN
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- EXIST ELECTRIC/TELECOM BOX
- EXIST TREE

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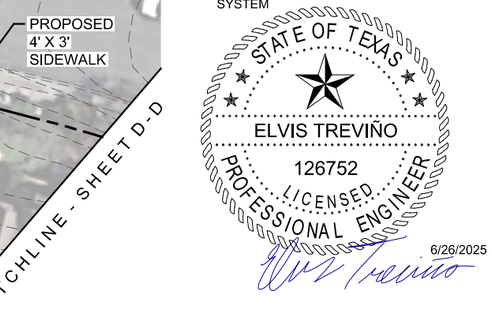

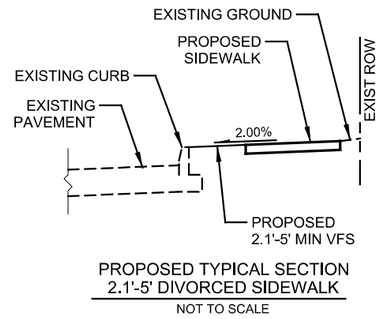

PROPOSED TYPICAL SECTION
2.1'-5' DIVORCED SIDEWALK
NOT TO SCALE

SCALE
HORZ: 1" = 40'

MAESTAS
8122 DATAPOINT DR, STE 840
SAN ANTONIO, TX 78229
(210) 366-1988
TBPE No. F-13
TBPLS No. 10194506

OVERALL SITE PLAN
SHEET 3 OF 5

COSA ARROWHEAD SUBDIVISION PHASE 2
SIDEWALK PROJECT

SHEET 3
OF 7

6/27/2025 1:58:23 PM

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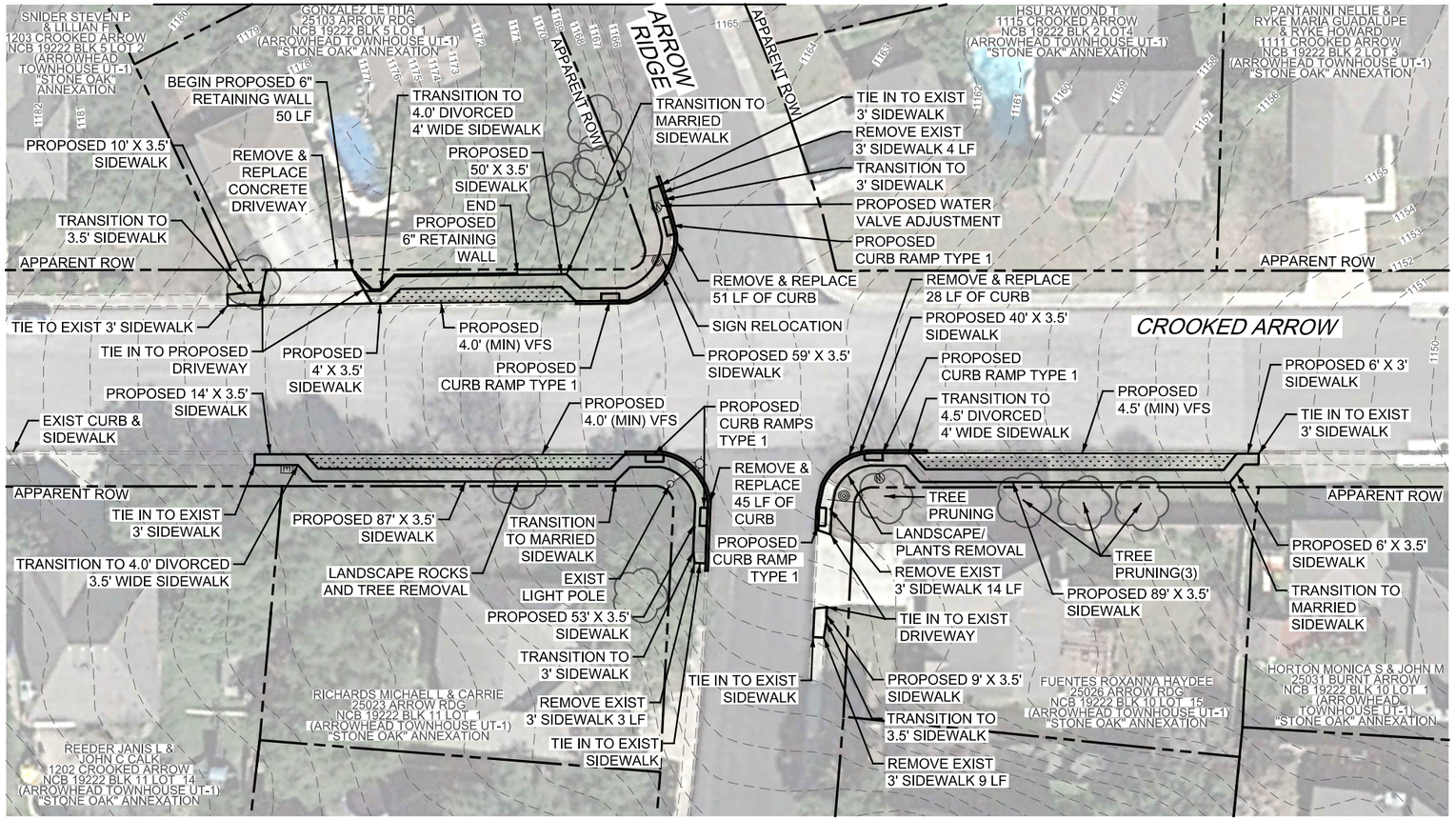
MATCHLINE - SHEET D-D



PLAN VIEW LEGEND

- EXISTING CONTOURS
- APPARENT RIGHT OF WAY
- PROP SIDEWALK
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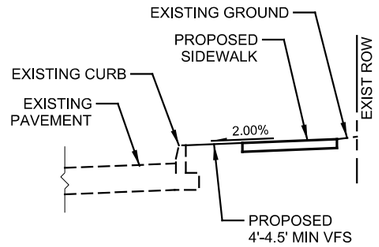
STATE OF TEXAS
ELVIS TREVIÑO
126752
LICENSED
PROFESSIONAL ENGINEER
6/26/2025



PROPOSED TYPICAL SECTION
4'-4.5' DIVORCED SIDEWALK
NOT TO SCALE

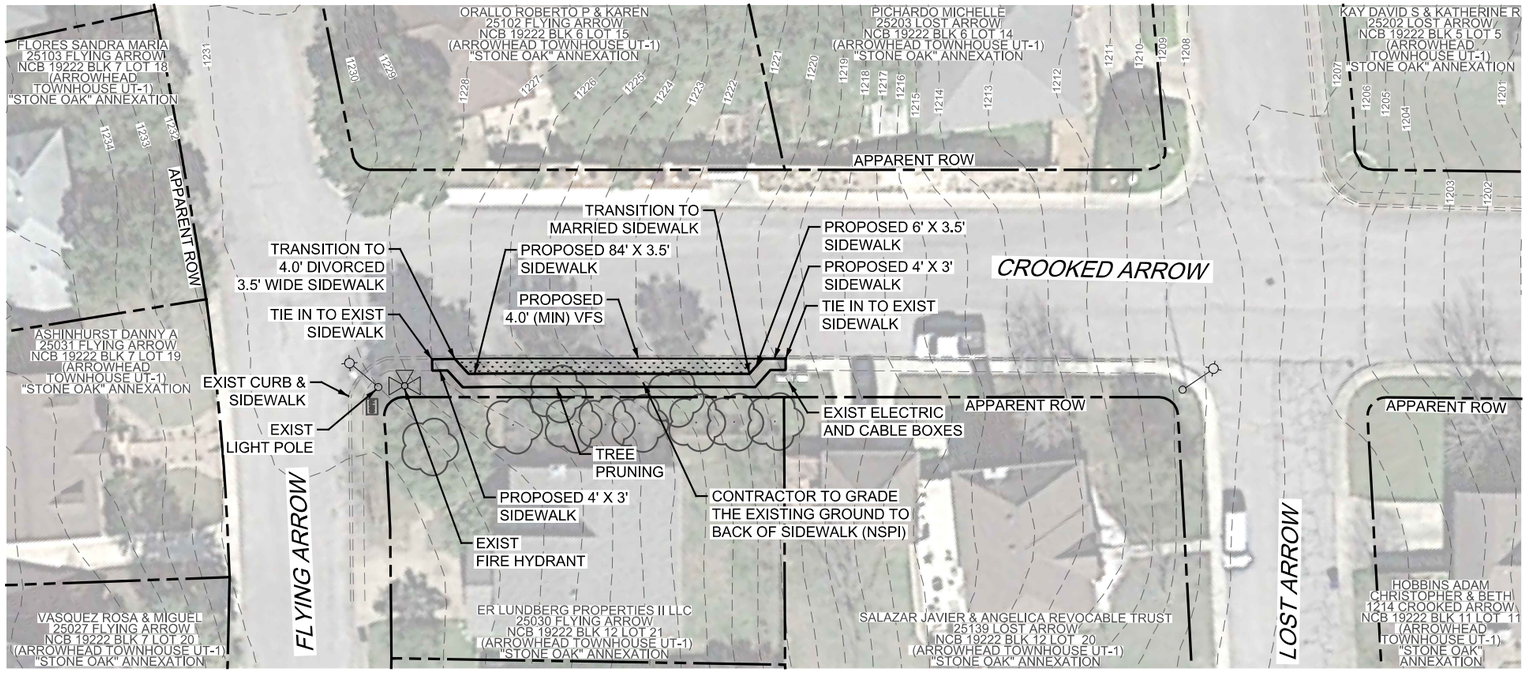
SCALE
HORZ: 1" = 40'

MAESTAS
8122 DATAPOINT DR, STE 840
SAN ANTONIO, TX 78229
(210) 366-1188
(210) 366-1133
TBPLS No. 10194506

OVERALL SITE PLAN
SHEET 4 OF 5

COSA ARROWHEAD SUBDIVISION PHASE 2
SIDEWALK PROJECT

SHEET 4
OF 7



PLAN VIEW LEGEND

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- PROP SIDEWALK
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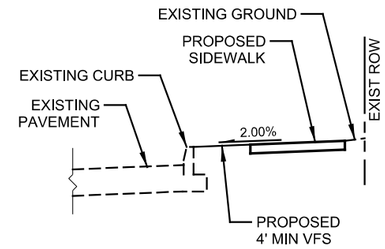
STATE OF TEXAS
ELVIS TREVIÑO
126752
LICENSED PROFESSIONAL ENGINEER
6/26/2025



PROPOSED TYPICAL SECTION
4' DIVORCED SIDEWALK
NOT TO SCALE

SCALE
HORZ: 1" = 40'

MAESTAS
8122 DATAPOINT DR, STE 840
SAN ANTONIO, TX 78229
(210) 366-1188
TBPE No. F-13123
TBPLS No. 10194506

OVERALL SITE PLAN
SHEET 5 OF 5

COSA ARROWHEAD SUBDIVISION PHASE 2
SIDEWALK PROJECT

SHEET 5
OF 7

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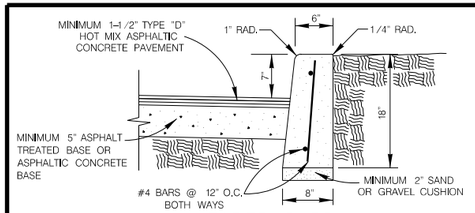
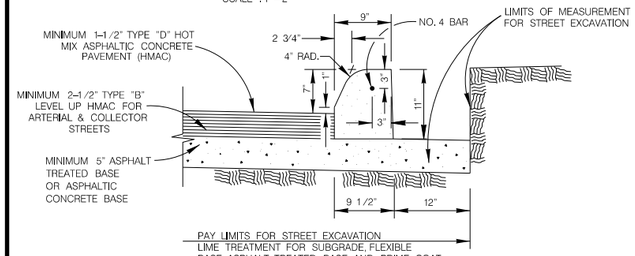


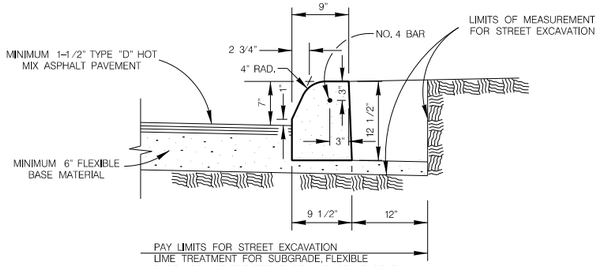
HEADER CURB

ITEM 500 ON SAND OR GRAVEL
SCALE : 1"=2'



CONCRETE CURB

ITEM 500 ON ASPHALT TREATED BASE OR ASPHALTIC CONCRETE BASE
SCALE : 1"=2'



CONCRETE CURB

ITEM 500 ON FLEXIBLE BASE MATERIAL
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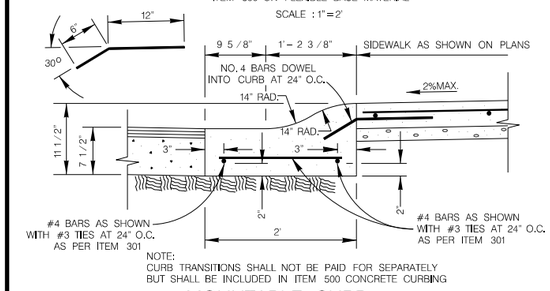
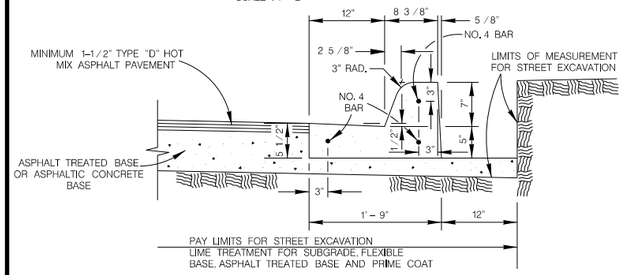


NOTE:
CURB TRANSITIONS SHALL NOT BE PAID FOR SEPARATELY BUT SHALL BE INCLUDED IN ITEM 500 CONCRETE CURBING

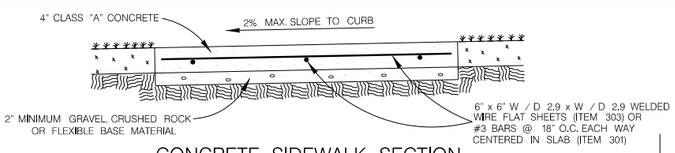
MOUNTABLE CURB

ITEM 500 ON COMPACTED SUBGRADE
SCALE : 1"=2'



TYPICAL CURB & GUTTER DETAIL

ITEM 500 ON ASPHALT TREATED BASE OR ASPHALTIC CONCRETE BASE
SCALE : 1"=2'



CONCRETE SIDEWALK SECTION

ITEM 502
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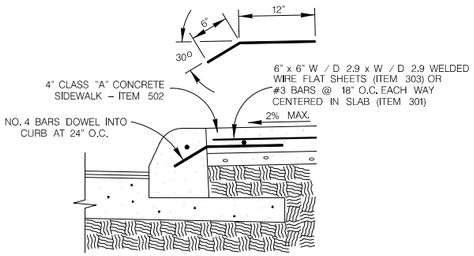
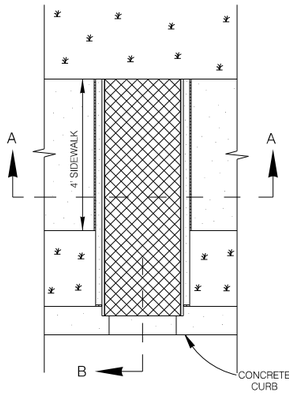


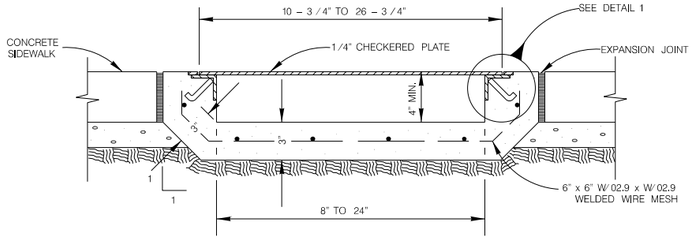
CONCRETE SIDEWALK ABUTTING CURB SECTION

ITEM 502
SCALE : 1"=2'



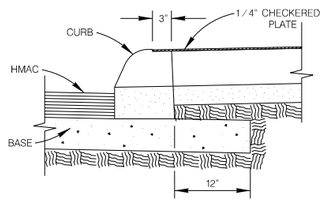
CONCRETE SIDEWALK DRAIN DETAIL

SCALE : 1"=4'



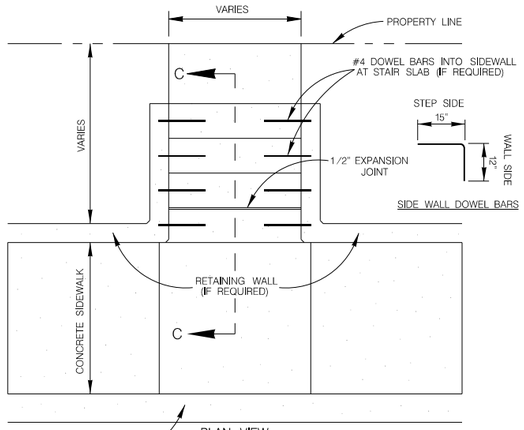
SECTION A–A

SCALE=1 : 12



SECTION B

SCALE : 1"=2'

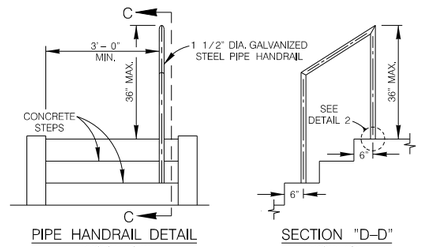


PLAN VIEW

SCALE : 1"=4'

CONCRETE STEPS

ITEM 524

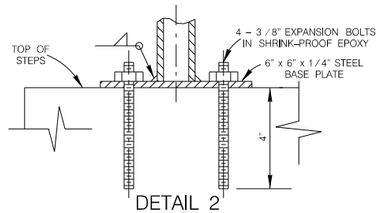


PIPE HANDRAIL DETAIL

PROFILE VIEW
SCALE : 1"=4'

SECTION "D–D"

FRONT VIEW
SCALE : 1"=4'



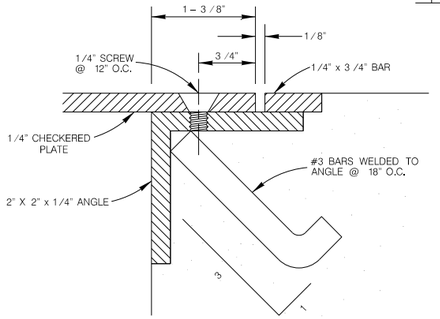
DETAIL 2

SCALE = 1 : 6

NOTES :
1. PLACE STEPS TO CONFORM WITH PROPOSED PARKWAY GRADING
2. 1–1/2" DIA. GALVANIZED STEEL PIPE HANDRAIL REQUIRED ON ONE SIDE OF THE STEPS WHEN 3 OR MORE RISERS ARE USED, OR AS DESIGNED BY ENGINEER. TO BE PAID UNDER ITEM 522

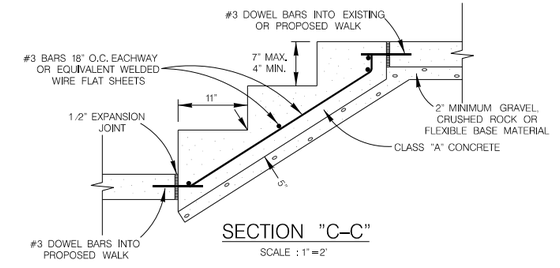
HANDRAIL FOR CONCRETE STEPS

ITEM 522



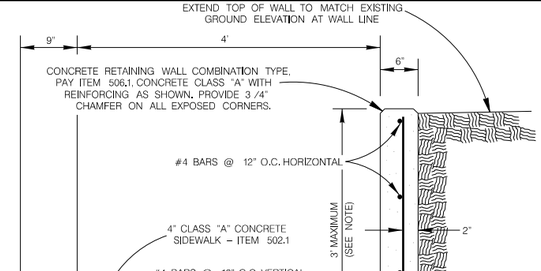
DETAIL 1

SCALE=1 : 1



SECTION "C–C"

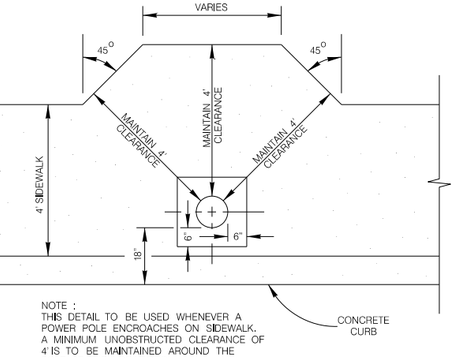
SCALE : 1"=2'



NOTE :
WALL HEIGHT TO BE SHOWN ON PLAN AT SPECIAL LOCATIONS WHERE COMBINATION RETAINING WALL IS REQUIRED

CONCRETE RETAINING WALL – COMBINATION TYPE

ITEM 506
SCALE : 1"=2'



NOTE :
THIS DETAIL TO BE USED WHENEVER A POWER POLE ENCROACHES ON SIDEWALK. A MINIMUM UNOBSTRUCTED CLEARANCE OF 4' IS TO BE MAINTAINED AROUND THE POLE AT THE LOCATIONS.

CONCRETE SIDEWALK @ UTILITY POWER POLE DETAIL

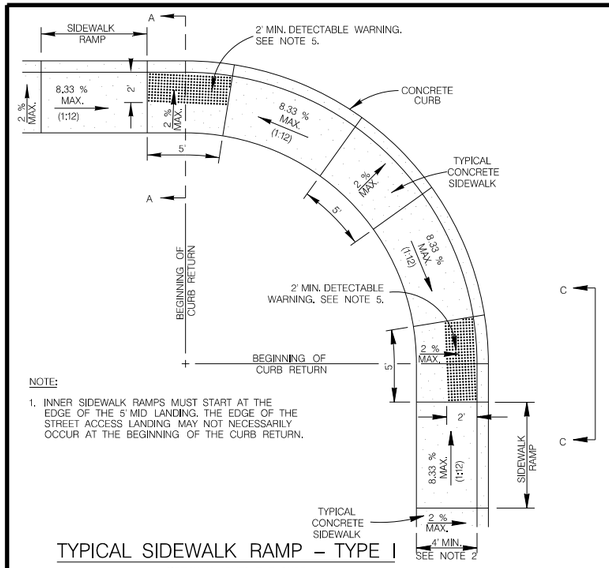
SCALE : 1"=4'

MAY 2009

CITY OF SAN ANTONIO
CAPITAL IMPROVEMENTS MANAGEMENT SERVICES DEPARTMENT

MISCELLANEOUS CONSTRUCTION STANDARDS I

95 % SUBMITTAL	PROJECT NO.:		DATE:
DRWN. BY: V. VASQUEZ	DSGN. BY:	CHKD. BY: R.S. HOSSEINI, P.E.	SHEET NO.: 6 OF 7



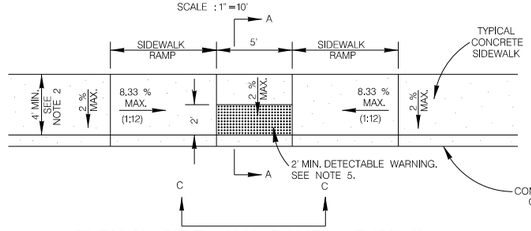
NOTE:

1. INNER SIDEWALK RAMPS MUST START AT THE EDGE OF THE 5' MID LANDING. THE EDGE OF THE STREET ACCESS LANDING MAY NOT NECESSARILY OCCUR AT THE BEGINNING OF THE CURB RETURN.

TYPICAL SIDEWALK RAMP – TYPE I

SIDEWALK ABUTS THE CURB

SCALE : 1" = 10'



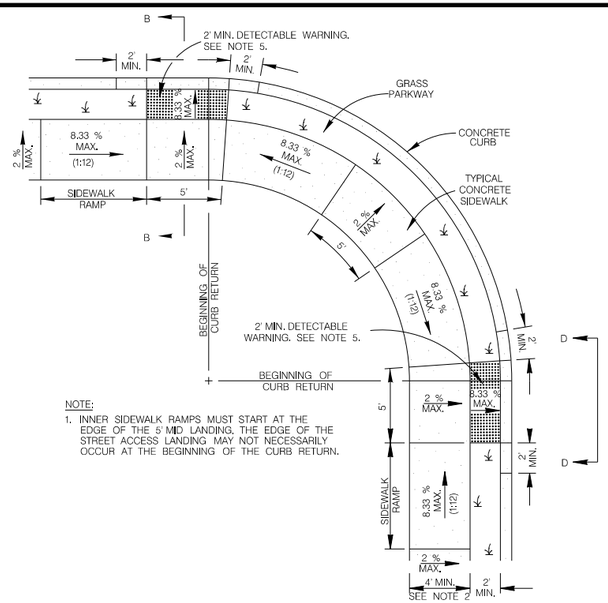
TYPICAL SIDEWALK RAMP – TYPE II

USED AT TEE INTERSECTIONS WHERE SIDEWALK ABUTS CURB

SCALE : 1" = 10'

GENERAL NOTES

1. WHEN POSSIBLE SIDEWALKS SHOULD BE PLACED NEXT TO THE PROPERTY LINE, ALLOWING A MINIMUM OF 1 FOOT BUFFER. DEVIATION OF THE PATHWAY FROM A STRAIGHT LINE IS ENCOURAGED TO AVOID TREES OR OTHER OBSTRUCTIONS.
2. FOR LOCAL TYPE "A" STREETS, SIDEWALKS SHALL HAVE A MINIMUM UNOBSTRUCTED WIDTH OF 4' AND IF SEPARATED FROM THE CURB, THE SIDEWALK SHALL BE LOCATED A MINIMUM OF 2' FROM THE BACK OF CURB.
3. FOR OTHER THAN LOCAL TYPE "A" STREETS, SIDEWALKS SHALL HAVE A MINIMUM UNOBSTRUCTED WIDTH OF 4' AND SEPARATED A MINIMUM OF 2' FROM THE BACK OF CURB OR AS AN OPTION, THE SIDEWALK SHALL HAVE A MINIMUM WIDTH OF 6' WHEN LOCATED AT THE BACK OF CURB.
4. SIDEWALK RAMP LENGTHS PRESENTED IN TABLE 1 ARE GUIDELINES ONLY. SIDEWALK RAMP LENGTHS SHALL BE OF SUFFICIENT LENGTH TO MAINTAIN 8.33% (1:12) MAXIMUM SLOPE.
5. ALL CURB-RAMPS OR LANDINGS ABUTTING THE CROSSWALK SHALL HAVE A DETECTABLE WARNING 24 INCHES DEEP (IN THE DIRECTION OF PEDESTRIAN TRAVEL) AND EXTENDING THE FULL WIDTH OF THE CURB RAMP OR LANDING. THE DETECTABLE WARNING SHALL CONSIST OF RAISED TRUNCATED DOMES ALIGNED IN A GRID PATTERN WITH A DIAMETER OF A NOMINAL 0.9 INCHES (23 MM), A HEIGHT OF NOMINAL 0.2 INCHES (5 MM) AND A CENTER-TO-CENTER SPACING OF NOMINAL 2.35 INCHES (60 MM). THE DETECTABLE WARNING SURFACE SHALL BE A CAST-IN-PLACE TILE CONFORMING TO THE CITY OF SAN ANTONIO STANDARD SPECIFICATIONS OR PAVERS CONFORMING TO TXDOT STANDARD PED-05, PEDESTRIAN FACILITIES.
6. DETECTABLE WARNINGS SHALL CONTRAST VISUALLY WITH ADJOINING SURFACES, EITHER LIGHT-ON-DARK, OR DARK-ON-LIGHT. THE MATERIAL USED TO PROVIDE CONTRAST SHALL BE AN INTEGRAL PART OF THE WALKING SURFACE.
7. SIDEWALK RAMP TYPE V SHALL BE USED ONLY WHERE THERE IS SIGNIFICANT RESTRICTION WITHIN THE PARKWAY TO CONSTRUCT TYPE I OR TYPE III RAMPS.
8. CONSTRUCTION OF ALL WHEELCHAIR RAMPS TO BE INCLUDED UNDER ITEMS "500 – CONCRETE CURB, GUTTER, AND CONCRETE CURB AND GUTTER" AND /OR "502 – CONCRETE SIDEWALKS". RAMP SURFACE SHALL BE BRUSH FINISHED.
9. THESE DETAILS ARE FOR REFERENCE ONLY. ACTUAL LOCATIONS OF WHEELCHAIR RAMPS TO BE SHOWN ON CONSTRUCTION PLANS. CITY CONSTRUCTION INSPECTOR CAN ADJUST LOCATIONS FOR SAFETY OR UTILITY CLEARANCE.
10. SIDEWALKS LESS THAN 5 FEET IN WIDTH SHALL BE PROVIDED WITH A PASSING SPACE AT A MAXIMUM SPACING OF 200 FEET.
11. WHEELCHAIR RAMP SHALL BE CONSTRUCTED WITH 4" CLASS "A" CONCRETE AND 2" MINIMUM GRAVEL, CRUSHED ROCK OR FLEXIBLE BASE MATERIAL.
12. REINFORCING STEEL SHALL BE #3 BARS AT 18" O.C.E.W. OR 6" x 6" – W2.9 x W2.9 WIRE MESH.
13. SIDEWALK GRADES SHALL NOT EXCEED THE GRADE ESTABLISHED FOR THE ADJACENT ROADWAY. ANY SIDEWALK CONSTRUCTION THAT DEVIATES FROM THE NATURAL GRADE OF THE ROADWAY TO CREATE A GRADE STEEPER THAN THE EXISTING ROADWAY WILL REQUIRE RAMPS, HANDRAILS AND RESTING PLATFORMS TO BE CONSTRUCTED IN ACCORDANCE WITH ADA AND TAS STANDARDS.
14. SIDEWALK CROSS GRADE SHALL HAVE A MAXIMUM SLOPE OF 2%. LANDINGS SHALL HAVE A MAXIMUM SLOPE OF 2% IN ANY DIRECTION.
15. THE CHANGE OF GRADE BETWEEN ADJACENT SURFACES SHALL BE LESS THAN 11%. THE CHANGE OF GRADE SHALL BE DEFINED AS THE ALGEBRAIC DIFFERENCE OF THE ADJACENT SURFACE SLOPES. IN THE CASE OF A STREET ACCESS RAMP DESIGNED AT THE 8.33% MAXIMUM SLOPE, THE ADJACENT PAVEMENT CROSS SLOPE SHALL BE LESS THAN 2.67% (I.E. 8.33–(–2.67) = 11). IN ADDITION, THE ADJACENT PAVEMENT CROSS SLOPE SHALL BE LESS THAN OR EQUAL TO 5%.
16. IF THE CHANGE OF GRADE BETWEEN ADJACENT SURFACES IS GREATER THAN OR EQUAL TO 11%, A LEVELING STRIP, 2 FEET IN LENGTH, SHALL BE PROVIDED TO TRANSITION THE ADJACENT SURFACES.
17. ADA COMPLIANCE IN ALTERATIONS INCLUDE ONLY THAT WORK WITHIN THE LIMITS, BOUNDARIES OR SCOPE OF A PLANNED PROJECT.



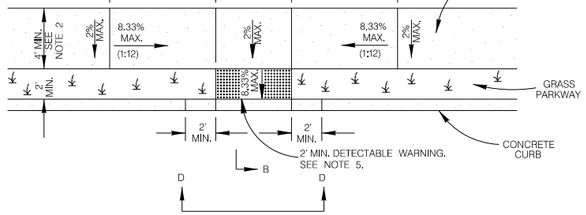
NOTE:

1. INNER SIDEWALK RAMPS MUST START AT THE EDGE OF THE 5' MID LANDING. THE EDGE OF THE STREET ACCESS LANDING MAY NOT NECESSARILY OCCUR AT THE BEGINNING OF THE CURB RETURN.

TYPICAL SIDEWALK RAMP – TYPE III

SIDEWALK SEPARATED FROM CURB

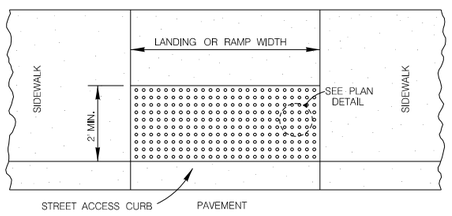
SCALE : 1" = 10'



TYPICAL SIDEWALK RAMP – TYPE IV

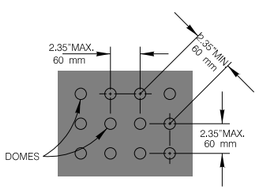
USED AT TEE INTERSECTIONS WHERE SIDEWALK IS SEPARATED FROM CURB

SCALE : 1" = 10'



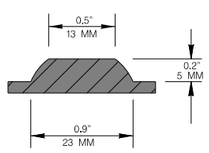
DETECTABLE WARNING SURFACE

SCALE : 1" = 4'



PLAN DETAIL

NO SCALE

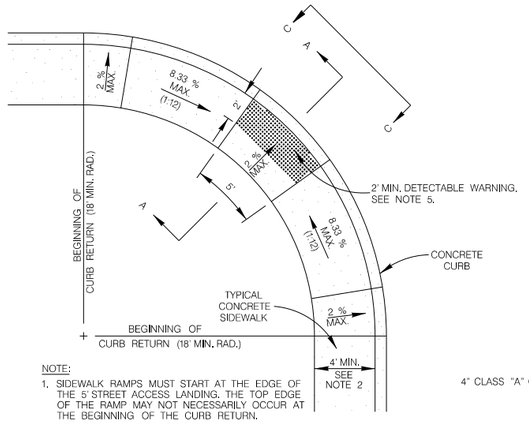


DOME SECTION

NO SCALE

NOTE:

STAMPED CONCRETE TRUNCATED DOMES WILL NOT BE ALLOWED TO BE USED FOR DETECTABLE WARNING ON WHEELCHAIR RAMPS. CONTRACTOR MUST SUBMIT TRUNCATED DOME INFORMATION THAT IS TO BE USED ON WHEELCHAIR RAMPS TO THE PROJECT MANAGER FOR APPROVAL AT LEAST 30 DAYS PRIOR TO INSTALLATION.



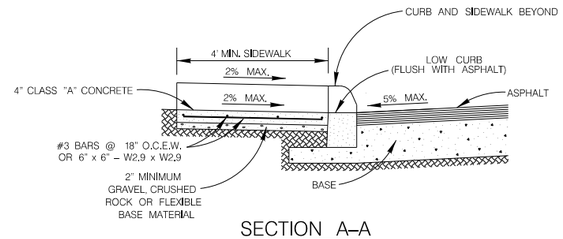
NOTE:

1. SIDEWALK RAMPS MUST START AT THE EDGE OF THE 5' STREET ACCESS LANDING. THE TOP EDGE OF THE RAMP MAY NOT NECESSARILY OCCUR AT THE BEGINNING OF THE CURB RETURN.
2. TYPE V RAMPS MUST HAVE 18' MIN. RADIUS.

TYPICAL SIDEWALK RAMP – TYPE V

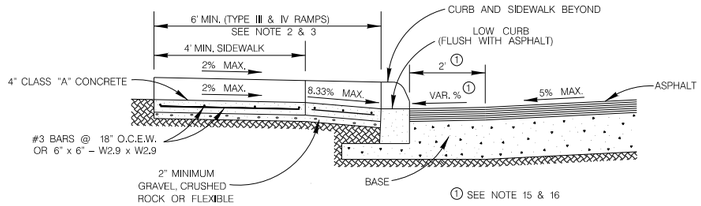
SIDEWALK ABUTS CURB

SCALE : 1" = 10'



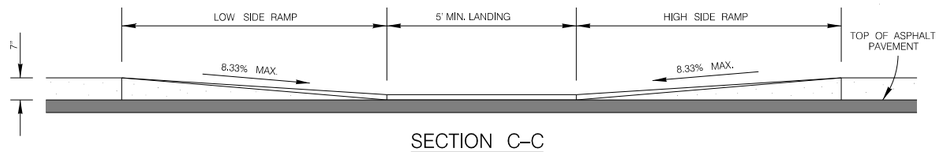
SECTION A–A

SCALE : 1" = 4'



SECTION B–B

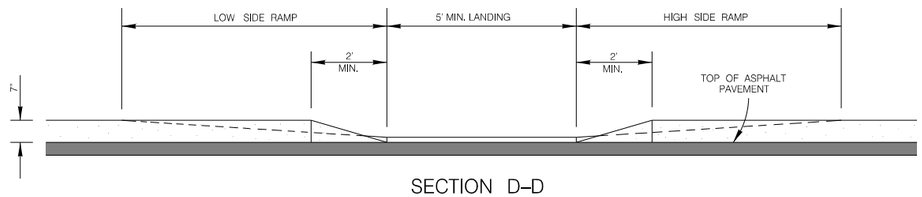
SCALE : 1" = 4'



SECTION C–C

CURB PROFILE WHERE SIDEWALK ABUTS CURB

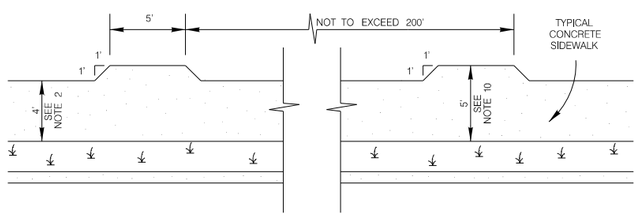
SCALE : 1" = 4'



SECTION D–D

CURB PROFILE WHERE SIDEWALK IS SEPARATED FROM CURB

SCALE : 1" = 4'



SIDEWALK PASSING SPACE

SCALE : 1" = 10'

TABLE 1 (SEE NOTE 4)		
GUTTER SLOPE	SIDEWALK RAMP LENGTH (1:12)	
	LOW SIDE	HIGH SIDE
1%	5'–6"	7'–2"
2%	5'–0"	8'–4"
3%	4'–6"	10'–0"
4%	4'–2"	12'–6"
5%	3'–10"	16'–8"

MAY 2009

CITY OF SAN ANTONIO

CAPITAL IMPROVEMENTS MANAGEMENT SERVICES DEPARTMENT

WHEELCHAIR RAMP STANDARDS

% SUBMITTAL	PROJECT NO.:		DATE:
DRWN. BY: V. VASQUEZ	DSGN. BY:	CHKD. BY: R.S. HOSSEINI, P.E.	SHEET NO.: 7 OF 7

Temporary Stormwater Section

Texas Commission on Environmental Quality

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

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

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

Signature

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

Print Name of Customer/Agent: Elvis Treviño, PE

Date: 06/26/2025

Signature of Customer/Agent:

Regulated Entity Name: CoSA Arrowhead Subdivision Phase 2 Sidewalk Project

Project Information

Potential Sources of Contamination

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

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

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

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

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

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

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

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

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

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

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

Sequence of Construction

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

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

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

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

Temporary Best Management Practices (TBMPs)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

☒ N/A

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

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

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

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

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

Soil Stabilization Practices

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

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

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

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

Administrative Information

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

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

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

TEMPORARY STORMWATER SECTION ATTACHMENTS

ATTACHMENT A — Spill Response Actions

The Contractor is required to remediate any spills, and to immediately report spills (including sanitary sewer discharge) of reportable quantities to the following:

*To the National Response Center at (800) 424-8802,
*To the Edwards Aquifer Authority at (210) 222-2204,
*To the San Antonio Water Systems (SAWS) at (210) 704-7297 and one of the following:

To the State Emergency Response Center (800) 832-8224 (if after hours), or to the TCEQ San Antonio Regional Office (210) 490-3096 (if during business hours).

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

The following steps will help reduce the storm water impacts of leaks and spills:
Education

(1) Be aware that different materials pollute in different amounts. Make sure that each employee knows what a “significant spill” is for each material they use, and what is the appropriate response for “significant” and “insignificant” spills. Employees should also be aware of when spill must be reported to the TCEQ. Information available in 30 TAC 327.4 and 40 CFR 302.4.
(2) Educate employees and subcontractors on potential dangers to humans and the environment from spills and leaks.
(3) Hold regular meetings to discuss and reinforce appropriate disposal procedures (incorporate into regular safety meetings).
(4) Establish a continuing education program to indoctrinate new employees.
(5) Have contractor’s superintendent or representative oversee and enforce proper spill prevention and control measures.

General Measures

(1) To the extent that the work can be accomplished safely, spills of oil, petroleum products, and substances listed under 40 CFR parts 110,117, and 302, and sanitary and septic wastes should be contained and cleaned up immediately.
(2) Store hazardous materials and wastes in covered containers and protect from vandalism.
(3) Place a stockpile of spill cleanup materials where it will be readily accessible.
(4) Train employees in spill prevention and cleanup.

(5) Designate responsible individuals to oversee and enforce control measures.
(6) Spills should be covered and protected from storm water runoff during rainfall to the extent that it does not compromise clean-up activities.
(7) Do not bury or wash spills with water.
(8) Store and dispose of used clean up materials, contaminated materials, and recovered spill material that is no longer suitable for the intended purpose in conformance with the provisions in applicable BMPs.
(9) Do not allow water used for cleaning and decontamination to enter storm drains or watercourses. Collect and dispose of contaminated water in accordance with applicable regulations.
(10) Contain water overflow or minor water spillage and do not allow it to discharge into drainage facilities or watercourses.
(11) Place Material Safety Data Sheets (MSDS), as well as proper storage, cleanup, and spill reporting instructions for hazardous materials stored or used on the project site in an open, conspicuous, and accessible location.
(12) Keep waste storage areas clean, well-organized, and equipped with ample cleanup supplies as appropriate for the materials being stored. Perimeter controls, containment structures, covers, and liners should be repaired or replaced as needed to maintain proper function.

Cleanup

(1) Clean up leaks and spills immediately.
(2) Use a rag for small spills on paved surfaces, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be disposed of as hazardous waste.
(3) Never hose down or bury dry material spills. Clean up as much of the material as possible and dispose of properly. See the waste management BMPs in this section for specific information.

Minor Spills

(1) Minor spills typically involve small quantities of oil, gasoline, paint, etc. which can be controlled by the first responder at the discovery of the spill.
(2) Use absorbent materials on small spills rather than hosing down or burying the spill.
(3) Absorbent materials should be promptly removed and disposed of properly.
(4) Follow the practice below for a minor spill:
(5) Contain the spread of the spill.
(6) Recover spilled materials.
(7) Clean the contaminated area and properly dispose of contaminated materials.

Semi-Significant Spills

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

Spills should be cleaned up immediately:

(1) Contain spread of the spill.
(2) Notify the project foreman immediately.
(3) If the spill occurs on paved or impermeable surfaces, clean up using "dry" methods (absorbent materials, cat litter and/or rags). Contain the spill by encircling with absorbent materials and do not let the spill spread widely.
(4) If the spill occurs in dirt areas, immediately contain the spill by constructing an earthen dike. Dig up and properly dispose of contaminated soil.
(5) If the spill occurs during rain, cover spill with tarps or other material to prevent contaminating runoff.

Significant/Hazardous Spills

For significant or hazardous spills that are in reportable quantities:

(1) Notify the TCEQ by telephone as soon as possible and within 24 hours at 210-490-3096 (San Antonio) between 8 AM and 5 PM. After hours, contact the Environmental Release Hotline at 1-800-832-8224. It is the contractor's responsibility to have all emergency phone numbers at the construction site.
(2) For spills of federal reportable quantities, in conformance with the requirements in 40 CFR parts 110,119, and 302, the contractor should notify the National Response Center at (800) 424-8802.
(3) Notification should first be made by telephone and followed up with a written report.
(4) The services of a spill's contractor or a Haz-Mat team should be obtained immediately. Construction personnel should not attempt to clean up until the appropriate and qualified staffs have arrived at the job site.
(5) Other agencies which may need to be consulted include, but are not limited to, the City Police Department, County Sheriff Office, Fire Departments, etc.

More information on spill rules and appropriate responses is available on the TCEQ website at: https://www.tceq.texas.gov/response

Vehicle and Equipment Maintenance

(1) If maintenance must occur onsite, use a designated area and a secondary containment, located away from drainage courses, to prevent the run-on of storm water and the runoff of spills.
(2) Regularly inspect onsite vehicles and equipment for leaks and repair immediately
(3) Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment onsite.
(4) Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
(5) Place drip pans or absorbent materials under paving equipment when not in use.
(6) Use absorbent materials on small spills rather than hosing down or burying the spill. Remove the absorbent materials promptly and dispose of properly.

(7) Promptly transfer used fluids to the proper waste or recycling drums. Do not leave full drip pans or other open containers lying around.
(8) Oil filters disposed of in trashcans or dumpsters can leak oil and pollute storm water. Place the oil filter in a funnel over a waste oil-recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask the oil supplier or recycler about recycling oil filters.
(9) Store cracked batteries in a non- leaking secondary container. Do this with all cracked batteries even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Vehicle and Equipment Fueling

(1) If fueling must occur on site, use designated areas, located away from drainage courses, to prevent the run-on of storm water and the runoff of spills.
(2) Discourage “topping off” of fuel tanks.
(3) Always use secondary containment, such as a drain pan, when fueling to catch spills/ leaks.

ATTACHMENT B — Potential Sources of Contamination

Potential sources of contamination include the hydrocarbons, hydraulic fluid and fuels required to service and operate the construction equipment, the materials and liquids used to conduct paving operations, various paints and solvents, and soil disturbed and mobilized during excavation. Additional sources of contamination include spills associated with vehicle accidents that might occur within the boundaries of the project.

ATTACHMENT C — Sequence of Major Events

1. Install erosion and sedimentation controls down-slope of work area and initiate SWPPP inspection and maintenance activities. Post the required SWPPP site notification.

2. Provide written notification to the TCEQ 48 hours prior to commencement of construction. Schedule an on-site pre-construction coordination meeting, if applicable.

3. Begin phased construction including the following:
    - Phase 2: Construct sidewalk and vegetative filter strip along the entire length of the project. 0.48 acres) (4 weeks).

4. Remove temporary erosion/sedimentation controls once disturbed areas are re-vegetated. Restore all areas disturbed by the removal of E&S controls.

5. Provide final notification of completion of construction in compliance with TCEQ and SWPPP requirements.

    The receiving waters are Unnamed Tributary 1 to Panther Springs Creek.

ATTACHMENT D – Temporary Best Management Practices

During the construction phase, the BMPs selected for the water quality protection include the following:

- Silt fences on the upstream side of disturbed areas to route flow around work area limiting the flow over the work area.
- Construction exits will be used to minimize offsite tracking of sediment. The locations of all temporary BMPs are shown on the Temporary Erosion and Sedimentation Control Plan sheets. Standard details show information relevant to BMP installation and maintenance. The locations of staging areas will be determined by the contractor. Appropriate erosion controls will be utilized to prevent sediment discharges from the staging areas.

The locations of all temporary BMPs are shown on the WPAP SW3P plan sheets. Standard details show information relevant to BMP installation and maintenance. The locations of staging areas will be determined by the contractor. Appropriate erosion control will be utilized to prevent sediment discharges from staging areas.

Texas Commission on Environmental Quality
Water Pollution Abatement Plan
General Construction Notes

1. A written notice of construction must be submitted to the TCEQ regional office at least 48 hours prior to the start of any regulated activities. This notice must include:
   - the name of the approved project; - the activity start date; and - the contact information of the prime contractor.

2. All contractors conducting regulated activities associated with this project must be provided with complete copies of the approved Water Pollution Abatement Plan (WPAP) and the TCEQ letter indicating the specific conditions of its approval. During the course of these regulated activities, the contractors are required to keep on-site copies of the approved plan and approval letter.

3. If any sensitive feature(s) (caves, solution cavity, sink hole, etc.) is discovered during construction, all regulated activities near the sensitive feature must be suspended immediately. The appropriate TCEQ regional office must be immediately notified of any sensitive features encountered during construction. Construction activities may not be resumed until the TCEQ has reviewed and approved the appropriate protective measures in order to protect any sensitive feature and the Edwards Aquifer from potentially adverse impacts to water quality.

4. No temporary or permanent hazardous substance storage tank shall be installed within 150 feet of a water supply source, distribution system, well, or sensitive feature.

5. Prior to beginning any construction activity, all temporary erosion and sedimentation (E&S) control measures must be properly installed and maintained in accordance with the manufacturers specifications. If inspections indicate a control has been used inappropriately, or incorrectly, the applicant must replace or modify the control for site situations. These controls must remain in place until the disturbed areas have been permanently stabilized.

6. Any sediment that escapes the construction site must be collected and properly disposed of before the next rain event to ensure it is not washed into surface streams, sensitive features, etc.

7. Sediment must be removed from the sediment traps or sedimentation basins no later than when it occupies 50% of the basin's design capacity.

8. Litter, construction debris, and construction chemicals exposed to stormwater shall be prevented from being discharged offsite.

9. All excavated material that will be stored on-site must have proper E&S controls. For storage or disposal of spoils at another site on the Edwards Aquifer Recharge Zone, the owner of the site must receive approval of a water pollution abatement plan for the placement of fill material or mass grading prior to the placement of spoils at the other site.

10. If portions of the site will have a cease in construction activity lasting longer than 14 days, soil stabilization in those areas shall be initiated as soon as possible prior to the 14th day of inactivity. If activity will resume prior to the 21st day, stabilization measures are not required. If drought conditions or inclement weather prevent action by the 14th day, stabilization measures shall be initiated as soon as possible.

11. The following records should be maintained and made available to the TCEQ upon request:
    -the dates when major grading activities occur;
    -the dates when construction activities temporarily or permanently cease on a portion of the site; and
    -the dates when stabilization measures are initiated.

12. The holder of any approved Edward's Aquifer protection plan must notify the appropriate regional office in writing and obtain approval from the executive director prior to initiating any of the following:
    A. any physical or operational modification of any best management practices (BMPs) or structure(s), including but not limited to temporary or permanent ponds, dams, berms, silt fences, and diversionary structures;
    B. any change in the nature or character of the regulated activity from that which was originally approved;
    C. any change that would significantly impact the ability to prevent pollution of the Edwards Aquifer; or
    D. any development of land previously identified as undeveloped in the approved contributing zone plan.

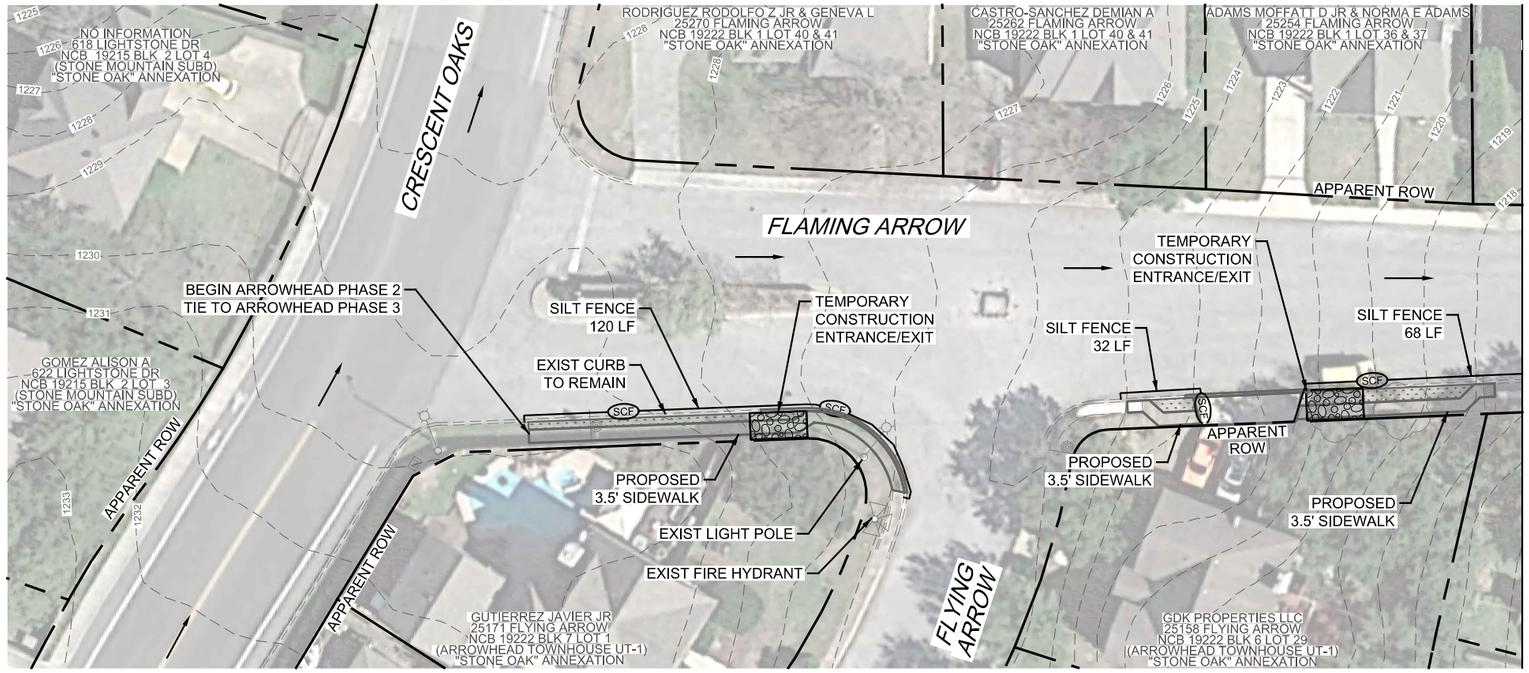
Austin Regional Office 12100 Park 35 Circle, Bldg A Austin, Texas 78753-1808 Phone (512) 339-2929 Fax (512) 339-3795	San Antonio Regional Office 14250 Judson Road San Antonio, Texas 78233-4480 Phone (210) 490-3096 Fax (210) 545-4329

STATE OF TEXAS
ELVIS TREVIÑO
126752
LICENSED
PROFESSIONAL ENGINEER
6/26/2025

MAESTAS
8122 DATAPOINT DR, STE 840
SAN ANTONIO, TX 78229
(210) 566-1988
FIRM No. 13131
TBPLS No. 10194506

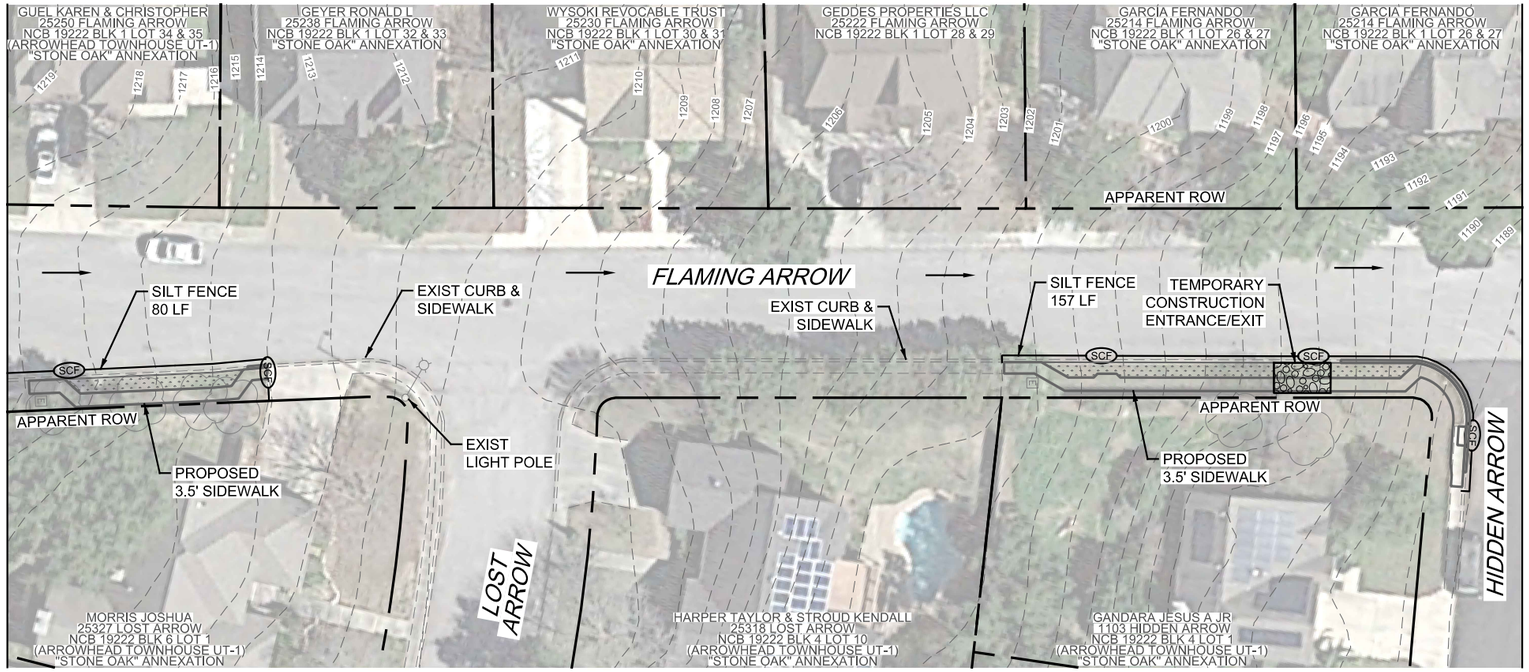
TEMPORARY WATER POLLUTION ABATEMENT PLAN NOTES
COSA ARROWHEAD SUBDIVISION PHASE 2 SIDEWALK PROJECT

SHEET 1
OF 1



MATCHLINE - SHEET A-A

MATCHLINE - SHEET A-A



MATCHLINE - SHEET B-B

PLAN VIEW LEGEND

- SCF — SILT FENCE
- CGF — CURB GRAVEL FILTER
- FLOW ARROW
- XXX — EXISTING CONTOURS
- RIGHT OF WAY
- CONSTRUCTION EXIT (TY 1)

* AREAS OF SOIL DISTURBANCE WILL BE FROM BACK OF CURB TO RIGHT-OF-WAY

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SCALE
HORZ: 1" = 40'

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TBPE No. F-13183
TBPLS No. 10194506

TEMPORARY STORM WATER POLLUTION PREVENTION PLAN
SHEET 1 OF 4
COSA ARROWHEAD SUBDIVISION PHASE 2
SIDEWALK PROJECT

SHEET 1
OF 4

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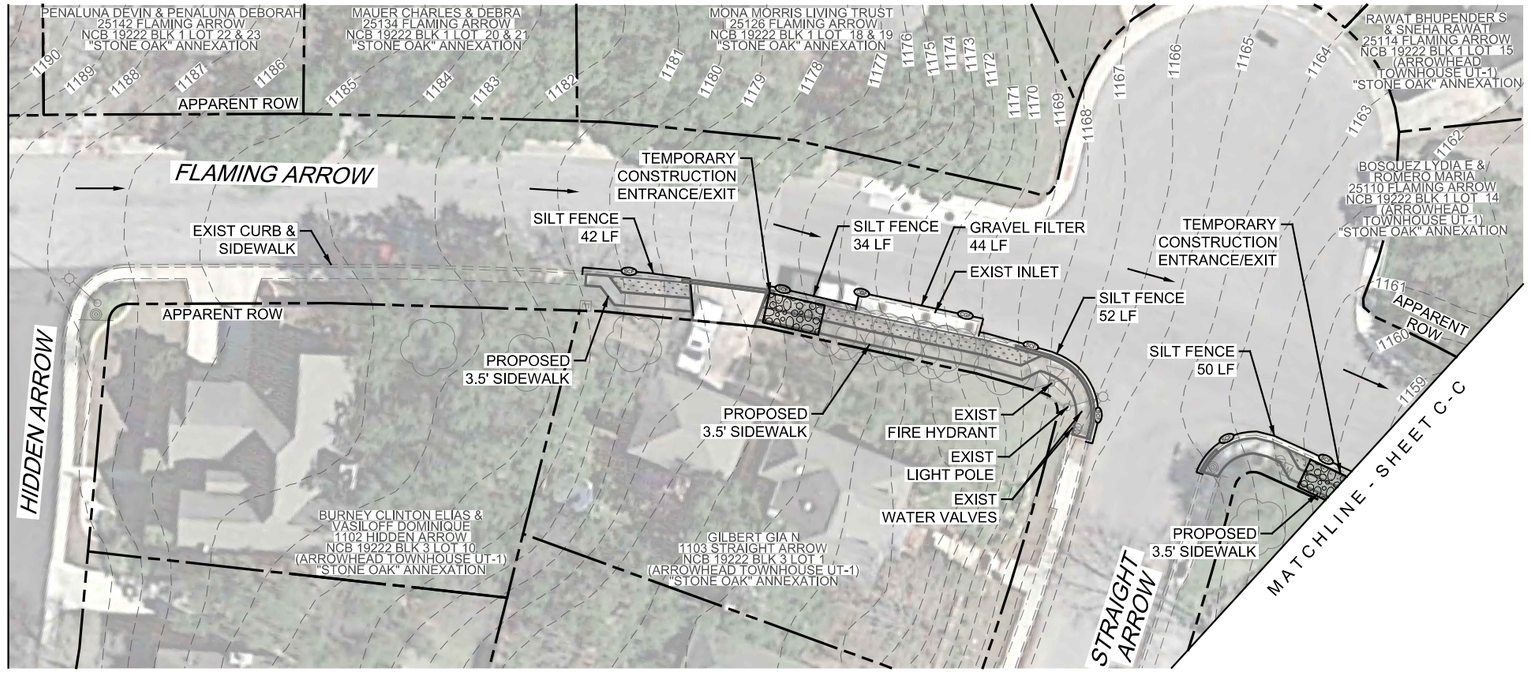

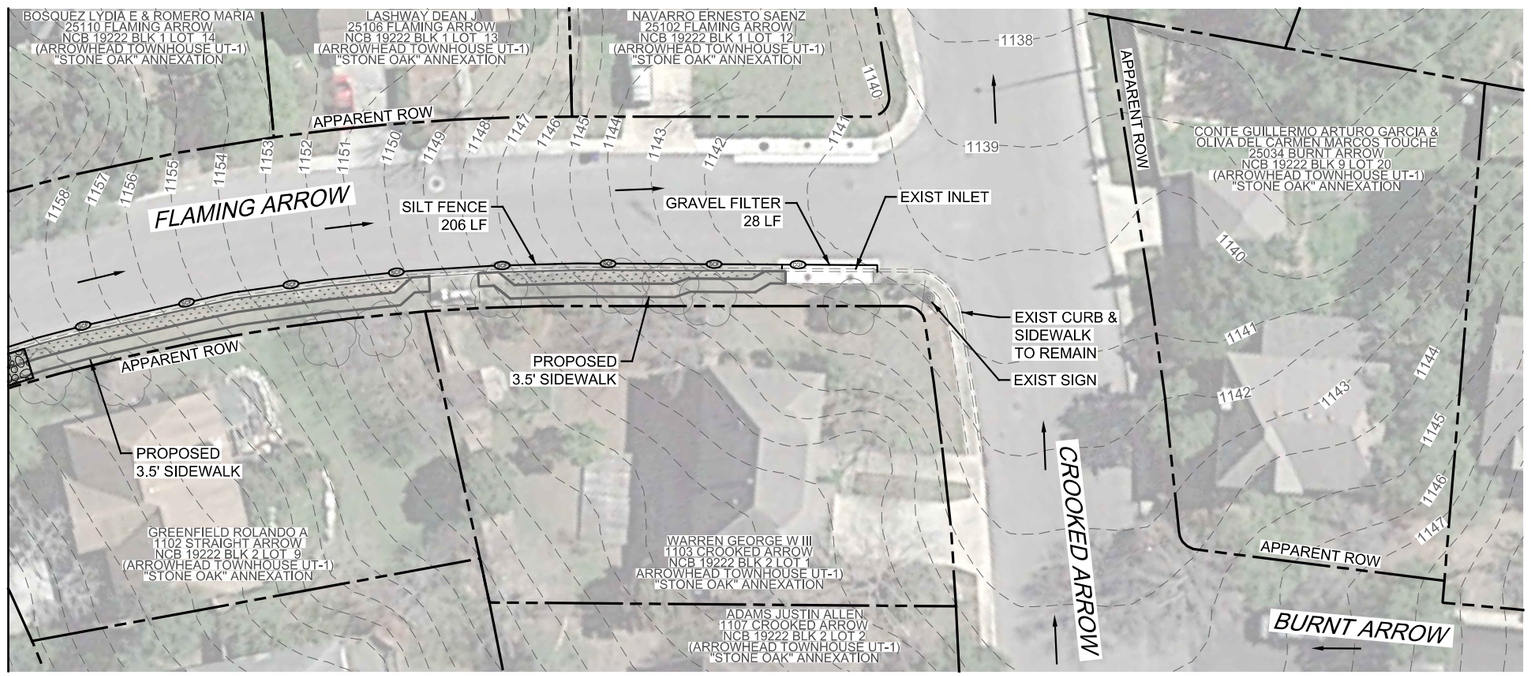

PLAN VIEW LEGEND

- SILT FENCE
- CURB GRAVEL FILTER
- FLOW ARROW
- XXX EXISTING CONTOURS
- RIGHT OF WAY
- CONSTRUCTION EXIT (TY 1)

* AREAS OF SOIL DISTURBANCE WILL BE FROM BACK OF CURB TO RIGHT-OF-WAY

SCALE
HORZ: 1" = 40'

MAESTAS
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TBPLS No. 10194506

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TEMPORARY STORM WATER POLLUTION PREVENTION PLAN
SHEET 2 OF 4
COSA ARROWHEAD SUBDIVISION PHASE 2
SIDEWALK PROJECT

SHEET 2
OF 4

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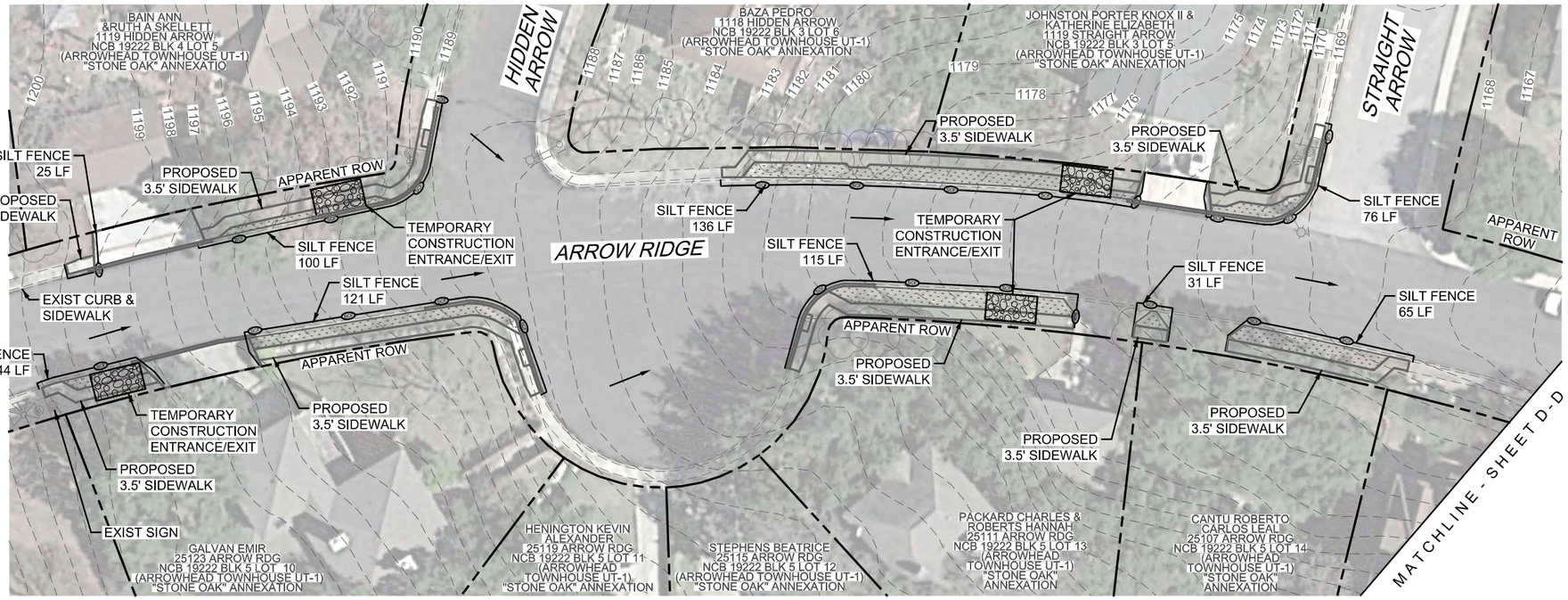
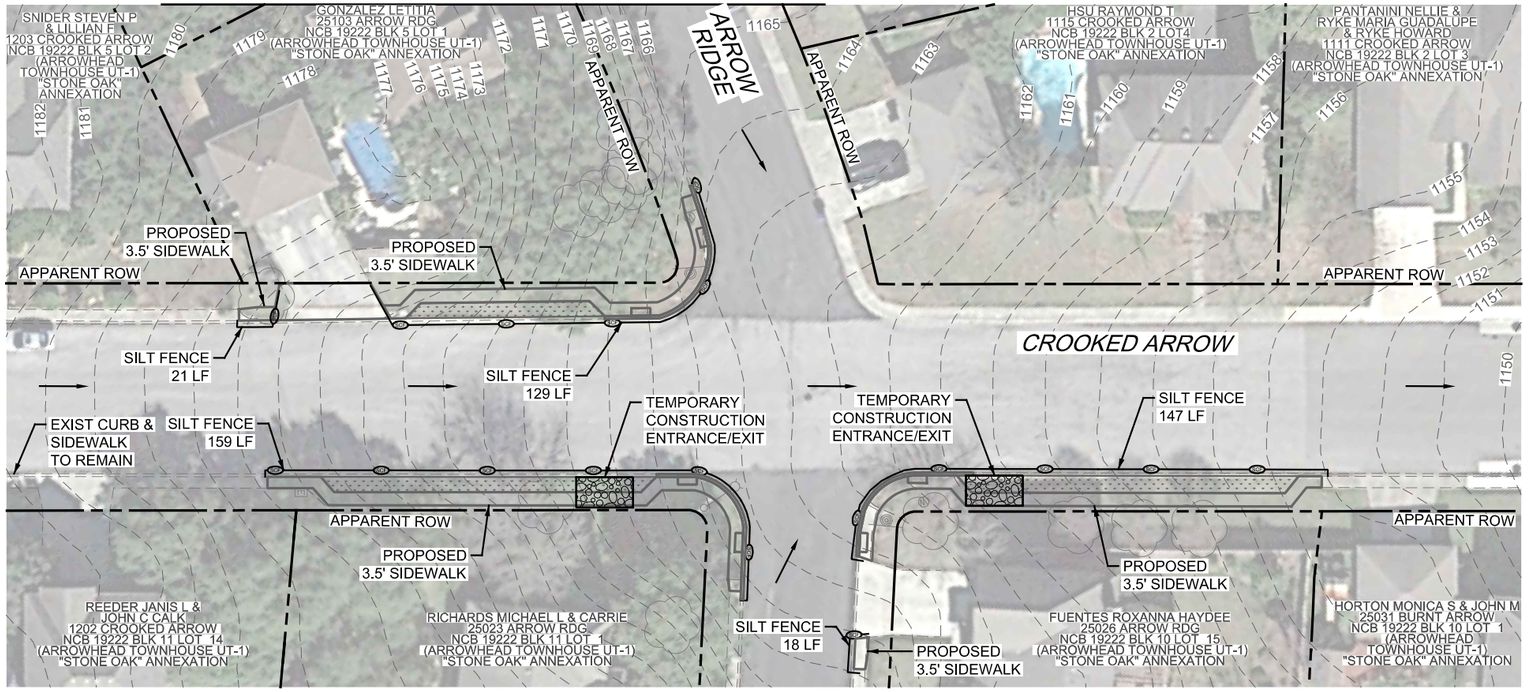


MATCHLINE - SHEET D-D



PLAN VIEW LEGEND

- SILT FENCE
- CURB GRAVEL FILTER
- FLOW ARROW
- XXX- EXISTING CONTOURS
- RIGHT OF WAY
- CONSTRUCTION EXIT (TY 1)

* AREAS OF SOIL DISTURBANCE WILL BE FROM BACK OF CURB TO RIGHT-OF-WAY

SCALE
HORZ: 1" = 40'

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TEMPORARY STORM WATER POLLUTION PREVENTION PLAN
SHEET 3 OF 4
COSA ARROWHEAD SUBDIVISION PHASE 2
SIDEWALK PROJECT

SHEET 3
OF 4

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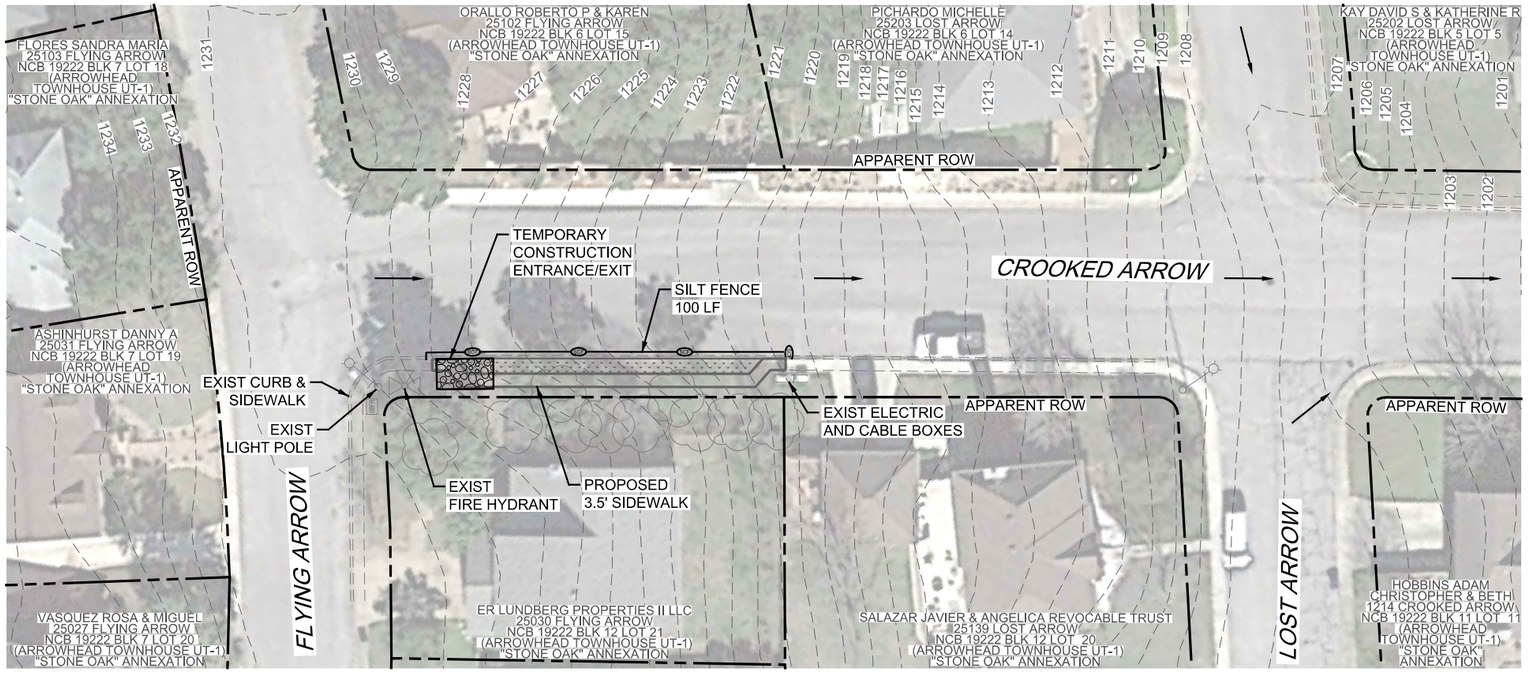

PLAN VIEW LEGEND

- SILT FENCE
- CURB GRAVEL FILTER
- FLOW ARROW
- XXX EXISTING CONTOURS
- RIGHT OF WAY
- CONSTRUCTION EXIT (TY 1)

* AREAS OF SOIL DISTURBANCE WILL BE FROM BACK OF CURB TO RIGHT-OF-WAY

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SCALE
HORZ: 1" = 40'

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(210) 366-1988
TBPE No. 13387
TBPLS No. 10194506

TEMPORARY STORM WATER POLLUTION PREVENTION PLAN
SHEET 4 OF 4

COSA ARROWHEAD SUBDIVISION PHASE 2
SIDEWALK PROJECT

SHEET 4
OF 4

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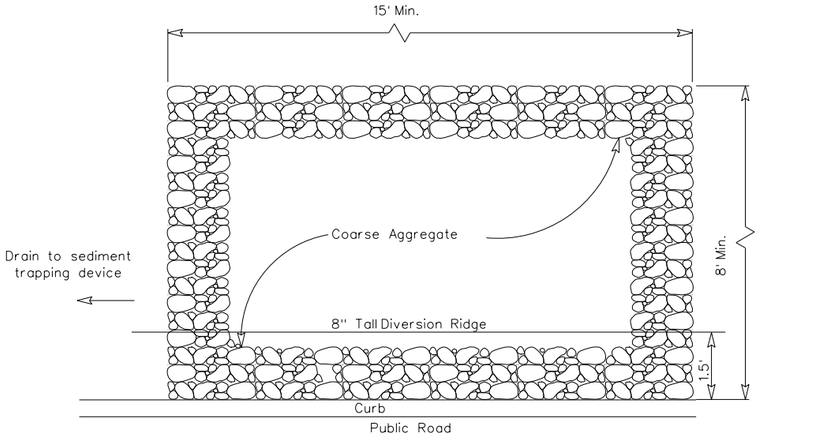
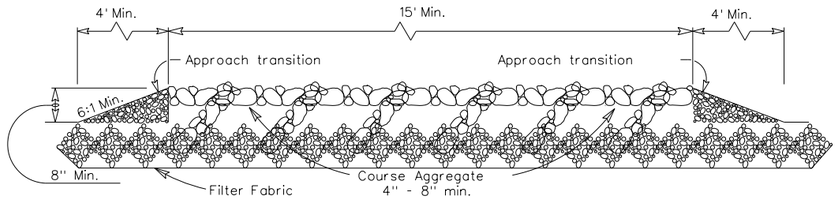


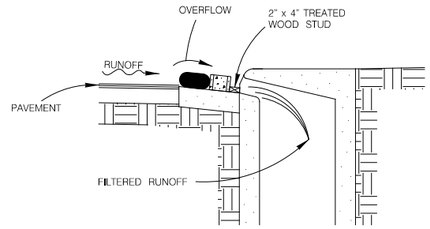
PLAN



PROFILE

CONSTRUCTION EXIT (TYPE 1)

Construction exit is reduced size
Equipment size is limited to those
Elements the size a Skid steer or Bobcat



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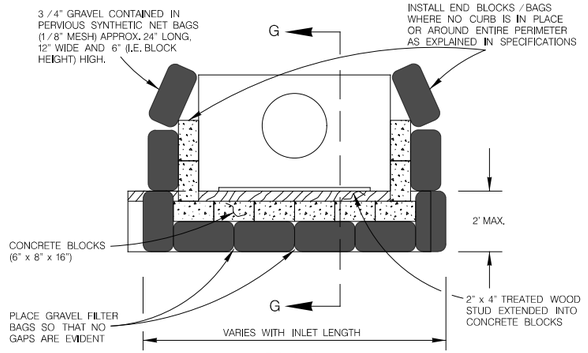
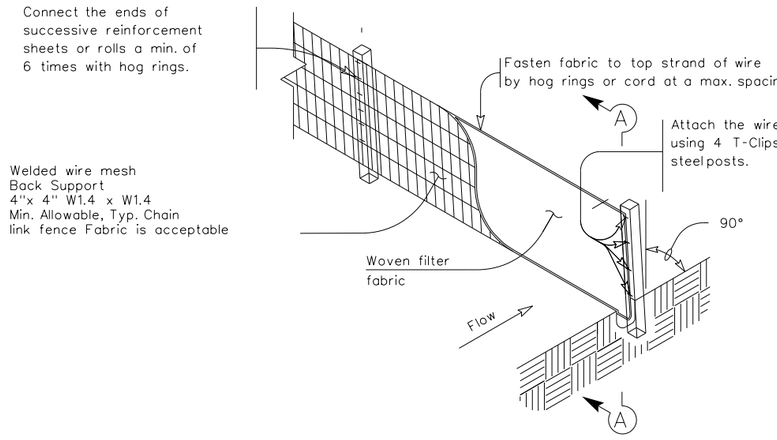


PLAN

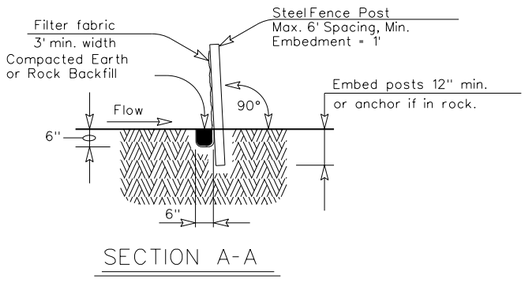
SCALE : NTS

NOTE:
GRAVEL FILTERS CAN BE USED ON PAVEMENT OR BARE GROUND.

CURB INLET GRAVEL FILTER



TEMPORARY SEDIMENT CONTROL FENCE



SECTION A-A

MAESTAS
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(210) 366-1333
TBPELS No. 10194506

NOTES AND TEMP BMP DETAILS
PREVENTION PLAN LAYOUT
COSA ARROWHEAD SUBDIVISION
PHASE 2 SIDEWALK PROJECT
CLEARSTONE DR TO FLAMING ARROW

SHEET 1
OF 1

ATTACHMENT E – Request to Temporarily Seal a Feature

Not applicable.

ATTACHMENT F – Structural Practices

Sediment generated by the proposed activities will be controlled through the use of silt fencing. Construction vehicle traffic will be routed in a manner to avoid, where possible, creating loose sediment or mud that could enter waterways. The vegetative filter strips shall be installed using sod to have immediate sediment reduction.

ATTACHMENT G – Drainage Area Map

Attached – see the following sheet.

Area ID	Total Area (Acres)	C Value	I_{25}	Q_{25} (cfs)
A	0.02	0.76	11.14	0.2
B	0.04	0.75	11.14	0.3
C	0.03	0.73	11.14	0.2
D	0.04	0.76	11.14	0.3
E	0.06	0.70	11.14	0.5
F	0.04	0.75	11.14	0.3
G	0.03	0.82	11.14	0.3
H	0.05	0.79	11.14	0.4
I	0.04	0.76	11.14	0.3
J	0.03	0.82	11.14	0.3
K	0.04	0.76	11.14	0.3
L	0.03	0.73	11.14	0.2
M	0.03	0.69	11.14	0.2

LEGEND

- (XX) DRAINAGE AREAS
- DRAINAGE AREA BOUNDARIES
- 1' CONTOURS
- FLOWPATH
- FLOW DIRECTION

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SCALE
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TBPLS No. 10194506

DRAINAGE AREA MAP

SHEET 1 OF 1
COSA ARROWHEAD SUBDIVISION PHASE 2
SIDEWALK PROJECT

SHEET 1
OF 1

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ATTACHMENT H – Temporary Sediment Pond Plan and Calculations

Sediment ponds are not planned for this project.

ATTACHMENT I – Inspection and Maintenance

Key to maintaining the performance of and efficiency of the temporary BMPs is inspection and repair when needed. The project will use an established schedule of inspection to identify the weak or failing sections of the sediment controls and institute repairs immediately to ensure the continued performance of the installed BMPs. BMPs will be inspected at least weekly and after each rain event. Damaged BMPs will either be repaired or replaced as needed. Staging of the project activities will also be used to reduce the amount of ground damage to minimize the potential for sediment to enter the waterways. The areas adjacent to creeks and drainage ways shall have priority followed by protecting storm sewer inlets. If storms damage the BMPs, efforts will be made to immediately to restore them to original performance levels.

Silt Fence

(1) Inspection will be made weekly or after each rainfall event and repair or replacement should be made promptly as needed by the contractor.
(2) Remove sediment when buildup reaches 6 inches. Accumulated silt will be removed after each rainfall and disposed of in a manner which will not cause additional siltation.
(3) Replace any torn fabric or install a second line of fencing parallel to the torn section.
(4) Dikes will be Inspected and realigned as needed to prevent gaps between sections.
(5) Replace or repair any sections crushed or collapsed during construction activity. If a section of fence is obstructing vehicular access, consider relocating it to a spot where it will provide equal protection, but will not obstruct vehicles. A triangular filter dike may be preferable to a silt fence at common vehicle access points.
(6) When construction is complete, the sediment should be disposed of in a manner that will not cause additional siltation and the prior location of the silt fence should be revegetated. The fence itself should be disposed of in an approved landfill.

Construction Exit

(1) Inspection will be made weekly or after each rainfall event and repair or replacement should be made promptly as needed by the contractor.
(2) The entrance should be maintained in a condition which will prevent tracking or flowing of sediment onto public rights-of-way. This may require periodic top dressing with additional stone as conditions demand and repair and/or cleanout of any measures used to trap sediment.
(3) All sediment spilled, dropped, washed, or tracked onto public rights-of-way should be removed immediately by contractor.
(4) When necessary, wheels should be cleaned to remove sediment prior to entrance onto public right-of-way.

(5) When washing is required, it should be done on an area stabilized with crushed stone that drains into an approved sediment trap or sediment basin.
(6) All sediment should be prevented from entering any storm drain, ditch, or water course by using approved methods.

ATTACHMENT J – Schedule of Interim and Permanent Soil Stabilization Practices

Interim on-site stabilization measures, which are continuous, will include minimizing soil disturbances by exposing the smallest practical area of land required for the shortest period of time and maximizing use of natural vegetation. As soon as practical, all disturbed soil will be stabilized as per project specifications in accordance with pages 1-35 to 1-60 of TCEQ's Technical Guidance Manual (TGM) RG-348 (2005). Mulching, netting, erosion blankets and seeding are acceptable.

The management of land by using ground cover reduces erosion by reducing the flow rate of runoff and the raindrop impact. Bare soils should be seeded or otherwise stabilized within 14 calendar days after final grading or where construction activity has temporarily ceased for more than 21 days. Stabilization will involve simply sodding and fertilizing. Sediment that has escaped the site due to the failure of sediment and erosion controls should be removed as soon as possible to minimize offsite impacts. Permission should be obtained from adjacent landowners prior to offsite sediment removal.

Permanent Stormwater Section

Texas Commission on Environmental Quality

for Regulated Activities on the Edwards Aquifer Recharge Zone and Relating to 30 TAC §213.5(b)(4)(C), (D)(Ii), (E), and (5), Effective June 1, 1999

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

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

Signature

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

Print Name of Customer/Agent: Elvis Treviño, PE

Date: 06/26/2025

Signature of Customer/Agent

Elvis Treviño

Regulated Entity Name: CoSA Arrowhead Subdivision Phase 2 Sidewalk Project

Permanent Best Management Practices (BMPs)

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

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

   ☐ N/A

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

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

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

☐ N/A

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

   ☐ N/A

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

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

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

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

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

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

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

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

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

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

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

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

☐ N/A

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

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

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

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

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

☐ N/A

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

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

    ☐ N/A

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

    ☒ N/A

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

    ☐ N/A

Responsibility for Maintenance of Permanent BMP(s)

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

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

    ☐ N/A

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

    ☐ N/A

PERMANENT STORMWATER SECTION ATTACHMENTS

ATTACHMENT A - 20% or Less Impervious Cover Waiver

Not applicable.

ATTACHMENT B - BMPs for Upgradient Stormwater

Under proposed conditions, offsite surface water will flow through the project limits on the southeast side of Crooked Arrow into the road. From these areas will enter and remain in the street and will be finally allowed to enter the Unnamed Tributary 1 to Panther Springs Creek from the west side of Stone Oak Pkwy via the Arrowhead Subdivision roadways, drainage inlets and unnamed stream south of Stone Oak Pkwy. The proposed sidewalk will slope towards the vegetated filter strip along the east, west, north and south sides of the sidewalk, allowing the runoff from the proposed segment of sidewalk to pass the proposed BMP.

ATTACHMENT C – BMPs for On-site Stormwater

Treatment for the runoff from the drainage area on the newly constructed sidewalk shall be addressed by vegetative filter strip placed on the east side of sidewalk for approximately 1088 LF on west side of Flaming Arrow and Arrow Ridge, vegetative filter strip placed on the west side of sidewalk for approximately 279 LF on east side of Arrow Ridge, vegetative filter strip placed on south side of sidewalk for approximately 123 LF on north side of Crooked Arrow and vegetative filter strip placed on north side of sidewalk for approximately 402 LF on south side of Crooked Arrow in the Arrowhead Subdivision.

ATTACHMENT D – BMPS FOR SURFACE STREAMS

No sensitive geologic features exist on the project site. The proposed project will only create new pedestrian impervious cover and will not treat storm-water runoff from Flaming Arrow, Arrow Ridge and Crooked Arrow prior to being discharged into the existing inlets located to the southeast of the proposed improvements. The nature of the sidewalk improvement should not increase risk to surface streams. Treatment of the sidewalk by vegetative filter strip will provide protection to surface streams.

Action plan if sensitive features are encountered:

1. Immediately stop construction in the vicinity of the feature.
2. Notify TCEQ San Antonio Regional office staff.
3. Contact a qualified professional Geologist (and Karst biologist, if necessary) to assess the sensitivity of the feature.
4. If necessary, install temporary erosion and sedimentation controls to protect the feature from surface contamination.
5. Develop and submit to the TCEQ for review a feature closer and/or protection plan.
6. Commence construction in the vicinity of the feature only after the feature closure/protection plans has been approved by the TCEQ and the feature has been permanently protected from surface contamination.

ATTACHMENT E – Request to Seal Features

Not applicable.

ATTACHMENT F – Construction Plans/Design Calculations

Attached. See Site Plan and Storm Water Pollution Prevention Plan.

Texas Commission on Environmental Quality
Water Pollution Abatement Plan
General Construction Notes

1. A written notice of construction must be submitted to the TCEQ regional office at least 48 hours prior to the start of any regulated activities. This notice must include:
   - the name of the approved project; - the activity start date; and - the contact information of the prime contractor.

2. All contractors conducting regulated activities associated with this project must be provided with complete copies of the approved Water Pollution Abatement Plan (WPAP) and the TCEQ letter indicating the specific conditions of its approval. During the course of these regulated activities, the contractors are required to keep on-site copies of the approved plan and approval letter.

3. If any sensitive feature(s) (caves, solution cavity, sink hole, etc.) is discovered during construction, all regulated activities near the sensitive feature must be suspended immediately. The appropriate TCEQ regional office must be immediately notified of any sensitive features encountered during construction. Construction activities may not be resumed until the TCEQ has reviewed and approved the appropriate protective measures in order to protect any sensitive feature and the Edwards Aquifer from potentially adverse impacts to water quality.

4. No temporary or permanent hazardous substance storage tank shall be installed within 150 feet of a water supply source, distribution system, well, or sensitive feature.

5. Prior to beginning any construction activity, all temporary erosion and sedimentation (E&S) control measures must be properly installed and maintained in accordance with the manufacturers specifications. If inspections indicate a control has been used inappropriately, or incorrectly, the applicant must replace or modify the control for site situations. These controls must remain in place until the disturbed areas have been permanently stabilized.

6. Any sediment that escapes the construction site must be collected and properly disposed of before the next rain event to ensure it is not washed into surface streams, sensitive features, etc.

7. Sediment must be removed from the sediment traps or sedimentation basins no later than when it occupies 50% of the basin's design capacity.

8. Litter, construction debris, and construction chemicals exposed to stormwater shall be prevented from being discharged offsite.

9. All excavated material that will be stored on-site must have proper E&S controls. For storage or disposal of spoils at another site on the Edwards Aquifer Recharge Zone, the owner of the site must receive approval of a water pollution abatement plan for the placement of fill material or mass grading prior to the placement of spoils at the other site.

10. If portions of the site will have a cease in construction activity lasting longer than 14 days, soil stabilization in those areas shall be initiated as soon as possible prior to the 14th day of inactivity. If activity will resume prior to the 21st day, stabilization measures are not required. If drought conditions or inclement weather prevent action by the 14th day, stabilization measures shall be initiated as soon as possible.

11. The following records should be maintained and made available to the TCEQ upon request:
    -the dates when major grading activities occur;
    -the dates when construction activities temporarily or permanently cease on a portion of the site; and
    -the dates when stabilization measures are initiated.

12. The holder of any approved Edward's Aquifer protection plan must notify the appropriate regional office in writing and obtain approval from the executive director prior to initiating any of the following:
    A. any physical or operational modification of any best management practices (BMPs) or structure(s), including but not limited to temporary or permanent ponds, dams, berms, silt fences, and diversionary structures;
    B. any change in the nature or character of the regulated activity from that which was originally approved;
    C. any change that would significantly impact the ability to prevent pollution of the Edwards Aquifer; or
    D. any development of land previously identified as undeveloped in the approved contributing zone plan.

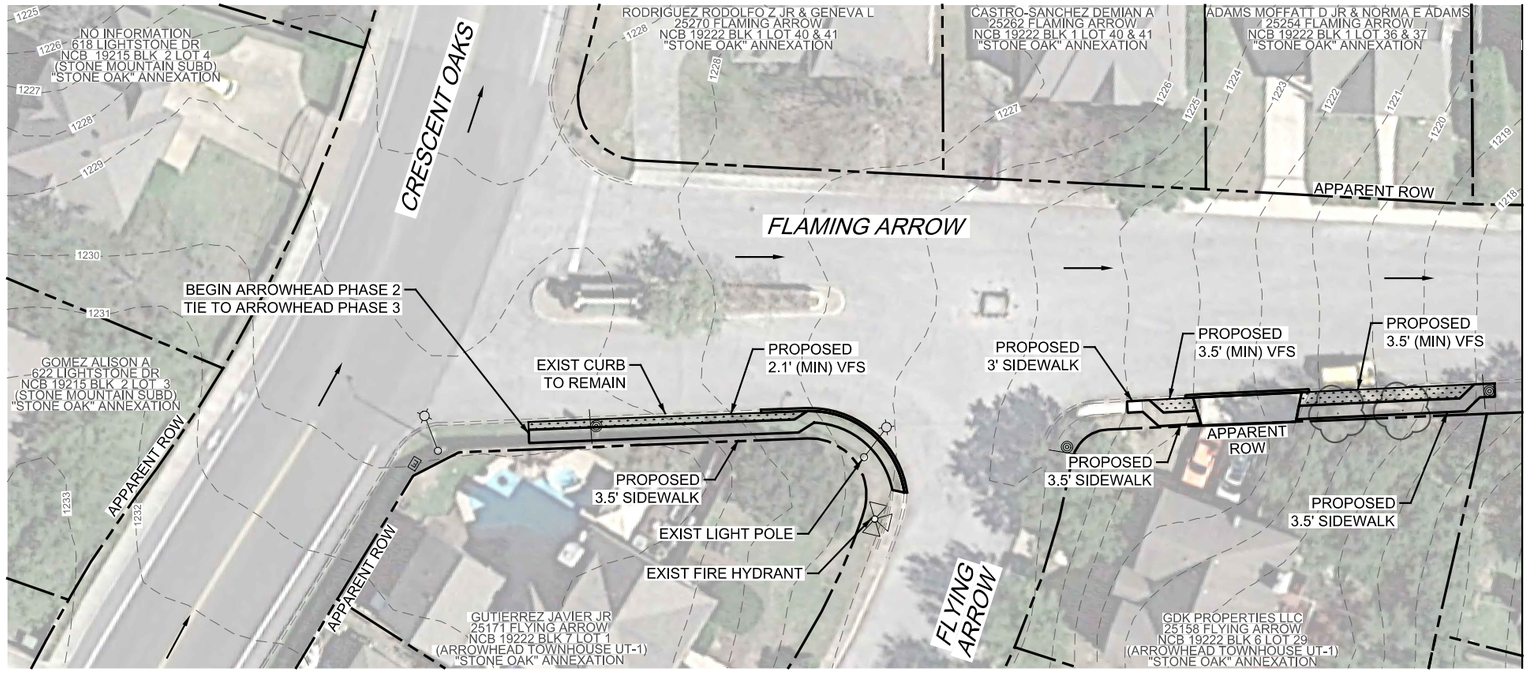
Austin Regional Office 12100 Park 35 Circle, Bldg A Austin, Texas 78753-1808 Phone (512) 339-2929 Fax (512) 339-3795	San Antonio Regional Office 14250 Judson Road San Antonio, Texas 78233-4480 Phone (210) 490-3096 Fax (210) 545-4329

STATE OF TEXAS
ELVIS TREVIÑO
126752
LICENSED
PROFESSIONAL ENGINEER
6/26/2025

MAESTAS
8122 DATAPOINT DR, STE 840
SAN ANTONIO, TX 78229
(210) 566-1988
TBPE No. F-13123
TBPLS No. 10194506

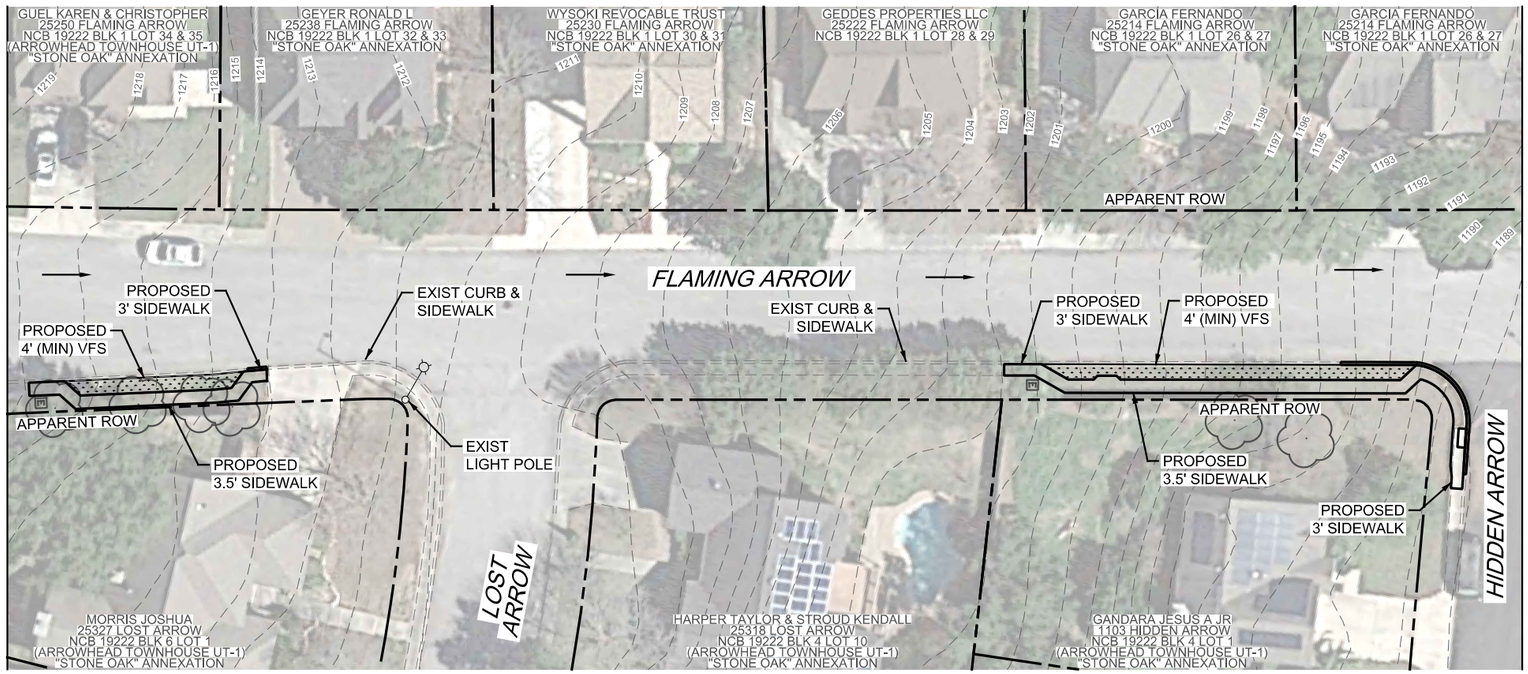
PERMANENT WATER POLLUTION ABATEMENT PLAN NOTES
COSA ARROWHEAD SUBDIVISION PHASE 2 SIDEWALK PROJECT

SHEET 1
OF 1



MATCHLINE - SHEET A-A

MATCHLINE - SHEET A-A



MATCHLINE - SHEET B-B

PLAN VIEW LEGEND

- PROP SIDEWALK
- VEGETATIVE FILTER STRIP
- XXX EXISTING CONTOURS
- APPARENT RIGHT OF WAY

SCALE
HORZ: 1" = 40'

MAESTAS
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(210) 366-1188
TBPE No. 13183
TBPLS No. 10194506

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6/26/2025

PERMANENT STORM WATER POLLUTION PREVENTION PLAN
SHEET 1 OF 4
COSA ARROWHEAD SUBDIVISION PHASE 2
SIDEWALK PROJECT

SHEET 1
OF 4

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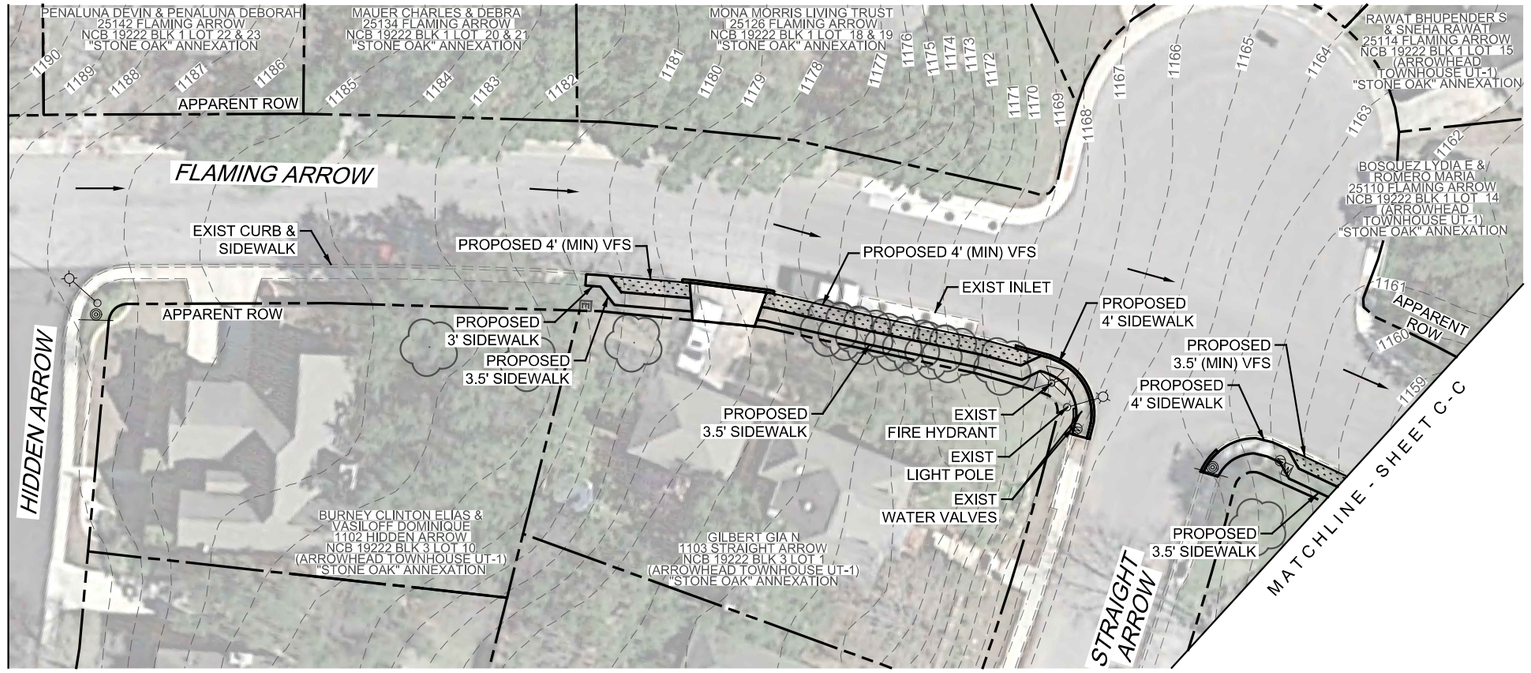

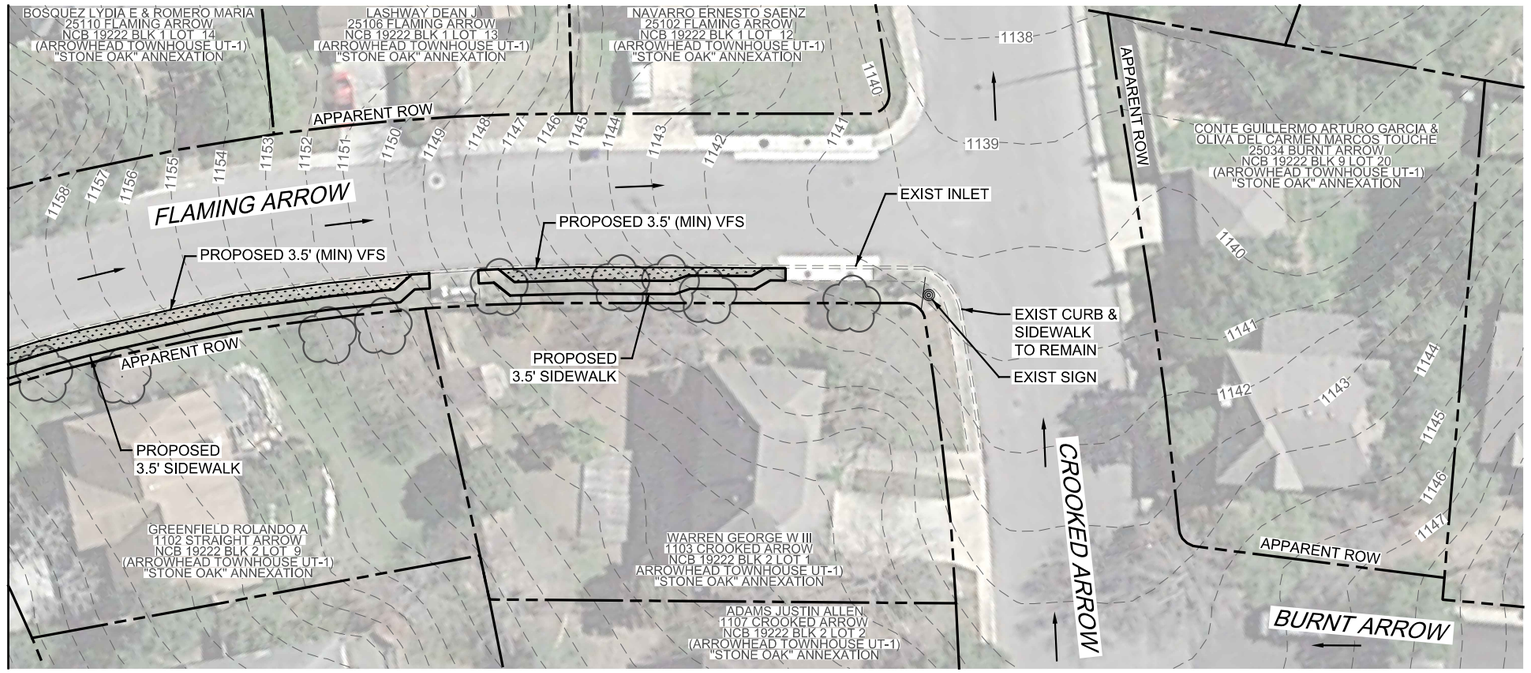

PLAN VIEW LEGEND

- PROP SIDEWALK
- VEGETATIVE FILTER STRIP
- XXX EXISTING CONTOURS
- APPARENT RIGHT OF WAY

SCALE
HORZ: 1" = 40'

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PERMANENT STORM WATER POLLUTION PREVENTION PLAN
SHEET 2 OF 4
COSA ARROWHEAD SUBDIVISION PHASE 2
SIDEWALK PROJECT

SHEET 2
OF 4

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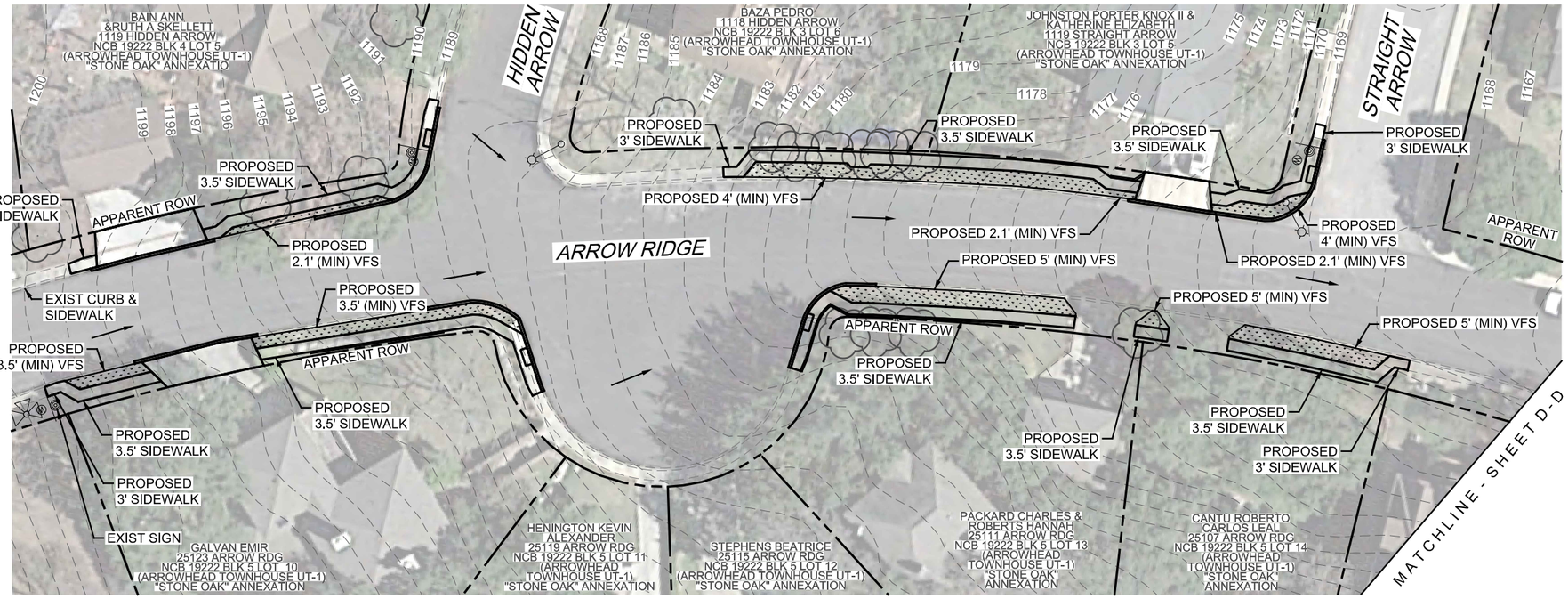

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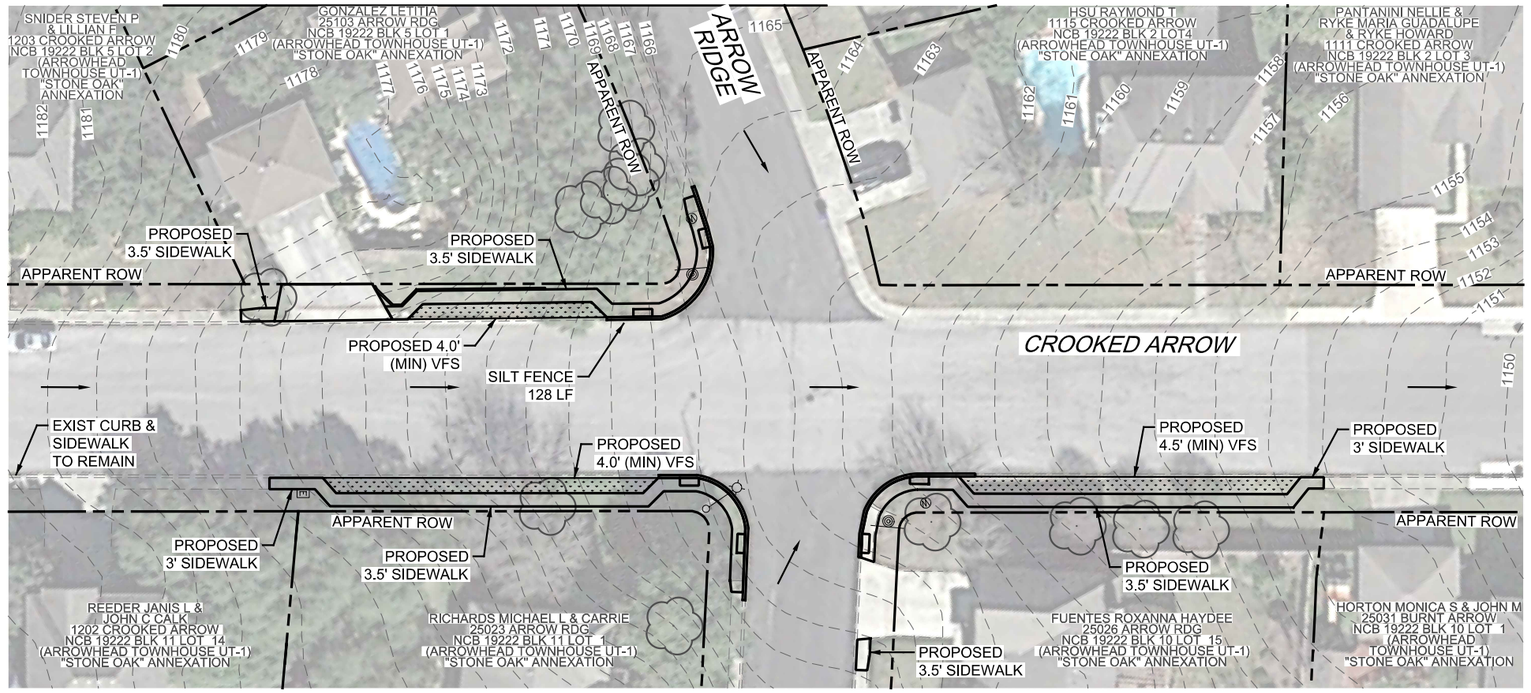

PLAN VIEW LEGEND

- PROP SIDEWALK
- VEGETATIVE FILTER STRIP
- XXX EXISTING CONTOURS
- APPARENT RIGHT OF WAY

SCALE
HORZ: 1" = 40'

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6/26/2025

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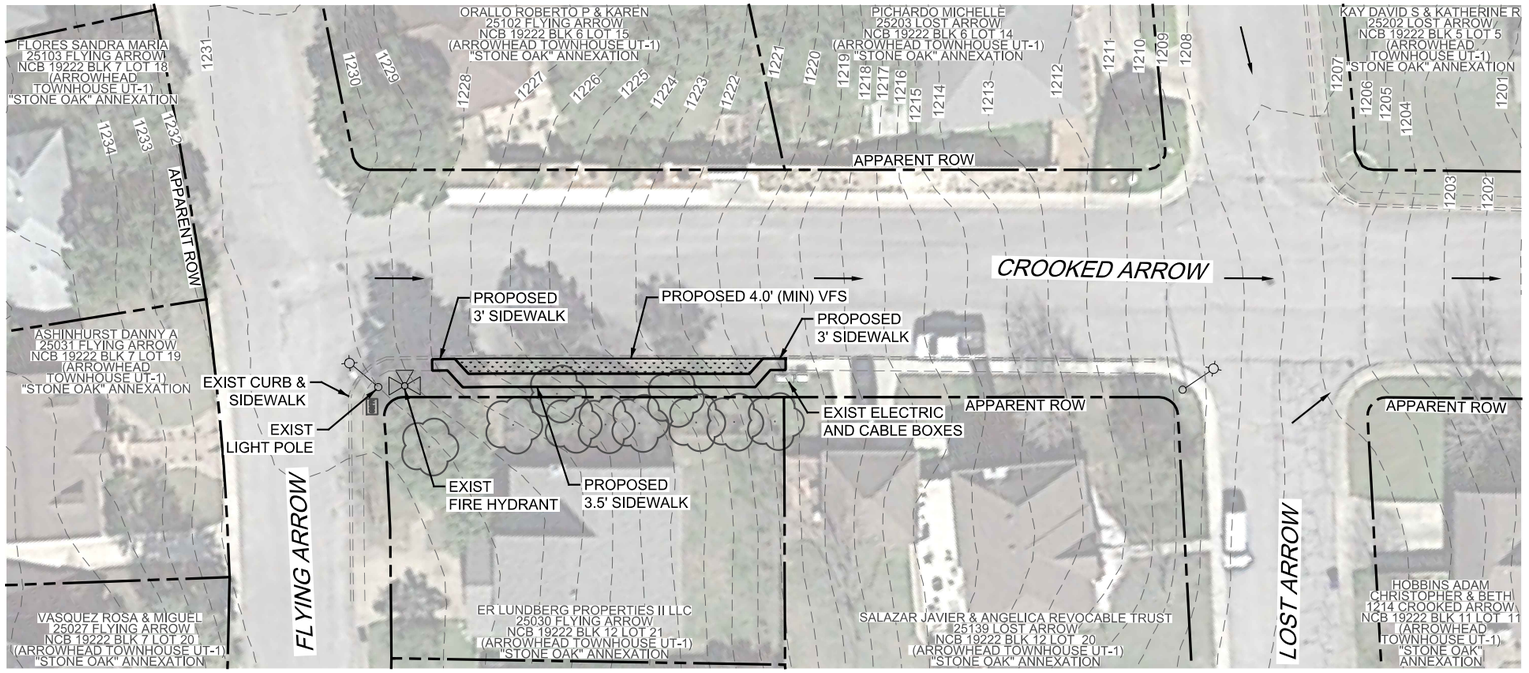
PERMANENT STORM WATER POLLUTION PREVENTION PLAN
SHEET 3 OF 4
COSA ARROWHEAD SUBDIVISION PHASE 2
SIDEWALK PROJECT

SHEET 3
OF 4



PLAN VIEW LEGEND

- PROP SIDEWALK
- VEGETATIVE FILTER STRIP
- XXX EXISTING CONTOURS
- APPARENT RIGHT OF WAY

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SCALE
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PERMANENT STORM WATER POLLUTION PREVENTION PLAN
SHEET 4 OF 4

COSA ARROWHEAD SUBDIVISION PHASE 2
SIDEWALK PROJECT

SHEET 4
OF 4

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: CoSA Arrowhead Subdivision Phase 2 Sidew
Date Prepared: 6/26/2025

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

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

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

where:

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

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Bexar	
Total project area included in plan * =	0.48	acres
Predevelopment impervious area within the limits of the plan * =	0.00	acres
Total post-development impervious area within the limits of the plan* =	0.24	acres
Total post-development impervious cover fraction * =	0.50	
P =	30	inches
$L_{M\ TOTAL\ PROJECT}$ =	196	lbs.

* **The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 13

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

Drainage Basin/Outfall Area No. = A

Total drainage basin/outfall area =	0.02	acres
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres
Post-development impervious area within drainage basin/outfall area =	0.01	acres
Post-development impervious fraction within drainage basin/outfall area =	0.50	
$L_{M\ THIS\ BASIN}$ =	8	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = **Vegetated Filter Strips**

Removal efficiency = **85** percent

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

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

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where:

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

A_C = **0.02** acres
A_I = **0.01** acres
A_P = **0.01** acres
L_R = **9** lbs

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

Desired $L_{M\ THIS\ BASIN}$ = **8** lbs.

F = **0.89**

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

Rainfall Depth = **1.60** inches
Post Development Runoff Coefficient = **0.36**
On-site Water Quality Volume = **42** cubic feet

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

Off-site area draining to BMP = **0.00** acres

Off-site Impervious cover draining to BMP =	0.00	acres	
Impervious fraction of off-site area =	0		
Off-site Runoff Coefficient =	0.00		
Off-site Water Quality Volume =	0	cubic feet	
Storage for Sediment =	8		
Total Capture Volume (required water quality volume(s) x 1.20) =	50	cubic feet	

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

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

Required Water Quality Volume for retention basin =	NA	cubic feet	

Irrigation Area Calculations:

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

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

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

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

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

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

Required Water Quality Volume for Bioretention Basin =	NA	cubic feet	

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

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

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

Required Water Quality Volume for Constructed Wetlands =	**NA**	cubic feet

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

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

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

14. Stormwater Management StormFilter® by CONTECH

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

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

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

Design parameters for the swale:

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

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

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

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

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

Q = CiA = #DIV/0! cfs

To calculate the flow velocity in the swale:

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

To calculate the resulting swale length:

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

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

15B. Alternative Method using Excel Solver

Design Q = CiA = #DIV/0! cfs

Manning's Equation Q =	0.00	cfs	Error 1 =	#DIV/0!
Swale Width=	6.00	ft		

Instructions are provided to the right (green comments).

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =		ft		
Design Discharge =	0.00	cfs	Error 2 =	#DIV/0!
Design Depth =	0.33	ft		
Flow Velocity =	#DIV/0!	cfs		
Minimum Length =	#DIV/0!	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.

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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.

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17. Wet Vaults Designed as Required in RG-348 Pages 3-30 to 3-32 & 3-79

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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 = 0.33
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 = 0.36 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: V_{OR} = Q/A

Q = Runoff rate calculated above = 0.36 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete Designed as Required in RG-348 Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series Designed as Required in RG-348 Pages 3-32

Michael E. Barrett, Ph.D.. P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =	86.38	percent	NET EFFICIENCY OF THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 =	75.00	percent	
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 =	70.00	percent	
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 =	0.00	percent	

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_I AND A_P VALUES ARE FROM SECTION 3 ABOVE)

L_R = E_{TOT} X P X (A_I X 34.6 X A_P X0.54) =	9.11	lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area=	**NA**	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) =	0	Model Size
Surface Area =	#N/A	ft^2
Overflow Rate =	#VALUE!	V_{or}
Rounded Overflow Rate =	#VALUE!	V_{or}
BMP Efficiency % =	#VALUE!	%
L_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	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 $\geq$ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: CoSA Arrowhead Subdivision Phase 2 Sidew
Date Prepared: 6/26/2025

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

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

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

where:

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

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Bexar	
Total project area included in plan * =	0.48	acres
Predevelopment impervious area within the limits of the plan * =	0.00	acres
Total post-development impervious area within the limits of the plan* =	0.24	acres
Total post-development impervious cover fraction * =	0.50	
P =	30	inches
$L_{M\ TOTAL\ PROJECT}$ =	196	lbs.

* **The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 13

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

Drainage Basin/Outfall Area No. = B

Total drainage basin/outfall area =	0.04	acres
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres
Post-development impervious area within drainage basin/outfall area =	0.02	acres
Post-development impervious fraction within drainage basin/outfall area =	0.50	
$L_{M\ THIS\ BASIN}$ =	16	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = **Vegetated Filter Strips**

Removal efficiency = **85** percent

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

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

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where:

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

A_C = **0.04** acres
A_I = **0.02** acres
A_P = **0.02** acres
L_R = **18** lbs

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

Desired $L_{M\ THIS\ BASIN}$ = **16** lbs.

F = **0.89**

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

Rainfall Depth = **1.60** inches
Post Development Runoff Coefficient = **0.36**
On-site Water Quality Volume = **83** cubic feet

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

Off-site area draining to BMP = **0.00** acres

Off-site Impervious cover draining to BMP =	0.00	acres	
Impervious fraction of off-site area =	0		
Off-site Runoff Coefficient =	0.00		
Off-site Water Quality Volume =	0	cubic feet	
Storage for Sediment =	17		
Total Capture Volume (required water quality volume(s) x 1.20) =	100	cubic feet	

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

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

Required Water Quality Volume for retention basin =	NA	cubic feet	

Irrigation Area Calculations:

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

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

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

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

9A. Full Sedimentation and Filtration System

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

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	NA	square feet	**For maximum water depth of 8 feet**

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

Required Water Quality Volume for Bioretention Basin =	NA	cubic feet	

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

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

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

Required Water Quality Volume for Constructed Wetlands =	**NA**	cubic feet

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

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

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

14. Stormwater Management StormFilter® by CONTECH

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

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

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

Design parameters for the swale:

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

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

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

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

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

Q = CiA = #DIV/0! cfs

To calculate the flow velocity in the swale:

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

To calculate the resulting swale length:

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

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

15B. Alternative Method using Excel Solver

Design Q = CiA = #DIV/0! cfs

Manning's Equation Q =	0.00	cfs	Error 1 =	#DIV/0!
Swale Width=	6.00	ft		

Instructions are provided to the right (green comments).

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =		ft		
Design Discharge =	0.00	cfs	Error 2 =	#DIV/0!
Design Depth =	0.33	ft		
Flow Velocity =	#DIV/0!	cfs		
Minimum Length =	#DIV/0!	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.

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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.

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17. Wet Vaults Designed as Required in RG-348 Pages 3-30 to 3-32 & 3-79

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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 = 0.33
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 = 0.36 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: V_{OR} = Q/A

Q = Runoff rate calculated above = 0.36 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete Designed as Required in RG-348 Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series Designed as Required in RG-348 Pages 3-32

Michael E. Barrett, Ph.D.. P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$	86.38	percent	NET EFFICIENCY OF THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 =	75.00	percent	
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 =	70.00	percent	
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 =	0.00	percent	

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_I AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_I X 34.6 X A_P X0.54) =$	18.21	lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area=	**NA**	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) =	0	Model Size
Surface Area =	#N/A	ft^2
Overflow Rate =	#VALUE!	V_{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 $\geq$ 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	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 $\geq$ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: CoSA Arrowhead Subdivision Phase 2 Sidew
Date Prepared: 6/26/2025

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

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

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

where:

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

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Bexar	
Total project area included in plan * =	0.48	acres
Predevelopment impervious area within the limits of the plan * =	0.00	acres
Total post-development impervious area within the limits of the plan* =	0.24	acres
Total post-development impervious cover fraction * =	0.50	
P =	30	inches
$L_{M\ TOTAL\ PROJECT}$ =	196	lbs.

* **The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 13

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

Drainage Basin/Outfall Area No. = C

Total drainage basin/outfall area =	0.03	acres
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres
Post-development impervious area within drainage basin/outfall area =	0.01	acres
Post-development impervious fraction within drainage basin/outfall area =	0.33	
$L_{M\ THIS\ BASIN}$ =	8	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = **Vegetated Filter Strips**

Removal efficiency = **85** percent

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

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

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where:

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

A_C = **0.03** acres
A_I = **0.01** acres
A_P = **0.02** acres
L_R = **9** lbs

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

Desired $L_{M\ THIS\ BASIN}$ = **8** lbs.

F = **0.88**

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

Rainfall Depth = **1.50** inches
Post Development Runoff Coefficient = **0.27**
On-site Water Quality Volume = **45** cubic feet

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

Off-site area draining to BMP = **0.00** acres

Off-site Impervious cover draining to BMP =	0.00	acres	
Impervious fraction of off-site area =	0		
Off-site Runoff Coefficient =	0.00		
Off-site Water Quality Volume =	0	cubic feet	
Storage for Sediment =	9		
Total Capture Volume (required water quality volume(s) x 1.20) =	54	cubic feet	

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

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

Required Water Quality Volume for retention basin =	NA	cubic feet	

Irrigation Area Calculations:

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

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

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

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

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

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

Required Water Quality Volume for Bioretention Basin =	NA	cubic feet

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

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

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

Required Water Quality Volume for Constructed Wetlands =	**NA**	cubic feet

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

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

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

14. Stormwater Management StormFilter® by CONTECH

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

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

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

Design parameters for the swale:

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

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

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

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

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

Q = CiA = #DIV/0! cfs

To calculate the flow velocity in the swale:

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

To calculate the resulting swale length:

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

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

15B. Alternative Method using Excel Solver

Design Q = CiA = #DIV/0! cfs

Manning's Equation Q =	0.00	cfs	Error 1 =	#DIV/0!
Swale Width=	6.00	ft		

Instructions are provided to the right (green comments).

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =		ft		
Design Discharge =	0.00	cfs	Error 2 =	#DIV/0!
Design Depth =	0.33	ft		
Flow Velocity =	#DIV/0!	cfs		
Minimum Length =	#DIV/0!	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.

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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.

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17. Wet Vaults Designed as Required in RG-348 Pages 3-30 to 3-32 & 3-79

The result
If the resul

Required Load Removal Based upon Equation 3.3 =	**NA**	lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: Q = CiA

C = runoff coefficient for the drainage area =	0.20	
i = design rainfall intensity =	1.1	in/hour
A = drainage area in acres =	1	acres
Q = flow rate in cubic feet per second =	0.22	cubic feet/sec

C = Runoff Coefficient = $0.546\ (IC)^2 + 0.328\ (IC) + 0.03$

RG-348 Page 3-31 Equation 3.5: V_{OR} = Q/A

Q = Runoff rate calculated above =	0.22	cubic feet/sec
A = Water surface area in the wet vault =	150	square feet
V_{OR} = Overflow Rate =	0.00	feet/sec
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	53	percent
Load removed by Wet Vault =	#VALUE!	lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs =	0.5	in/hour
Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 =	0.75	percent
Efficiency Reduction for Actual Rainfall Intensity =	0.83	percent
Resultant TSS Load removed by Wet Vault =	#VALUE!	lbs

18. Permeable Concrete Designed as Required in RG-348 Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series Designed as Required in RG-348 Pages 3-32

Michael E. Barrett, Ph.D.. P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$	86.38	percent	NET EFFICIENCY OF THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = $E_1 =$	75.00	percent	
EFFICIENCY OF THE SECOND BMP IN THE SERIES = $E_2 =$	70.00	percent	
EFFICIENCY OF THE THIRD BMP IN THE SERIES = $E_3 =$	0.00	percent	

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_I AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_I X 34.6 X A_P X0.54) =$	9.25	lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area=	**NA**	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) =	0	Model Size
Surface Area =	#N/A	ft^2
Overflow Rate =	#VALUE!	V_{or}
Rounded Overflow Rate =	#VALUE!	V_{or}
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit $\geq$ 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	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 $\geq$ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: CoSA Arrowhead Subdivision Phase 2 Sidew
Date Prepared: 6/26/2025

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

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

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

where:

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

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Bexar	
Total project area included in plan * =	0.48	acres
Predevelopment impervious area within the limits of the plan * =	0.00	acres
Total post-development impervious area within the limits of the plan* =	0.24	acres
Total post-development impervious cover fraction * =	0.50	
P =	30	inches
$L_{M\ TOTAL\ PROJECT}$ =	196	lbs.

* **The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 13

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

Drainage Basin/Outfall Area No. = D

Total drainage basin/outfall area =	0.04	acres
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres
Post-development impervious area within drainage basin/outfall area =	0.02	acres
Post-development impervious fraction within drainage basin/outfall area =	0.50	
$L_{M\ THIS\ BASIN}$ =	16	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = **Vegetated Filter Strips**

Removal efficiency = **85** percent

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

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

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where:

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

A_C = **0.04** acres
A_I = **0.02** acres
A_P = **0.02** acres
L_R = **18** lbs

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

Desired $L_{M\ THIS\ BASIN}$ = **16** lbs.

F = **0.89**

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

Rainfall Depth = **1.60** inches
Post Development Runoff Coefficient = **0.36**
On-site Water Quality Volume = **83** cubic feet

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

Off-site area draining to BMP = **0.00** acres

Off-site Impervious cover draining to BMP =	0.00	acres	
Impervious fraction of off-site area =	0		
Off-site Runoff Coefficient =	0.00		
Off-site Water Quality Volume =	0	cubic feet	
Storage for Sediment =	17		
Total Capture Volume (required water quality volume(s) x 1.20) =	100	cubic feet	

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

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

Required Water Quality Volume for retention basin =	NA	cubic feet	

Irrigation Area Calculations:

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

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

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

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

9A. Full Sedimentation and Filtration System

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

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	NA	square feet	**For maximum water depth of 8 feet**

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

Required Water Quality Volume for Bioretention Basin =	NA	cubic feet	

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

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

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

Required Water Quality Volume for Constructed Wetlands =	**NA**	cubic feet

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

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

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

14. Stormwater Management StormFilter® by CONTECH

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

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

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

Design parameters for the swale:

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

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

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

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

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

Q = CiA = #DIV/0! cfs

To calculate the flow velocity in the swale:

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

To calculate the resulting swale length:

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

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

15B. Alternative Method using Excel Solver

Design Q = CiA = #DIV/0! cfs

Manning's Equation Q =	0.00	cfs	Error 1 =	#DIV/0!
Swale Width=	6.00	ft		

Instructions are provided to the right (green comments).

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =		ft		
Design Discharge =	0.00	cfs	Error 2 =	#DIV/0!
Design Depth =	0.33	ft		
Flow Velocity =	#DIV/0!	cfs		
Minimum Length =	#DIV/0!	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.

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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.

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17. Wet Vaults Designed as Required in RG-348 Pages 3-30 to 3-32 & 3-79

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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 = 0.33
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 = 0.36 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: V_{OR} = Q/A

Q = Runoff rate calculated above = 0.36 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete Designed as Required in RG-348 Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series Designed as Required in RG-348 Pages 3-32

Michael E. Barrett, Ph.D.. P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$	86.38	percent	NET EFFICIENCY OF THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 =	75.00	percent	
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 =	70.00	percent	
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 =	0.00	percent	

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_I AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_I X 34.6 X A_P X0.54) =$	18.21	lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area=	**NA**	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) =	0	Model Size
Surface Area =	#N/A	ft^2
Overflow Rate =	#VALUE!	V_{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 $\geq$ 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	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 $\geq$ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: CoSA Arrowhead Subdivision Phase 2 Sidew
Date Prepared: 6/26/2025

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

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

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

where:

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

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Bexar	
Total project area included in plan * =	0.48	acres
Predevelopment impervious area within the limits of the plan * =	0.00	acres
Total post-development impervious area within the limits of the plan* =	0.24	acres
Total post-development impervious cover fraction * =	0.50	
P =	30	inches
$L_{M\ TOTAL\ PROJECT}$ =	196	lbs.

* **The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 13

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

Drainage Basin/Outfall Area No. = E

Total drainage basin/outfall area =	0.06	acres
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres
Post-development impervious area within drainage basin/outfall area =	0.02	acres
Post-development impervious fraction within drainage basin/outfall area =	0.33	
$L_{M\ THIS\ BASIN}$ =	16	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = **Vegetated Filter Strips**

Removal efficiency = **85** percent

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

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

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where:

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

A_C = **0.06** acres
A_I = **0.02** acres
A_P = **0.04** acres
L_R = **18** lbs

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

Desired $L_{M\ THIS\ BASIN}$ = **16** lbs.

F = **0.88**

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

Rainfall Depth = **1.50** inches
Post Development Runoff Coefficient = **0.27**
On-site Water Quality Volume = **90** cubic feet

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

Off-site area draining to BMP = **0.00** acres

Off-site Impervious cover draining to BMP =	0.00	acres	
Impervious fraction of off-site area =	0		
Off-site Runoff Coefficient =	0.00		
Off-site Water Quality Volume =	0	cubic feet	
Storage for Sediment =	18		
Total Capture Volume (required water quality volume(s) x 1.20) =	108	cubic feet	

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

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

Required Water Quality Volume for retention basin =	NA	cubic feet	

Irrigation Area Calculations:

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

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

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

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

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

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

Required Water Quality Volume for Bioretention Basin =	NA	cubic feet

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

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

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

Required Water Quality Volume for Constructed Wetlands =	**NA**	cubic feet

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

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

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

14. Stormwater Management StormFilter® by CONTECH

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

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

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

Design parameters for the swale:

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

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

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

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

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

Q = CiA = #DIV/0! cfs

To calculate the flow velocity in the swale:

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

To calculate the resulting swale length:

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

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

15B. Alternative Method using Excel Solver

Design Q = CiA = #DIV/0! cfs

Manning's Equation Q =	0.00	cfs	Error 1 =	#DIV/0!
Swale Width=	6.00	ft		

Instructions are provided to the right (green comments).

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =		ft		
Design Discharge =	0.00	cfs	Error 2 =	#DIV/0!
Design Depth =	0.33	ft		
Flow Velocity =	#DIV/0!	cfs		
Minimum Length =	#DIV/0!	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.

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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.

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17. Wet Vaults Designed as Required in RG-348 Pages 3-30 to 3-32 & 3-79

The result
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Required Load Removal Based upon Equation 3.3 =	**NA**	lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: Q = CiA

C = runoff coefficient for the drainage area =	0.20	
i = design rainfall intensity =	1.1	in/hour
A = drainage area in acres =	1	acres
Q = flow rate in cubic feet per second =	0.22	cubic feet/sec

C = Runoff Coefficient = $0.546\ (IC)^2 + 0.328\ (IC) + 0.03$

RG-348 Page 3-31 Equation 3.5: V_{OR} = Q/A

Q = Runoff rate calculated above =	0.22	cubic feet/sec
A = Water surface area in the wet vault =	150	square feet
V_{OR} = Overflow Rate =	0.00	feet/sec
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	53	percent
Load removed by Wet Vault =	#VALUE!	lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs =	0.5	in/hour
Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 =	0.75	percent
Efficiency Reduction for Actual Rainfall Intensity =	0.83	percent
Resultant TSS Load removed by Wet Vault =	#VALUE!	lbs

18. Permeable Concrete Designed as Required in RG-348 Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series Designed as Required in RG-348 Pages 3-32

Michael E. Barrett, Ph.D.. P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$	86.38	percent	NET EFFICIENCY OF THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 =	75.00	percent	
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 =	70.00	percent	
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 =	0.00	percent	

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_I AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_I X 34.6 X A_P X0.54) =$	18.49	lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area=	**NA**	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) =	0	Model Size
Surface Area =	#N/A	ft^2
Overflow Rate =	#VALUE!	V_{or}
Rounded Overflow Rate =	#VALUE!	V_{or}
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit $\geq$ 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	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 $\geq$ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: CoSA Arrowhead Subdivision Phase 2 Sidew
Date Prepared: 6/26/2025

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

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

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

where:

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

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Bexar	
Total project area included in plan * =	0.48	acres
Predevelopment impervious area within the limits of the plan * =	0.00	acres
Total post-development impervious area within the limits of the plan* =	0.24	acres
Total post-development impervious cover fraction * =	0.50	
P =	30	inches
$L_{M\ TOTAL\ PROJECT}$ =	196	lbs.

* The values entered in these fields should be for the total project area.

Number of drainage basins / outfalls areas leaving the plan area = 13

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

Drainage Basin/Outfall Area No. = F

Total drainage basin/outfall area =	0.04	acres
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres
Post-development impervious area within drainage basin/outfall area =	0.02	acres
Post-development impervious fraction within drainage basin/outfall area =	0.50	
$L_{M\ THIS\ BASIN}$ =	16	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Vegetated Filter Strips

Removal efficiency = **85** percent

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

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

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where:

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

A_C = **0.04** acres
A_I = **0.02** acres
A_P = **0.02** acres
L_R = **18** lbs

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

Desired $L_{M\ THIS\ BASIN}$ = **16** lbs.

F = **0.89**

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

Rainfall Depth = **1.60** inches
Post Development Runoff Coefficient = **0.36**
On-site Water Quality Volume = **83** cubic feet

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

Off-site area draining to BMP = **0.00** acres

Off-site Impervious cover draining to BMP =	0.00	acres	
Impervious fraction of off-site area =	0		
Off-site Runoff Coefficient =	0.00		
Off-site Water Quality Volume =	0	cubic feet	
Storage for Sediment =	17		
Total Capture Volume (required water quality volume(s) x 1.20) =	100	cubic feet	

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

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

Required Water Quality Volume for retention basin =	NA	cubic feet	

Irrigation Area Calculations:

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

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

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

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

9A. Full Sedimentation and Filtration System

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

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	NA	square feet	**For maximum water depth of 8 feet**

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

Required Water Quality Volume for Bioretention Basin =	NA	cubic feet	

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

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

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

Required Water Quality Volume for Constructed Wetlands =	**NA**	cubic feet

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

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

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

14. Stormwater Management StormFilter® by CONTECH

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

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

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

Design parameters for the swale:

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

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

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

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

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

Q = CiA = #DIV/0! cfs

To calculate the flow velocity in the swale:

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

To calculate the resulting swale length:

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

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

15B. Alternative Method using Excel Solver

Design Q = CiA = #DIV/0! cfs

Manning's Equation Q =	0.00	cfs	Error 1 =	#DIV/0!
Swale Width=	6.00	ft		

Instructions are provided to the right (green comments).

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =		ft		
Design Discharge =	0.00	cfs	Error 2 =	#DIV/0!
Design Depth =	0.33	ft		
Flow Velocity =	#DIV/0!	cfs		
Minimum Length =	#DIV/0!	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.

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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.

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17. Wet Vaults Designed as Required in RG-348 Pages 3-30 to 3-32 & 3-79

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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 = 0.33
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 = 0.36 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: V_{OR} = Q/A

Q = Runoff rate calculated above = 0.36 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete Designed as Required in RG-348 Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series Designed as Required in RG-348 Pages 3-32

Michael E. Barrett, Ph.D.. P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$	86.38	percent	NET EFFICIENCY OF THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 =	75.00	percent	
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 =	70.00	percent	
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 =	0.00	percent	

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_I AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_I X 34.6 X A_P X0.54) =$	18.21	lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area=	**NA**	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) =	0	Model Size
Surface Area =	#N/A	ft^2
Overflow Rate =	#VALUE!	V_{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 $\geq$ 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	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 $\geq$ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: CoSA Arrowhead Subdivision Phase 2 Sidew
Date Prepared: 6/26/2025

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

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

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

where:

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

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Bexar	
Total project area included in plan * =	0.48	acres
Predevelopment impervious area within the limits of the plan * =	0.00	acres
Total post-development impervious area within the limits of the plan* =	0.24	acres
Total post-development impervious cover fraction * =	0.50	
P =	30	inches
$L_{M\ TOTAL\ PROJECT}$ =	196	lbs.

* The values entered in these fields should be for the total project area.

Number of drainage basins / outfalls areas leaving the plan area = 13

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

Drainage Basin/Outfall Area No. = G

Total drainage basin/outfall area =	0.03	acres
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres
Post-development impervious area within drainage basin/outfall area =	0.02	acres
Post-development impervious fraction within drainage basin/outfall area =	0.67	
$L_{M\ THIS\ BASIN}$ =	16	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Vegetated Filter Strips

Removal efficiency = **85** percent

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

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

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where:

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

A_C = **0.03** acres
A_I = **0.02** acres
A_P = **0.01** acres
L_R = **18** lbs

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

Desired $L_{M\ THIS\ BASIN}$ = **16** lbs.

F = **0.90**

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

Rainfall Depth = **1.70** inches
Post Development Runoff Coefficient = **0.47**
On-site Water Quality Volume = **88** cubic feet

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

Off-site area draining to BMP = **0.00** acres

Off-site Impervious cover draining to BMP =	0.00	acres	
Impervious fraction of off-site area =	0		
Off-site Runoff Coefficient =	0.00		
Off-site Water Quality Volume =	0	cubic feet	
Storage for Sediment =	18		
Total Capture Volume (required water quality volume(s) x 1.20) =	105	cubic feet	

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

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

Required Water Quality Volume for retention basin =	NA	cubic feet	

Irrigation Area Calculations:

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

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

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

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

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

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

Required Water Quality Volume for Bioretention Basin =	NA	cubic feet	

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

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

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

Required Water Quality Volume for Constructed Wetlands =	**NA**	cubic feet

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

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

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

14. Stormwater Management StormFilter® by CONTECH

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

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

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

Design parameters for the swale:

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

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

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

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

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

Q = CiA = #DIV/0! cfs

To calculate the flow velocity in the swale:

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

To calculate the resulting swale length:

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

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

15B. Alternative Method using Excel Solver

Design Q = CiA = #DIV/0! cfs

Manning's Equation Q =	0.00	cfs	Error 1 =	#DIV/0!
Swale Width=	6.00	ft		

Instructions are provided to the right (green comments).

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =		ft		
Design Discharge =	0.00	cfs	Error 2 =	#DIV/0!
Design Depth =	0.33	ft		
Flow Velocity =	#DIV/0!	cfs		
Minimum Length =	#DIV/0!	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.

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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.

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17. Wet Vaults Designed as Required in RG-348 Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = **NA** lbs

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First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: Q = CiA

C = runoff coefficient for the drainage area = 0.49
C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.54 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: V_{OR} = Q/A

Q = Runoff rate calculated above = 0.54 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete Designed as Required in RG-348 Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series Designed as Required in RG-348 Pages 3-32

Michael E. Barrett, Ph.D.. P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$	86.38	percent	NET EFFICIENCY OF THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 =	75.00	percent	
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 =	70.00	percent	
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 =	0.00	percent	

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_I AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_I X 34.6 X A_P X0.54) =$	18.07	lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area=	**NA**	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) =	0	Model Size
Surface Area =	#N/A	ft^2
Overflow Rate =	#VALUE!	V_{or}
Rounded Overflow Rate =	#VALUE!	V_{or}
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit $\geq$ 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	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 $\geq$ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: CoSA Arrowhead Subdivision Phase 2 Sidew
Date Prepared: 6/26/2025

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

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

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

where:

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

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Bexar	
Total project area included in plan * =	0.48	acres
Predevelopment impervious area within the limits of the plan * =	0.00	acres
Total post-development impervious area within the limits of the plan* =	0.24	acres
Total post-development impervious cover fraction * =	0.50	
P =	30	inches
$L_{M\ TOTAL\ PROJECT}$ =	196	lbs.

* **The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 13

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

Drainage Basin/Outfall Area No. = H

Total drainage basin/outfall area =	0.05	acres
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres
Post-development impervious area within drainage basin/outfall area =	0.03	acres
Post-development impervious fraction within drainage basin/outfall area =	0.60	
$L_{M\ THIS\ BASIN}$ =	24	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = **Vegetated Filter Strips**

Removal efficiency = **85** percent

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

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

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where:

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

A_C = **0.05** acres
A_I = **0.03** acres
A_P = **0.02** acres
L_R = **27** lbs

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

Desired $L_{M\ THIS\ BASIN}$ = **24** lbs.

F = **0.90**

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

Rainfall Depth = **1.70** inches
Post Development Runoff Coefficient = **0.42**
On-site Water Quality Volume = **130** cubic feet

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

Off-site area draining to BMP = **0.00** acres

Off-site Impervious cover draining to BMP =	0.00	acres	
Impervious fraction of off-site area =	0		
Off-site Runoff Coefficient =	0.00		
Off-site Water Quality Volume =	0	cubic feet	
Storage for Sediment =	26		
Total Capture Volume (required water quality volume(s) x 1.20) =	156	cubic feet	

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

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

Required Water Quality Volume for retention basin =	NA	cubic feet	

Irrigation Area Calculations:

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

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

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

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

9A. Full Sedimentation and Filtration System

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

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	NA	square feet	**For maximum water depth of 8 feet**

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

Required Water Quality Volume for Bioretention Basin =	NA	cubic feet	

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

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

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

Required Water Quality Volume for Constructed Wetlands =	**NA**	cubic feet

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

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

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

14. Stormwater Management StormFilter® by CONTECH

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

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

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

Design parameters for the swale:

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

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

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

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

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

Q = CiA = #DIV/0! cfs

To calculate the flow velocity in the swale:

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

To calculate the resulting swale length:

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

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

15B. Alternative Method using Excel Solver

Design Q = CiA = #DIV/0! cfs

Manning's Equation Q =	0.00	cfs	Error 1 =	#DIV/0!
Swale Width=	6.00	ft		

Instructions are provided to the right (green comments).

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =		ft		
Design Discharge =	0.00	cfs	Error 2 =	#DIV/0!
Design Depth =	0.33	ft		
Flow Velocity =	#DIV/0!	cfs		
Minimum Length =	#DIV/0!	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.

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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.

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17. Wet Vaults Designed as Required in RG-348 Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = **NA** lbs

The result
If the resul

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 = 0.42
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$

Q = flow rate in cubic feet per second = 0.47 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: V_{OR} = Q/A

Q = Runoff rate calculated above = 0.47 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete Designed as Required in RG-348 Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series Designed as Required in RG-348 Pages 3-32

Michael E. Barrett, Ph.D.. P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$	86.38	percent	NET EFFICIENCY OF THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = $E_1 =$	75.00	percent	
EFFICIENCY OF THE SECOND BMP IN THE SERIES = $E_2 =$	70.00	percent	
EFFICIENCY OF THE THIRD BMP IN THE SERIES = $E_3 =$	0.00	percent	

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_I AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_I X 34.6 X A_P X0.54) =$	27.18	lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area=	**NA**	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) =	0	Model Size
Surface Area =	#N/A	ft^2
Overflow Rate =	#VALUE!	V_{or}
Rounded Overflow Rate =	#VALUE!	V_{or}
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit $\geq$ 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	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 $\geq$ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: **CoSA Arrowhead Subdivision Phase 2 Sidew**
Date Prepared: **6/26/2025**

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

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

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

where:

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

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Bexar	
Total project area included in plan * =	0.48	acres
Predevelopment impervious area within the limits of the plan * =	0.00	acres
Total post-development impervious area within the limits of the plan* =	0.24	acres
Total post-development impervious cover fraction * =	0.50	
P =	30	inches
$L_{M\ TOTAL\ PROJECT}$ =	196	lbs.

* **The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = **13**

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

Drainage Basin/Outfall Area No. = **I**

Total drainage basin/outfall area =	0.04	acres
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres
Post-development impervious area within drainage basin/outfall area =	0.02	acres
Post-development impervious fraction within drainage basin/outfall area =	0.50	
$L_{M\ THIS\ BASIN}$ =	16	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = **Vegetated Filter Strips**

Removal efficiency = **85** percent

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

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

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where:

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

A_C = **0.04** acres
A_I = **0.02** acres
A_P = **0.02** acres
L_R = **18** lbs

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

Desired $L_{M\ THIS\ BASIN}$ = **16** lbs.

F = **0.89**

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

Rainfall Depth = **1.60** inches
Post Development Runoff Coefficient = **0.36**
On-site Water Quality Volume = **83** cubic feet

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

Off-site area draining to BMP = **0.00** acres

Off-site Impervious cover draining to BMP =	0.00	acres	
Impervious fraction of off-site area =	0		
Off-site Runoff Coefficient =	0.00		
Off-site Water Quality Volume =	0	cubic feet	
Storage for Sediment =	17		
Total Capture Volume (required water quality volume(s) x 1.20) =	100	cubic feet	

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

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

Required Water Quality Volume for retention basin =	NA	cubic feet	

Irrigation Area Calculations:

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

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

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

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

9A. Full Sedimentation and Filtration System

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

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	NA	square feet	**For maximum water depth of 8 feet**

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

Required Water Quality Volume for Bioretention Basin =	NA	cubic feet	

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

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

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

Required Water Quality Volume for Constructed Wetlands =	**NA**	cubic feet

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

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

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

14. Stormwater Management StormFilter® by CONTECH

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

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

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

Design parameters for the swale:

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

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

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

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

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

Q = CiA = #DIV/0! cfs

To calculate the flow velocity in the swale:

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

To calculate the resulting swale length:

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

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

15B. Alternative Method using Excel Solver

Design Q = CiA = #DIV/0! cfs

Manning's Equation Q =	0.00	cfs	Error 1 =	#DIV/0!
Swale Width=	6.00	ft		

Instructions are provided to the right (green comments).

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =		ft		
Design Discharge =	0.00	cfs	Error 2 =	#DIV/0!
Design Depth =	0.33	ft		
Flow Velocity =	#DIV/0!	cfs		
Minimum Length =	#DIV/0!	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.

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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.

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17. Wet Vaults Designed as Required in RG-348 Pages 3-30 to 3-32 & 3-79

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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 = 0.33
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 = 0.36 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: V_{OR} = Q/A

Q = Runoff rate calculated above = 0.36 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete Designed as Required in RG-348 Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series Designed as Required in RG-348 Pages 3-32

Michael E. Barrett, Ph.D.. P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$	86.38	percent	NET EFFICIENCY OF THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 =	75.00	percent	
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 =	70.00	percent	
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 =	0.00	percent	

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_I AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_I X 34.6 X A_P X0.54) =$	18.21	lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area=	**NA**	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) =	0	Model Size
Surface Area =	#N/A	ft^2
Overflow Rate =	#VALUE!	V_{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 $\geq$ 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	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 $\geq$ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: CoSA Arrowhead Subdivision Phase 2 Sidew
Date Prepared: 6/26/2025

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

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

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

where:

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

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Bexar	
Total project area included in plan * =	0.48	acres
Predevelopment impervious area within the limits of the plan * =	0.00	acres
Total post-development impervious area within the limits of the plan* =	0.24	acres
Total post-development impervious cover fraction * =	0.50	
P =	30	inches
$L_{M\ TOTAL\ PROJECT}$ =	196	lbs.

* **The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 13

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

Drainage Basin/Outfall Area No. = J

Total drainage basin/outfall area =	0.03	acres
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres
Post-development impervious area within drainage basin/outfall area =	0.02	acres
Post-development impervious fraction within drainage basin/outfall area =	0.67	
$L_{M\ THIS\ BASIN}$ =	16	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = **Vegetated Filter Strips**

Removal efficiency = **85** percent

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

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

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where:

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

A_C = **0.03** acres
A_I = **0.02** acres
A_P = **0.01** acres
L_R = **18** lbs

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

Desired $L_{M\ THIS\ BASIN}$ = **16** lbs.

F = **0.90**

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

Rainfall Depth = **1.70** inches
Post Development Runoff Coefficient = **0.47**
On-site Water Quality Volume = **88** cubic feet

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

Off-site area draining to BMP = **0.00** acres

Off-site Impervious cover draining to BMP =	0.00	acres	
Impervious fraction of off-site area =	0		
Off-site Runoff Coefficient =	0.00		
Off-site Water Quality Volume =	0	cubic feet	
Storage for Sediment =	18		
Total Capture Volume (required water quality volume(s) x 1.20) =	105	cubic feet	

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

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

Required Water Quality Volume for retention basin =	NA	cubic feet	

Irrigation Area Calculations:

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

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

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

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

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

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

Required Water Quality Volume for Bioretention Basin =	NA	cubic feet	

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

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

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

Required Water Quality Volume for Constructed Wetlands =	**NA**	cubic feet

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

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

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

14. Stormwater Management StormFilter® by CONTECH

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

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

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

Design parameters for the swale:

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

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

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

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

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

Q = CiA = #DIV/0! cfs

To calculate the flow velocity in the swale:

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

To calculate the resulting swale length:

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

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

15B. Alternative Method using Excel Solver

Design Q = CiA = #DIV/0! cfs

Manning's Equation Q =	0.00	cfs	Error 1 =	#DIV/0!
Swale Width=	6.00	ft		

Instructions are provided to the right (green comments).

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =		ft		
Design Discharge =	0.00	cfs	Error 2 =	#DIV/0!
Design Depth =	0.33	ft		
Flow Velocity =	#DIV/0!	cfs		
Minimum Length =	#DIV/0!	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.

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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.

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17. Wet Vaults Designed as Required in RG-348 Pages 3-30 to 3-32 & 3-79

Required Load Removal Based upon Equation 3.3 = **NA** lbs

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First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: Q = CiA

C = runoff coefficient for the drainage area = 0.49
C = Runoff Coefficient = $0.546 (IC)^2 + 0.328 (IC) + 0.03$
i = design rainfall intensity = 1.1 in/hour
A = drainage area in acres = 1 acres

Q = flow rate in cubic feet per second = 0.54 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: V_{OR} = Q/A

Q = Runoff rate calculated above = 0.54 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete Designed as Required in RG-348 Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series Designed as Required in RG-348 Pages 3-32

Michael E. Barrett, Ph.D.. P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$	86.38	percent	NET EFFICIENCY OF THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 =	75.00	percent	
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 =	70.00	percent	
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 =	0.00	percent	

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_I AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_I X 34.6 X A_P X0.54) =$	18.07	lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area=	**NA**	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) =	0	Model Size
Surface Area =	#N/A	ft^2
Overflow Rate =	#VALUE!	V_{or}
Rounded Overflow Rate =	#VALUE!	V_{or}
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit $\geq$ 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	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 $\geq$ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: CoSA Arrowhead Subdivision Phase 2 Sidew
Date Prepared: 6/26/2025

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

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

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

where:

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

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Bexar	
Total project area included in plan * =	0.48	acres
Predevelopment impervious area within the limits of the plan * =	0.00	acres
Total post-development impervious area within the limits of the plan* =	0.24	acres
Total post-development impervious cover fraction * =	0.50	
P =	30	inches
$L_{M\ TOTAL\ PROJECT}$ =	196	lbs.

* **The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 13

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

Drainage Basin/Outfall Area No. = K

Total drainage basin/outfall area =	0.04	acres
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres
Post-development impervious area within drainage basin/outfall area =	0.02	acres
Post-development impervious fraction within drainage basin/outfall area =	0.50	
$L_{M\ THIS\ BASIN}$ =	16	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = **Vegetated Filter Strips**

Removal efficiency = **85** percent

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

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

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where:

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

A_C = **0.04** acres
A_I = **0.02** acres
A_P = **0.02** acres
L_R = **18** lbs

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

Desired $L_{M\ THIS\ BASIN}$ = **16** lbs.

F = **0.89**

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

Rainfall Depth = **1.60** inches
Post Development Runoff Coefficient = **0.36**
On-site Water Quality Volume = **83** cubic feet

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

Off-site area draining to BMP = **0.00** acres

Off-site Impervious cover draining to BMP =	0.00	acres	
Impervious fraction of off-site area =	0		
Off-site Runoff Coefficient =	0.00		
Off-site Water Quality Volume =	0	cubic feet	
Storage for Sediment =	17		
Total Capture Volume (required water quality volume(s) x 1.20) =	100	cubic feet	

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

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

Required Water Quality Volume for retention basin =	NA	cubic feet	

Irrigation Area Calculations:

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

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

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

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

9A. Full Sedimentation and Filtration System

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

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	NA	square feet	**For maximum water depth of 8 feet**

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

Required Water Quality Volume for Bioretention Basin =	NA	cubic feet	

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

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

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

Required Water Quality Volume for Constructed Wetlands =	**NA**	cubic feet

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

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

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

14. Stormwater Management StormFilter® by CONTECH

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

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

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

Design parameters for the swale:

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

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

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

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

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

Q = CiA = #DIV/0! cfs

To calculate the flow velocity in the swale:

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

To calculate the resulting swale length:

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

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

15B. Alternative Method using Excel Solver

Design Q = CiA = #DIV/0! cfs

Manning's Equation Q =	0.00	cfs	Error 1 =	#DIV/0!
Swale Width=	6.00	ft		

Instructions are provided to the right (green comments).

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =		ft		
Design Discharge =	0.00	cfs	Error 2 =	#DIV/0!
Design Depth =	0.33	ft		
Flow Velocity =	#DIV/0!	cfs		
Minimum Length =	#DIV/0!	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.

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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.

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17. Wet Vaults Designed as Required in RG-348 Pages 3-30 to 3-32 & 3-79

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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 = 0.33
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 = 0.36 cubic feet/sec

RG-348 Page 3-31 Equation 3.5: V_{OR} = Q/A

Q = Runoff rate calculated above = 0.36 cubic feet/sec
A = Water surface area in the wet vault = 150 square feet

V_{OR} = Overflow Rate = 0.00 feet/sec

Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) = 53 percent

Load removed by Wet Vault = #VALUE! lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs = 0.5 in/hour

Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 = 0.75 percent
Efficiency Reduction for Actual Rainfall Intensity = 0.83 percent

Resultant TSS Load removed by Wet Vault = #VALUE! lbs

18. Permeable Concrete Designed as Required in RG-348 Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series Designed as Required in RG-348 Pages 3-32

Michael E. Barrett, Ph.D.. P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$	86.38	percent	NET EFFICIENCY OF THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = E_1 =	75.00	percent	
EFFICIENCY OF THE SECOND BMP IN THE SERIES = E_2 =	70.00	percent	
EFFICIENCY OF THE THIRD BMP IN THE SERIES = E_3 =	0.00	percent	

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_I AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_I X 34.6 X A_P X0.54) =$	18.21	lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area=	**NA**	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) =	0	Model Size
Surface Area =	#N/A	ft^2
Overflow Rate =	#VALUE!	V_{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 $\geq$ 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	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 $\geq$ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: CoSA Arrowhead Subdivision Phase 2 Sidew
Date Prepared: 6/26/2025

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

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

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

where:

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

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Bexar	
Total project area included in plan * =	0.48	acres
Predevelopment impervious area within the limits of the plan * =	0.00	acres
Total post-development impervious area within the limits of the plan* =	0.24	acres
Total post-development impervious cover fraction * =	0.50	
P =	30	inches
$L_{M\ TOTAL\ PROJECT}$ =	196	lbs.

* **The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 13

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

Drainage Basin/Outfall Area No. = L

Total drainage basin/outfall area =	0.03	acres
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres
Post-development impervious area within drainage basin/outfall area =	0.01	acres
Post-development impervious fraction within drainage basin/outfall area =	0.33	
$L_{M\ THIS\ BASIN}$ =	8	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = **Vegetated Filter Strips**

Removal efficiency = **85** percent

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

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

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where:

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

A_C = **0.03** acres
A_I = **0.01** acres
A_P = **0.02** acres
L_R = **9** lbs

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

Desired $L_{M\ THIS\ BASIN}$ = **8** lbs.

F = **0.88**

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

Rainfall Depth = **1.50** inches
Post Development Runoff Coefficient = **0.27**
On-site Water Quality Volume = **45** cubic feet

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

Off-site area draining to BMP = **0.00** acres

Off-site Impervious cover draining to BMP =	0.00	acres	
Impervious fraction of off-site area =	0		
Off-site Runoff Coefficient =	0.00		
Off-site Water Quality Volume =	0	cubic feet	
Storage for Sediment =	9		
Total Capture Volume (required water quality volume(s) x 1.20) =	54	cubic feet	

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

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

Required Water Quality Volume for retention basin =	NA	cubic feet	

Irrigation Area Calculations:

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

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

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

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

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

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

Required Water Quality Volume for Bioretention Basin =	NA	cubic feet

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

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

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

Required Water Quality Volume for Constructed Wetlands =	**NA**	cubic feet

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

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

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

14. Stormwater Management StormFilter® by CONTECH

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

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

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

Design parameters for the swale:

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

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

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

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

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

Q = CiA = #DIV/0! cfs

To calculate the flow velocity in the swale:

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

To calculate the resulting swale length:

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

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

15B. Alternative Method using Excel Solver

Design Q = CiA = #DIV/0! cfs

Manning's Equation Q =	0.00	cfs	Error 1 =	#DIV/0!
Swale Width=	6.00	ft		

Instructions are provided to the right (green comments).

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =		ft		
Design Discharge =	0.00	cfs	Error 2 =	#DIV/0!
Design Depth =	0.33	ft		
Flow Velocity =	#DIV/0!	cfs		
Minimum Length =	#DIV/0!	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.

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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.

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17. Wet Vaults Designed as Required in RG-348 Pages 3-30 to 3-32 & 3-79

The result
If the resul

Required Load Removal Based upon Equation 3.3 =	**NA**	lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: Q = CiA

C = runoff coefficient for the drainage area =	0.20	
i = design rainfall intensity =	1.1	in/hour
A = drainage area in acres =	1	acres
Q = flow rate in cubic feet per second =	0.22	cubic feet/sec

C = Runoff Coefficient = $0.546\ (IC)^2 + 0.328\ (IC) + 0.03$

RG-348 Page 3-31 Equation 3.5: V_{OR} = Q/A

Q = Runoff rate calculated above =	0.22	cubic feet/sec
A = Water surface area in the wet vault =	150	square feet
V_{OR} = Overflow Rate =	0.00	feet/sec
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	53	percent
Load removed by Wet Vault =	#VALUE!	lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs =	0.5	in/hour
Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 =	0.75	percent
Efficiency Reduction for Actual Rainfall Intensity =	0.83	percent
Resultant TSS Load removed by Wet Vault =	#VALUE!	lbs

18. Permeable Concrete Designed as Required in RG-348 Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series Designed as Required in RG-348 Pages 3-32

Michael E. Barrett, Ph.D.. P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$	86.38	percent	NET EFFICIENCY OF THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = $E_1 =$	75.00	percent	
EFFICIENCY OF THE SECOND BMP IN THE SERIES = $E_2 =$	70.00	percent	
EFFICIENCY OF THE THIRD BMP IN THE SERIES = $E_3 =$	0.00	percent	

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_I AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_I X 34.6 X A_P X0.54) =$	9.25	lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area=	**NA**	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) =	0	Model Size
Surface Area =	#N/A	ft^2
Overflow Rate =	#VALUE!	V_{or}
Rounded Overflow Rate =	#VALUE!	V_{or}
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit $\geq$ 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	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 $\geq$ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: CoSA Arrowhead Subdivision Phase 2 Sidew
Date Prepared: 6/26/2025

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

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

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

where:

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

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Bexar	
Total project area included in plan * =	0.48	acres
Predevelopment impervious area within the limits of the plan * =	0.00	acres
Total post-development impervious area within the limits of the plan* =	0.24	acres
Total post-development impervious cover fraction * =	0.50	
P =	30	inches
$L_{M\ TOTAL\ PROJECT}$ =	196	lbs.

* **The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 13

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

Drainage Basin/Outfall Area No. = M

Total drainage basin/outfall area =	0.03	acres
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres
Post-development impervious area within drainage basin/outfall area =	0.01	acres
Post-development impervious fraction within drainage basin/outfall area =	0.33	
$L_{M\ THIS\ BASIN}$ =	8	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = **Vegetated Filter Strips**

Removal efficiency = **85** percent

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

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

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where:

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

A_C = **0.03** acres
A_I = **0.01** acres
A_P = **0.02** acres
L_R = **9** lbs

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

Desired $L_{M\ THIS\ BASIN}$ = **8** lbs.

F = **0.88**

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

Rainfall Depth = **1.50** inches
Post Development Runoff Coefficient = **0.27**
On-site Water Quality Volume = **45** cubic feet

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

Off-site area draining to BMP = **0.00** acres

Off-site Impervious cover draining to BMP =	0.00	acres	
Impervious fraction of off-site area =	0		
Off-site Runoff Coefficient =	0.00		
Off-site Water Quality Volume =	0	cubic feet	
Storage for Sediment =	9		
Total Capture Volume (required water quality volume(s) x 1.20) =	54	cubic feet	

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

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

Required Water Quality Volume for retention basin =	NA	cubic feet	

Irrigation Area Calculations:

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

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

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

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

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	NA	cubic feet	
Minimum filter basin area =	NA	square feet	
Maximum sedimentation basin area =	NA	square feet	For minimum water depth of 2 feet
Minimum sedimentation basin area =	NA	square feet	For maximum water depth of 8 feet

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

Required Water Quality Volume for Bioretention Basin =	NA	cubic feet

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

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

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

Required Water Quality Volume for Constructed Wetlands =	**NA**	cubic feet

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

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

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

14. Stormwater Management StormFilter® by CONTECH

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

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

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

Design parameters for the swale:

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

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

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

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

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

Q = CiA = #DIV/0! cfs

To calculate the flow velocity in the swale:

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

To calculate the resulting swale length:

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

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

15B. Alternative Method using Excel Solver

Design Q = CiA = #DIV/0! cfs

Manning's Equation Q =	0.00	cfs	Error 1 =	#DIV/0!
Swale Width=	6.00	ft		

Instructions are provided to the right (green comments).

Flow Velocity	#DIV/0!	ft/s
Minimum Length =	#DIV/0!	ft

Instructions are provided to the right (blue comments).

Design Width =		ft		
Design Discharge =	0.00	cfs	Error 2 =	#DIV/0!
Design Depth =	0.33	ft		
Flow Velocity =	#DIV/0!	cfs		
Minimum Length =	#DIV/0!	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.

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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.

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17. Wet Vaults Designed as Required in RG-348 Pages 3-30 to 3-32 & 3-79

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Required Load Removal Based upon Equation 3.3 =	**NA**	lbs

First calculate the load removal at 1.1 in/hour

RG-348 Page 3-30 Equation 3.4: Q = CiA

C = runoff coefficient for the drainage area =	0.20	
i = design rainfall intensity =	1.1	in/hour
A = drainage area in acres =	1	acres
Q = flow rate in cubic feet per second =	0.22	cubic feet/sec

C = Runoff Coefficient = $0.546\ (IC)^2 + 0.328\ (IC) + 0.03$

RG-348 Page 3-31 Equation 3.5: V_{OR} = Q/A

Q = Runoff rate calculated above =	0.22	cubic feet/sec
A = Water surface area in the wet vault =	150	square feet
V_{OR} = Overflow Rate =	0.00	feet/sec
Percent TSS Removal from Figure 3-1 (RG-348 Page 3-31) =	53	percent
Load removed by Wet Vault =	#VALUE!	lbs

If a bypass occurs at a rainfall intensity of less than 1.1 in/hours
Calculate the efficiency reduction for the actual rainfall intensity rate

Actual Rainfall Intensity at which Wet Vault bypass Occurs =	0.5	in/hour
Fraction of rainfall treated from Figure 3-2 RG-348 Page 3-32 =	0.75	percent
Efficiency Reduction for Actual Rainfall Intensity =	0.83	percent
Resultant TSS Load removed by Wet Vault =	#VALUE!	lbs

18. Permeable Concrete Designed as Required in RG-348 Pages 3-79 to 3-83

PERMEABLE CONCRETE MAY ONLY BE USED ON THE CONTRIBUTING ZONE

19. BMPs Installed in a Series Designed as Required in RG-348 Pages 3-32

Michael E. Barrett, Ph.D.. P.E. recommended that the coefficient for E_2 be changed from 0.5 to 0.65 on May 3, 2006

$E_{TOT} = [1 - ((1 - E_1) X (1 - 0.65E_2) x (1 - 0.25E_3))] X 100 =$	86.38	percent	NET EFFICIENCY OF THE BMPs IN THE SERIES
EFFICIENCY OF FIRST BMP IN THE SERIES = $E_1 =$	75.00	percent	
EFFICIENCY OF THE SECOND BMP IN THE SERIES = $E_2 =$	70.00	percent	
EFFICIENCY OF THE THIRD BMP IN THE SERIES = $E_3 =$	0.00	percent	

THEREFORE, THE NET LOAD REMOVAL WOULD BE:
(A_I AND A_P VALUES ARE FROM SECTION 3 ABOVE)

$L_R = E_{TOT} X P X (A_I X 34.6 X A_P X0.54) =$	9.25	lbs

20. Stormceptor

Required TSS Removal in BMP Drainage Area=	**NA**	lbs
Impervious Cover Overtreatment=	0.0000	ac
TSS Removal for Uncaptured Area =	0.00	lbs

BMP Sizing

Effective Area =	NA	EA
Calculated Model Size(s) =	#N/A	
Actual Model Size (if multiple values provided in Calculated Model Size or if you are choosing a larger model size) =	0	Model Size
Surface Area =	#N/A	ft^2
Overflow Rate =	#VALUE!	V_{or}
Rounded Overflow Rate =	#VALUE!	V_{or}
BMP Efficiency % =	#VALUE!	%
L_R Value =	#VALUE!	lbs
TSS Load Credit =	#VALUE!	lbs
Is Sufficient Treatment Available? (TSS Credit $\geq$ 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	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 $\geq$ TSS Uncapt.)	#VALUE!	
TSS Treatment by BMP (LM + TSS Uncapt.) =	#VALUE!	

ATTACHMENT G – Maintenance Plan

Attached following this page.

Attachment G

Maintenance Plan and Schedule for Permanent Erosion Controls

Vegetative Filter Strips

PROJECT NAME: CoSA Arrowhead Subdivision Phase 2 Sidewalk Project

LOCATION: Within the Arrowhead Subdivision along Flaming Arrow, Arrow Ridge and Crooked Arrow.

CITY, STATE ZIP: San Antonio, TX 78258

Vegetative filter Strips:

Once a vegetated area is well established, little additional maintenance is generally necessary. The key to establishing a viable vegetated feature is the care and maintenance it receives in the first few months after it is planted. Once established, all vegetated BMPs require some basic maintenance to ensure the health of the plants including:

Inspections: BMP facilities shall be inspected at least twice a year to evaluated facility operation. Additional inspections shall occur after periods of heavy rain. The filter strip will be checked for uniformity of grass cover, debris and litter, and areas of sediment accumulation. Bare spots and areas of erosion identified during semi-annual inspections will be replanted and restored to meet specifications. Construction of a level spreader device may be necessary to reestablish shallow overland flow.

Records

The City of San Antonio shall keep records of the inspections on forms that shall be retained. Efforts will be made by the City to keep WPAP maintenance plans for WPAPs in the same region together for better coordination.

The inspection shall note at a minimum:

- uniformity of grass cover,
- debris and litter, and
- areas of sediment accumulation.
- Address if remediation was done during the inspection or if a task order needs to be established to replanting and restore filter strip to meet the specifications.
- Or other task order to remain in compliance with the WPAP permit.

Sediment Removal: Remove sediment in vegetative filter strip when they build up to 3 inches at any spot or cover vegetation. Excess sediment should be removed by hand or with flat-bottomed shovels. If areas are eroded, they should be filled, compacted, and reseeded so that the final grade is level with the bottom of the swale. Sediment removal will be performed as needed based on the inspections in the inspection section.

Pest Management: The integrated pest management plan (IMP) shall assess if there are excessive pests during each inspection. Problem insects and weeds will be controlled with minimal or no use of insecticides and herbicides.

Debris and Litter Removal: Trash tends to accumulate in vegetated areas, particularly along highways. Any filter strip structures (i.e., level spreaders) should be kept free of obstructions to reduce floatables being flushed downstream, and for aesthetic reasons. The need for this practice is determined through periodic inspection but should be performed no less than 4 times per year.

Mowing: Grass areas in and around vegetative filter strips must be mowed at least twice annually to limit vegetation height to 18 inches. Grass cuttings should be collected and disposed of offsite, or a mulching mower can be used. Regular mowing should also include weed control practices; however, herbicide use should be kept to a minimum.

Grass Reseeding And Mulching: A healthy dense grass should be maintained on the filter strip. If areas are eroded, they should be filled, compacted, and reseeded so that the final grade is level. Grass damaged during the sediment removal process should be promptly replaced using the same seed mix used during filter strip establishment.

If possible, flow should be diverted from the damaged areas until the grass is firmly established. Bare spots and areas of erosion identified during semi-annual inspections must be replanted and restored to meet specifications. Corrective maintenance, such as weeding, or replanting should be done more frequently in the first two to three years after installation to ensure stabilization. Dense vegetation may require irrigation immediately after planting, and during particularly dry periods, particularly as the vegetation is initially established.

An amended copy of this document will be provided to TCEQ within thirty (30) days of any changes in the following information:

Responsible Party for Maintenance:	City of San Antonio
Contact Person:	Justin Gawlik, PE
Address:	100 W. Houston Street, 15th Floor
City, State Zip:	San Antonio, TX 78205
Telephone Number:	(210) 207-0614

Signature of the Responsible Party: _____

The Maintenance Plan and Schedule for Permanent Erosion Control has been prepared by Elvis Treviño, PE and is certified to be in compliance with TCEQ regulations.

_____

Elvis Treviño, PE

ATTACHMENT H – Pilot-Scale Field Testing Plan

Not applicable.

ATTACHMENT I – Measures for Minimizing Surface Stream Contamination

The proposed Arrowhead Subdivision improvements will create only new impervious cover for pedestrians and will not increase risk to local streams. Treatment will be provided at the vegetative filter strip prior to entering the existing inlets.

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

I Justin Gawlik, PE,
Print Name

Public Works Engineer,
Title - Owner/President/Other

of The City of San Antonio,
Corporation/Partnership/Entity Name

have authorized Elvis Treviño, PE
Print Name of Agent/Engineer

of Maestas & Associates, LLC
Print Name of Firm

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

I also understand that:

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

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

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

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

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

SIGNATURE PAGE:

Applicant's Signature

2·5·25
Date

THE STATE OF Texas §

County of Bexar §

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

GIVEN under my hand and seal of office on this 5th day of February, 2025.

SAN JUANA GARCIA
Notary ID #6430891
My Commission Expires
July 10, 2026

NOTARY PUBLIC

San Juana Garcia
Typed or Printed Name of Notary

MY COMMISSION EXPIRES: July 10, 2026

Application Fee Form

Texas Commission on Environmental Quality

Name of Proposed Regulated Entity: CoSA Arrowhead Subdivision Phase 2 Sidewalk Project

Regulated Entity Location: Within the Arrowhead Subdivision along Flaming Arrow, Arrow Ridge and Crooked Arrow.

Name of Customer: City of San Antonio

Contact Person: Elvis Treviño, PE Phone: 210-366-1988

Customer Reference Number (if issued):CN 600130652

Regulated Entity Reference Number (if issued):RN _____

Austin Regional Office (3373)

☐ Hays ☐ Travis ☐ Williamson

San Antonio Regional Office (3362)

☒ Bexar ☐ Medina ☐ Uvalde

☐ Comal ☐ Kinney

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

☐ Austin Regional Office

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

☒ San Antonio Regional Office

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

Site Location (Check All That Apply):

☒ Recharge Zone ☐ Contributing Zone ☐ Transition Zone

Type of Plan	***Size***	***Fee Due***
Water Pollution Abatement Plan, Contributing Zone Plan: One Single Family Residential Dwelling	N/A Acres	$
Water Pollution Abatement Plan, Contributing Zone Plan: Multiple Single Family Residential and Parks	N/A Acres	$
Water Pollution Abatement Plan, Contributing Zone Plan: Non-residential	X.XX Acres	$
Sewage Collection System	N/A L.F.	$
Lift Stations without sewer lines	N/A Acres	$
Underground or Aboveground Storage Tank Facility	N/A Tanks	$
Piping System(s)(only)	N/A Each	$
Exception	1 Each	$ 500
Extension of Time	N/A Each	$

Signature: _____ Date: 06/26/2025

Application Fee Schedule

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

Water Pollution Abatement Plans and Modifications

Contributing Zone Plans and Modifications

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

Organized Sewage Collection Systems and Modifications

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

Underground and Aboveground Storage Tank System Facility Plans and Modifications

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

Exception Requests

Project	*Fee*
Exception Request	$500

Extension of Time Requests

Project	*Fee*
Extension of Time Request	$150