City of Round Rock

Stormwater Master Plan

Drainage Section
Volume 1

May 2014

ROUND ROCK, TEXAS
PURPOSE. PASSION. PROSPERITY.

HALFF
AVO: 29113

HALFF

4030 West Braker Lane, Ste 450
Austin, Texas 78759
(512) 252-8184
Fax (512) 252-8141

March 27, 2014 AVO 29113

Lance Shellenberger
Storm Water Project Manager
2008 Enterprise
Round Rock, Texas 78664

Re: **Stormwater Master Plan – Drainage Section**
Final Report

Mr. Shellenberger:

Transmitted herewith are 3 bound copies and one digital version of the Final Report entitled, Stormwater Master Plan – Drainage Section for the City of Round Rock

This report presents a brief overview of the project methodology from field data collection and assessment of the City's infrastructure to project development and selection. The report appendices document the results of the study effort as well as the GIS interface. This "living document" includes a time stamped inventory of the City's existing stormwater infrastructure that can be easily appended by the City staff to document future issues as well as track the implementation of the City's Stormwater CIP.

It has been a privilege and a challenge for our firm to prepare this plan. Halff Associates is especially appreciative of the cooperation of the members of the City Staff who have assisted in the development of this plan.

We are pleased to be of continued assistance to the City of Round Rock. Do not hesitate to contact us if you have any questions or comments regarding the future implementation of this plan.

Sincerely,
HALFF ASSOCIATES, INC.

Michael A. Moya PE, CFM
Vice President

VOLUME 1: Table of Contents

Executive Summary

The purpose of the Stormwater Master Plan (SMP) is to: (1) establish a process to access the City's stormwater infrastructure, (2) identify and assess existing and potential flood and erosion risk, (3) develop conceptual engineering solutions to mitigate risk, and (4) provide a systematic approach to allocate funds for the City's stormwater CIP. The goal of this SMP is to create a "living document" whereby the vast majority of the information is digital and is actively managed via the City of Round Rock's existing robust Geographical Information System (GIS) framework. The field data collection effort identified channel erosion, dam integrity, general maintenance, floodplain obstructions, roadway crossings, storm outfalls, structures, utilities, high water marks, drainage issues, and water quality problems for about 67 miles of stream. Using an interactive mobile GIS iPad tool, that leverages the City's existing GIS data, the City will continue to append the field data collection process, as well as track their stormwater CIP. The resulting field data collection efforts were validated by leveraging the Upper Brushy Creek Water Control Improvement District (UBCWCID) hydrologic and hydraulic (H&H) computer modeling efforts. No additional H&H modeling efforts were conducted for this initial Plan, although further detailed modeling will most likely be required prior to implementation of mitigation projects. As the existing conditions of 2014 change over time, (either due to flood damages, future modeling efforts, or the construction of capital projects) the SMP will be updated. The various maps and Access databases are linked such that updated summary reports can be generated.

As of January 2014, the estimated funding to address the majority of the City's drainage needs from creeks is approximately $15 million. This total does not include the costs for flood mitigation along the main stem of Lake Creek which is additional anticipated cost of approximately $15 million. The potential solutions and costs for Lake Creek are being developed by the UBCWCID as part of the Brushy Creek Watershed study. A summary of projects identified for this phase of the Stormwater Master Plan is provided in Appendix A. Project locations are displayed in Figure 1.

This SMP formal document will serve as a User's Manual to help the reader get oriented with the types of data that were generated, as well as the linkage between the data sets. A detail description of the GIS interface is provided in Appendix B. As unfunded SMP project sites continue to deteriorate, additions/changes to data may be collected to update the database. The rating score and resulting prioritization associated with these additions/changes to data will automatically update in a digital environment.

Introduction

The purpose of the SMP is to: (1) establish a process to access the City's stormwater infrastructure, (2) identify and assess existing and potential flood and erosion risk, (3) develop conceptual engineering solutions to mitigate risk, and (4) provide a systematic approach to allocate funds for the City's stormwater CIP.

The initial phase of the SMP was to establish an accurate, consistent field data collection process to evaluate about 67 miles of streams, using an interactive mobile GIS iPad tool that leverages the City's existing GIS data. Once the field observations were collected and documented, stormwater infrastructure problems were identified and assessed based on risk and severity. Problems identified in the field were validated with historical records, interviews/site visits with City staff, and Upper Brushy Creek Water Control Improvement District (UBCWCID) hydrologic and hydraulic analysis. Following the field data collection phase, subsequent problems were identified and assessed as follows:

Operations and Maintenance

With continued growth and development, existing streams and creeks can become stressed leading to the deterioration of existing infrastructure. Over time, stream degradation can lead to a multitude of problems such as flooding, damaged utilities, structurally weakened roadway crossings, and loss of property values. Minor issues that can be solved by City work crews were identified as Operation and Maintenance (O&M). Addressing O&M problems in a timely manner can save the future cost of fixing the problem after it has magnified. Ample funding for the O&M operations is a key component to minimizing the overall costs incurred in the SMP.

Project Development ("Issues")

Older developments, residential subdivisions and roadways were frequently designed utilizing an acceptable design criterion of that time. Over the years, the design criterion evolved resulting in these older facilities having a greater risk of flooding, relative to those designed to modern standards. For these inherited historical Issues, the flooding/erosion problems were identified and compiled. These Issues resulted in a list of potential projects with solutions to be in compliance with modern design standards.

Strategic Projects

Promoting prudent and responsible growth of the City can be accomplished by identifying strategic stormwater management projects. Projects may include solutions such as a public/private venture to construct a regional detention pond, large scale floodplain reclamation, and dedicated protection of a riparian corridor. As projects were identified and compiled, they were then evaluated based on criteria to ensure public safety, promote economic impact, consider environmental impact, and project timing.

The SMP is a digital "living document" that leverages the City's existing GIS database and provides the City with a tool to conduct periodic inventories and assessments of drainage problems, categorize stormwater issues, and manage the implementation of stormwater projects. Ultimately, every City stormwater project is defined and tracked based on: (1) the level of investment required, (2) the estimated benefits of that project, and (3) the time required to implement the project.

1. Field Data Collection

Field data collection is the first step to perform an inventory and assessment of drainage problems. A unique and flexible method was desired to perform data collection in the field and allow for future expansion. It was determined that the best method of collection would be a GIS integrated tool which would allow for recording of information, spatial distribution, and rapid updates.

1.1 Database

A digital ArcGIS SDE database was created to inventory existing infrastructure and drainage problems identified along the City of Round Rock stormwater corridors over the course of several field inspection visits. The consensus was to create a digital environment that could log any concerns of the waterways' current integrity from the field. The format and criteria for the database architecture and collection schema was developed from collaboration between Halff and the City of Round Rock. As decided by both parties, the criteria are divided into 11 categories, including: channel erosion, dam integrity, general maintenance, floodplain obstructions, roadway crossings, storm outfalls, structures, utilities, high water marks, drainage issues, and water quality problems. A specialized feature class was created for each category to contain attributes and collection objectives specific to each category as previous identified in the preliminary meeting. The general objective of the database design is such that one would be able to create records in the field within each categorized feature class and log all issues found of that nature via field inspections. These feature classes are endless and capable of continual recording, always holding the data of previously field inspections as new issues are discovered and revisited. The ArcGIS database schema also allows for previously logged issues to be revised and updated while maintaining the previously recorded information. This creates a historical inventory of an issue so that the City may observe the progression of the issue over time. **Figure 2** displays the described fields along with the database schema.

1.2 Method

The Halff field data application (available through the Apple Store©) is the tool of choice to utilize these feature classes and log live records the field using a cellular enabled iOS device. The application connects to an ArcGIS published web map to spatially navigate the Round Rock stormwater study streams and their surrounding channel terrain as condition issues/concerns are logged. The web map consists of collected field data along with basic streamline map data for reference of the study areas. This web map utilizes ESRI basemap data, City of Round Rock's storm sewer infrastructure data, and stream centerlines.

The 11 categorized feature classes are edited in the field, on the fly, as a field inspector creates a new 'point' within the designated feature class. This point is spatially correct (to the extent of the GPS accuracy) and supplies a physical real-world reference to the location of the issue the point identifies. At the time of point creation, the field inspector also populates several fields of feature-class-category specific attributes about the issue, in order to log a detailed level of data. With this established paradigm, one can stand in the field at the location of a particular identified problem, log the problem within the proper categorized issue type feature class and have a real world locality of where this problem exists on the study streams. The application also permits photographs to be taken of the problem and recorded with the issue, as it is logged to add another testimony of the status of the issue at that time.

The City selected approximately 67 stream miles for the initial data collection effort. The selected areas for initial field data collection were limited to creeks and streams with a minimum drainage area of 20 acres within the City's corporate and ETJ limits. The watersheds and estimated stream

distance of data collection are listed in **Table 1**. **Figure 3** shows a snap shot of the points collected in the field for the City of Round Rock as of February 19, 2014.

Table 1 – Stream Assessment

Watershed	Stream Distance (Miles)
Brushy Creek	17.6
Chandler Branch	19.3
Dry Branch	12.0
Dry Fork Creek	1.5
Gilleland Creek	1.7
Lake Creek	1.7
McNutt Creek	0.6
Onion Branch	11.8
Rattan Creek	0.8
Total	**67**

The digital ArcGIS SDE database allows for the connection of the data to an easily assessable web map. The web map allows users to view, query, and analyze the recorded data. One can open the web map and see data being recorded in the field instantaneously as it is logged. The web map provides a user friendly environment while not allowing viewers to alter or manipulate the data itself.

1.3 Moving Forward

A key feature of the ArcGIS database is that it allows for future expansion and flexibility. The database allows for the continual inventory of stormwater infrastructure and issues. If a new outfall is constructed, a road crossing replaced, or a newly identified flooding issue is identified by the City it can be logged and added to the database. The field collection method also allows for previously recorded infrastructure and issues to be revised in future field visits and updated to their most current status while maintaining the historical information previously recorded. The flexibility of the database allows for new feature classes to be added in order to collect data for additional Issue categories. Supplementary attributes can also be appended to the database to collect additional data on already created categories. The adaptable and elastic nature of the database allows for continuous expansion of recorded data and adaptability to any amendments the City may desire.

2. Internal Problem Assessment

After the data is collected in the field, it is passed through an internal problem assessment. The internal problem assessment identifies the severity of the problem discovered in the field through either a desktop analysis and/or a secondary field investigation. The initial step of the internal problem assessment is to sort problems identified in the field into two classifications: (1) Operation and Maintenance and (2) Secondary Field Investigation.

2.1 Operation and Maintenance

Operation and Maintenance (O&M) is the scheduled repair, preservation, and upkeep of current infrastructure. During the internal problem assessment, minor issues that can be solved by City work crews and do not require substantial engineering are to be identified as O&M items.

Examples of these items include: silted culverts, blocked storm outfalls, selective vegetation clearing, debris clearing, mowing, eroded utility caps, and small erosion patching.

The spatial location of an O&M item is identified by a polygon feature class in ArcGIS. Each O&M item is given a unique ID which allows for tracking of each specific item. The O&M ID is accompanied by a brief description of the problem/solution, the watershed in which is it located, and the field data points from which it was identified. The entry of O&M items into GIS allows for O&M maps to be created providing the spatial location of each O&M item to the City work crews. In the future, as additional O&M items are identified, they are added into the feature class and a polygon is created representing their spatial locations. The resulting product of the described procedure is provided in **Appendix C**.

2.2 Secondary Field Investigation

Drainage concerns deemed out of the scope of O&M during the "internal problem assessment" were identified for secondary field investigation. A secondary field visit was conducted by a Senior Engineer, who was generally accompanied by City staff. Additional data was logged with the mobile collection tool during this investigation. This additional data consisted of notes and photographs considered critical to the problem identification. A brief written narrative which describes the problem was then prepared by the Engineer who conducted the secondary investigation.

A polygon feature class for Secondary Field Investigation was created in the ArcGIS database. This feature class allows for the spatial location, extents, narrative (described above), photographs, and related field points to be stored into the database. Microsoft Access was then linked to the database to generate a one page report for every issue. Linking of Microsoft Access to the database allows the reports to be dynamic. Any changes or additions made to the feature class in the database are automatically reflected in the reports generated by Microsoft Access.

2.3 Project Development ("Issues")

Drainage concerns identified during the secondary field investigation were then presented to the City. These issues identified by the Engineer were then combined with additional issues identified through the following means: (1) City institutional knowledge, (2) previous drainage studies, and (3) UBCWCID hydrology and hydraulic models.

The City added additional issues from previous drainage complaints to those identified in the secondary field assessment. Additionally, hydraulic models provided by UBCWCID were also analyzed to find issues identified in the models such as "at-risk" homes and overtopping inline structures. Inline structures (road crossings) which had overtopping exceeding the City's criteria were added to the identified drainage issues.

All issues identified were added to a unique Issues polygon feature class in the ArcGIS database. Similarly to the secondary field assessment process, the issue's spatial location, extents, photographs, description, and related field points were added to the feature class. Dynamic reports were also created by linking Microsoft Access to the Issues feature class. Through this method additional issues identified in the future can be added to the database and the report will automatically be updated and available for the City's records. The Issue reports are available in **Appendix D**.

3. Projects

3.1 Project Identification

Once all the Issues were compiled a preliminary list of potential projects was presented to the City staff. This "preliminary" project list was based solely on the engineer opinion of potential projects. Through discussions the City and Engineer came to an agreement on a final project list. Project identification was based upon the following principals: severity of the issue, public impact, and developmental impact. The resulting effort of the project identification task is shown in **Appendix A.1**.

3.2 Concept Mitigation

For each of the projects that were identified a concept mitigation plan was prepared. Conceptual analysis of the drainage issue was performed in order to provide the City with suitable material for rough cost estimating, ranking, and prioritization. The tasks for the conceptual mitigation plan included the following:

- Review of the City supplied hydrologic, hydraulic, and GIS data including the UBCWCID Watershed Study to diagnose the contributing factors to the problem.
- Develop an exhibit of the subject area and proposed mitigation design.
- Develop a brief narrative summary of the problem, solution, challenges.
- Develop a conceptual opinion of probable construction cost.

The City provided the most up to date UBCWCID Watershed Study models for analysis. This analysis along with data gather during the field data collection and the secondary field investigation efforts were used to identify the contributing factors and develop a proposed solution. The limits of this solution included several brainstormed alternatives proposed by a team of individuals including representatives from the City and Halff. The selected proposed solutions and opinion of probable costs for each project was presented to the City staff. A two page report was created for each project which included the project exhibit, description of the problem, description of the solution, and challenges. These reports are provided in **Appendix A.2**.

3.3 Ranking & Categorization

In order to determine the prioritization of the projects, a ranking and categorization system must be established. The City of Round Rock developed a scoring matrix which provides a structured method of scoring, ranking, and prioritizing CIP projects. The scoring matrix defines a set list of 10 categories that define the critical aspect of an improvement project. These categories include: Emergency Access, Road Flooding and Mobility, Infrastructure Flooding and Erosion Threats, Property Damage, Funding Source, Project Cost, Economic Development, Riparian Corridor Project, Ease of Permitting, and Land and Easement Acquisitions. Each of these categories was assigned a weight which determines the influence of each category on the overall project score. Categories such as Emergency Access and Property Damage were assigned higher weights than the other categories since they are the most critical aspects of a drainage issue. Each category is to be assigned a raw rank based upon the guidance of the Project Scoring Sheet provided by the City. The score for each category was then multiplied by the category weight. All 10 category scores were then summed in order to create the total project score. The project score determined the ranking of the project and its prioritization. The Project Scoring Sheet is provided in **Appendix A.3**. The resulting project score was then included in the two page project report shown in **Appendix A.2**.

Figures

ROUND ROCK, TEXAS
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Chandler Branch
McNutt Creek
Dry Fork Creek
Onion Branch
Brushy Creek
Lake Creek
Dry Branch
Rattan Creek
Gilleland Creek
35
1431
79
45

Legend

- Capital Improvement Projects
- City-Limits
- Major Watersheds
- Streams

Figure 1
Project Location Collection Map

N

0 5,000 10,000 Feet

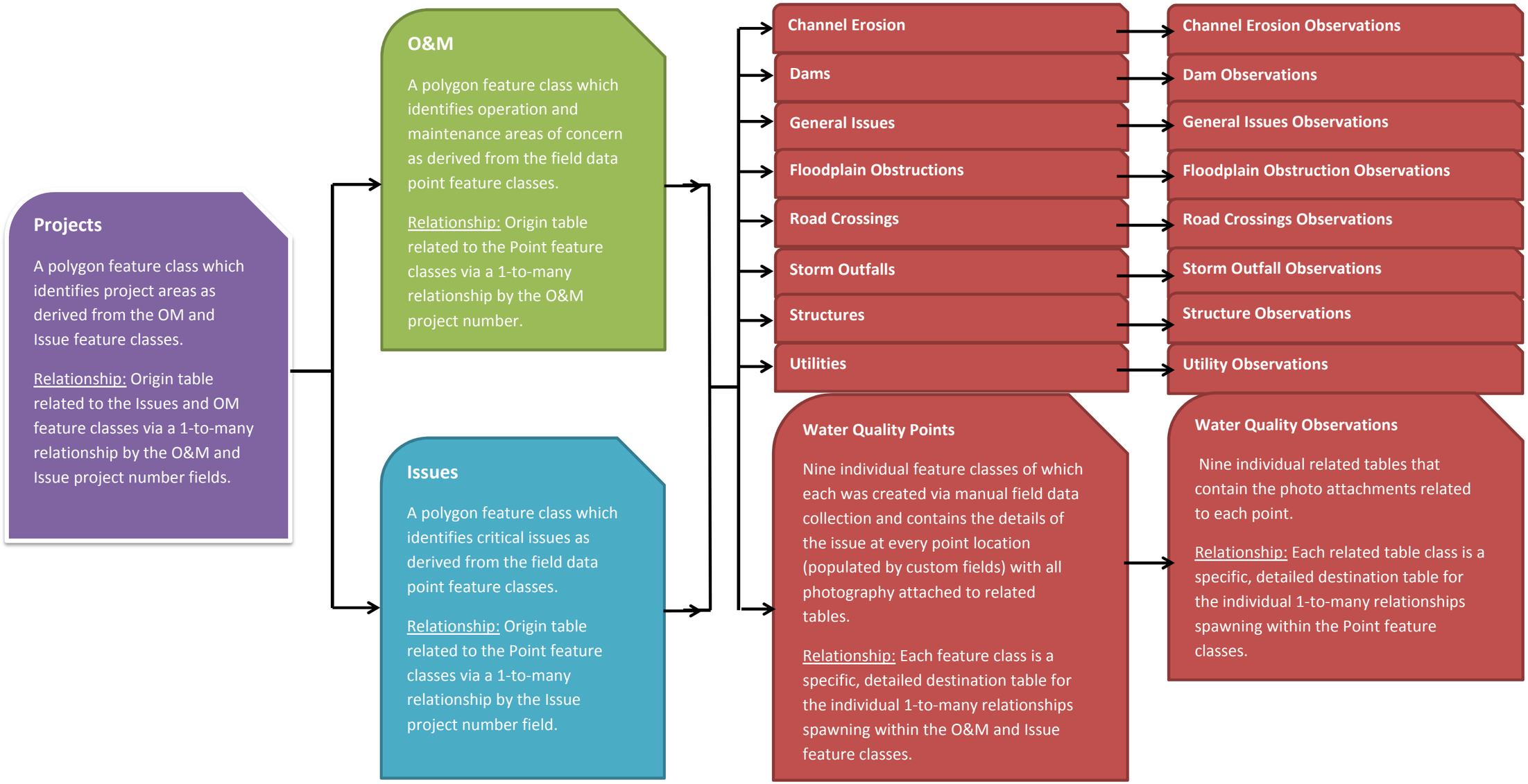
0 1 2 Miles

Date: 5/12/2014

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, A

Path: I:\29000s\29113 RR-Storm Water\Reports\Summary Report\Overal Project Location Exec Summ.mxd

Figure 2: ArcGIS Database Architecture



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Legend

- Storm Outfall
- Channel Erosion
- Dams
- General Data
- Floodplain Obstructions
- Road Crossing
- Structural
- Utility
- Water Quality
- City-Limits
- Major Watersheds
- Streams

Figure 3
Field Data Collection Map

N

0 5,000 10,000 Feet

0 1 2 Miles

Date: 5/12/2014

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, A

Path: I:\29000s\29113 RR-Storm Water\Reports\Summary Report\Figures\FieldCollectionMap.mxd

Appendix A

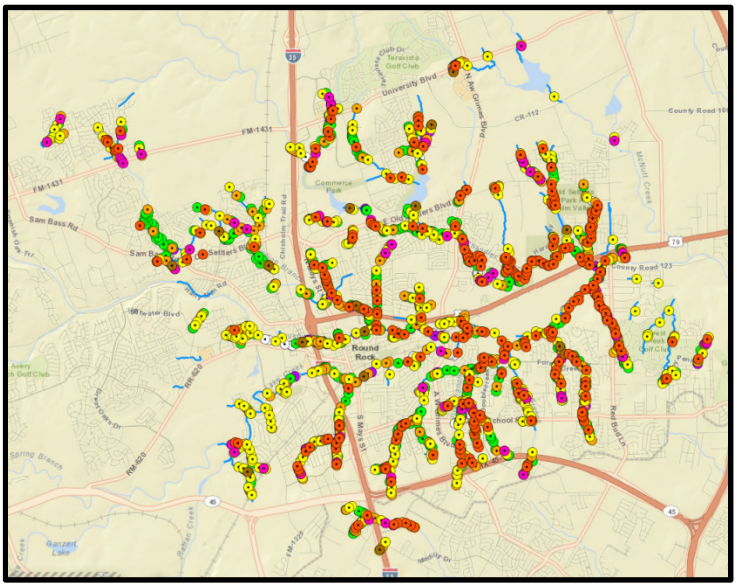
Projects

City of Round Rock Project List

Project ID	Project Name	Watershed	CoRR Stream Name	Project Type	Referenced Issues	Project Score	Cost
2013A	Gap Channel	Chandler Branch	Chandler Branch Trib 16C	Channelization			
2013B	Kensington Place - Green Slopes	Dry Branch	Dry Branch Tributary 1	Detention, Channelization, Culvert Modification	DB36, DB69, DB70	393	$750k-$1M
2013C	Sonoma at Brushy Creek	Brushy Creek	Brushy Creek Tributary 44	Channel Stabilization	BC51	266	$250k-750k
2013D	Forest Creek - Harvey Penick	Brushy Creek	Brushy Creek Tributary 48	Resistive Bank Stabilization	BC43	281	<$250k
2013E	Rock Hollow	Chandler Branch	Chandler Branch Tributary 16	Channelization	CB10	310	<$250k
2013F.0	Chisholm Valley	Lake Creek	Lake Creek Tributaries 1 & 2	Modeling - System	LC59-LC64	481	<$250k
2013F.1	Chisholm Valley East-West	Lake Creek	Lake Creek Tributary 2	Regional Detention	LC59, LC60, LC61	309	$1M-$2M
2013F.2	Chisholm Valley North-South	Lake Creek	Lake Creek Tributary 1	Channel Stabilization & Culvert Modification	LC62, LC63, LC64, LC80, LC81	463	$250k-750k
2013G	Old Settlers Blvd. at Dam 14 Trib	Chandler Branch	Chandler Branch Tributary 16	Conveyance	CB11	302	$250k-750k
2013H	Eagle Ridge - Lake Side	Chandler Branch	Chandler Branch Tributary 16	Channel Stabilization	CB19	311	<$250k
2013I.1	The Woods - Oak Hollow	Onion Branch	Onion Branch	Water Quality	OB29	238	<$250k
2013I.2	The Woods - Oak Hollow	Onion Branch	Onion Branch	Floodplain Reduction	OB29	321	$250k-750k
2013J	South Creek	Dry Branch	Dry Branch	Channel Stabilization	DB31	250	$750k-$1M
2013K	Lake Forest	Brushy Creek	Brushy Creek Tributary 44	Channel Stabilization	BC48	274	<$250k
2013L	Sonoma at Forest Creek Drive	Brushy Creek	Brushy Creek Tributary 44A	Channel Stabilization	BC49	261	<$250k
2013M	A.W. Grimes Blvd. at Brushy Creek	Brushy Creek	Brushy Creek	Bridge Scouring	BC54	284	<$250k
2013N	Brushy Slopes	Brushy Creek	Brushy Creek	Residential Flooding	BC56	395	<$250k
2013O	Greenlawn Blvd. at Gilleland Creek	Gilleland Creek	Gilleland Creek	Road Overtopping	GC83	377	<$250k
2013P	Round Rock West	Lake Creek	Lake Creek	Floodplain Reduction			
2013Q	Chisholm Trail at Brushy Creek	Brushy Creek	Brushy Creek	Structure Replacement	BC57	432	$750k-$1M
2013R	Burnet Street at Lake Creek	Lake Creek	Lake Creek	Structure Replacement	WCID		
2013S	Harrell Parkway at Chandler Branch Trib. 23	Chandler Branch	Chandler Branch Tributary 23	Structure Replacement	WCID		
2013T	Harrell Parkway at Chandler Branch	Chandler Branch	Chandler Branch	Structure Replacement	CB06	386	$250k-750k
2013X.1	Major Creek Modeling	Dry Branch	Dry Branch	Modeling - Detention	DB34	212	<$250k
2013X.2	Round Rock West Detention	Lake Creek	Lake Creek Tributary 12	Modeling - Detention	LC58	306	<$250k
2013X.3	Dry Branch Trib. 1 through Windy Park	Dry Branch	Dry Branch Tributary 1 T2	Modeling - Capacity	CoRR		
2013Y.1	Chisholm Trail at Brushy Creek	Brushy Creek	Brushy Creek	Automatic Gating		399	<$250k
2013Y.2	A.W. Grimes Blvd. at Brushy Creek	Brushy Creek	Brushy Creek	Automatic Gating		421	<$250k
2013Z.1	Summit Street at Brushy Creek	Brushy Creek	Brushy Creek	Gating		377	<$250k
2013Z.2	Burnet Street at Lake Creek	Lake Creek	Lake Creek	Gating		377	<$250k
2013Z.3	Park Lane at Lake Creek	Lake Creek	Lake Creek	Gating		377	<$250k
2013Z.4	Nash Street West at Lake Creek Trib 1	Lake Creek	Lake Creek Tributary 1	Gating		377	<$250k
2013Z.5	Harrell Parkway (S) at Chandler Branch	Chandler Branch	Chandler Branch	Gating		404	<$250k

City of Round Rock
Storm Water Master Plan

Appendix A.2
Project Summaries



Prepared For:
City of Round Rock
Utilities & Environmental Services
Stormwater Management

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Prepared By:
Halff Associates, Inc.
4030 West Braker Lane, Suite 450
Austin, TX 78759
Texas Firm Registration No. F-312

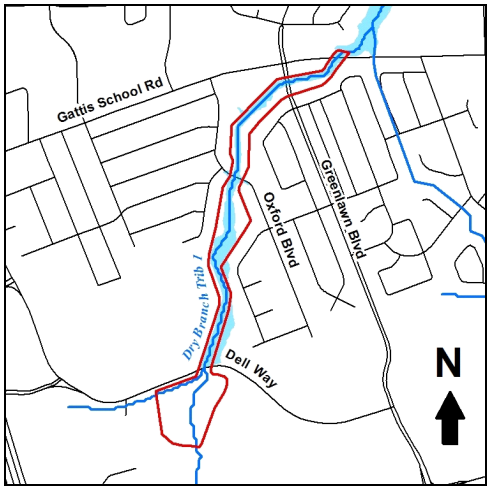
HALFF

Project Number: R-12-10-11-G11

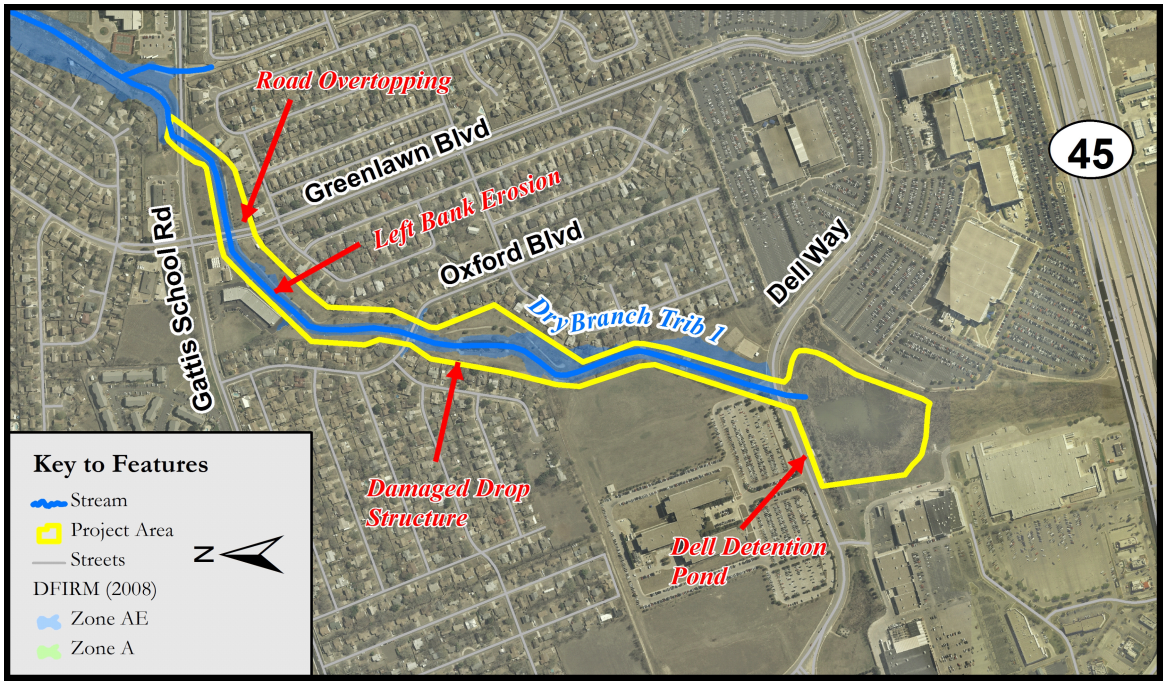
Project: 2013B - Kensington Place - Green Slopes

Dry Branch Tributary 1

Slope and sediment imbalance is causing deposition on the upstream section of Dry Branch Tributary 1 and scour on the downstream section. The concrete grade control structure upstream of Oxford Boulevard is undercut and has water flowing underneath the structure. The lower end of this structure is also cracked and slowly separating from the main body of the structure. Oxford Blvd. overtops 1.9' according to the Upper Brushy Creek WCID models which exceeds the 1' allowable criteria. Downstream of Oxford Blvd. to Greenlawn Blvd. there is scour on the left bank (looking downstream) and instability through the reach which could impact existing infrastructure on the left bank. Greenlawn Blvd. overtops at 0.6' which barely exceeds the 0.5' criteria. However, the overtopping contributes to the intersection flooding at the Gattis School Rd. and Greenlawn Blvd.



Reference Issues: DB36, DB69, DB70



Project: 2013B - Kensington Place - Green Slopes

Dry Branch Tributary 1

Solution

Additional storage at Dell Way Detention Basin could reduce the peak flow through Dry Branch Tributary 1. This increase in storage can come from either increasing the pond volume or decreasing the culvert size at Dell Way. If adequate detention is obtained the overtopping at Oxford Blvd. can be brought within the allowable limit of 1 ft and the overflow into the Gattis School Rd. and Greenlawn Blvd. intersection can be eliminated. The drop structure just upstream of Oxford Blvd. can be replaced with concrete, rock revetment mattress, or loose rock riffle. The rock revetment mattress and the loose rock riffle can provide additional energy dissipation and decrease erosional forces downstream. Construction of resistive bank stabilization on the left bank from Oxford Blvd. to Greenlawn Blvd. is needed to protect the existing infrastructure.

Challenges

- Close coordination with the Private property owner (Dell) will be needed to obtain potential easements.

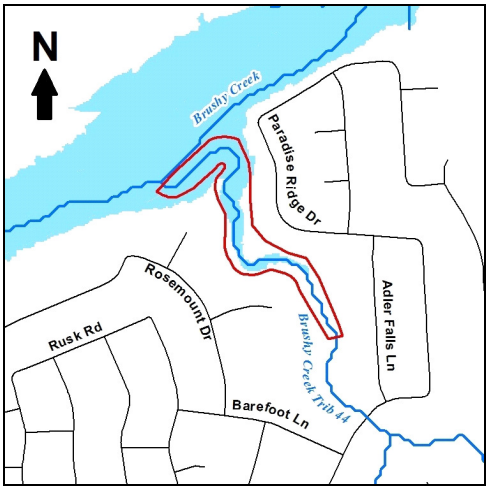
- The Corps permit requirements should be able to be covered with a Nationwide General Permit. However, the more work that is performed in this reach, a higher level of coordination could be required.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	4	108
Public Safety	Road Flooding and Mobility	22	4	88
Public Safety	Infrastructure Flooding and Erosion Threat	23	1	23
Public Safety	Property Damage	24	0	0
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Between $750k and $1M)	18	3	54
Economic Impact	Economic Development	13	1	13
Environmental Impact	Riparian Corridor Project	13	2	26
Project Timing	Ease of Permitting	13	3	39
Project Timing	Land and Easement Acquisitions	14	3	42
			Project Score	**393**

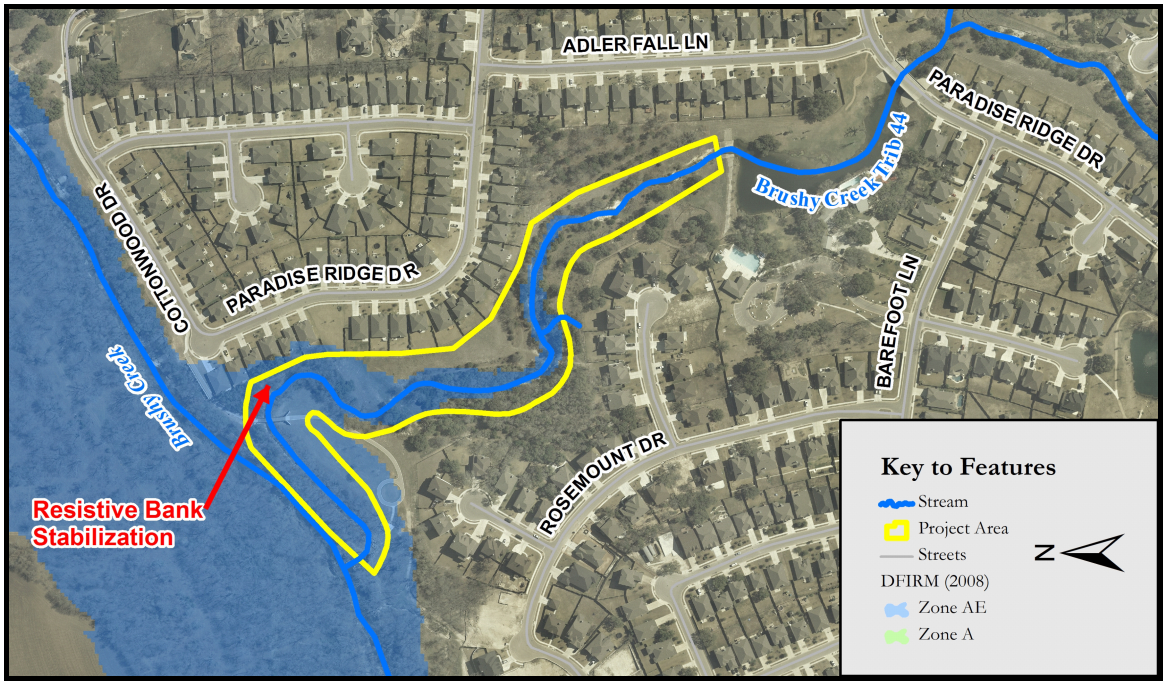
Project: 2013C - Sonoma at Brushy Creek

Brushy Creek Tributary 44

Brushy Creek Tributary 44 experiences vertical bank scour approximately 10 feet tall on both sides of the channel as the tributary approaches Brushy Creek. The right bank is scoured back to the fence line of several homes on Paradise Ridge Drive. If this erosion continues to widen the right bank the homes will begin to lose property and fence lines. Mature hardwood trees on both sides of the eroded channel are at risk. These hardwood trees are most likely keeping the right bank stabilized. If these trees are undermined and lost the right bank erosion could accelerate and threaten the homes.



Reference Issues: BC51



Project: 2013C - Sonoma at Brushy Creek

Brushy Creek Tributary 44

Solution

Installation of resistive bank stabilization on the right bank can protect the eroded right bank from encroaching further on the homes along Paradise Ridge Dr. Longitudinal fill stone toe protection will protect the right bank of the channel while also reclaiming some of the eroded slope. This solution will also move the top of the bank away from the current location right at the fence line of the homes. The resulting filled slope will be gentler than the existing slope and can be armored with the traditional Turf Reinforcement Mat and revegetated. This technique will not require removal of any large trees and can easily work around the existing trees.

Challenges

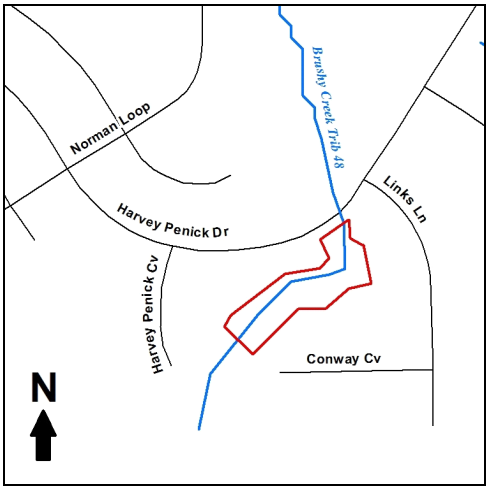
- Construction access to the area is difficult due to the steep eroded banks and dense vegetation.
- Currently there is no existing hydraulic model for this tributary.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	0	0
Public Safety	Road Flooding and Mobility	22	0	0
Public Safety	Infrastructure Flooding and Erosion Threat	23	0	0
Public Safety	Property Damage	24	3	72
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Between $250k and 750k)	18	4	72
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	1	13
Project Timing	Ease of Permitting	13	3	39
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**266**

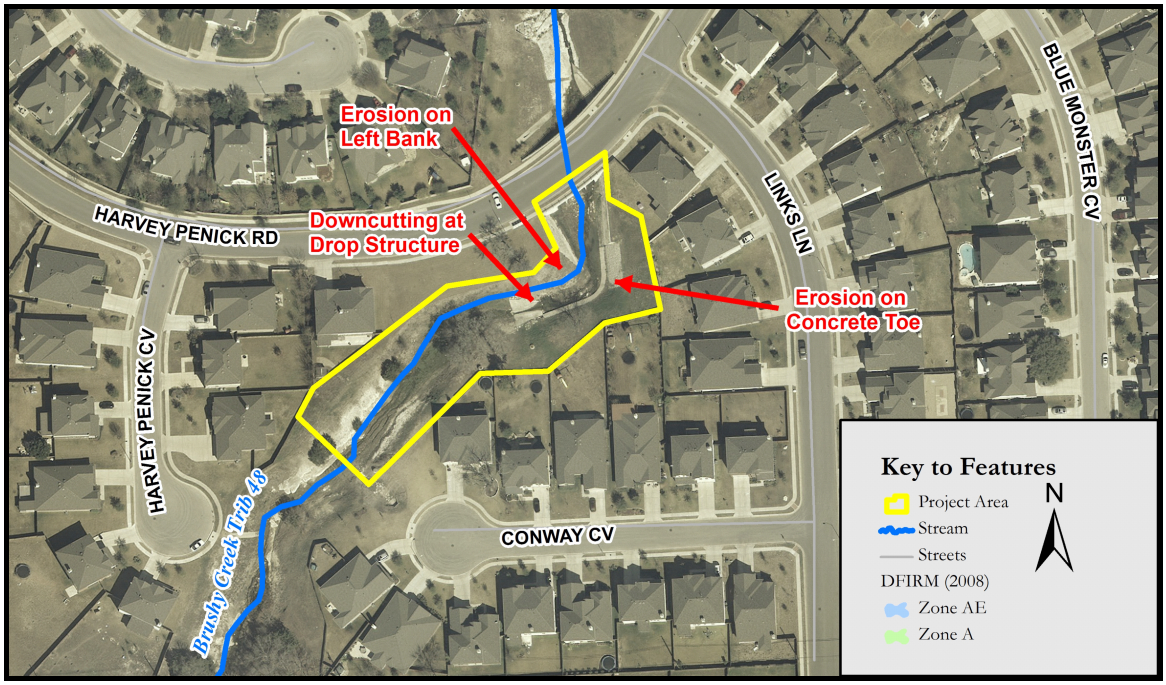
Project: 2013D - Forest Creek - Harvey Penick

Brushy Creek Tributary 48

Brushy Creek Tributary 48 takes a hard left turn (approximately 90 degrees) before going under Harvey Penick Rd. A drop structure just upstream of this turn has approximately 2 feet of downcutting under the downstream toe. An existing 8" wastewater line passes under this drop structure. Further downcutting could lead to undermining and putting this wastewater line at risk. The concrete toe along the outside bend (right bank) has been undercut over 2 feet. The erosion on the outside toe is beginning to undermine the concrete armoring. Erosion has started on the left inside bank which is not armored and is migrating towards Harvey Penick Dr.



Reference Issues: BC43



Project: 2013D - Forest Creek - Harvey Penick

Brushy Creek Tributary 48

Solution

Installation of resistive bank stabilization can protect the eroded right bank. Loose rock rip rap along the sloped right bank will protect the bank from further erosion. The rip rap will need to be toed into the channel in order to insure the rip rap remains in place. The left bank needs to be excavated in order to "round out" the bend to improve the transition angle of the turn. This will reduce the erosive forces on the inside (left) bank. Replacing the existing concrete grade control structure with rock riffle will reduce the velocity in the downstream problem reach. Reducing this velocity will decrease the erosive forces and help the rock rip rap armoring downstream. This rock riffle will also continue to protect the existing 8" wastewater line which crosses the channel in this location.

Challenges

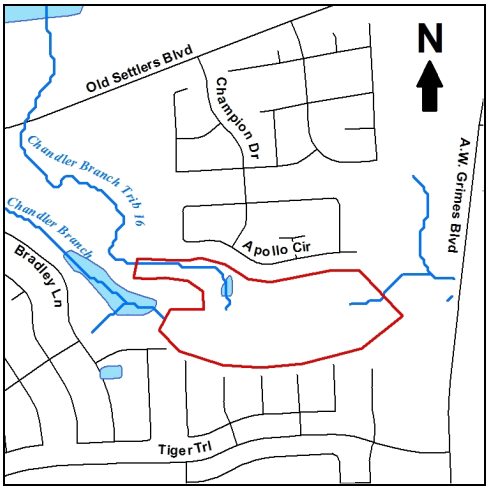
- Construction access to the area is difficult due to the limited work zone area.
- Wastewater line crosses under the upstream concrete drop structure.
- Water line crossing near the Harvey Penick Rd. culvert headwall.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	0	0
Public Safety	Road Flooding and Mobility	22	0	0
Public Safety	Infrastructure Flooding and Erosion Threat	23	3	69
Public Safety	Property Damage	24	0	0
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Less than $250k)	18	5	90
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	1	13
Project Timing	Ease of Permitting	13	3	39
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**281**

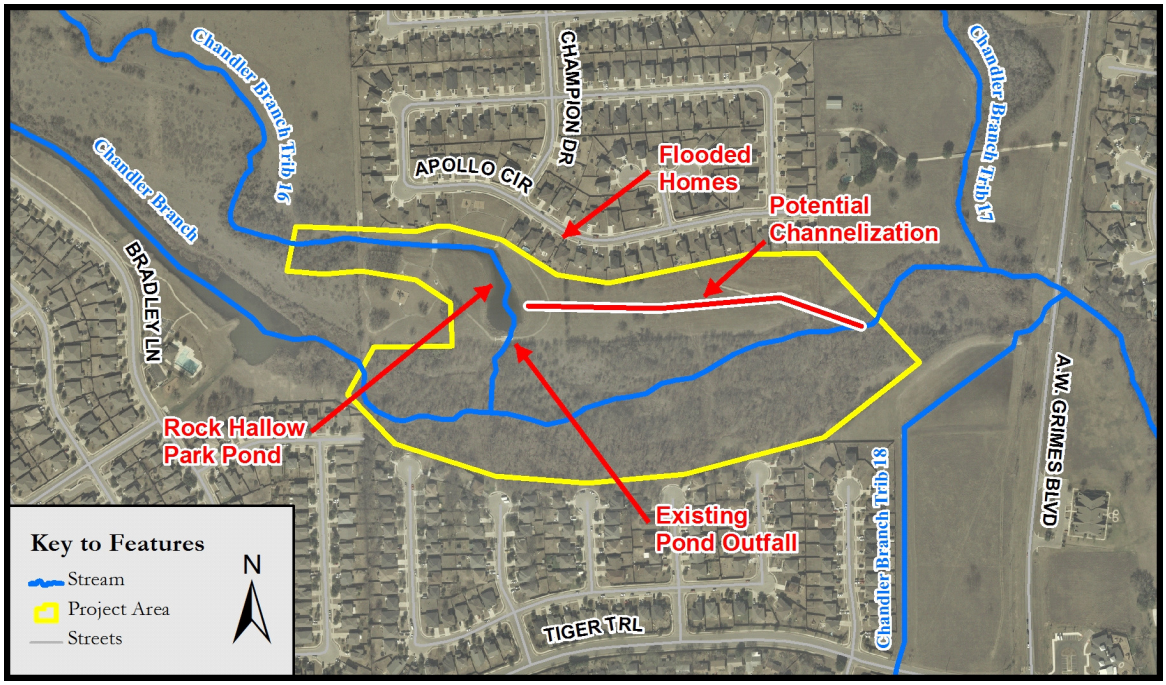
Project: 2013E - Rock Hollow

Chandler Branch Tributary 16

Rock Hallow Park Pond is in line with Chandler Branch Tributary 16 and is just south of Rhodes subdivision. Historical flooding shows that the water surface from the pond has reached over 6 inches up the fence line along several homes directly to the east of the pond. The right embankment of the pond is only slightly higher than the outfall weir of the pond resulting in frequent spilling to the east towards the homes. The pond outfalls into Chandler Branch mainstem which is choked by dense vegetation both upstream and downstream of the outfall. Additional 2-D hydraulic modeling has shown that Chandler Branch backflows into the pond which increases the severity of spilling from the pond to the east.



Reference Issues: CB10



Project: 2013E - Rock Hollow

Chandler Branch Tributary 16

Solution

Channelization from the eastern embankment of the pond and tying into Chandler Branch further downstream can prevent the homes from being flooded. The land along this route is currently owned by the City so no land acquisition is required. The existing pond outfall will need to be raised in order to prevent outflow from the pond and backflow from Chandler Branch. The channelization will also reduce the flow contributing to the choked section of Chandler Branch. The relocation of the existing flowline will also provide additional detention possibilities in the open park land to the east.

Challenges

- The area surrounding the park to the south is located within the Chandler Creek MUD. Therefore, any modification outside of the City Park or drainage easements will require cooperation with the MUD.

- Increases in pond size could potentially lead to water rights issues with the State.

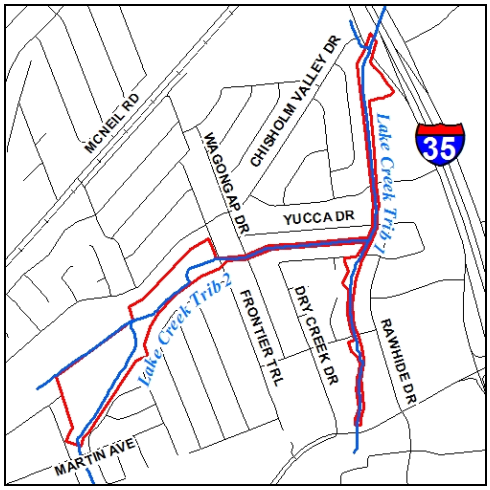
- The impact on FM 1460 (A.W. Grimes Blvd) downstream needs to be considered.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	0	0
Public Safety	Road Flooding and Mobility	22	0	0
Public Safety	Infrastructure Flooding and Erosion Threat	23	0	0
Public Safety	Property Damage	24	3	72
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Less than $250k)	18	5	90
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	1	13
Project Timing	Ease of Permitting	13	5	65
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**310**

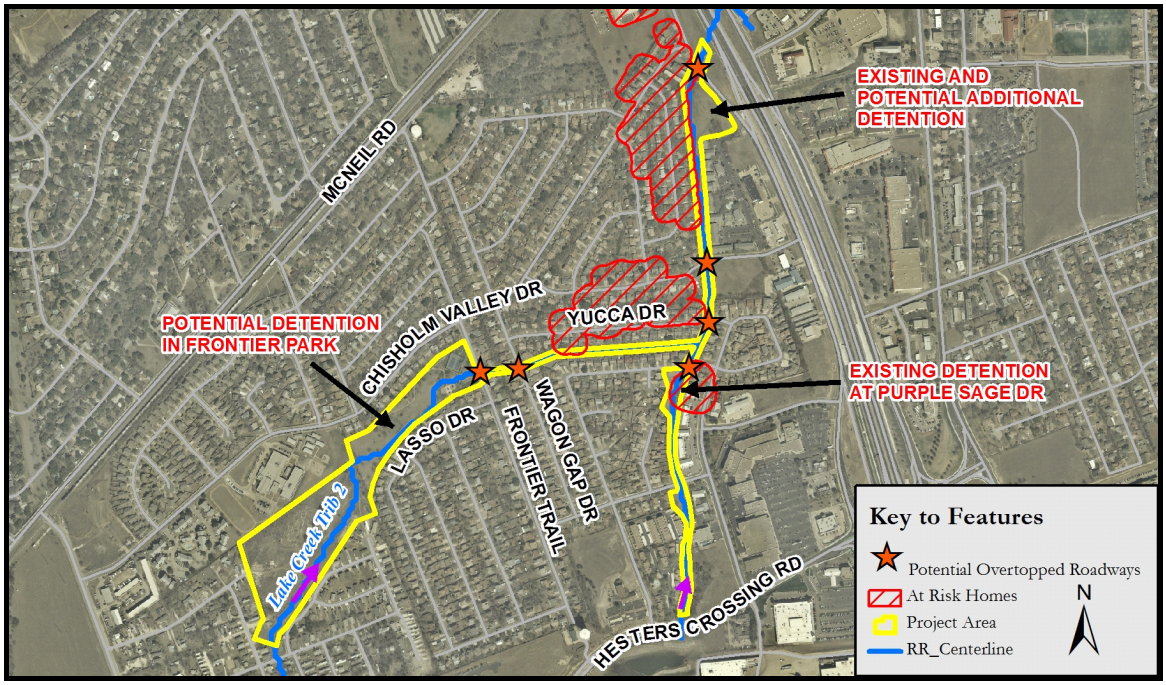
Project: 2013F.0 - Chisholm Valley

Lake Creek Tributaries 1 & 2

Lake Creek Tributary 1 and Tributary 2 run through the Chisholm Valley subdivision. The current WCID models indicate that approximately 98 structures are at risk during the 100-yr storm event along these two reaches. The current models also indicate that 6 roadways crossings exceed the City of Round Rock overtopping criteria for the 100-yr storm event. However, these models do not account for the existing detention at Purple Sage Dr. and at the IH-35 southbound frontage road. The detention outlet structure at Purple Sage Drive is also undersized and causes several structures to be inundated upstream.



Reference Issues: LC59-LC64



Project: 2013F.0 - Chisholm Valley

Lake Creek Tributaries 1 & 2

Solution

Refining of the current hydrologic and hydraulic models for this reach will allow for investigation of alternatives to reduce the number of at risk structures and the risk of road overtoppings in the Chisholm Valley area. Additional detention is available at several locations in this reach and could potentially decrease the number of structures at risk along these two tributaries. Alternative analysis can also determine if modification to the existing detention structures at Purple Sage Dr. and the IH-35 service road could provide additional detention benefits. Examining the hydrologic interactions within this problematic watershed will help to focus upon and generate the most cost effective alternatives.

Challenges

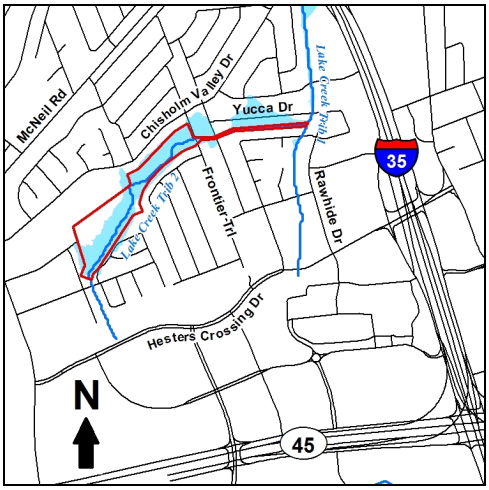
- None

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	4	108
Public Safety	Road Flooding and Mobility	22	2	44
Public Safety	Infrastructure Flooding and Erosion Threat	23	1	23
Public Safety	Property Damage	24	5	120
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Less than $250k)	18	5	90
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	0	0
Project Timing	Ease of Permitting	13	2	26
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**481**

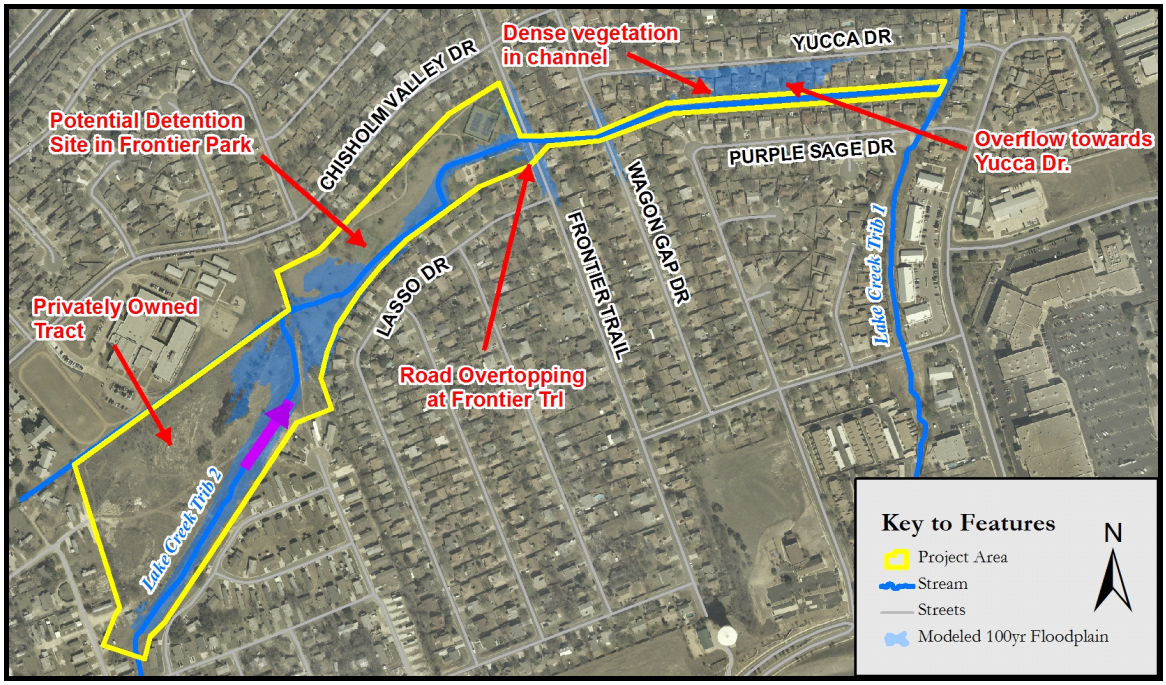
Project: 2013F.1 - Chisholm Valley East-West

Lake Creek Tributary 2

Large mature trees within existing engineered drainage ditch in Lake Creek Tributary 2 between Yucca Dr. and Purple Sage Dr. are "choking' the channel causing a potential increase in the water surface elevation. The capacity of this engineered channel downstream of Wagon Gap Drive is inadequate causing spilling during the 100-yr event between 603 Yucca Drive and 505 Yucca Drive, which inundates 8 homes. This spilling can possibly contribute to additional flooding issues down Yucca Drive. Frontier Trail is overtopped by 0.65 ft exceeding the allowable limit of 6 inches for a nonresidential road during the 100-yr event. Wagon Gap Drive is also overtopped by 0.6 ft during the 100-yr event although it meets the allowable limit of 1 ft.



Reference Issues: LC59, LC60, LC61



Project: 2013F.1 - Chisholm Valley East-West

Lake Creek Tributary 2

Solution

Selective clearing of the dense vegetation and trees in the engineered channel downstream of Wagon Gap Drive will improve conveyance. Several large caliper hardwood trees will need to be cleared, but these trees are within the existing City drainage easement. Construction of a detention facility in Frontier Park can reduce the 100-yr peak flow and potentially prevent the flooding of the 8 homes along Yucca Drive. This detention facility could also prevent Frontier Trial and Wagon Gap Drive from being overtopped. This detention facility could provide further benefits downstream on Lake Creek Tributary and Lake Creek.

Challenges

- The privately owned track upstream of Frontier Park may have to be purchased in order to compensate the Park for the land rededicated to detention.

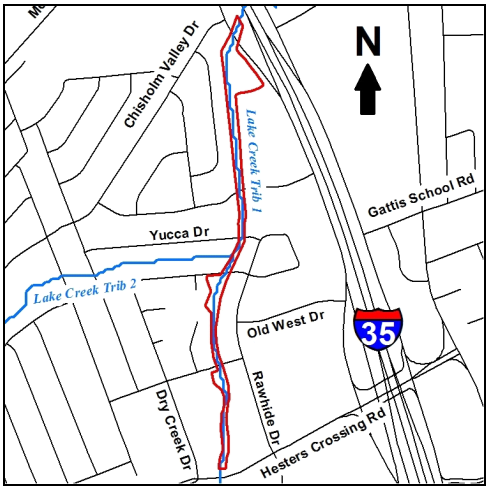
- An 18" wastewater line parallels the existing stream centerline through Frontier Park. This wastewater line could potentially have to be relocated.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	0	0
Public Safety	Road Flooding and Mobility	22	2	44
Public Safety	Infrastructure Flooding and Erosion Threat	23	0	0
Public Safety	Property Damage	24	4	96
Economic Impact	Funding Source	13	3	39
Economic Impact	Project Cost (Between $1M and $2M)	18	2	36
Economic Impact	Economic Development	13	1	13
Environmental Impact	Riparian Corridor Project	13	2	26
Project Timing	Ease of Permitting	13	1	13
Project Timing	Land and Easement Acquisitions	14	3	42
			Project Score	**309**

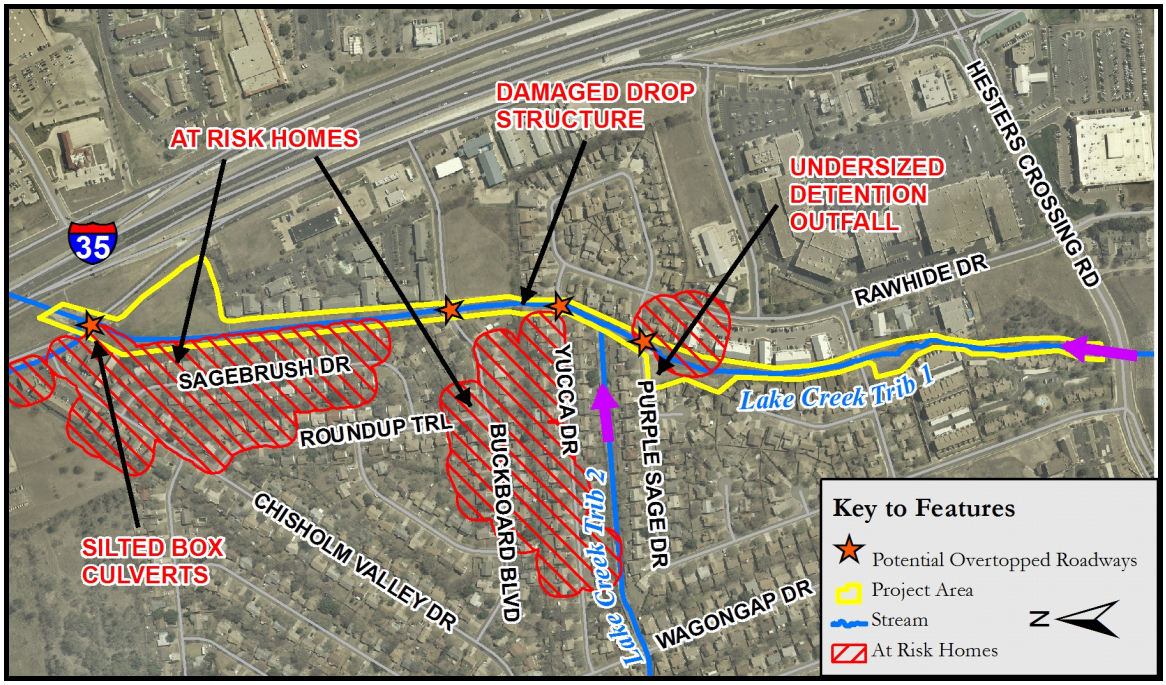
Project: 2013F.2 - Chisholm Valley North-South

Lake Creek Tributary 1

Lake Creek Tributary 1 experiences several issues beginning at Hester's Crossing and ending at the southbound service road of IH-35. The WCID model indicates that the Purple Sage Rd., Yucca Dr., Buckboard Blvd., and IH-35 southbound service road are all overtop by more than 1 ft in the 100-year ultimate storm. The detention pond upstream of Purple Sage Dr. is undersized, and WCID models show that Purple Sage Dr. overtops during the 25-yr event. The WCID model also indicates that over 50 structures are at risk during the 100-yr event along this reach. Just downstream of Yucca Dr. a concrete drop structure is cracked and undermined. The multiple box culverts at the IH-35 southbound frontage road are much wider than the approaching channel, and the outside culverts are showing evidence of siltation. It appears that there is a significant headloss at this expansion point. Additionally, the WCID hydrologic model does not appear to account for the storage at the frontage road and at Purple Sage Dr.



Reference Issues: LC62, LC63, LC64, LC80, LC81



Project: 2013F.2 - Chisholm Valley North-South

Lake Creek Tributary 1

Solution

The existing hydrologic model needs to be revisited to include the detention basin upstream of Purple Sage. It is important to determine if the Purple Sage basin does provide peak flow attenuation at that crossing. The hydrologic model could be modified assuming that one of the two detention basins alternatives on Lake Creek Tributary 2 (Project 2013F) is developed. This new basin along with the existing basin at Purple Sage could have significant impacts on reducing the peak flows at Yucca Dr. and Buckboard Blvd. The hydrologic model could be modified assuming some detention at the southbound frontage road of IH-35. Use the information in conjunction in developing some of the other Alternatives. The cracked concrete drop structure downstream of Yucca Drive needs to be replaced with a rock riffle in order to provide additional energy dissipation through the reach.

Challenges

- Discuss grant opportunities with TPWD for development of trails.

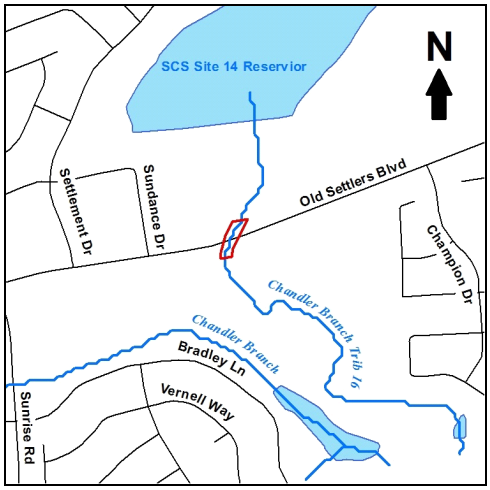
- Project 2013F (upstream detention at Frontier Park) could have a major impact on the hydrology in this reach. The resulting hydraulics of reduced flow rates could affect the Alternative solutions.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	4	108
Public Safety	Road Flooding and Mobility	22	2	44
Public Safety	Infrastructure Flooding and Erosion Threat	23	1	23
Public Safety	Property Damage	24	5	120
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Between $250k and 750k)	18	4	72
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	0	0
Project Timing	Ease of Permitting	13	2	26
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**463**

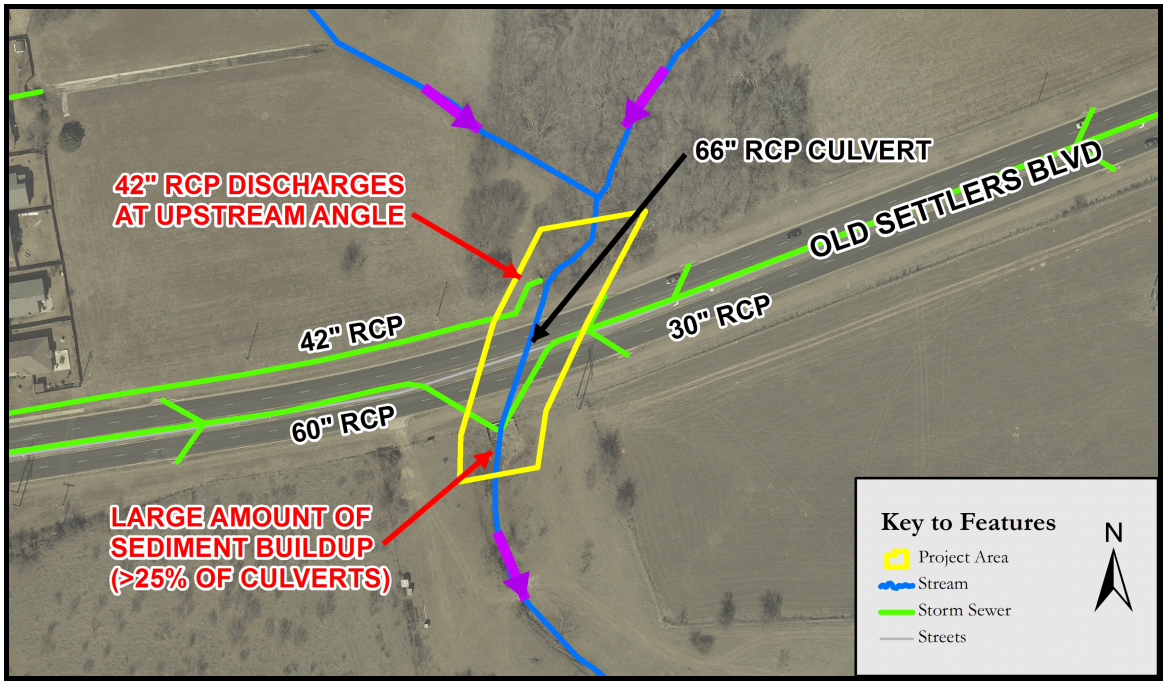
Project: 2013G - Old Settlers Blvd. at Dam 14 Trib

Chandler Branch Tributary 16

Chandler Branch Tributary 16 passes under Old Settlers Blvd. through a 66" RCP. At the upstream headwall of Old Settlers Blvd, a 42" stormwater RCP discharges in the upstream direction, which causes a large amount of head loss and conveyance issues. On the downstream side of Old Settlers Blvd a 60" RCP coming from the west and a 30" RCP coming from the east join with the 66" RCP (under Old Settlers Blvd) and form 3 outlets at the downstream headwall. The grade just downstream of Old Settlers is flat which causes a large amount of sediment buildup on the downstream side of the culvert crossing. The sediment accumulation could also be caused by low velocities through the culvert caused by the head loss from the upstream (42" RCP). This sediment buildup is clogging 50% of all three of the outlet pipes (66", 60", and 30" RCPs) which could cause Old Settlers Blvd to overtop and the inlets of the stormwater pipes to operate inefficiently during a major event.



Reference Issues: CB11



Project: 2013G - Old Settlers Blvd. at Dam 14 Trib

Chandler Branch Tributary 16

Solution

Modification of the existing culvert system can reduce the head loss caused by the 42" RCP stormwater outfall discharging at an upstream angle. Replacement of the 66" culvert with a 6' x 6' box culvert will allow the 42" stormwater outfall to tie in under Old Settler Blvd and discharge at a downstream angle. The two other stormwater outfalls (60" and 30" RCPs) could also tie in under the roadway in order to create a single culvert outlet on the downstream side of Old Settlers Blvd. Allowing these stormwater outfalls to discharge at downstream angles will decrease head loss and increase velocities allowing the sediment to move further downstream. Construction of a sloped concrete apron on the downstream side of the culvert will further reduce the sediment buildup and erosive forces.

Challenges

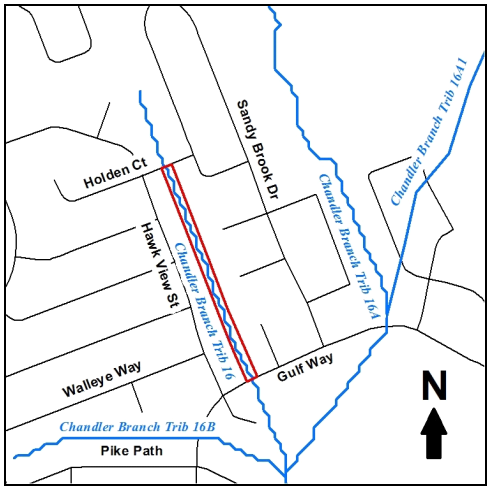
- The temporary constriction or shutdown of Old Settlers Blvd during modification to the existing culvert system would cause significant traffic issues.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	2	54
Public Safety	Road Flooding and Mobility	22	0	0
Public Safety	Infrastructure Flooding and Erosion Threat	23	1	23
Public Safety	Property Damage	24	0	0
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Between $250k and 750k)	18	4	72
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	0	0
Project Timing	Ease of Permitting	13	5	65
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**302**

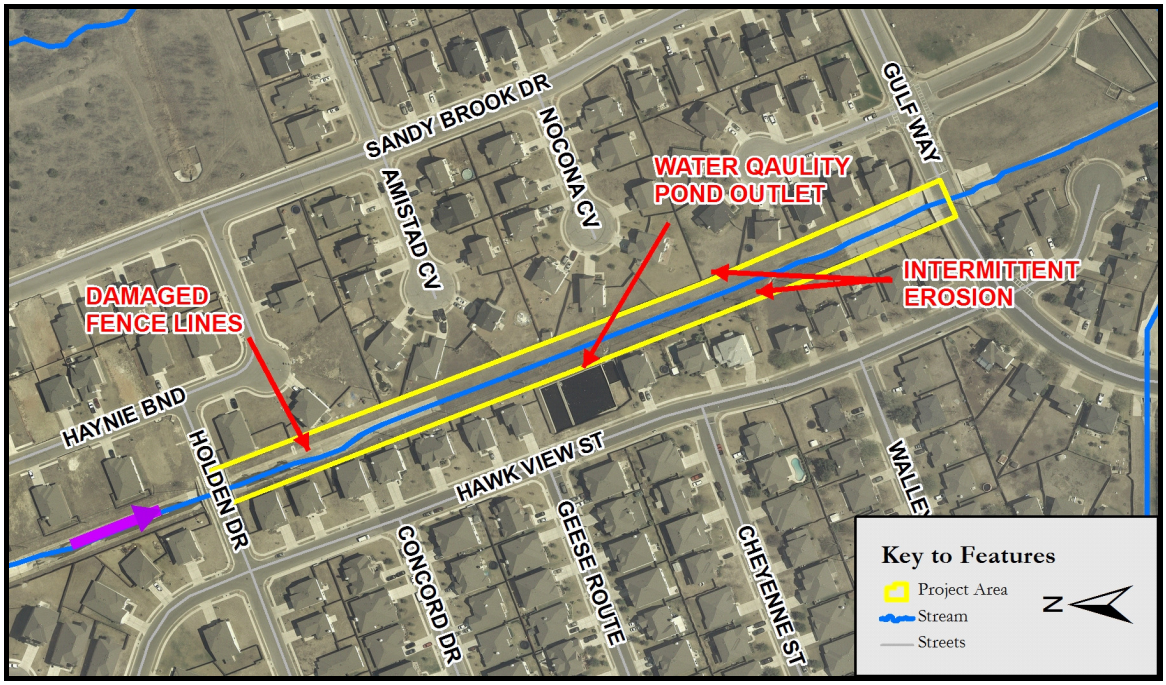
Project: 2013H - Eagle Ridge - Lake Side

Chandler Branch Tributary 16

This 2,400 foot reach is an engineered linear earthen channel with a concrete pilot channel and a slope of 0.8 percent. The earthen channel is subject to intermittent erosion as the water depth gets just higher than the concrete pilot channel. The erosion patterns appear to meander from side to side of the concrete channel. The vegetation on the east side of the channel (gets direct sunlight from the south and west) has not taken hold and the earthen channel is bare. Toward the north end of the reach (toward Holden Dr.) the concrete pilot channel moves toward the west side of the channel leaving the slope of the earthen ditch bank with a steep slope. The wooden privacy fences in this short reach are being undercut and impacted. A water quality basin exists on the west side about half way along the channel. The outlet is regulated with rock rip rap with the outflow moving under the existing wooden fence. The earthen channel is not armored and about two feet of scour has occurred (partially endangering an existing power pole).



Reference Issues: CB19



Project: 2013H - Eagle Ridge - Lake Side

Chandler Branch Tributary 16

Solution

To solve the meandering erosive issue about one foot of a nine foot wide permanent turf reinforcement mat (TRM) could be inserted vertically adjacent to the edge of the concrete pilot channel. The remaining width of TRM could be extended out over the earthen channel then anchor and vegetate. The TRM will provide a transition buffer zone that will dampen the higher velocities of the concrete pilot channel as the stormwater moves laterally out into the rest of the earthen channel. Soil amendments to the left bank (east) of compost or fungi will help support grasses and will allow vegetation to take place without temporary irrigation. The armoring of the water quality basin outlet needs to be extended from the fence line to the concrete pilot channel. The existing scour hole will need to be filled with soil and armored with TRM. This solution would help the riparian corridor by vegetating the banks and improving the soil balance.

Challenges

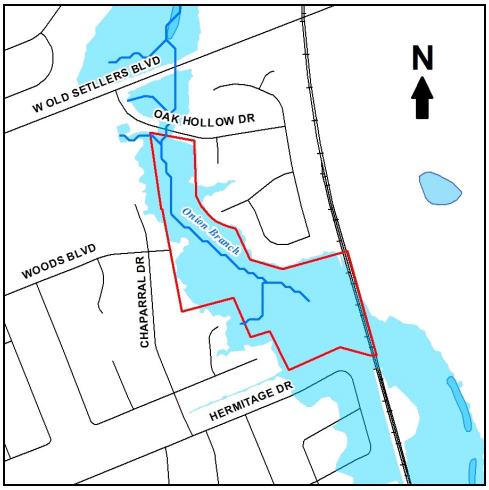
- None

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	0	0
Public Safety	Road Flooding and Mobility	22	0	0
Public Safety	Infrastructure Flooding and Erosion Threat	23	1	23
Public Safety	Property Damage	24	1	24
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Less than $250k)	18	5	90
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	3	39
Project Timing	Ease of Permitting	13	5	65
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**311**

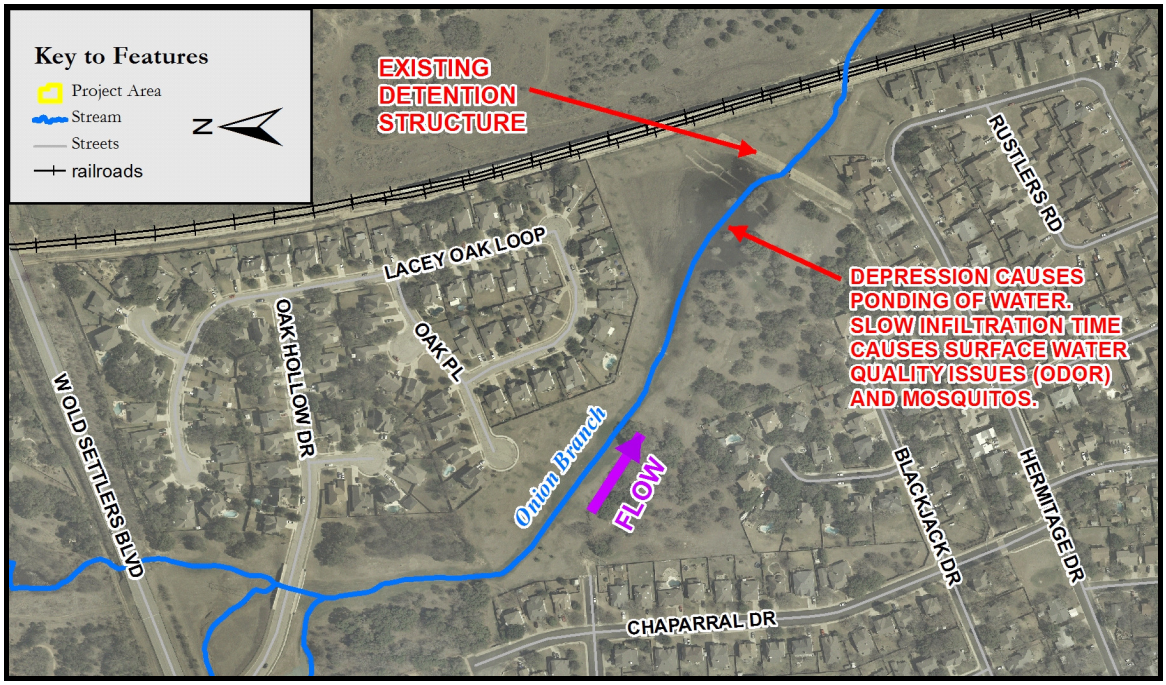
Project: 2013I.1 - The Woods - Oak Hollow

Onion Branch

Onion Branch passes between Oak Hollow and The Woods subdivisions then goes under a Union Pacific Railroad through four 8' x 4' box culverts. There is an existing concrete detention structure just upstream of the railroad crossing. A depression just upstream of the detention structure causes water to pond. This stagnant water contributes to water quality (odor) issues and can provide a breeding ground for mosquitos and other bugs. Additionally, the baffle blocks on the existing detention structure are dense and form a "trash rack" that collects debris and needs frequent maintenance.



Reference Issues: OB29



Project: 2013I.1 - The Woods - Oak Hollow

Onion Branch

Solution

At the detention basin breach the concrete outlet structure and energy dissipation device, but keep the concrete dam crest intact. The existing detention structure is completely inundated by the 100-year storm backwater. This breach would reduce maintenance requirements for trash and storm debris removal at the outlet. The water moves through this area of the reach with a low velocity so the existing energy dissipation is not needed. Specific plants could be added to help minimize standing water by increasing transpiration. The increased transpiration would help reduce the stagnant water and reduce the potential for mosquitos.

Challenges

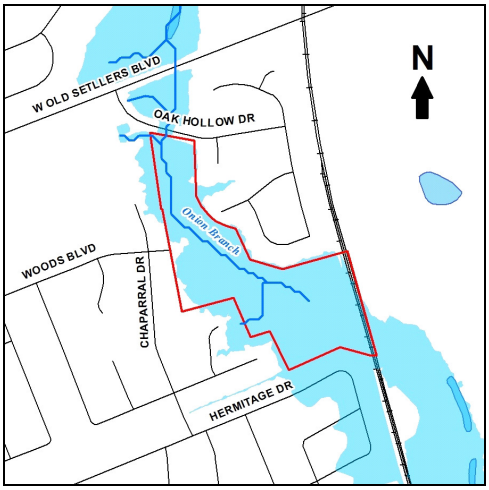
- Coordination with adjacent HOA regarding the anticipated Level of Effort regarding basin maintenance.
- Coordination with adjacent HOA regarding acceptable plant list.
- This reach is in the Edwards Aquifer Recharge Zone

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	0	0
Public Safety	Road Flooding and Mobility	22	0	0
Public Safety	Infrastructure Flooding and Erosion Threat	23	0	0
Public Safety	Property Damage	24	0	0
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Less than $250k)	18	5	90
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	1	13
Project Timing	Ease of Permitting	13	5	65
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**238**

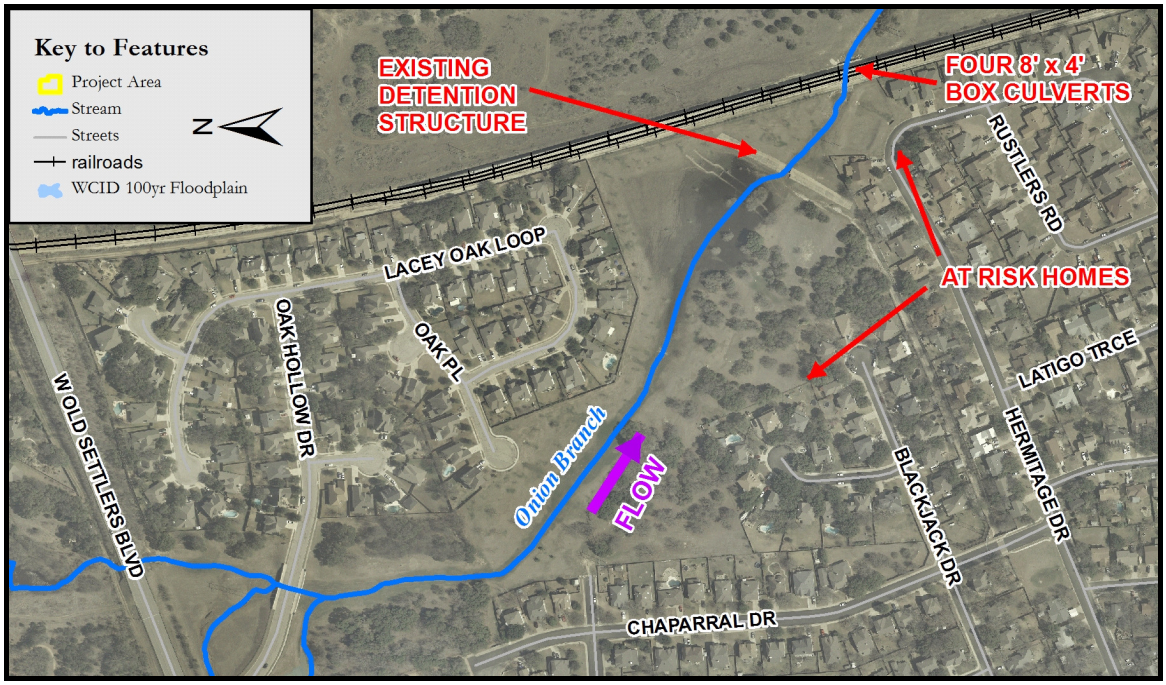
Project: 2013I.2 - The Woods - Oak Hollow

Onion Branch

Onion Branch passes between Oak Hollow and The Woods subdivisions then goes under a Union Pacific Railroad through four 8' x 4' box culverts. There is an existing concrete detention structure just upstream of the railroad crossing. The railroad crossing is overtopped 2.9 feet in the 25-year event and 3.4 feet in the 100-year event according to the WCID ultimate condition models. The backwater from the railroad creates a very flat floodplain slope (essentially a lake) extending upstream to Old Settlers Blvd. It appears that approximately 10 homes (in the Hermitage Drive area) would become surrounded (or have their access significantly impacted) by the backwater from this railroad trestle overtopping.



Reference Issues: OB29



Project: 2013I.2 - The Woods - Oak Hollow

Onion Branch

Solution

Addition of culverts to the railroad crossing can reduce the 25-year WSEL to a degree that the residential roadways would be more passable and the affected homes would be more accessible. Additional concrete pipes could be "jack and bored" through the embankment. The weir flow over the trestle in the 25-year ultimate condition is around 320 cfs. An additional three 48" diameter pipes would help achieve this reduction.

Challenges

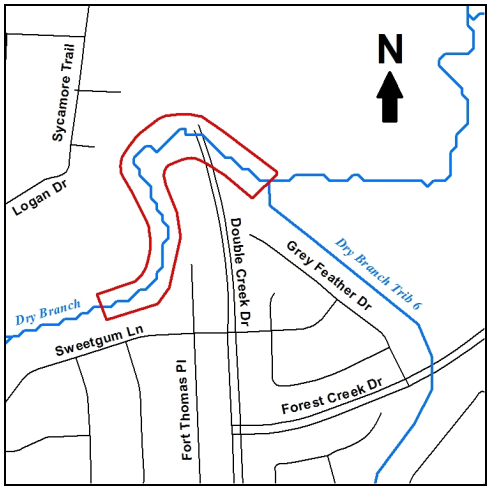
- Coordination with the railroad company.
- Length of time to get an agreement with the railroad company.
- Remote chance that the railroad company would participate in the cost of this project.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	5	135
Public Safety	Road Flooding and Mobility	22	1	22
Public Safety	Infrastructure Flooding and Erosion Threat	23	0	0
Public Safety	Property Damage	24	1	24
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Between $250k and 750k)	18	4	72
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	0	0
Project Timing	Ease of Permitting	13	2	26
Project Timing	Land and Easement Acquisitions	14	3	42
			Project Score	**321**

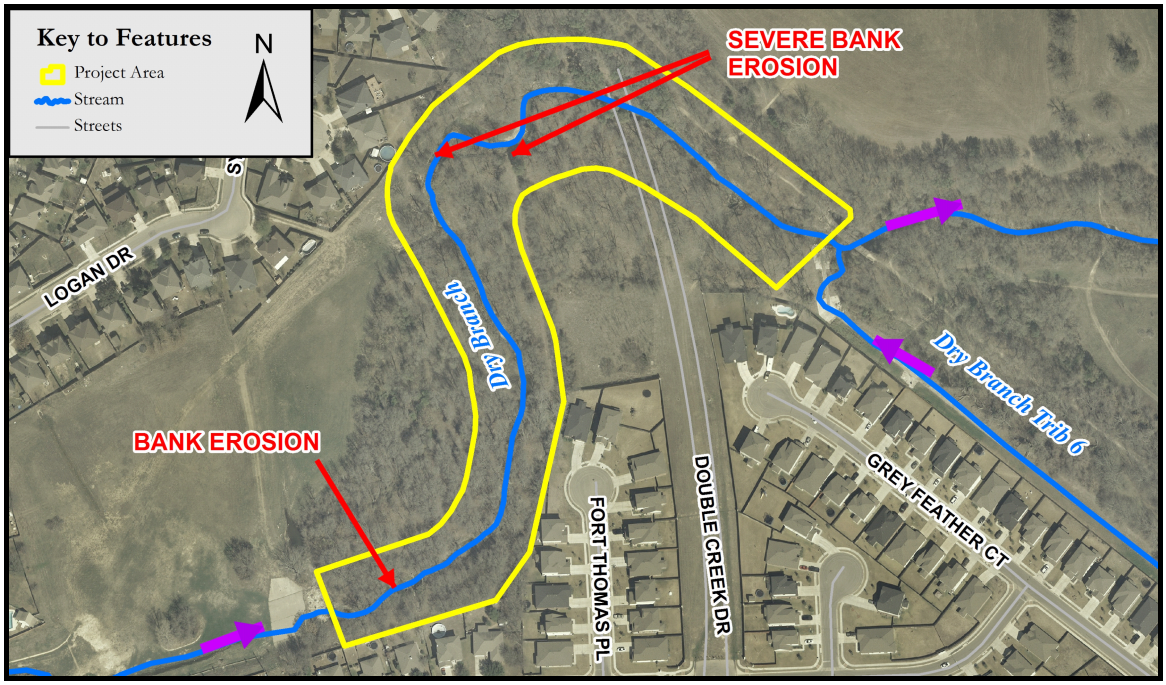
Project: 2013J - South Creek

Dry Branch

This 1700' reach is upstream of the existing railroad trestle located where Double Creek Drive would cross Dry Branch if it were extended. In this reach Dry Branch makes several meander bends each displaying significant bank scour. Several 100 feet of vertical scour with bank heights as much as 10' were observed. WCID hydraulic models indicate velocities upward of 14 fps and water depths of 17 feet in the 100-year event. Unchecked, these meanders may put the homes on Tenanza Cove and Sycamore Trail at risk. The eroded vertical bank is approximately 50' from the fence line of these homes. The land adjacent to this reach is undeveloped open space natural parkland. Although no trails or infrastructure exist in this park, unchecked bank scour certainly diminishes the use of this parkland and might add some risk to the patrons.



Reference Issues: DB31



Project: 2013J - South Creek

Dry Branch

Solution

Installment of longitudinal fill stone toe protection will help protect the outside curves of the meander from encroaching further on the homes along Tenaza Cove and Sycamore Trail. A "pyramid" of larger loose rock approximately 10 feet away from the existing toe will help resist erosive forces. The area behind the toe will be filled in with soil creating a gentler slope, armored with traditional Turf Reinforcement Mat (TRM), and revegetaed. This technique will reclaim some of the eroded bank would not require removal of any large trees. Placement of rock riffle grade control structures downstream and along the erosive area will provide additional energy dissipation. The grade control structures will increase the tailwater elevation and thereby reduce the stream "power" in the problem reach by reducing the slope

Challenges

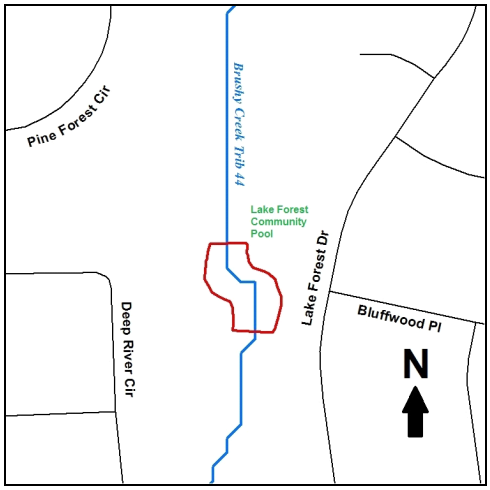
- Coordination with Parks Department
- This project may need to be timed with the extension of Double Creek Drive.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	0	0
Public Safety	Road Flooding and Mobility	22	0	0
Public Safety	Infrastructure Flooding and Erosion Threat	23	0	0
Public Safety	Property Damage	24	2	48
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Between $750k and $1M)	18	3	54
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	3	39
Project Timing	Ease of Permitting	13	3	39
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**250**

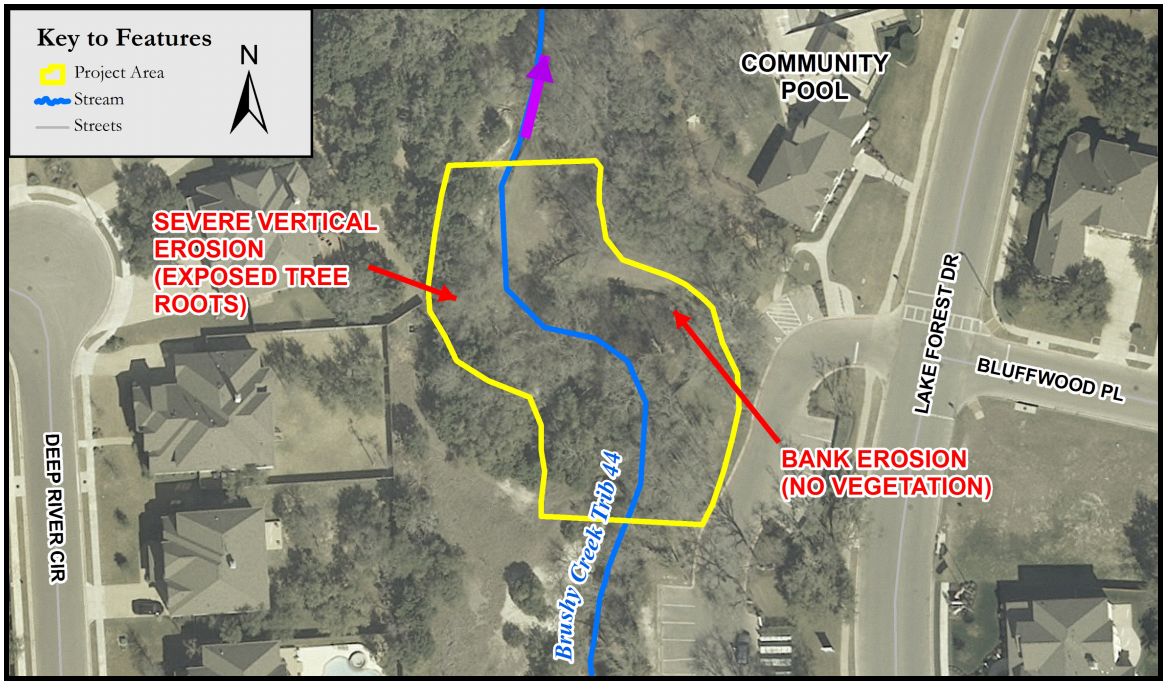
Project: 2013K - Lake Forest

Brushy Creek Tributary 44

A section of Brush Creek Tributary 44 parallels Lake Forest Drive for from Fernspring Drive to Bluffwood Drive. The channel bottom throughout this stretch has a bedrock bottom which creates high velocities in the channel. At the Lake Forest Community Pool, Brushy Creek Tributary 44 enters an S-curve with two approximately 90 degree bends. On the eastern slope of the first bend is a denuded slope with a metal fence on the top of the bank. The scoured slope is nearing the fence and will eventually undermine the fence. This bank also receives western sunlight and cannot support vegetation. The second bend forms a steep bank on the left bank (west). The vertical bank height approaches 10 feet and continued erosion will put several mature trees at risk of falling into the channel bottom.



Reference Issues: BC48



Project: 2013K - Lake Forest

Brushy Creek Tributary 44

Solution

The denuded banks of both bends are in need of resistive bank stabilization to prevent further erosion. Longitudinal fill stone protection (LFSTP) is a "pyramid" of larger loose rocks which will be located 5 to 10 feet from the existing toe. The area behind this longitudinal toe will be filled with soil, reclaiming some of the eroded slope. The resulting slope will be gentler and protected with traditional Turf Reinforcement Mat (TRM) and vegetated. The use of LFSTP will work around existing trees and provide soil that can be revegetated. A soil amendment to the first bend (western) which can include compost or fungi to create a proper "fungi to bacteria ratio" will help with moisture retention and allow vegetation to establish without temporary irrigation.

Challenges

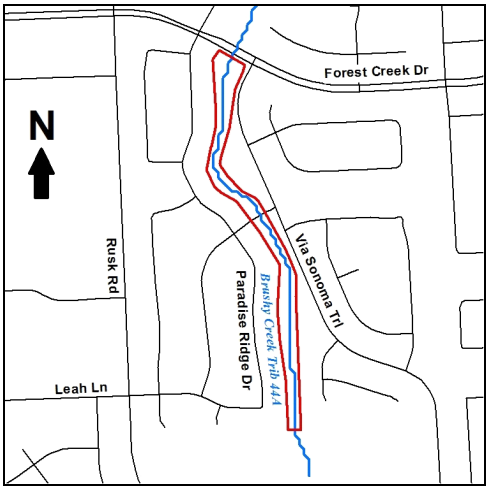
- Close coordination with the Forest Creek HOA will have to be undertaken due to the close proximity to the community pool.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	0	0
Public Safety	Road Flooding and Mobility	22	0	0
Public Safety	Infrastructure Flooding and Erosion Threat	23	0	0
Public Safety	Property Damage	24	1	24
Economic Impact	Funding Source	13	2	26
Economic Impact	Project Cost (Less than $250k)	18	5	90
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	3	39
Project Timing	Ease of Permitting	13	3	39
Project Timing	Land and Easement Acquisitions	14	4	56
			Project Score	**274**

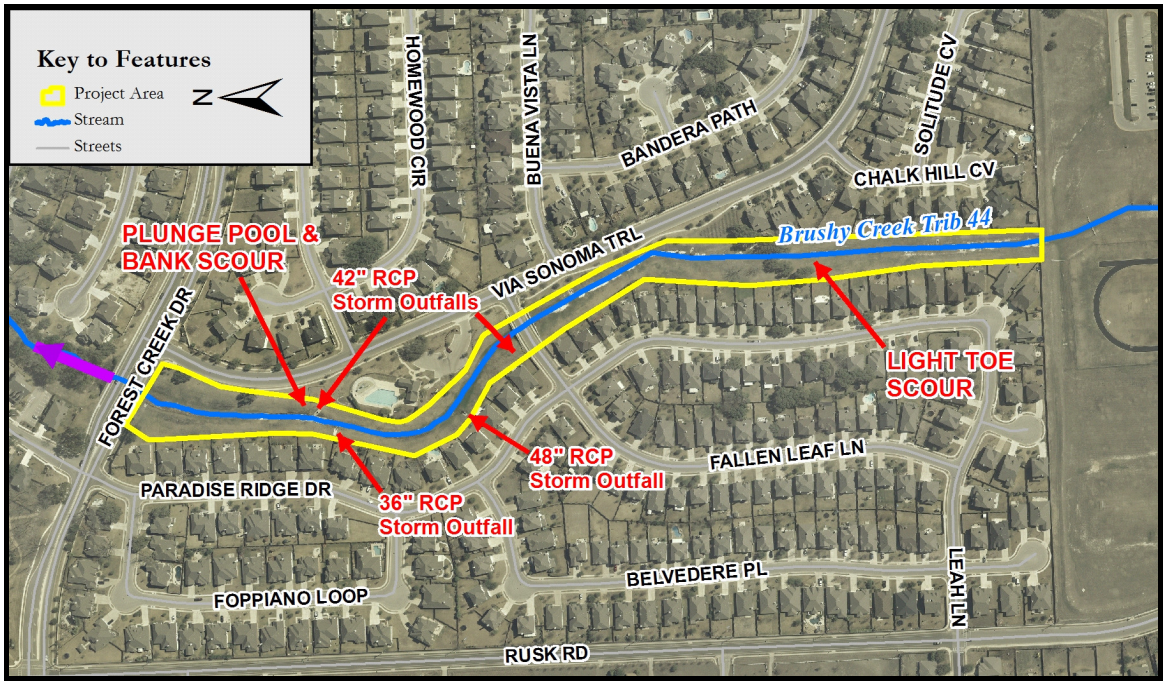
Project: 2013L - Sonoma at Forest Creek Drive

Brushy Creek Tributary 44A

This 2,400' reach parallels Via Sonoma Trail and extends from Leah Lane (southern end) downstream to Forest Creek Drive (northern end). The majority of the channel reach has scoured down to rock. Due to the increased velocity along the rock, the interface with the adjoining bank material is intermittently about one foot in height. Street drainage from Via Sonoma Trail is released into the tributary onto the right (eastern) bank. Although energy dissipation is provided at this headwall, the union with the channel flow has created a plunge pool. Plunge pools are nature's way of creating an energy dissipation feature. The problem at the plunge pool is that the rock-soil interface is being attacked and the banks have been cut roughly six feet deep.



Reference Issues: BC49



Project: 2013L - Sonoma at Forest Creek Drive

Brushy Creek Tributary 44A

ROUND ROCK, TEXAS
PURPOSE. PASSION. PROSPERITY.

Solution

Installment of resistive bank stabilization will protect the soil/rock interface at the toe of the channel. In order to slow localized velocities and reduce scour along the rock and soil interface, a thin rock filled gabion wire "revetment mattress" can be placed on top of the irregularly shaped rock invert. The mattress would extend horizontally out into the soil and the soil slopes regarded over the edges of the mattress and revegetated. Loose large rock rip rap can be placed in the "plunge pool" and extended up onto the vegetated soil banks. This would provide additional energy dissipation along with protecting the banks.

Challenges

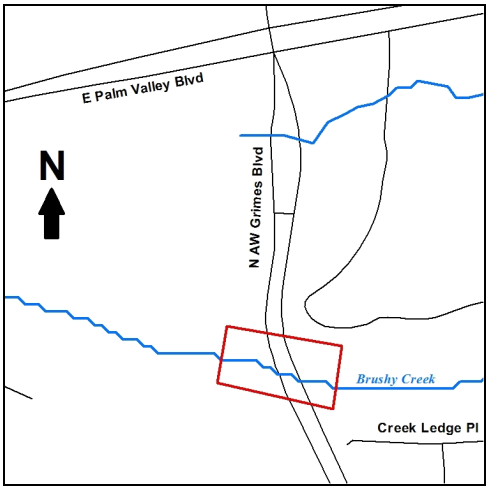
- None

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	0	0
Public Safety	Road Flooding and Mobility	22	0	0
Public Safety	Infrastructure Flooding and Erosion Threat	23	1	23
Public Safety	Property Damage	24	0	0
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Less than $250k)	18	5	90
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	1	13
Project Timing	Ease of Permitting	13	5	65
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**261**

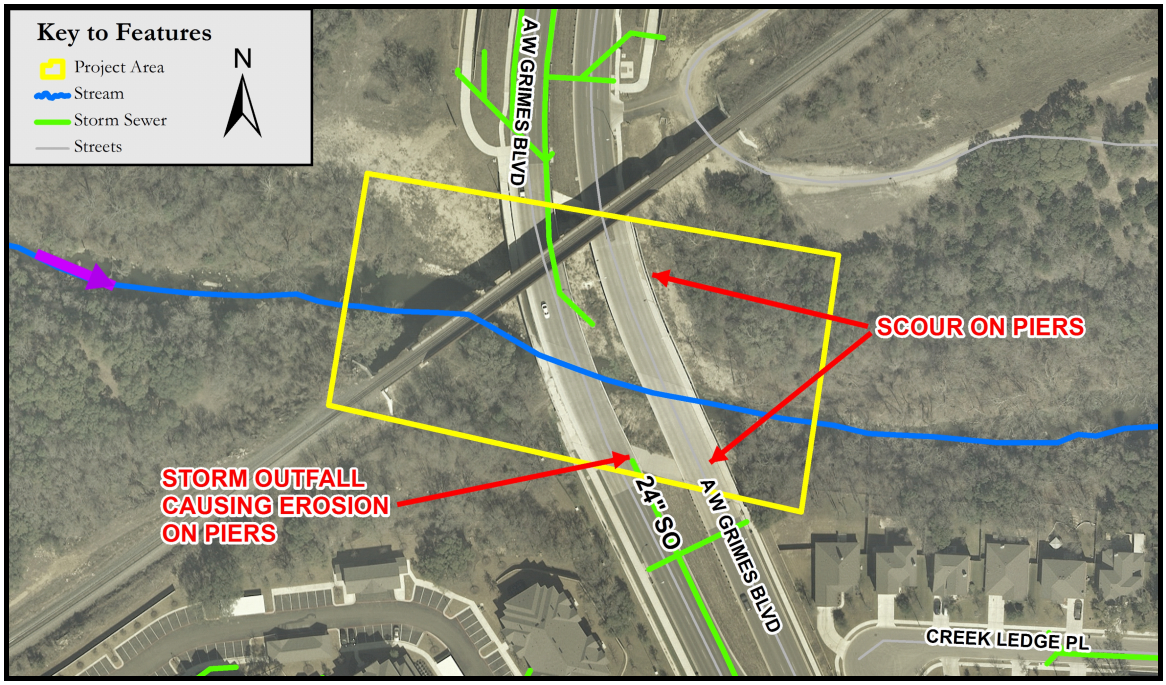
Project: 2013M - A.W. Grimes Blvd. at Brushy Creek

Brushy Creek

High velocities through Brushy Creek are scouring the bridge pears at A.W. Grimes Boulevard. There is no riparian vegetation along the creek banks or in the overbanks underneath the bridge leaving the bare soil susceptible to erosive forces. Additionally, a 24 in storm sewer pipe outfalls on the right (south) bank and is eroding around the adjacent piers to a depth of three to four feet. This storm outfall is also causing a plunge pool to form near the adjacent piers which is accelerating the bank scour. The continued erosion at the bridge piers could lead to foundational problems for the bridge crossing.



Reference Issues: BC54



Project: 2013M - A.W. Grimes Blvd. at Brushy Creek

Brushy Creek

Solution

Placement of large loose rock rip rap along the banks and around the piers will help protect the piers from further erosion. The scour channel and plunge pool formed by the storm outfall could be filled three-fourths of the depth with properly sized loose rock rip rap. Graded filter stone would be placed on the native soil before the larger rock rip rap is placed. This resistive measure will also provide energy dissipation to Brushy Creek.

Challenges

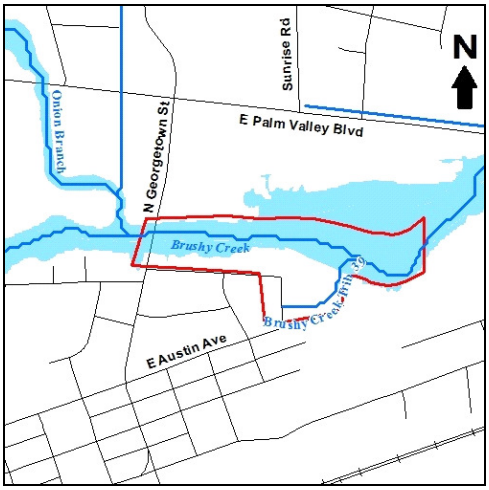
- The loose rock rip rap will have to be carefully sized and gradated to insure it does not wash downstream.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	0	0
Public Safety	Road Flooding and Mobility	22	0	0
Public Safety	Infrastructure Flooding and Erosion Threat	23	2	46
Public Safety	Property Damage	24	0	0
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Less than $250k)	18	5	90
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	1	13
Project Timing	Ease of Permitting	13	5	65
Project Timing	Land and Easement Acquisitions	14	5	70
			Project Score	**284**

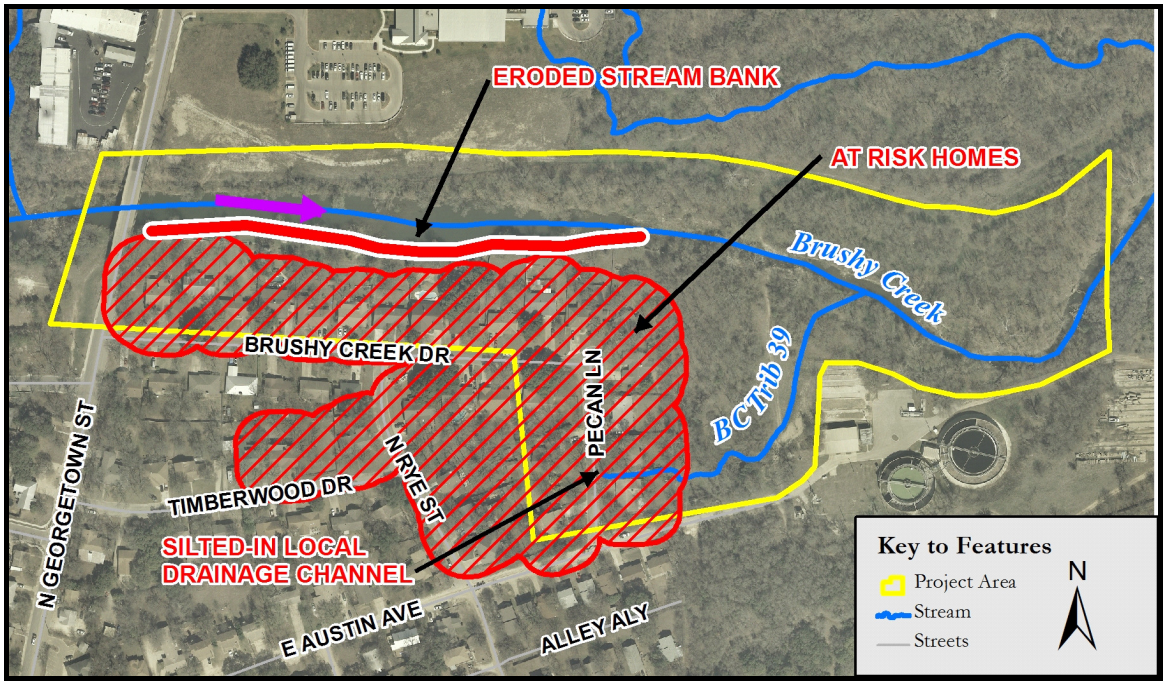
Project: 2013N - Brushy Slopes

Brushy Creek

Just downstream of Georgetown St., Brushy Creek parallels the south side of Palm Valley Blvd. and Brushy Creek Dr. Just downstream of Georgetown St. the right bank of Brushy Creek is experiencing severe bank erosion. Many of the residents along Brushy Creek Drive are losing property and fenclines due to the encroaching bank. Observations from the 10/31/13 flood event show that flow from the tributary upstream of Georgetown St. is pushing against the right bank and causing the vertical bank erosion. Brushy Creek Tributary 39 passes through a residential and drains into Brushy Creek further downstream. An 8' wide shallow local drainage flume had been developed between two homes composed of railroad timbers as vertical sidewalls. Over time silt has been deposited in that open channel such that it only has one foot of depth before it overflows into the adjacent residential lots. The WCID hydraulic models identify 30 structures as being a risk during the 100-yr storm event.



Reference Issues: BC56



Project: 2013N - Brushy Slopes

Brushy Creek

Solution

On the north bank underneath Georgetown Street, clear underbrush and remove "snags" that have formed which redirect flow to the south bank. Install resistive bank stabilization on the right bank just downstream from Georgetown Street. Recommend gabions stacked up to form an "L shaped" wall. All the time having the bank side of the stacked baskets kept in a nearly vertical (battered) line with the creek side being the stepped (terraced) face. The water is deep along this segment of Brushy Creek. Dewatering this right bank area for construction will be costly. The sediment in the residential flume on Tributary 39 needs to be cleaned out. Replacement of the timber flume with a stabilized conveyance channel is needed. A stabilized drop structure composed of a gabion basket is needed to pass flow from the residential flume downstream to Tributary 39.

Challenges

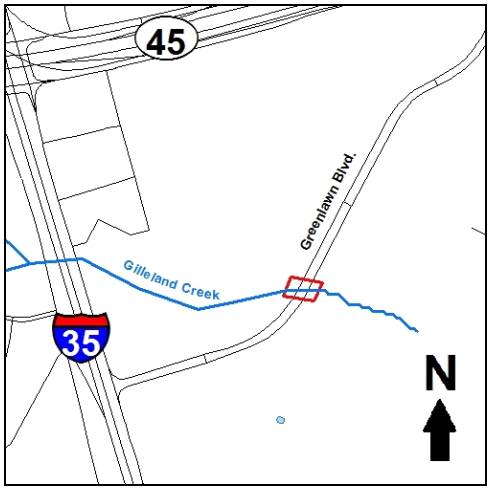
- Lack of drainage easements.
- Steep banks and deep water along Brushy Creek just downstream of Georgetown Street.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	3	81
Public Safety	Road Flooding and Mobility	22	1	22
Public Safety	Infrastructure Flooding and Erosion Threat	23	0	0
Public Safety	Property Damage	24	5	120
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Less than $250k)	18	5	90
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	0	0
Project Timing	Ease of Permitting	13	2	26
Project Timing	Land and Easement Acquisitions	14	4	56
			Project Score	**395**

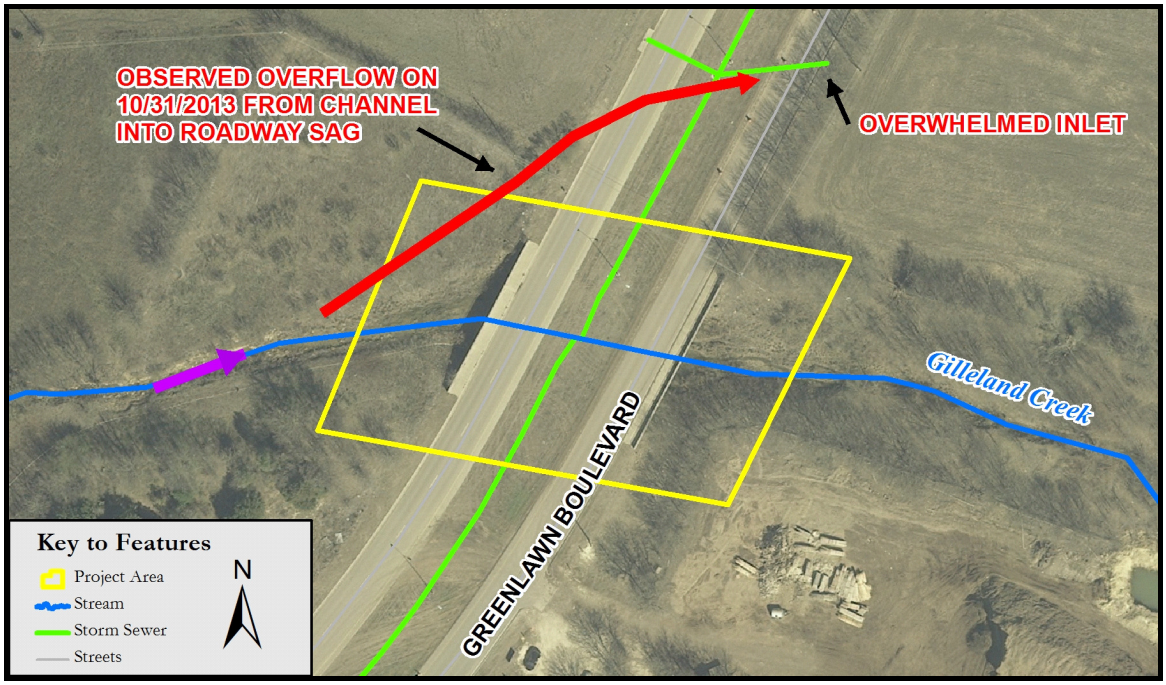
Project: 2013O - Greenlawn Blvd. at Gilleland Creek

Gilleland Creek

This 500' reach encompasses the Greenlawn Boulevard road crossing of Gilleland Creek just east of IH-35. Greenlawn Boulevard is a four lane major arterial roadway. The existing structure has six box culverts. Three of the six boxes (outside ends) have accumulated sediment which restricts their flow carrying capacity. The Gilleland 2009 LOMR (09-06-1966P-481026) indicates Greenlawn Blvd. overtops 4.2' in the 100-year ultimate condition event. The multiple box culverts at Greenlawn Blvd. are much wider than the approaching channel. It appears that there is a headloss at this expansion point. Greenlawn Boulevard has a "sag" or low point in the roadway just north of the Gilleland Creek crossing. Site observations after the October 31, 2013 flood indicated an overflow from the left side of the upstream (west) headwall diagonally across all lanes of the roadway and then exiting the eastern right-of-way near the sag inlet. This overflow created a deep pool causing the roadway to be closed during the flood



Reference Issues: GC83



Project: 2013O - Greenlawn Blvd. at Gilleland Creek

Gilleland Creek

Solution

Extension of the upstream concrete headwall to the north (left bank) along with an earthen (or rock) berm on the left edge of the floodplain would help transition the flow into the culverts. The extend headwall will allow for the hydraulic head to buildup on the upstream side and push more flow through the existing culvert system instead of flowing over the roadway. Consideration may need to be given to "disconnect" the inlet and pipe infrastructure from the culverts and have them work independently to collect and convey the local runoff at the sag to the east in an independent open channel.

Challenges

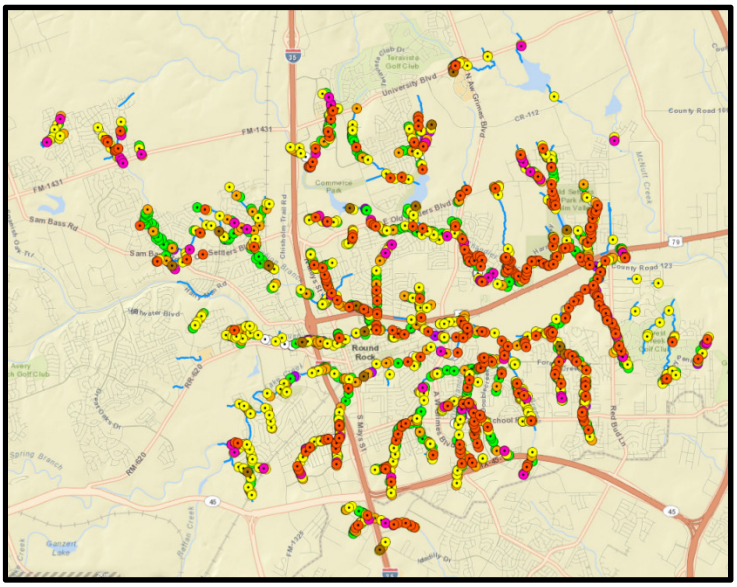
- Traffic control during construction.

- Coordination with adjacent land owner regarding the extension of the upstream headwall. The work would be in public ROW, but coordination could be beneficial. Provide for "local drainage" from the adjoining tract into the street ROW.

Type	Category	Weight	Score	Resultant Value
Public Safety	Emergency Access	27	4	108
Public Safety	Road Flooding and Mobility	22	4	88
Public Safety	Infrastructure Flooding and Erosion Threat	23	1	23
Public Safety	Property Damage	24	0	0
Economic Impact	Funding Source	13	0	0
Economic Impact	Project Cost (Less than $250k)	18	5	90
Economic Impact	Economic Development	13	0	0
Environmental Impact	Riparian Corridor Project	13	0	0
Project Timing	Ease of Permitting	13	2	26
Project Timing	Land and Easement Acquisitions	14	3	42
			Project Score	**377**

City of Round Rock
Storm Water Master Plan

Appendix A.3
Project Scoring Sheet



Prepared For:
City of Round Rock
Utilities & Environmental Services
Stormwater Management

ROUND ROCK, TEXAS
PURPOSE. PASSION. PROSPERITY.

Prepared By:
Halff Associates, Inc.
4030 West Braker Lane, Suite 450
Austin, TX 78759
Texas Firm Registration No. F-312

HALFF

Project Number: R-12-10-11-G11

Project Scoring Sheet

Projects rankings are based on ten (10) categories that are each assigned a weighted numeric factor. Use the criteria on the following pages to determine the score for each category. Then multiply that score by the weighted factor in the table and add the resultant values to determine the project's total score.

Type	Category	Weight	Score	Resultant Values
Public Safety	Emergency Access	27		
Public Safety	Road Flooding and Mobility	22		
Public Safety	Infrastructure Flooding and Erosion Threats	23		
Public Safety	Property Damage	24		
Economic Impact	Funding Source	13		
Economic Impact	Project Cost	18		
Economic Impact	Economic Development	13		
Environmental Impact	Riparian Corridor Project	13		
Project Timing	Ease of Permitting	13		
Project Timing	Land and Easement Acquisitions	14		
			Project Score	

Category Criteria

Below are the projects ranking categories, a brief description of the criteria for each category, and a scale to rank the criteria to determine the score for each category.

Emergency Access: Potential for significantly impacting ingress/egress during an ultimate 1% annual chance (100-year) flood event. Priority routes and service areas should be included.

Impassable with no alternative route	5
Impassable but alt route available	4
Response time increased more than three minutes	3
Passable but response time increased	2
Passable	1
None	0

Road Flooding and Mobility: Rank based on the type of street and the potential for flooding during an ultimate 1% annual chance (100-year) or 4% annual chance (25-year) flood event that will affect the general public mobility.

Moving water is likely to wash car off road*	5
Arterial (1% or 4%) flooded	4
Collector (4%) flooded	3
Collector (1%) or Local Roadway (4%) flooded	2
Local Roadway (1%)	1
None	0

*Depth and velocities considered utilizing 1% event.

Infrastructure Flooding and Erosion Threats: Potential that public infrastructure may be damaged due to flooding during an ultimate 1% annual chance (100-year) event or associated creek erosion. Rankings should consider risk and scope of critical infrastructure loss. Critical infrastructure includes water & wastewater utilities, public roads, and dams.
(Power may be used to determine risk, Power= Q*Slope*weightH2O)

Imminent risk of infrastructure failure	5
Imminent risk of infrastructure compromised	4
Moderate risk of infrastructure failure	3
Moderate risk of infrastructure compromised	2
Likely to threaten infrastructure in the future	1
None	0

Property Damage: Potential that property damage will be impacted during an ultimate 1% annual chance (100-year) flood. Ranking should consider the number of residential and commercial structures that may be flooded. Critical facilities include health and safety facilities, utilities, government facilities and hazardous materials facilities. (May include property loss due to erosion also)

10+ or critical facility effected	5
5-10 flooded	4
3 -5 flooded	3
2 flooded	2
1 flooded	1
None	0

Funding Source: Rank is based on the type of funding source.

Development or Partnership Funded	5
Joint project with no grants or other conditions	4
100% City funded	3
Funded with grants or joint project with conditions	2
Partially Committed	1
Not Available	0

Project Cost: Estimated cost of construction.

Less than $250,000	5
Between $250,000 and $750,000	4
Between $750,000 and $1,000,000	3
Between $1,000,000 and $2,000,000	2
Between $2,000,000 and $5,000,000	1
More than $5,000,000	0

Economic Development: Potential that construction of the project will positively impact economic development through reclamation of floodplain or prevention of creek erosion. Consider highest and best use development.

Opportunity for new commercial	5
Opportunity for new residential	4
Opportunity for additional commercial	3
Opportunity for additional Residential	2
Reclaim park space/ open space	1
No changes to existing development	0

Riparian Corridor[1] Protection: Potential that the project will improve the existing riparian corridor or maintain an otherwise healthy corridor. Rankings should consider natural channel design best management practices. (Trees, riffles & pools, lower velocities, etc.)

Meets more than 8 BMPs	5
Meets 7-8 BMPs	4
Meets 5-6 BMPs	3
Meets 3-4 BMPs	2
Meets 1-2 BMPs	1
None	0

[1] A riparian corridor is defined as a native plant community consisting of vegetation growing near a river, stream, creek, lake or other natural body of water creating a buffer between the creek and developed land.

Ease of Permitting: Consider the amount of time and complexity for applicable permitting. Use examples as a guide for other permits.

No permits	5
6 months or less no mitigation	4
6 months or less (WPAP & Nationwide)	3
7-12 months (CLOMR/ LOMR)	2
13-18 months (multiple)	1
18-24 months (Individual Permit)	0

Land and Easement Acquisition: Potential for added cost, complexity, and time through purchasing or condemnation with land and easement acquisition.

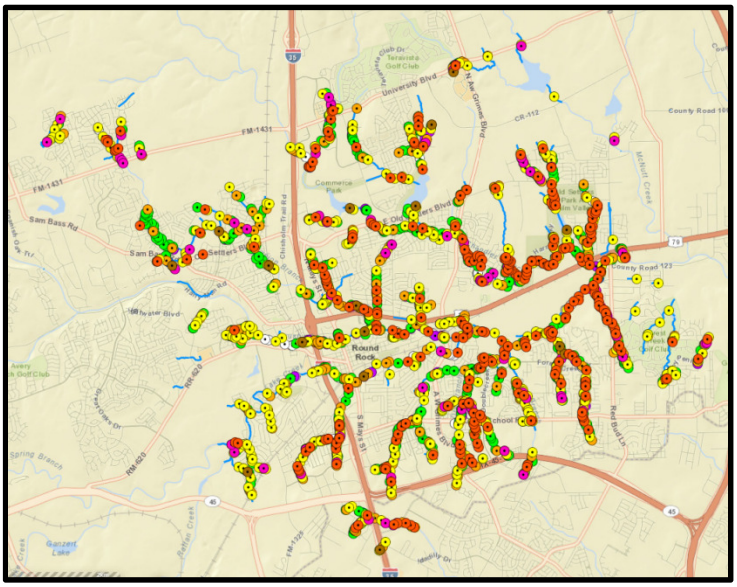
No acquisition required	5
All donated	4
Some purchase/ some donations	3
All purchased	2
Some condemnation required	1
Condemnation required for all	0

Appendix B

GIS Interface

City of Round Rock
Storm Water Master Plan

Appendix B.1
Connecting to a SDE Database



Prepared For:
City of Round Rock
Utilities & Environmental Services
Stormwater Management

ROUND ROCK, TEXAS
PURPOSE. PASSION. PROSPERITY.

Prepared By:
Halff Associates, Inc.
4030 West Braker Lane, Suite 450
Austin, TX 78759
Texas Firm Registration No. F-312

HALFF

Project Number: R-12-10-11-G11

B. GIS Interface

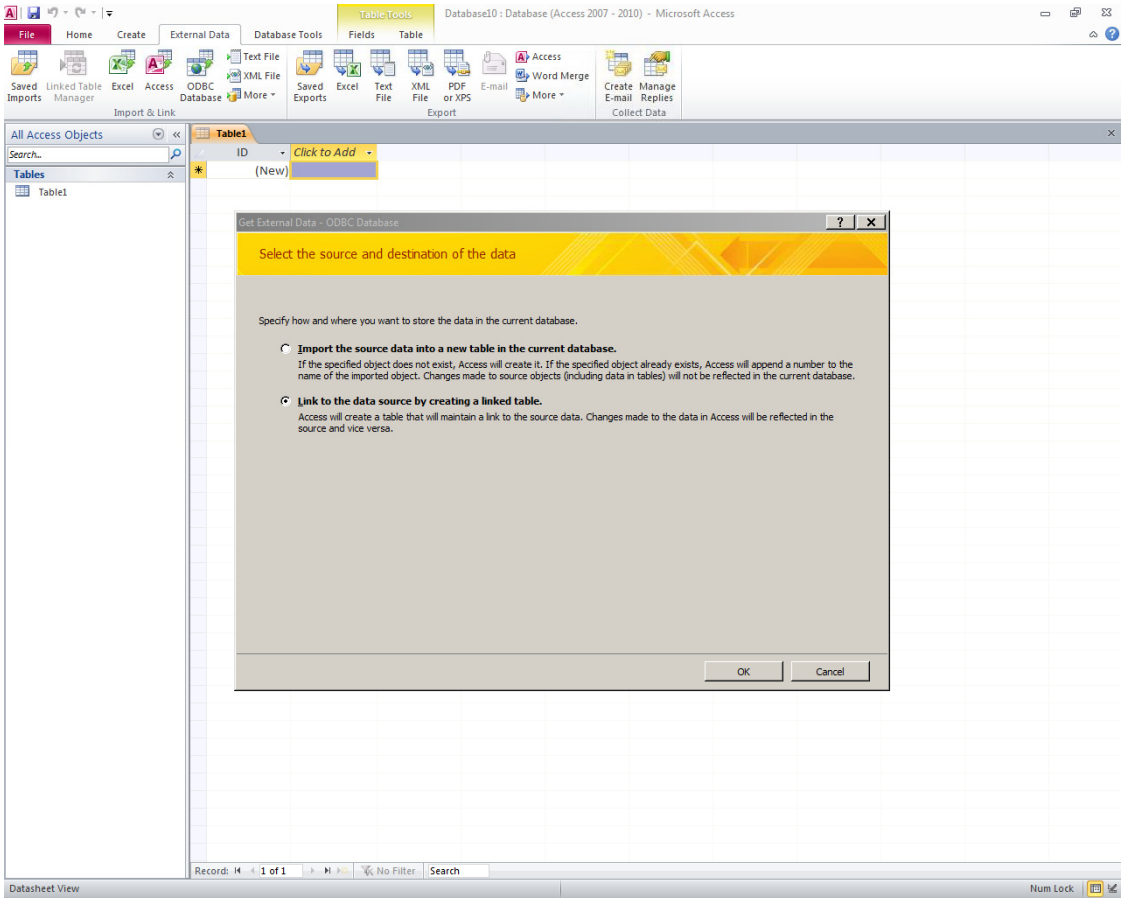
The following paragraphs outline workflows to complete common database tasks.

1. Connecting to a SDE Database

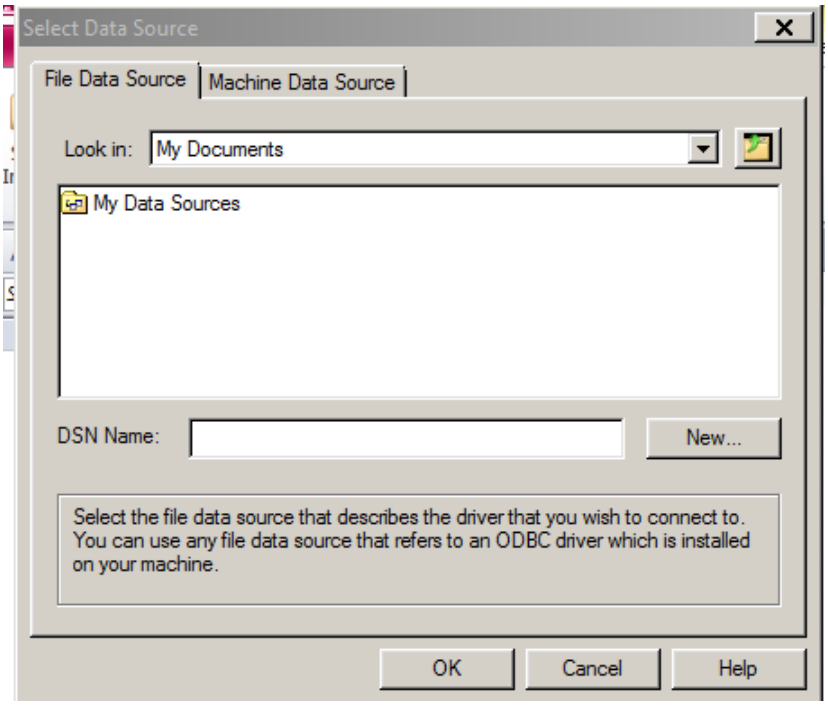
A connection to the SDE Database through Microsoft Access is created with a Data Source (.dsn) file. This file stores the connection information between Microsoft Access and the SDE Database used by the ODBC Database Connection to connect to the SDE Database.

i) Creating a .dsn file.

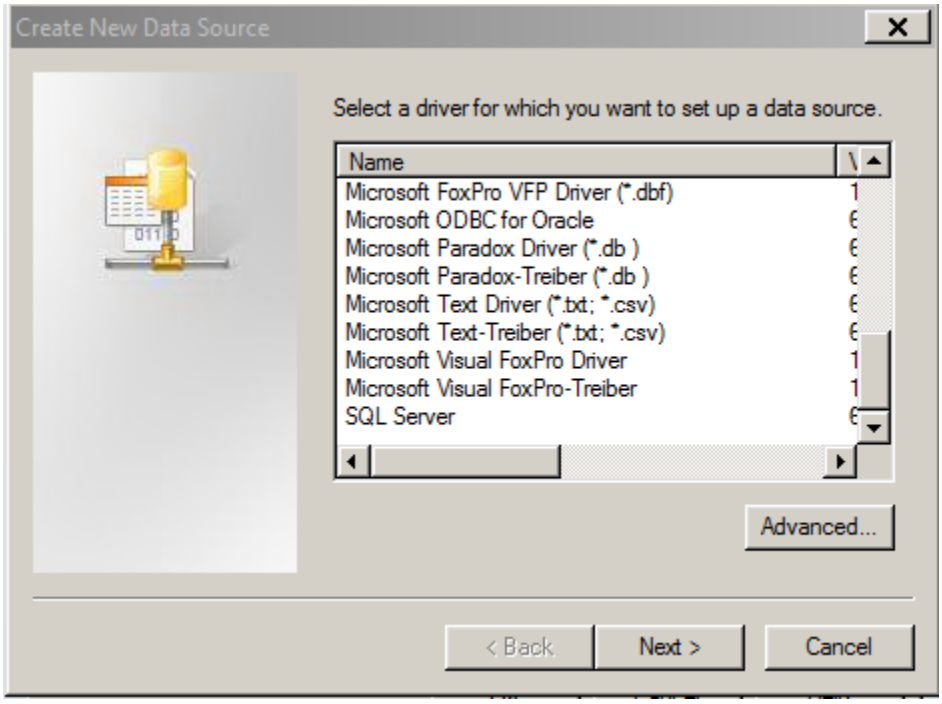
To create a .dsn click the ODBC Connection tool from the External Data Ribbon in the Access Database. Check the "Link to the data source by creating a linked table" Button and Click "OK". This opens the "Select Data Source Window".



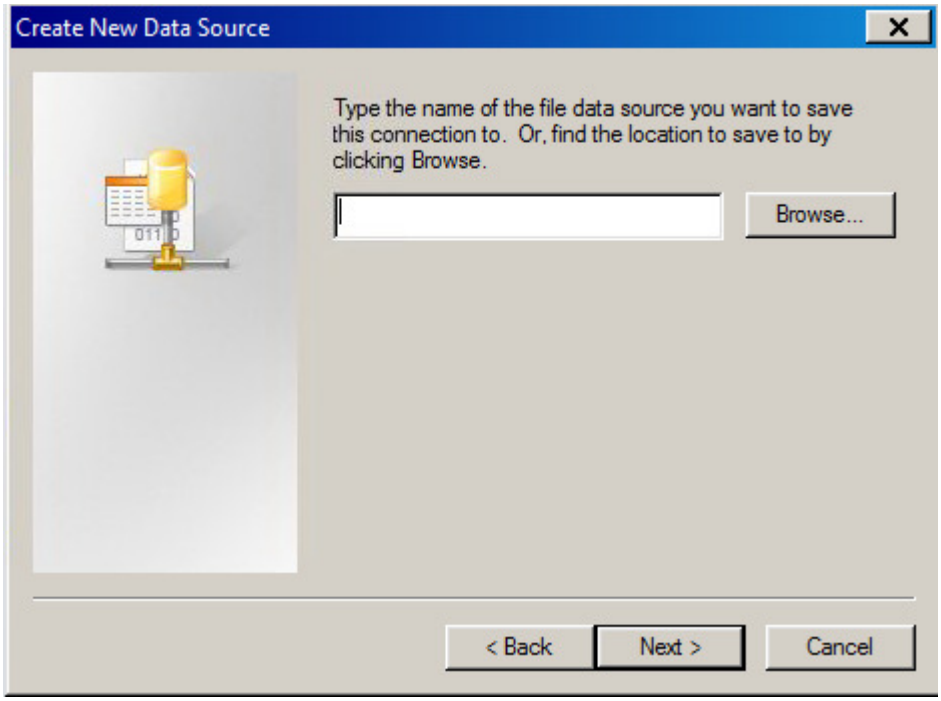
In the "Select Data Source Window" either select an existing DSN file name, or click "New…" to create a DSN file. Click "New…" This opens the Create Data Source Wizard.



In the Create New Data Source Window, click the appropriate diver (SQL Server is on the bottom). Select the correct Driver then click next.



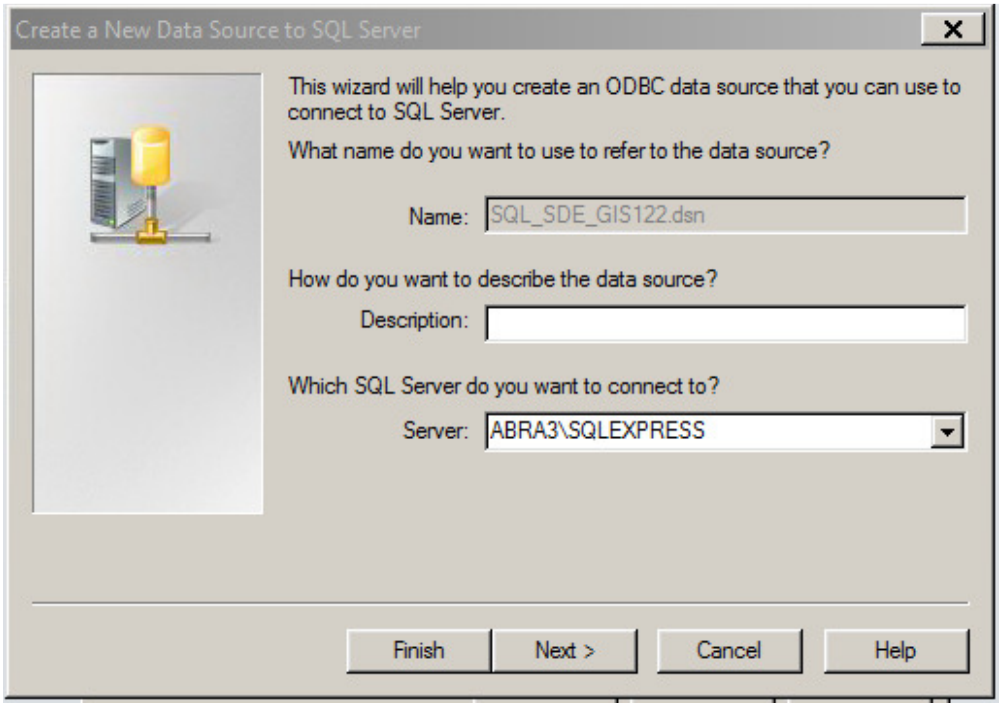
In the next window, Use the browse button to select the file name and location to store the Data Source File. Then Click "Next".



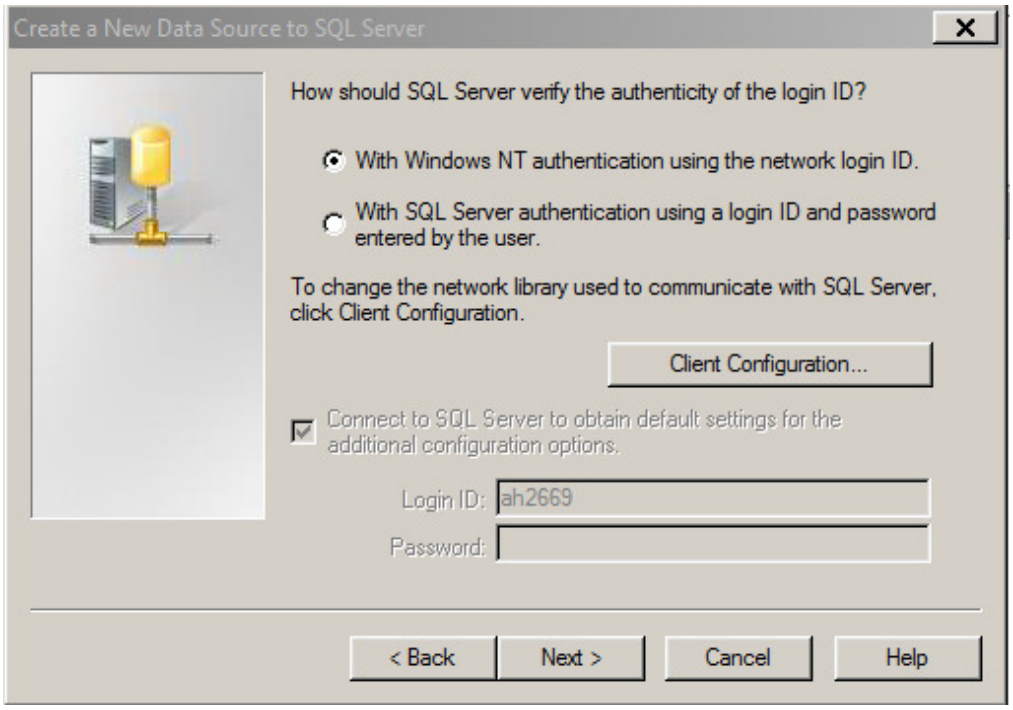
In the final window, verify that all of the Data is correct: Filename and Driver. If so, Click "Finish". This ends the "Create Data Source File Wizard, and opens the "Create a New Data Source to SQL Server Wizard".

(ii) Create an "ODBC Database Connection"

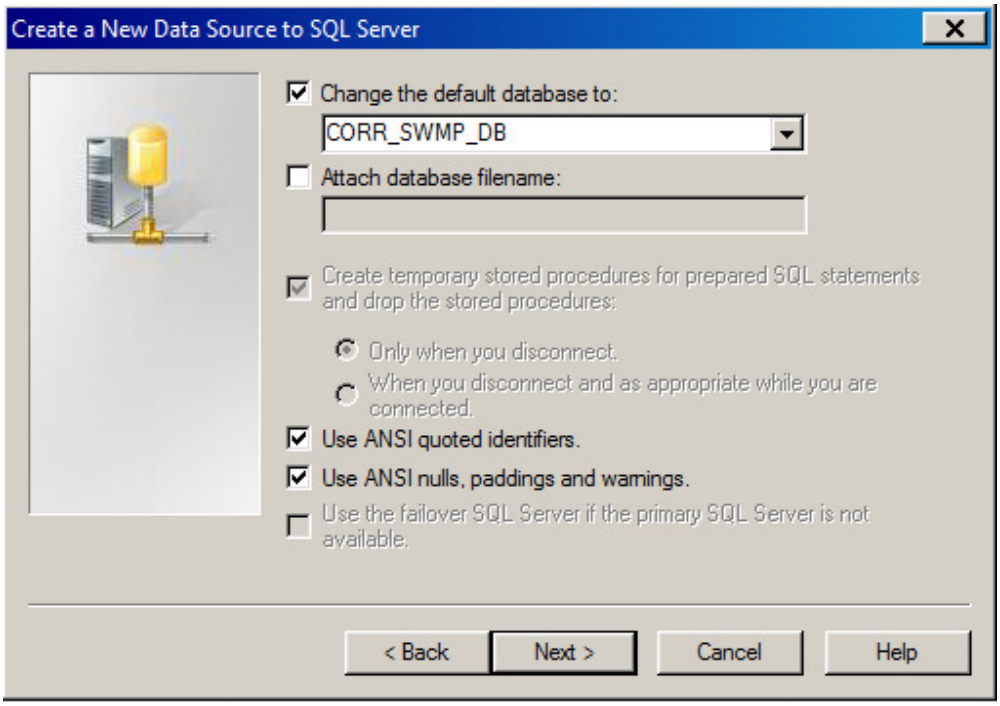
If the "Create a New Data Source to SQL Server" Window is not already opened, click the ODBC Database button in the External Data Ribbon. The "Name:" field should be populated with the .DSN file you just created or selected. Fill in the Description field and Select the Server to connect to.



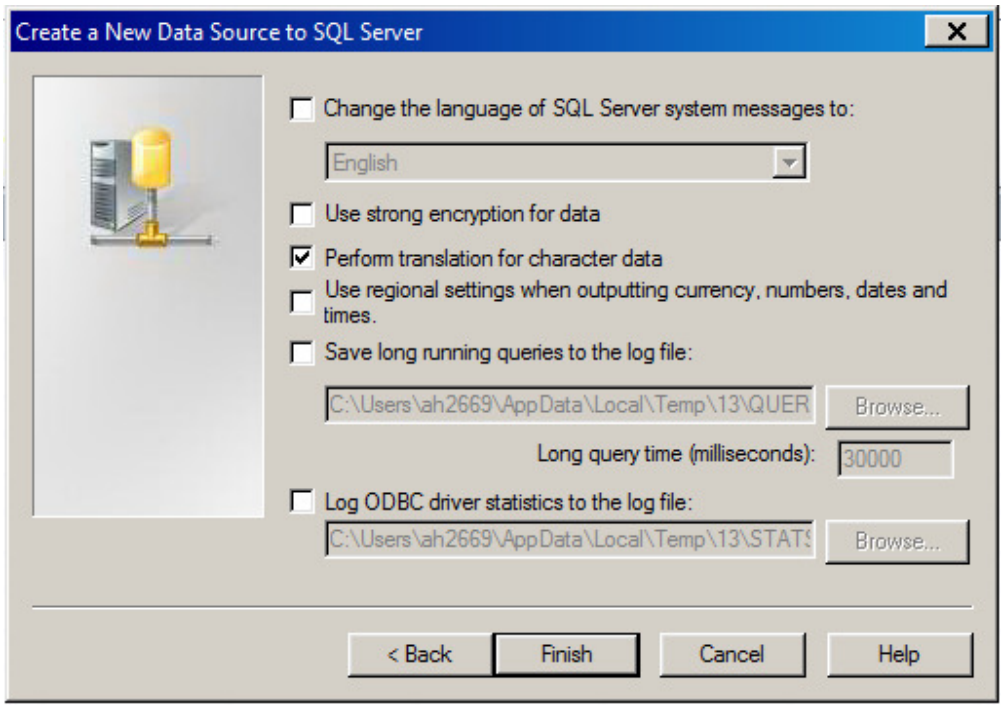
Populate any authentication LoginID or Password fields as needed. Then click "Next".



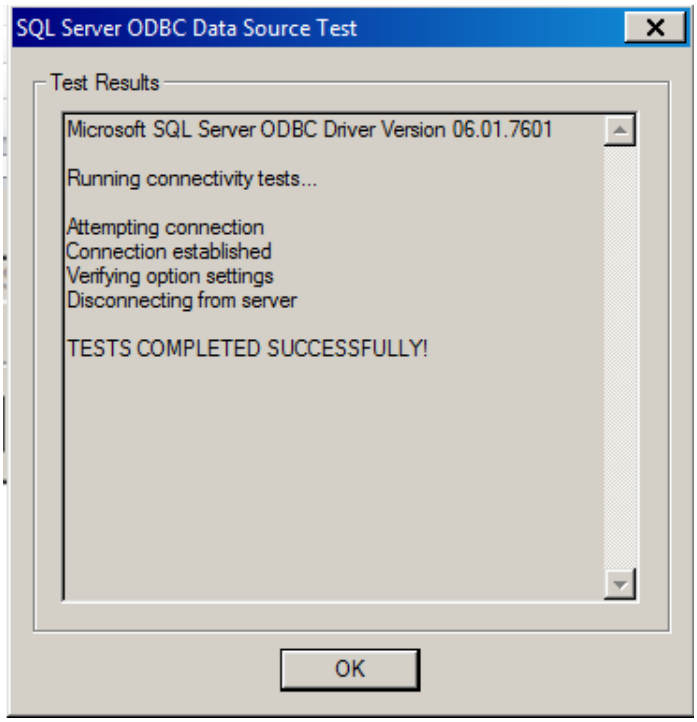
Change the Default database to the database that is being connected to. Then click "Next".



Change any settings as needed and click “Finish”

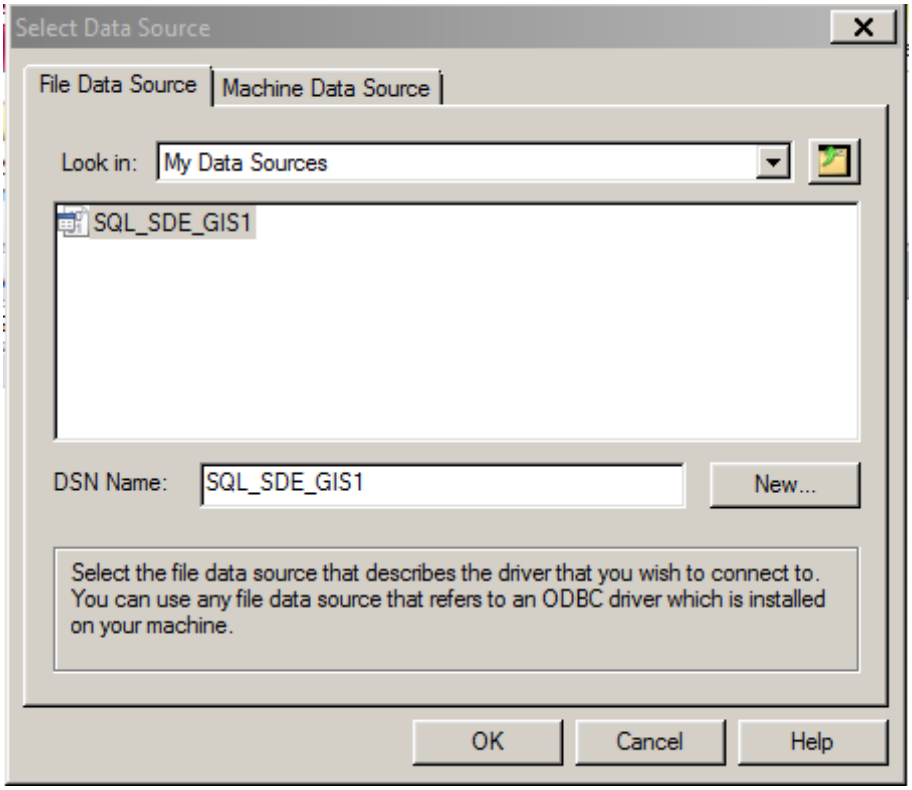


In the “ODBC Microsoft SQL Server Setup” Window, Click “Test Data Source…” to verify the connection.

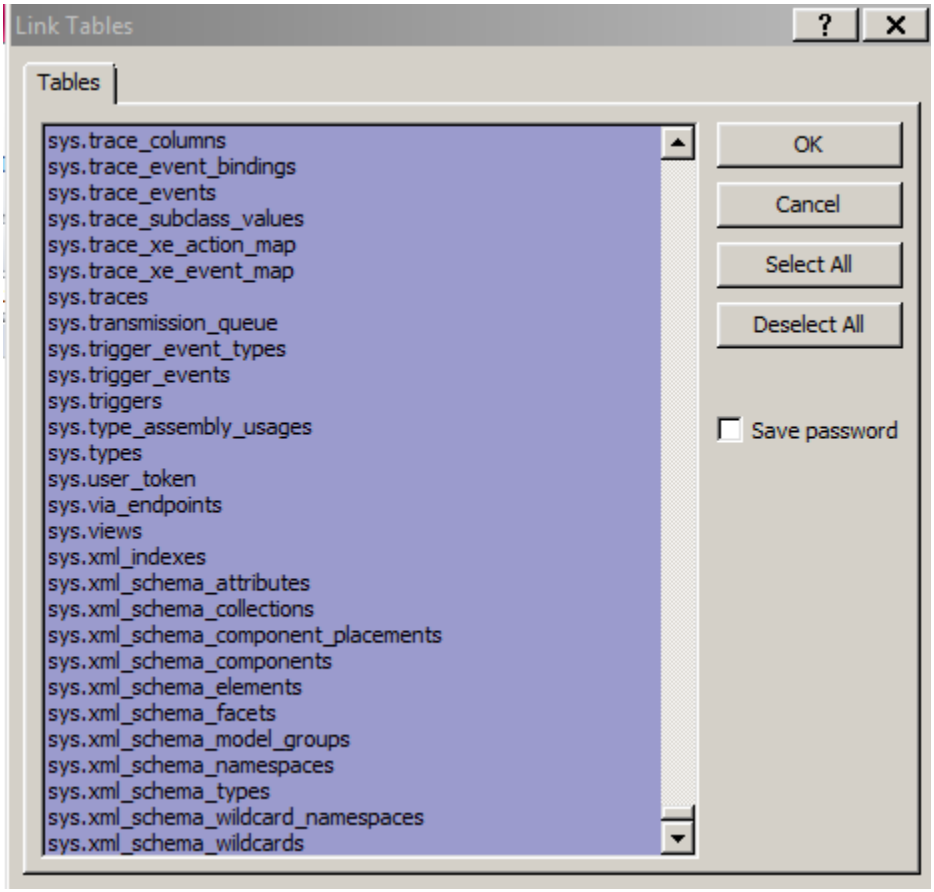


If successful click, “OK”, and the “OK” again. This creates a DSN file. In the window that opens, select the correct DSN file and click “OK”.

If not success, verify all connection authentication and settings then try again.

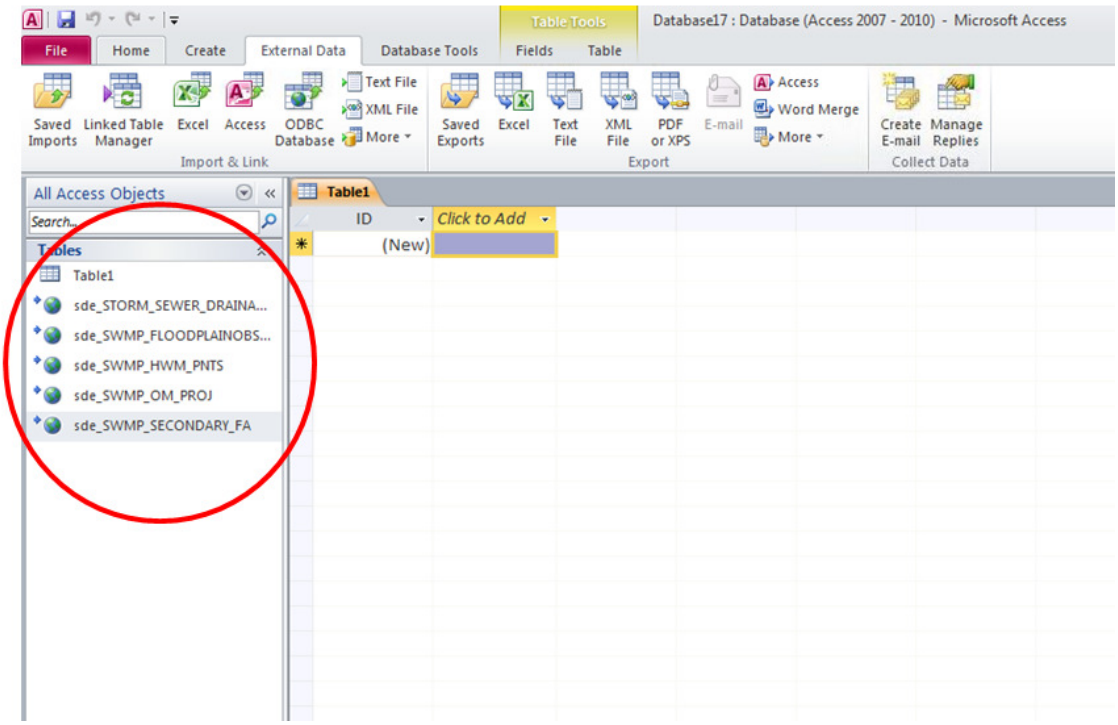


The next window contains all the Database tables that are available to link to. Select the desired tables to link to then click "OK".



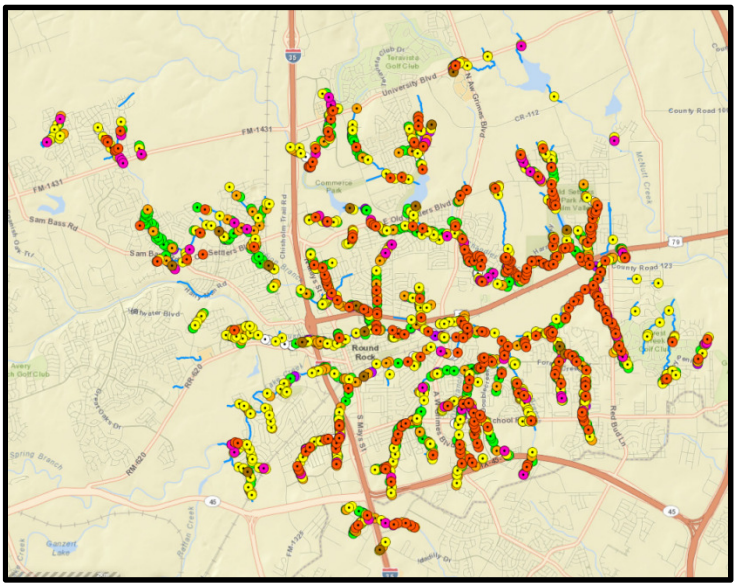
The selected tables are imported as a Link into the Access Database. **Any changes made in the database will reflect in Microsoft Access and the original connected Server.**

The linked Tables (illustrated with a globe and arrow) can be seen in the Access Objects Task pane.



City of Round Rock
Storm Water Master Plan

Appendix B.2
Managing Relationship Classes



Prepared For:
City of Round Rock
Utilities & Environmental Services
Stormwater Management

ROUND ROCK, TEXAS
PURPOSE. PASSION. PROSPERITY.

Prepared By:
Halff Associates, Inc.
4030 West Braker Lane, Suite 450
Austin, TX 78759
Texas Firm Registration No. F-312

HALFF

Project Number: R-12-10-11-G11

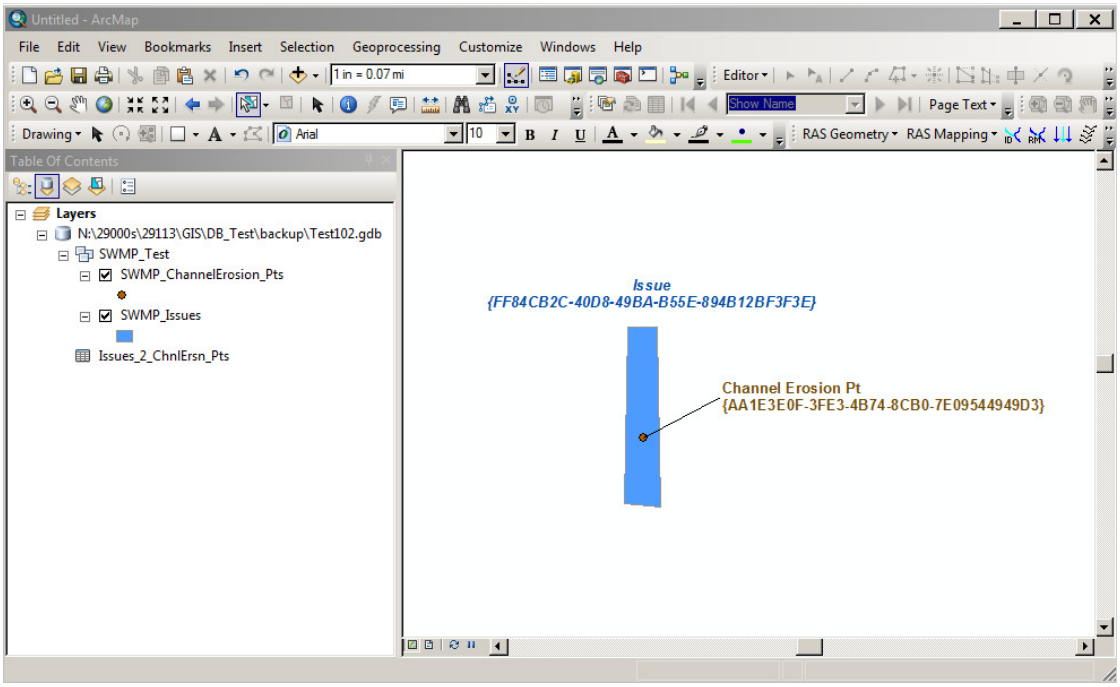
B. GIS Interface

2. Managing Relationship Classes

If a feature that is "Related" (Overlapping and relevant to another feature), a "Relationship" is needed to related the two features to each other within the database. This is done with an existing table in the SWMP Feature Dataset of the Database. The tables below illustrate the relationships in the database.

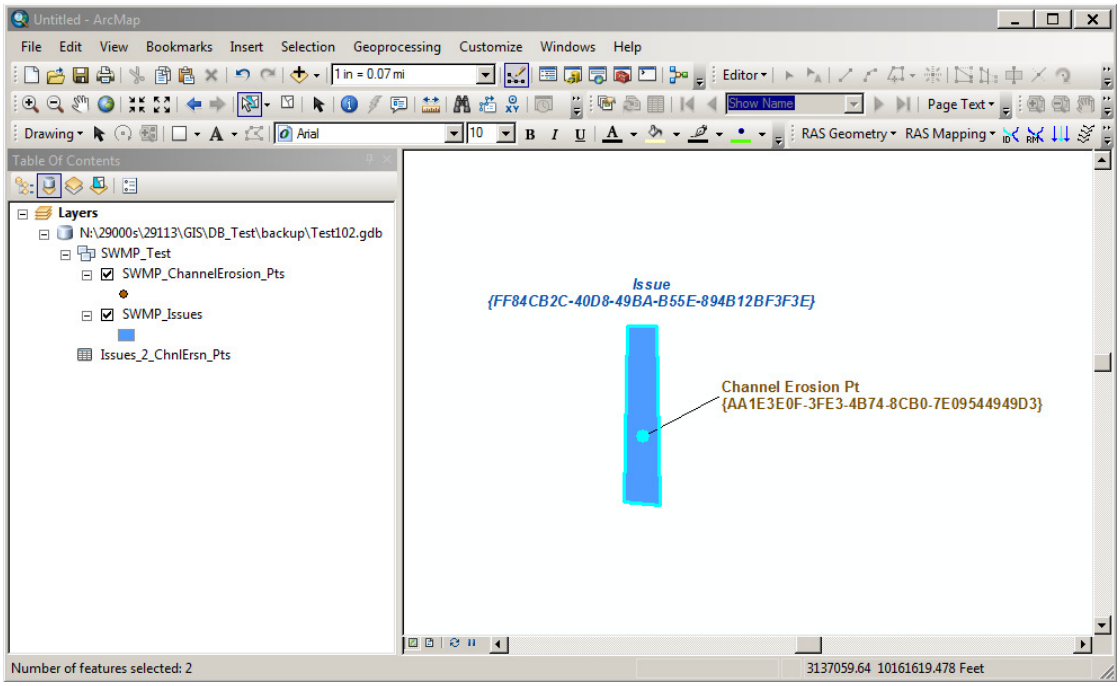
CIP to Issues
CIP to O&M Projects
Issues to Channel Erosion Points
Issues to Dam Points
Issues to Drainage Issue Points
Issues to Floodplain Observation Points
Issues to General Data Points
Issues to High Water Mark Points
Issues to Road Crossing Points
Issues to Storm Outfall Points
Issues to Structure Points
Issues to Utility Points
Issues to Water Quality Points

O&M to Channel Erosion Points
O&M to Dam Points
O&M to Drainage Issue Points
O&M to Floodplain Observation Points
O&M to General Data Points
O&M to High Water Mark Points
O&M to Road Crossing Points
O&M to Storm Outfall Points
O&M to Structure Points
O&M to Utility Points
O&M to Water Quality Points

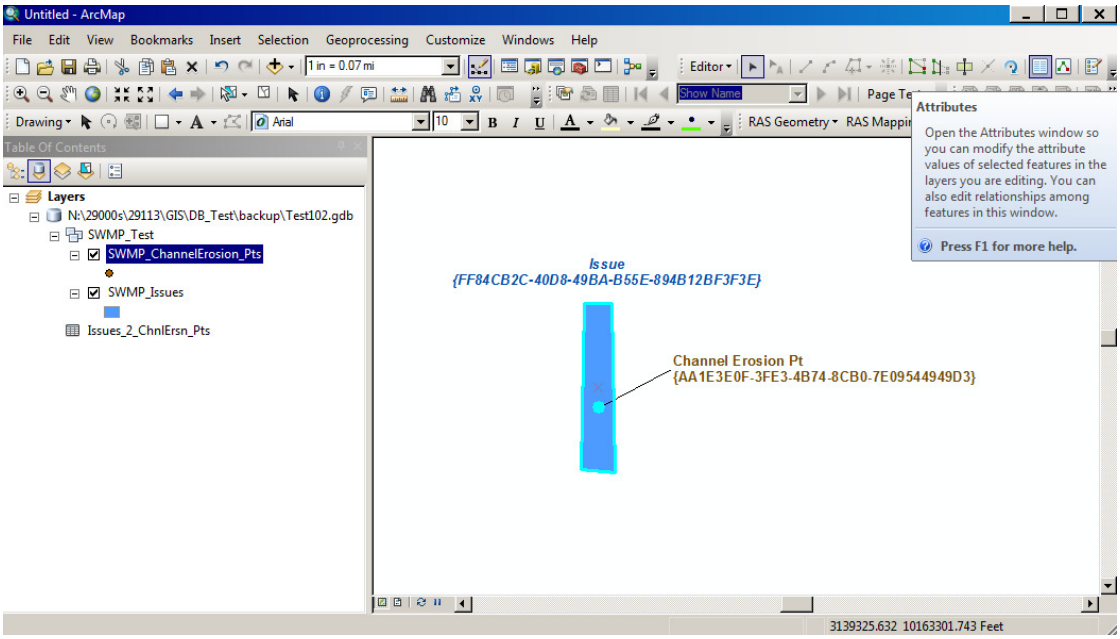


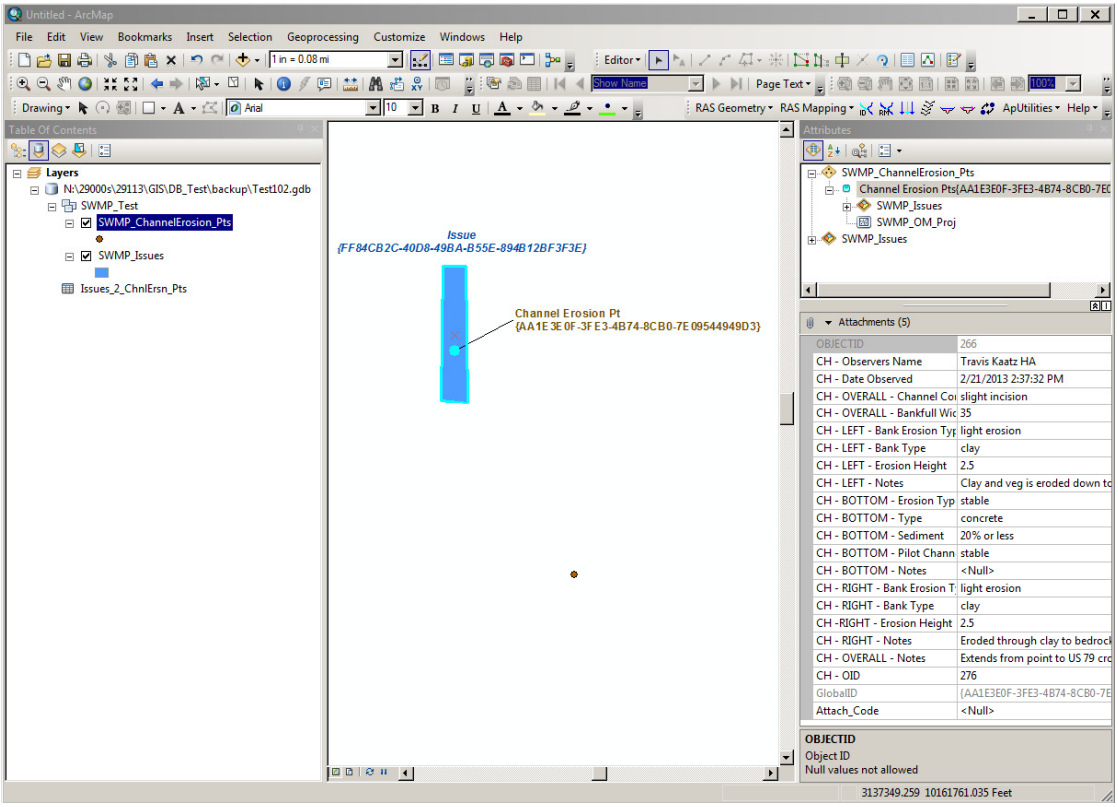
i. Creating a relationship

If a feature that is "Related" (Overlapping and relevant to another feature), a "Relationship" is needed to related the two features together within the database. To create a Relationship, first select the two related features in ArcGIS.

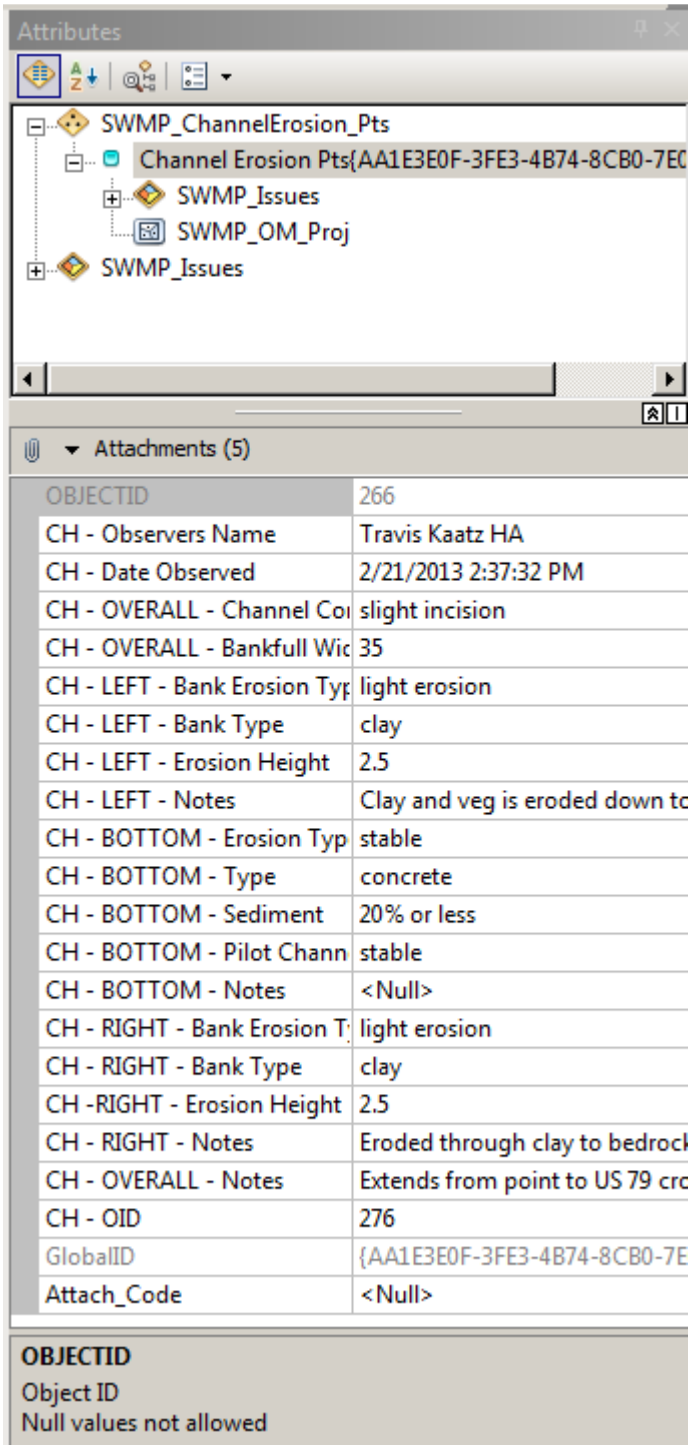


Enable Editor for either feature class being related. Then Click on the Attribute Button.

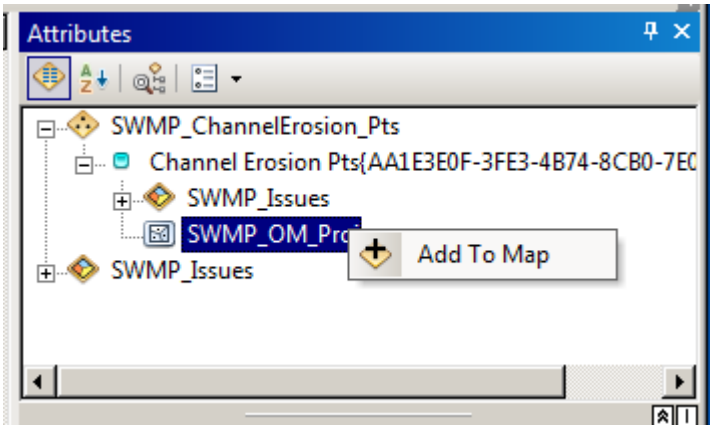




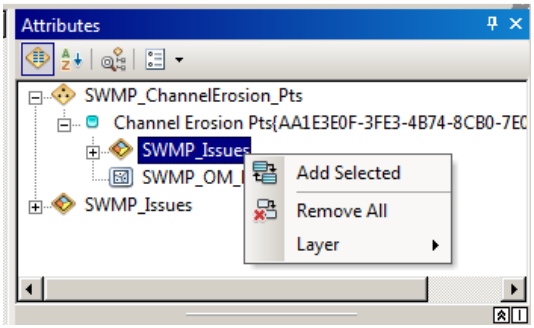
In the Attribute Task Pane, the relationships between the feature classes can be seen. The SWMP_ChannelErosion_Pts feature class is shown first, and then when the "+" button next to the feature class is pressed the Related Features are listed. If that related feature class is loaded in the opened Map Document (.mxd) then the feature is colored (ie SWMP_Issues). If the Feature Class is not in the map, then it appears gray (ie SWMP_OM_Proj).

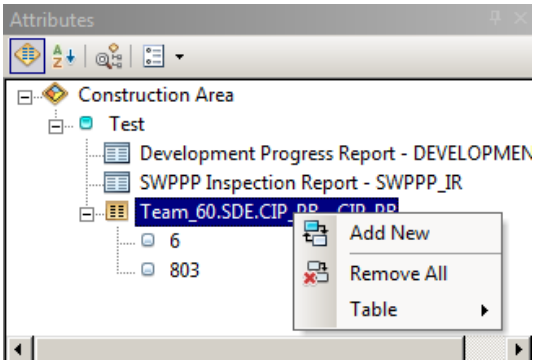


*Add the feature class not currently in the Map Document by right click the feature and select “Add To Map”

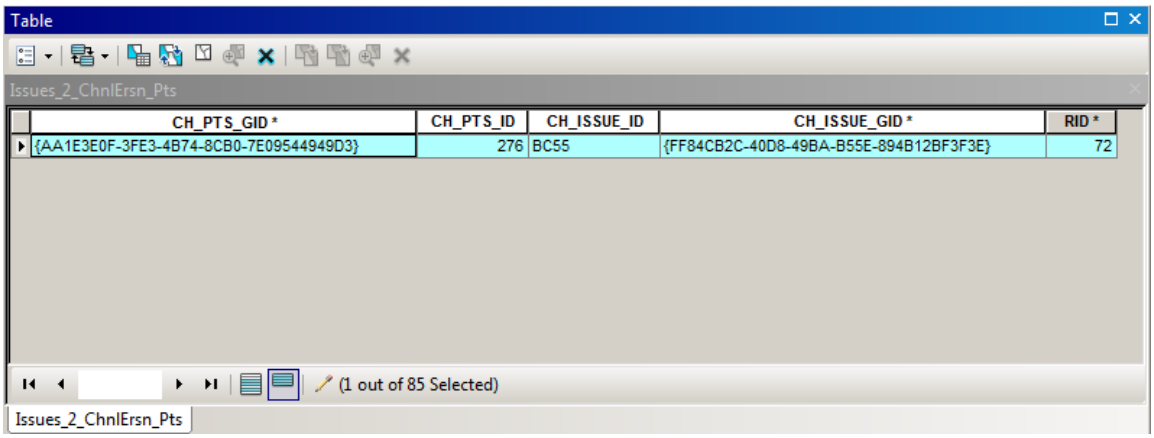


To create a relationship, make sure both features are selected, and then right click on the Related Feature Class you are adding to within the Attribute Task Pane and select “Add Selected”. If you are creating a new relationship to a Table select “Add New”





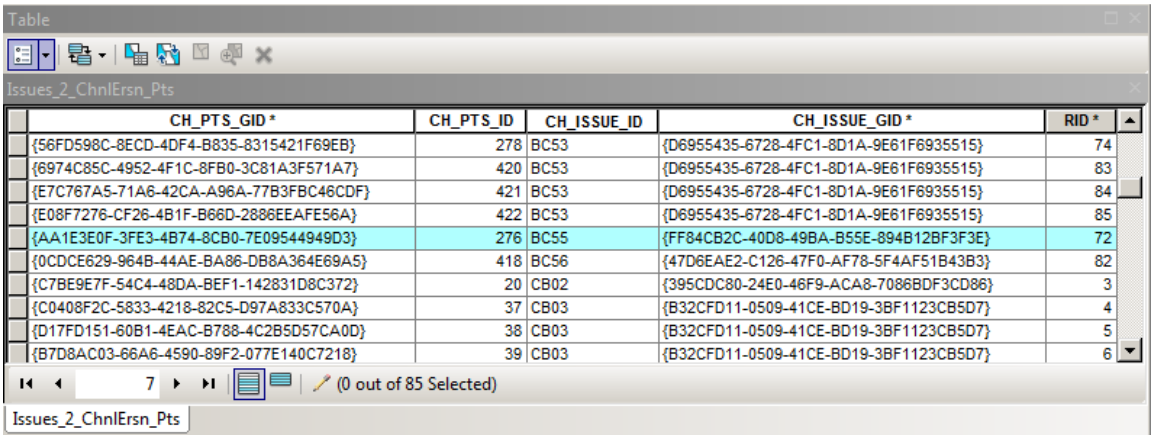
This adds the Global ID for each feature class to the Relationship table, thus create a Relationship between the two features. The two extra fields in the Relationship table (Feautre_PTS_ID and Feature_ISSUE_ID) must be entered manually. These are for reference only, to view the Common Name given to each feature (ie Point ID 276 and Issue ID BC55).



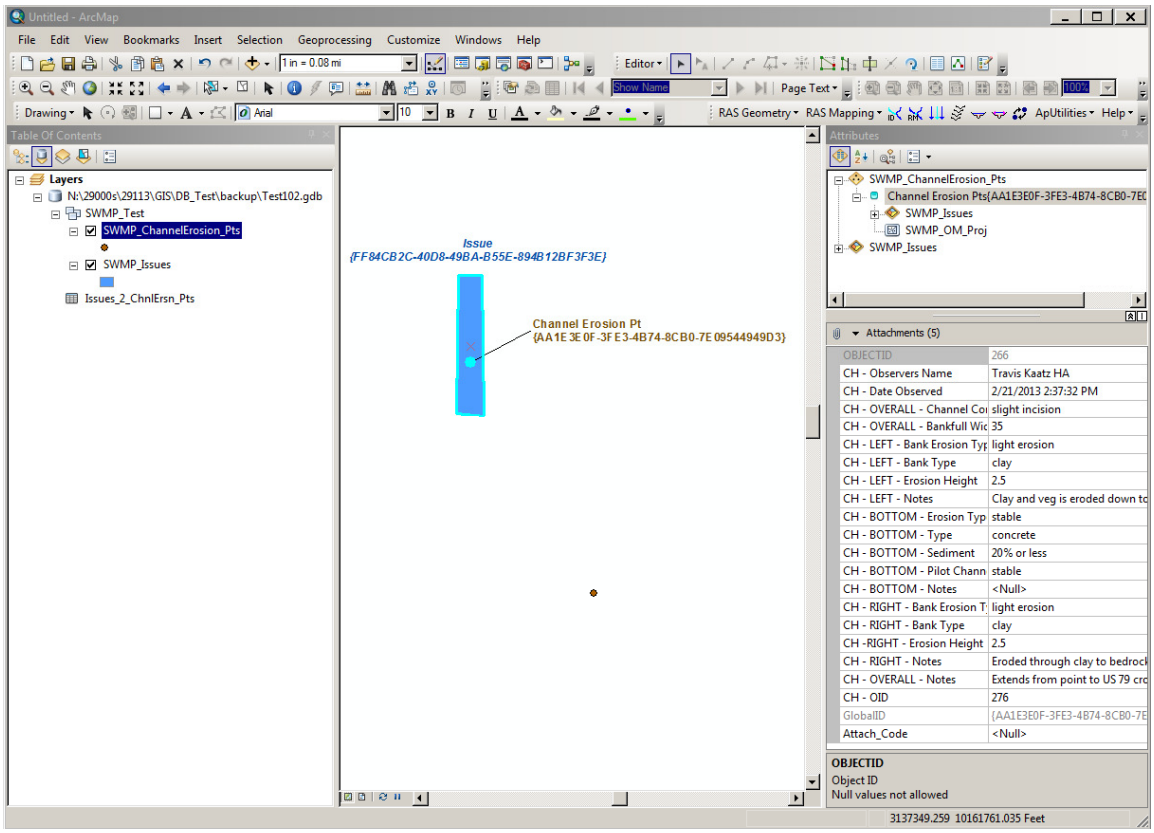
ii. Deleting a relationship

When a related feature is deleted, the relationship is also deleted and the related table is populated with a "Null" Value.

Before Relationship is deleted



CH_PTS_GID *	CH_PTS_ID	CH_ISSUE_ID	CH_ISSUE_GID *	RID *
{56FD598C-8ECD-4DF4-B835-8315421F69EB}	278	BC53	{D6955435-6728-4FC1-8D1A-9E61F6935515}	74
{6974C85C-4952-4F1C-8FB0-3C81A3F571A7}	420	BC53	{D6955435-6728-4FC1-8D1A-9E61F6935515}	83
{E7C767A5-71A6-42CA-A96A-77B3FBC46CDF}	421	BC53	{D6955435-6728-4FC1-8D1A-9E61F6935515}	84
{E08F7276-CF26-4B1F-B66D-2886EEAFE56A}	422	BC53	{D6955435-6728-4FC1-8D1A-9E61F6935515}	85
{AA1E3E0F-3FE3-4B74-8CB0-7E09544949D3}	276	BC55	{FF84CB2C-40D8-49BA-B55E-894B12BF3F3E}	72
{0CDCE629-964B-44AE-BA86-DB8A364E69A5}	418	BC56	{47D6EAE2-C126-47F0-AF78-5F4AF51B43B3}	82
{C7BE9E7F-54C4-48DA-BEF1-142831D8C372}	20	CB02	{395CDC80-24E0-46F9-ACA8-7086BDF3CD86}	3
{C0408F2C-5833-4218-82C5-D97A833C570A}	37	CB03	{B32CFD11-0509-41CE-BD19-3BF1123CB5D7}	4
{D17FD151-60B1-4EAC-B788-4C2B5D57CA0D}	38	CB03	{B32CFD11-0509-41CE-BD19-3BF1123CB5D7}	5
{B7D8AC03-66A6-4590-89F2-077E140C7218}	39	CB03	{B32CFD11-0509-41CE-BD19-3BF1123CB5D7}	6



After Relationship is deleted

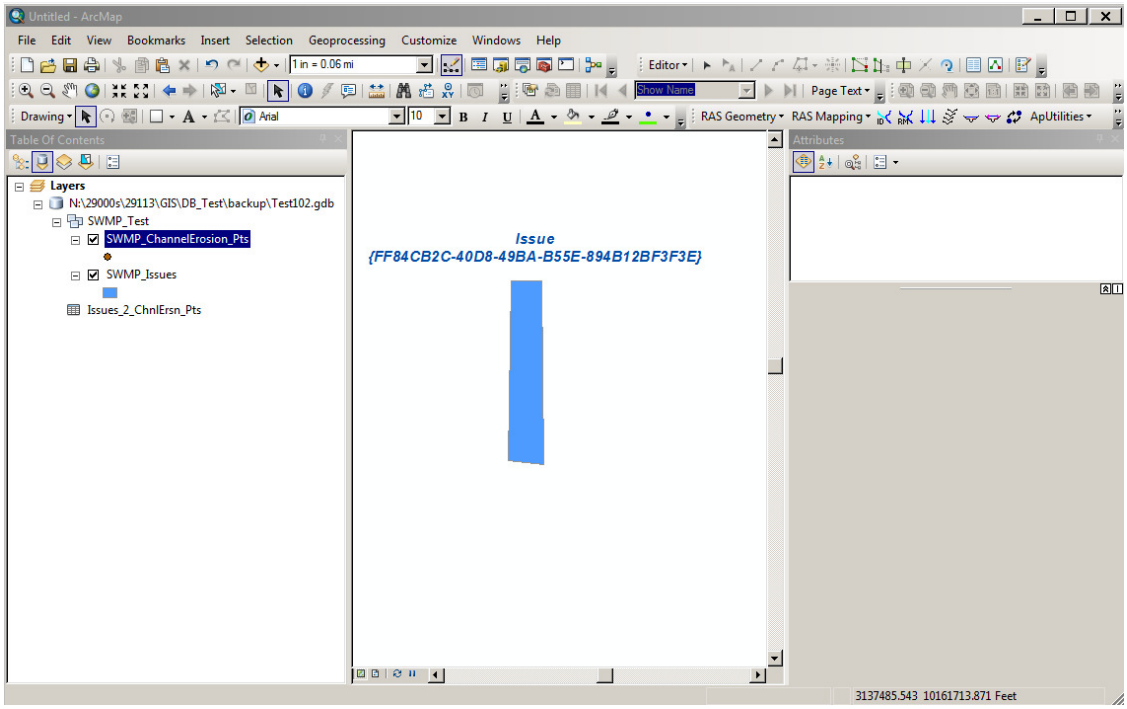
Table

Issues_2_ChnlErsn_Pts

CH_PTS_GID *	CH_PTS_ID	CH_ISSUE_ID	CH_ISSUE_GID *	RID *
{56FD598C-8ECD-4DF4-B835-8315421F69EB}	278	BC53	{D6955435-6728-4FC1-8D1A-9E61F6935515}	74
{6974C85C-4952-4F1C-8FB0-3C81A3F571A7}	420	BC53	{D6955435-6728-4FC1-8D1A-9E61F6935515}	83
{E7C767A5-71A6-42CA-A96A-77B3FBC46CDF}	421	BC53	{D6955435-6728-4FC1-8D1A-9E61F6935515}	84
{E08F7276-CF26-4B1F-B66D-2886EEAFE56A}	422	BC53	{D6955435-6728-4FC1-8D1A-9E61F6935515}	85
{0CDCE629-964B-44AE-BA86-DB8A364E69A5}	418	BC56	{47D6EAE2-C126-47F0-AF78-5F4AF51B43B3}	82
{C7BE9E7F-54C4-48DA-BEF1-142831D8C372}	20	CB02	{395CDC80-24E0-46F9-ACA8-7086BDF3CD86}	3
{C0408F2C-5833-4218-82C5-D97A833C570A}	37	CB03	{B32CFD11-0509-41CE-BD19-3BF1123CB5D7}	4
{D17FD151-60B1-4EAC-B788-4C2B5D57CA0D}	38	CB03	{B32CFD11-0509-41CE-BD19-3BF1123CB5D7}	5
{B7D8AC03-66A6-4590-89F2-077E140C7218}	39	CB03	{B32CFD11-0509-41CE-BD19-3BF1123CB5D7}	6
{1B2A7A19-97C7-4DCC-B5E1-20D50C0C727C}	40	CB03	{B32CFD11-0509-41CE-BD19-3BF1123CB5D7}	7

16 (3 out of 84 Selected)

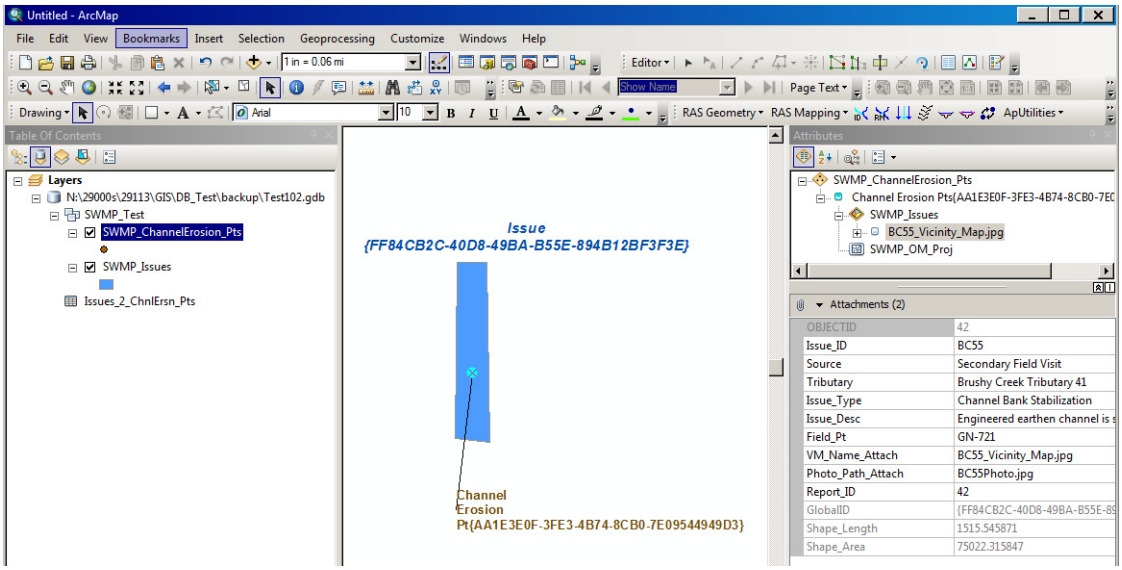
Issues_2_ChnlErsn_Pts



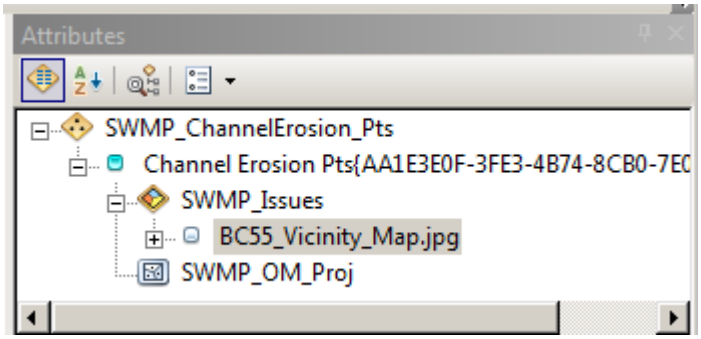
iii. Deleting a relationship but not a feature.

When a feature is no longer related to an issue, but that issue and feature need to remain in the database, the relationship needs to be removed while the features remain.

To remove the relationship, select one of the related features in Edit Mode and open the Attribute Task Pane.

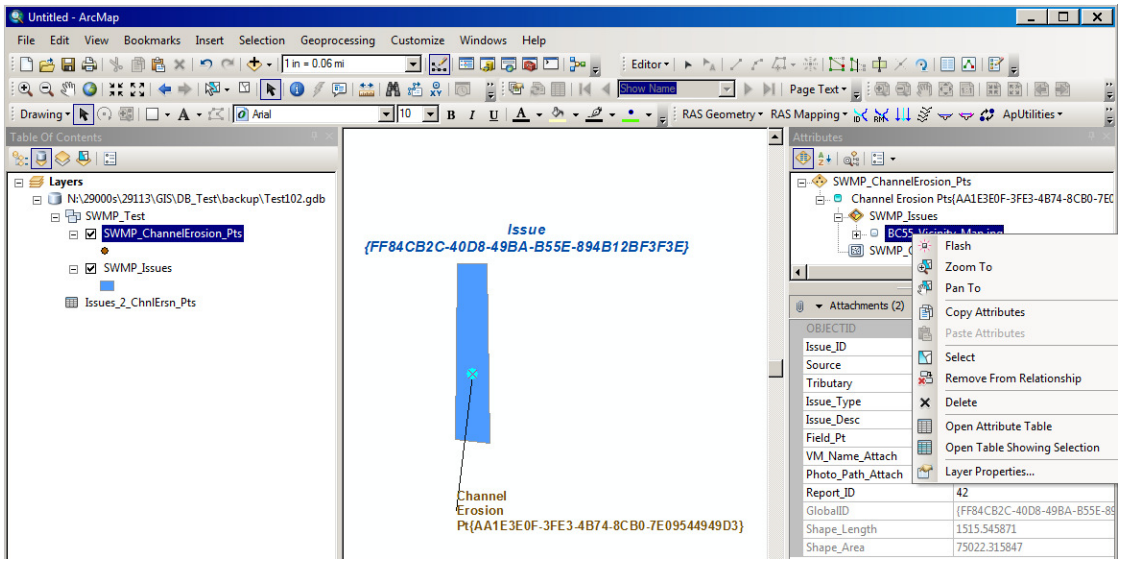


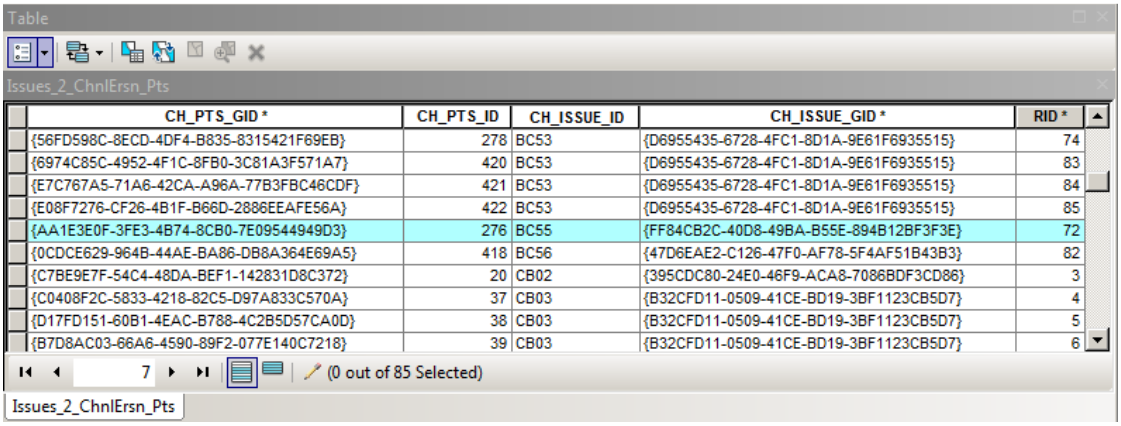
Expand the Feature Class and Feature until the specific features that share the relationship are seen (ie Channel Erosion Pts{AA1E3E0F-3FE3-4B74-8…} and SWMP_Issues BC55_Vicinity_Maps.jpg).



Right click the related feature; SWMP_Issues BC55_Vicinity_Maps.jpg and Click remove Relationship. This will remove the relationship between the two individual shared features.

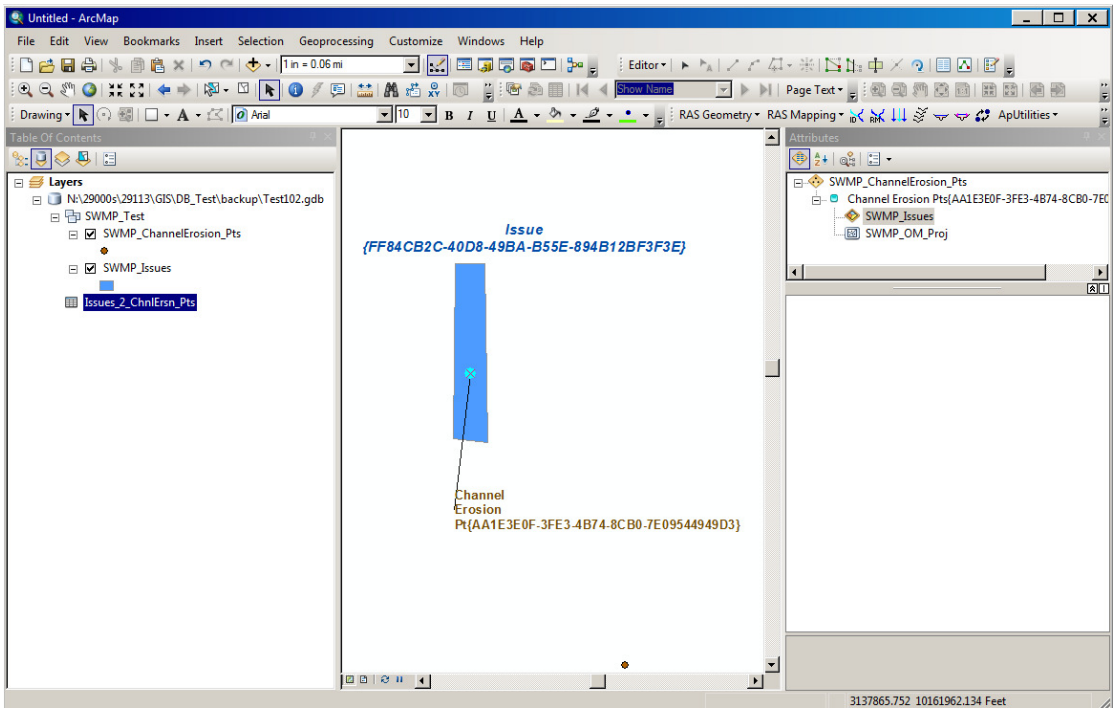
Before Relationship is deleted

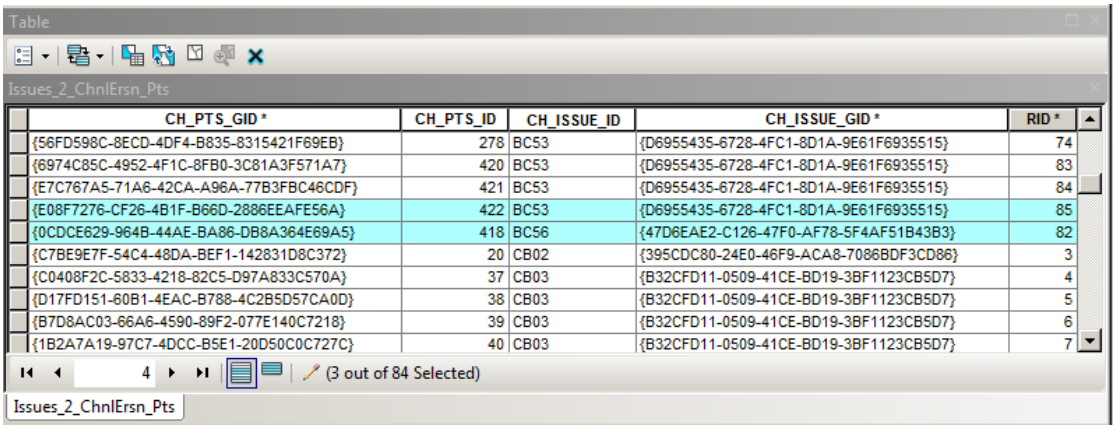




In the Attribute Task Pane on the right, there is no longer a listed related feature (i.e. SWMP_Issues BC55_Vicinity_Maps.jpg has been removed). However, both features remain, only the relationship is deleted.

After Relationship is deleted



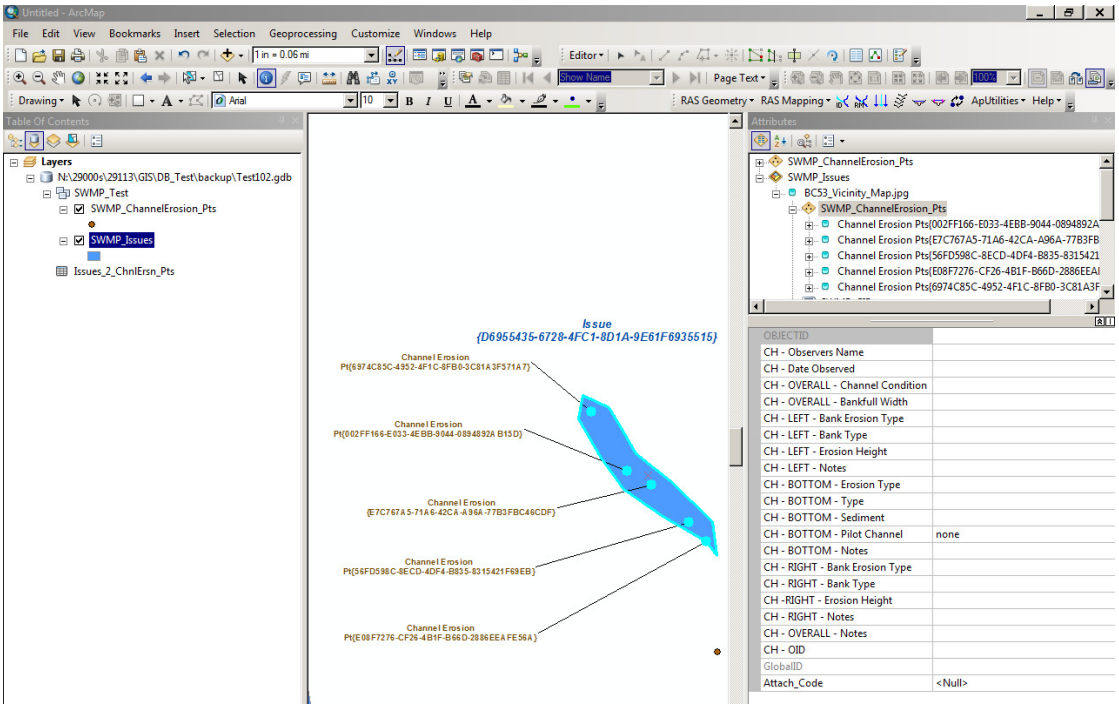


CH_PTS_GID *	CH_PTS_ID	CH_ISSUE_ID	CH_ISSUE_GID *	RID *
{56FD598C-8ECD-4DF4-B835-8315421F69EB}	278	BC53	{D6955435-6728-4FC1-8D1A-9E61F6935515}	74
{6974C85C-4952-4F1C-8FB0-3C81A3F571A7}	420	BC53	{D6955435-6728-4FC1-8D1A-9E61F6935515}	83
{E7C767A5-71A6-42CA-A96A-77B3FBC46CDF}	421	BC53	{D6955435-6728-4FC1-8D1A-9E61F6935515}	84
{E08F7276-CF26-4B1F-B66D-2886EEAFE56A}	422	BC53	{D6955435-6728-4FC1-8D1A-9E61F6935515}	85
{0CDCE629-964B-44AE-BA86-DB8A364E69A5}	418	BC56	{47D6EAE2-C126-47F0-AF78-5F4AF51B43B3}	82
{C7BE9E7F-54C4-48DA-BEF1-142831D8C372}	20	CB02	{395CDC80-24E0-46F9-ACA8-7086BDF3CD86}	3
{C0408F2C-5833-4218-82C5-D97A833C570A}	37	CB03	{B32CFD11-0509-41CE-BD19-3BF1123CB5D7}	4
{D17FD151-60B1-4EAC-B788-4C2B5D57CA0D}	38	CB03	{B32CFD11-0509-41CE-BD19-3BF1123CB5D7}	5
{B7D8AC03-66A6-4590-89F2-077E140C7218}	39	CB03	{B32CFD11-0509-41CE-BD19-3BF1123CB5D7}	6
{1B2A7A19-97C7-4DCC-B5E1-20D50C0C727C}	40	CB03	{B32CFD11-0509-41CE-BD19-3BF1123CB5D7}	7

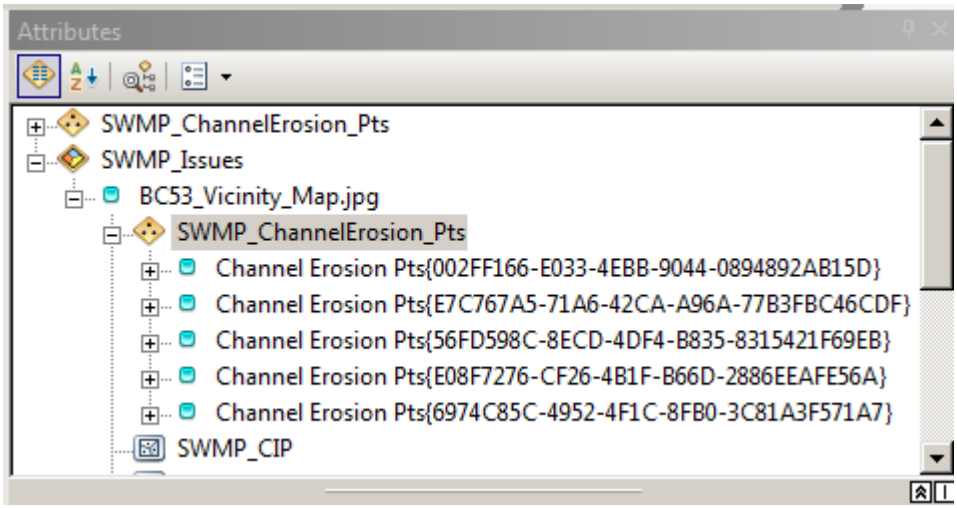
iv. Deleting multiple relationships but not a feature.

When multiple feature relationships are no longer related to an Issue or O&M, but that all features need to remain in the database, only remove the relationships.

To remove all associated related points within a related polygon, select the polygon (O&M or Issues) in Edit Mode and open the Attribute Task Pane.

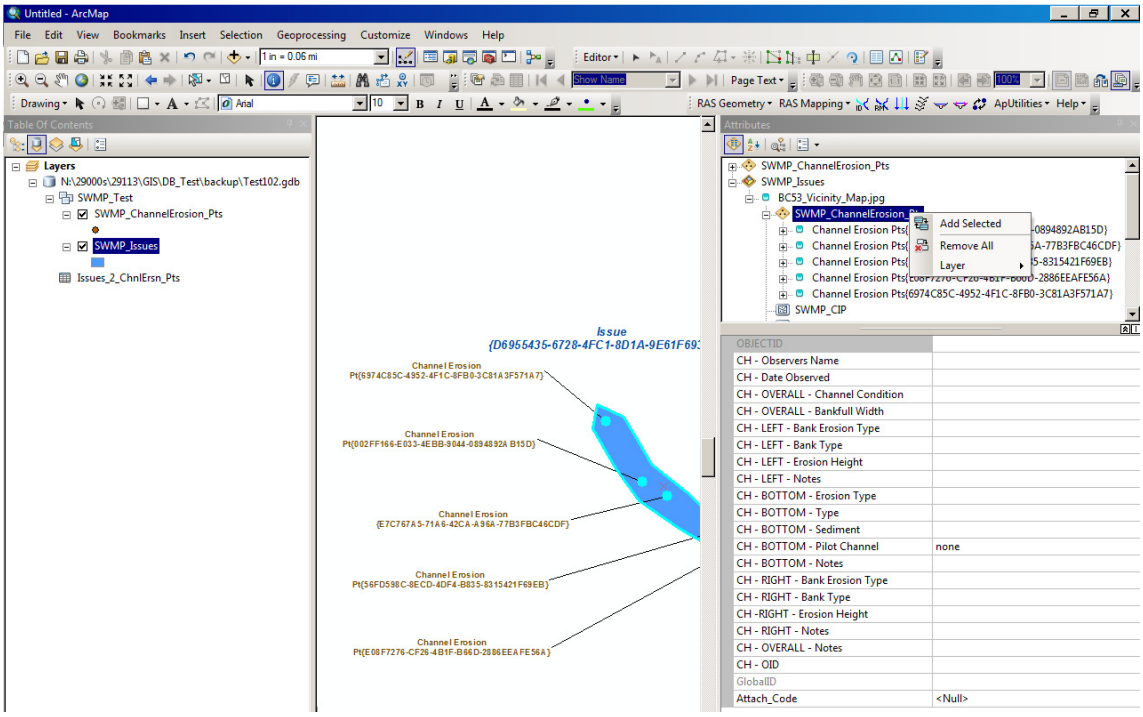


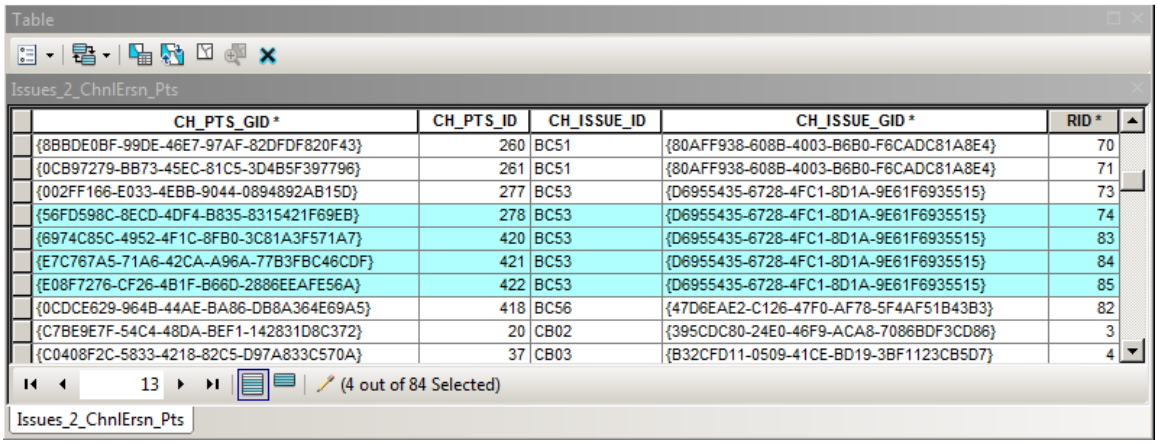
Expand the Feature Class and Feature until the specific features that share the relationship are seen (ie SWMP_Issues BC53 and SWMP_ChannelErosion_Pts).



Right click the related feature, SWMP_ChannelErossion_Pts, Click “Remove All”. This will remove the relationship between the selected polygon feature and all related points.

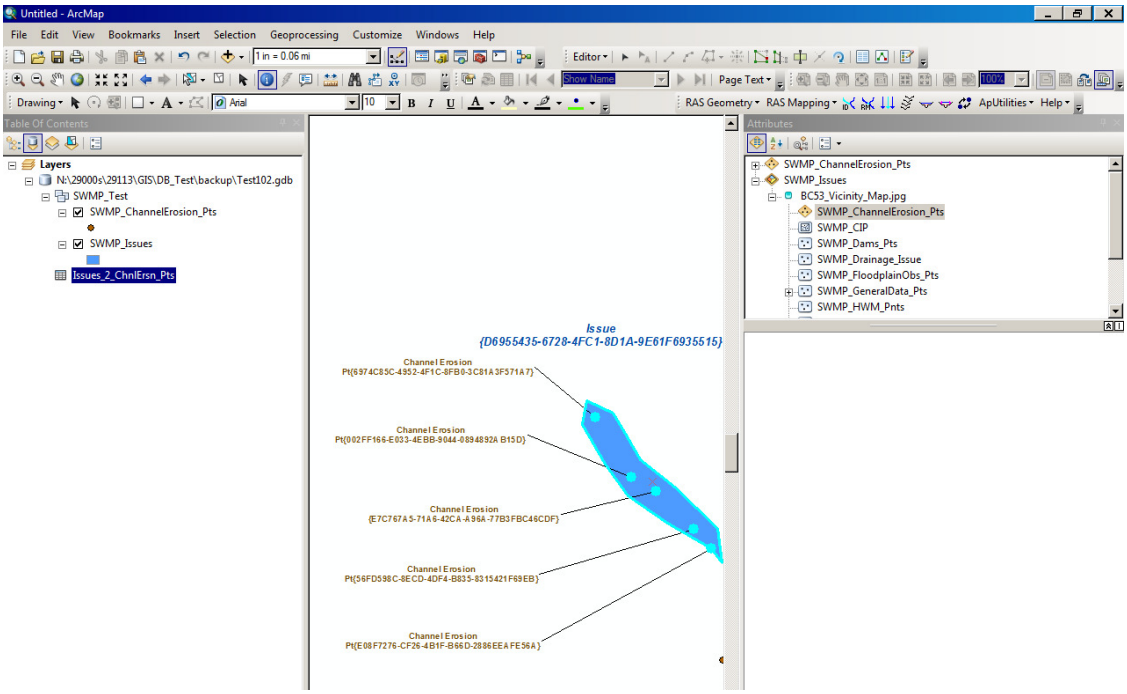
Before Relationship is deleted

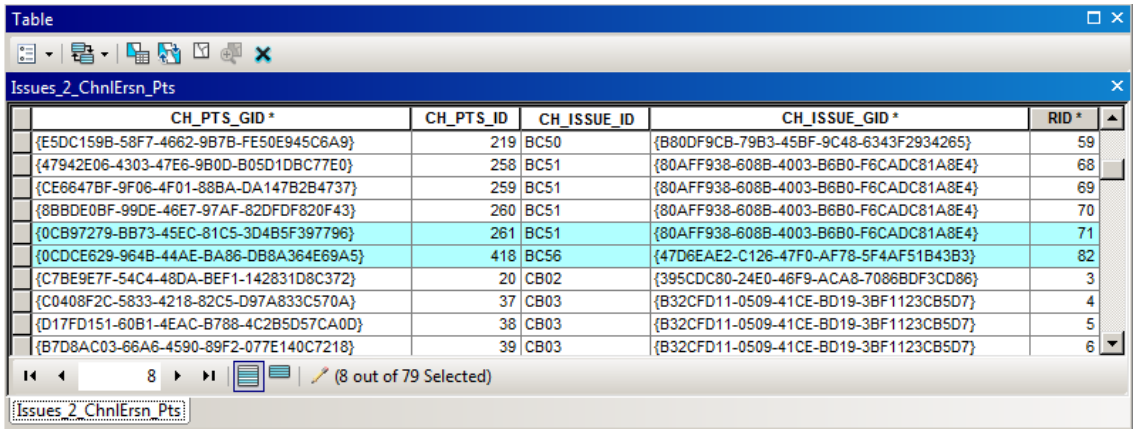




In the Attribute Task Pane on the right, there is no longer a listed related feature (i.e. SWMP_Issues BC55_Vicinity_Maps.jpg has been removed). However, all features remain, only the relationship was deleted.

After Relationship is deleted





Table

Issues_2_ChnlErsn_Pts

CH_PTS_GID *	CH_PTS_ID	CH_ISSUE_ID	CH_ISSUE_GID *	RID *
{E5DC159B-58F7-4662-9B7B-FE50E945C6A9}	219	BC50	{B80DF9CB-79B3-45BF-9C48-6343F2934265}	59
{47942E06-4303-47E6-9B0D-B05D1DBC77E0}	258	BC51	{80AFF938-608B-4003-B6B0-F6CADC81A8E4}	68
{CE6647BF-9F06-4F01-88BA-DA147B2B4737}	259	BC51	{80AFF938-608B-4003-B6B0-F6CADC81A8E4}	69
{8BBDE0BF-99DE-46E7-97AF-82DFDF820F43}	260	BC51	{80AFF938-608B-4003-B6B0-F6CADC81A8E4}	70
{0CB97279-BB73-45EC-81C5-3D4B5F397796}	261	BC51	{80AFF938-608B-4003-B6B0-F6CADC81A8E4}	71
{0CDCE629-964B-44AE-BA86-DB8A364E69A5}	418	BC56	{47D6EAE2-C126-47F0-AF78-5F4AF51B43B3}	82
{C7BE9E7F-54C4-48DA-BEF1-142831D8C372}	20	CB02	{395CDC80-24E0-46F9-ACA8-7086BDF3CD86}	3
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8 (8 out of 79 Selected)

Issues_2_ChnlErsn_Pts