Corey Bishop Drain
Board of Determination Meeting

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PURPOSE OF ENGINEERING REVIEW:

- Ottawa County Water Resources Commissioner issued a Request for Proposals in May of 2017 to perform an analysis and review of the conditions of the Corey Bishop Drain and the associated issue of sedimentation into Georgetown Lake.
- Review changes in land use within the Drainage District over time to determine changes that may have contributed to the erosion & subsequent sedimentation into Georgetown Lake.
- Determine potential causes of the sedimentation and erosion issues that exist throughout the drain
- Provide possible solutions for the repair and mitigation of erosion and sedimentation

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WORK PERFORMED:

- Review drainage district history and report land use changes and runoff impacts from these land use changes.
- Review storm water conveyance route(s) leading to and including the Cory Bishop Drain, noting history of changes, dates and impacts to the system.
- Review wetland and soil maps along with data from the Ottawa County GIS Department for analysis of the watershed.
- Estimate storm water flow rates and velocities for the primary different historical changes. Provide data for the 10, 50, and 100-year events.
- Complete minor elevation survey tying MDOT culvert (11-foot) outlet, county roads and Georgetown water surface together in order to reference elevations to one another.
- Provide opinion of possible solutions to the erosion problems of the Cory Bishop Drain.
- Provide engineer's approximate opinion of cost for each possible solution to fix the continuing erosion problem and its financial impacts compared with the physical impacts to address specific issues (Not covered at this BOD).

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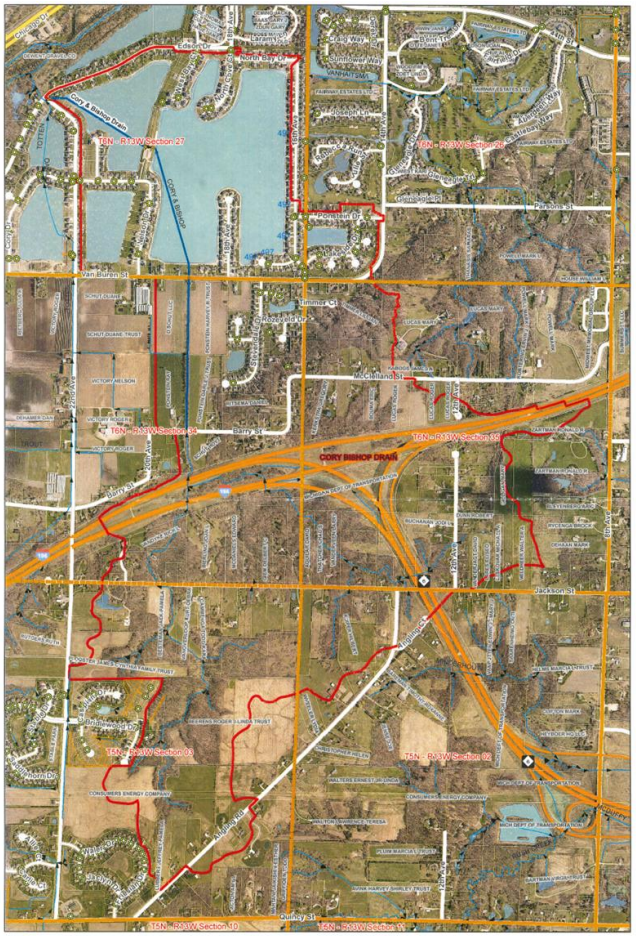
EXISTING DRAIN & DRAINAGE DISTRICT BOUNDARY:

Drain Length: 7090 feet (1.34 miles +/-)

District Boundary :

- 1542 acres +/-
- Determined from:
  - Ottawa County Drain Maps
  - Field Verification
  - Contour Data



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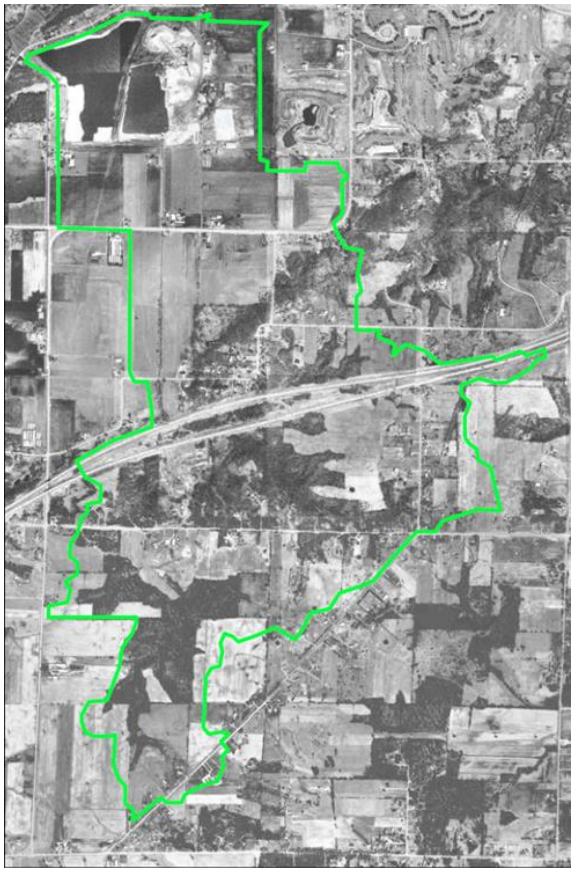
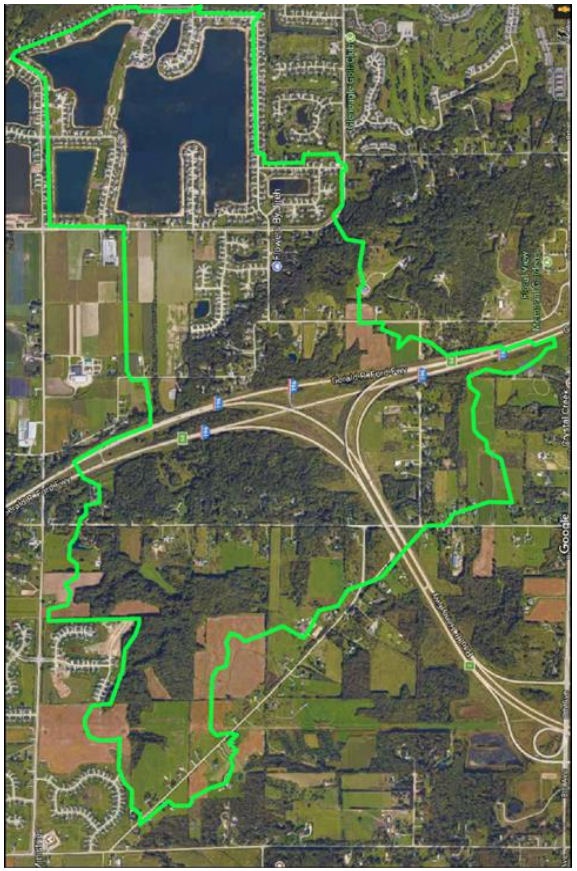
CURRENT & HISTORIC DRAINAGE DISTRICT AERIAL COMPARISON:

1994



2017



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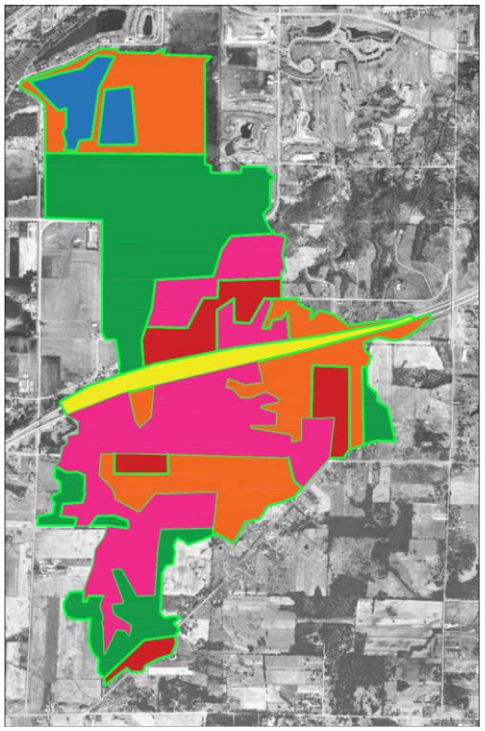
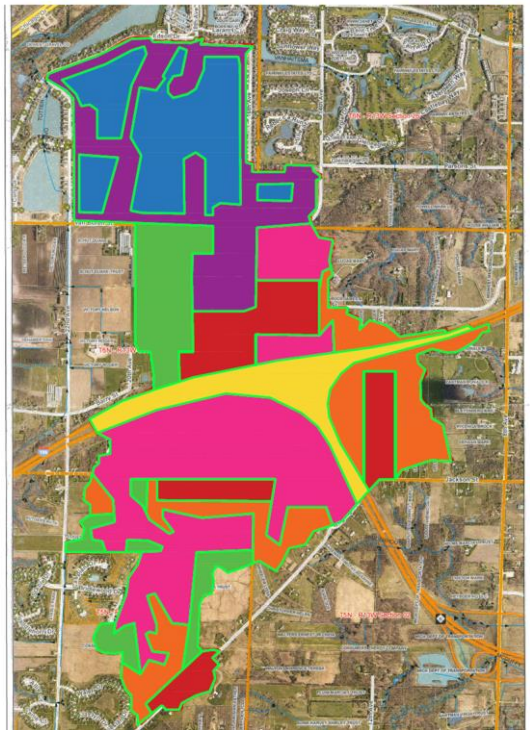
HISTORIC, CURRENT, AND FUTURE LAND USE COMPARISON:

1994



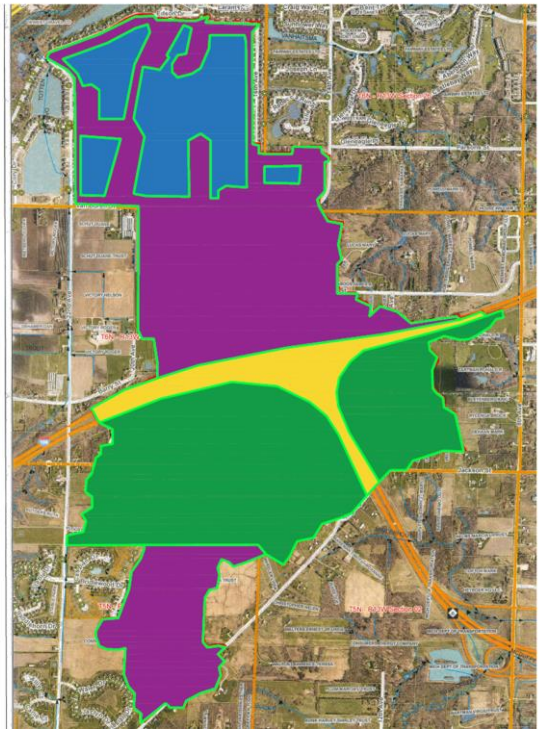
Composite “C” = 0.26

2017



Composite “C” = 0.40

Future



Composite “C” = 0.47

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EXISTING CONDITIONS

- ***Sedimentation & Van Buren Street Crossing***

Sedimentation in Georgetown Lake at the outlet of the Corey Bishop Drain (looking north from drain outlet)

Looking north toward the lake from the Van Buren Street box culvert outlet

Looking northeast at the inlet to the Van Buren Street 7’ x 16’ box culvert

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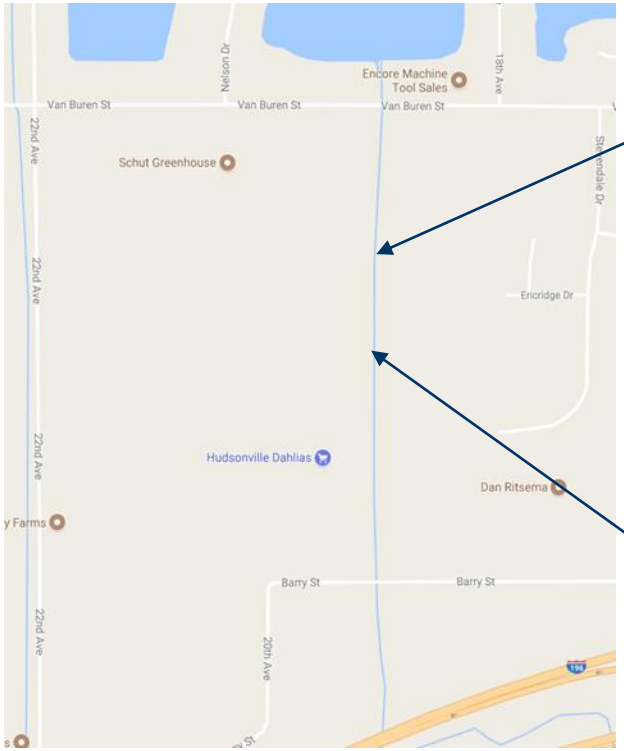
EXISTING CONDITIONS

- ***Bank Erosion***



Approximately 25 foot wide section of the west bank eroded into a shear cliff approximately 12 feet tall

Approximately 12 foot wide section of erosion along the east bank. It should be noted that this type of erosion is nearly continuous for the south 1300' of the drain channel between Barry St. and Van Buren St.

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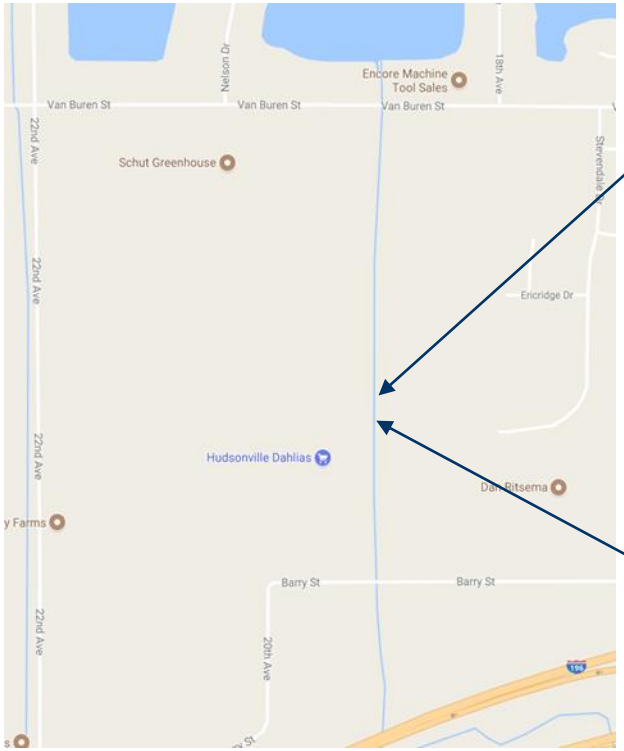
EXISTING CONDITIONS

- ***Bank Erosion***



Approximately 60 foot wide section of the west bank eroded into a near cliff approximately 15 feet tall with debris fallen into the drain channel

Typical cross section of drain channel looking downstream with erosion on the banks and debris in the drain channel

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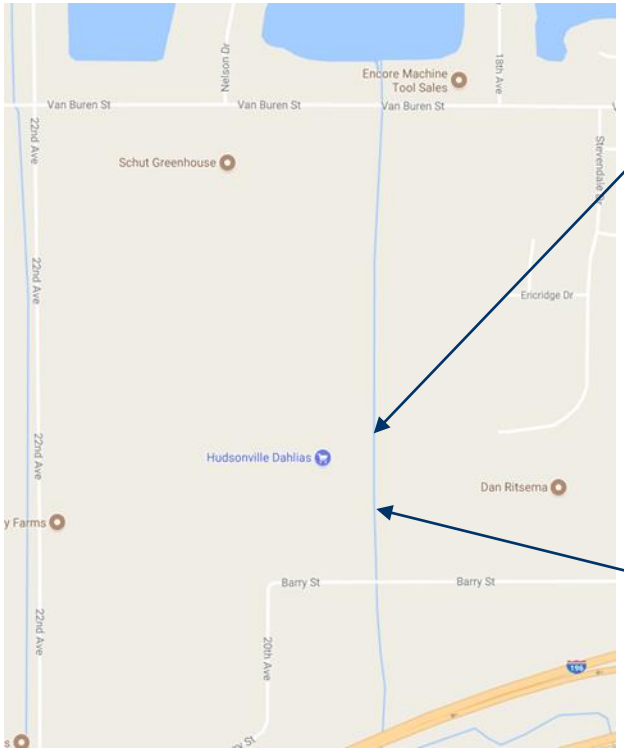
EXISTING CONDITIONS

- ***Debris & Obstructions***



Looking downstream at large debris piles in the drain channel

Looking downstream at large debris piles in the drain channel

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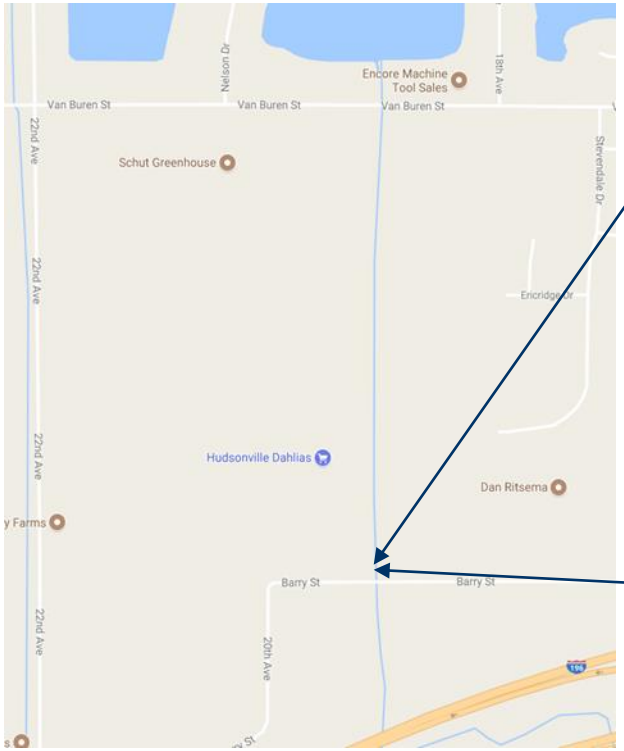
EXISTING CONDITIONS

- ***Debris***



Looking downstream (north) at riprap fallen into the drain channel

Looking east from the Barry St. culvert outlet with a scour pool shown in the bottom right of photo

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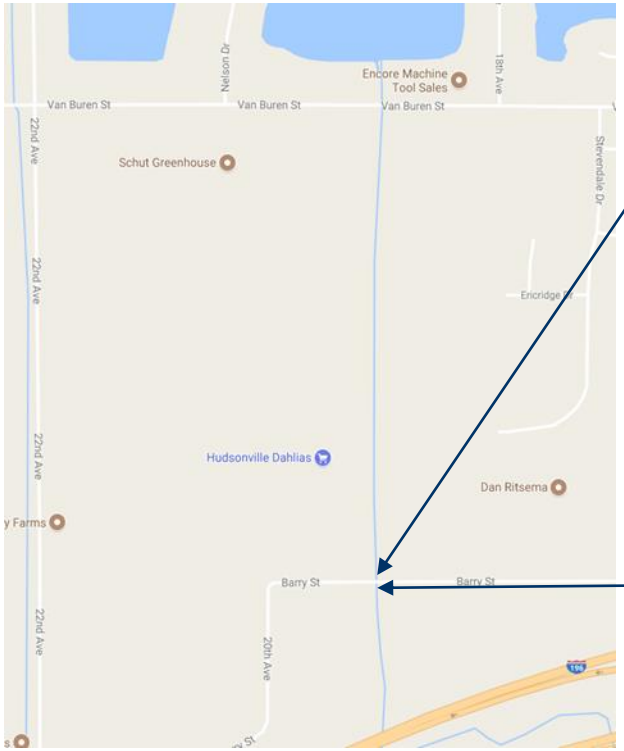
EXISTING CONDITIONS

- ***Barry Street Crossing***



Looking upstream at the Barry Street 6' x 12.5' box culvert with a large scour pool at the bottom of the photo

Looking upstream from the inlet to the Barry Street box culvert demonstrating the improperly graded channel south of Barry Street

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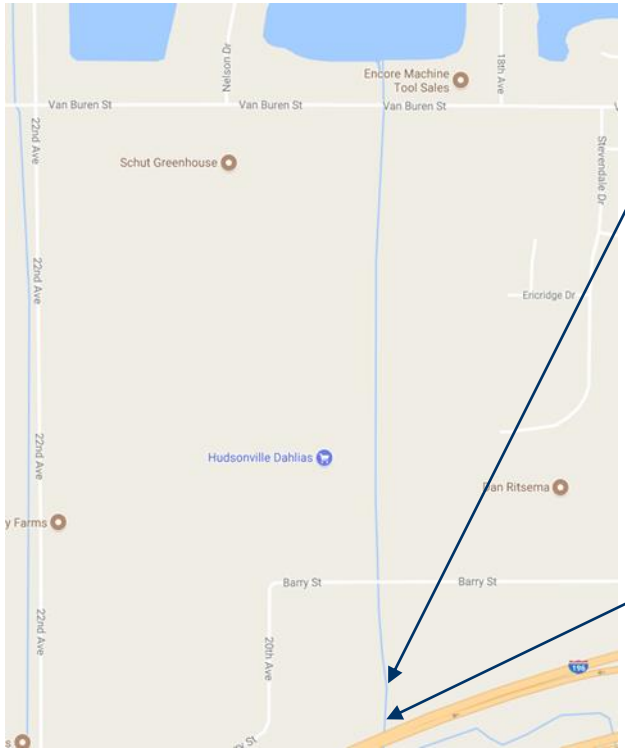
EXISTING CONDITIONS

- ***Channel Obstructions & Restricted Flow***



Looking upstream at the Barry Street 6' x 12.5' box culvert with a large scour pool at the bottom of the photo

Looking upstream at trees growing in the drain channel just north of the I-196 culvert outlet

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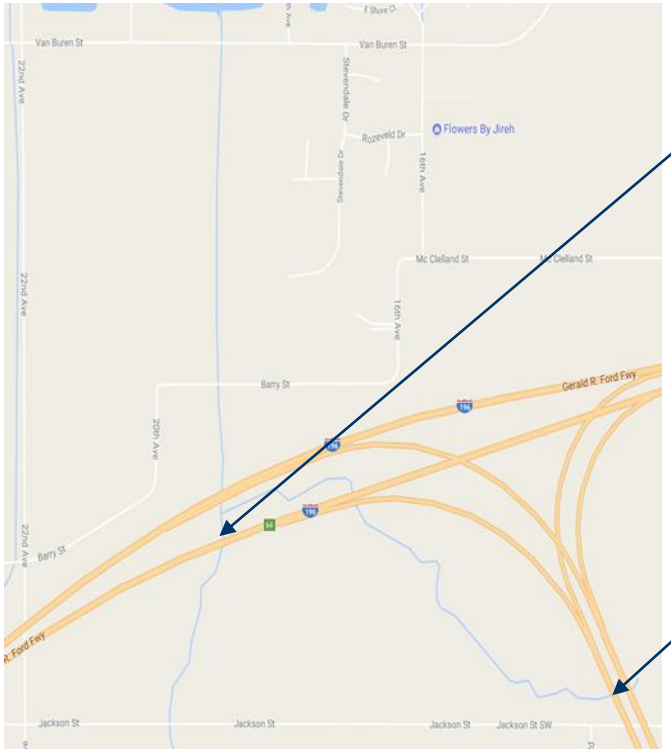
EXISTING CONDITIONS

- ***Sediment Accumulation***



Looking upstream through 11 foot culvert under I-196 with approximately 12-14 inches of accumulated sediment

Looking upstream through 10.83 x 7.87 foot box culvert under M-6 with approximately 6-8 inches of accumulated sediment

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EXISTING CONDITIONS SUMMARY:

Overall, the drain is in extremely poor condition. There are several locations with large debris in the drain channel ranging from old large rip rap to large dead trees that have fallen in from the eroded banks. Erosion along the banks of the section of drain from Barry Street to Van Buren Street is quite severe and seems to be continuously progressing as it appeared that there were a few sections of the bank that had recently collapsed into the channel at the time of inspection. Additionally, while the majority of the drain channel is only a few feet wide and roughly 6-8" deep through this section, there are multiple locations where the water has pooled in areas as large as 10' in width, 4' in depth and 15-20' in length. It is probable that all of the erosion along the banks through this section is the culprit for the sedimentation into Georgetown Lake as this loose sediment can be easily transported during a storm event. Additionally, due to the various restrictions of flow through this section, the water cannot maintain a natural path and continues to erode the banks of the drain, further compounding the problem.

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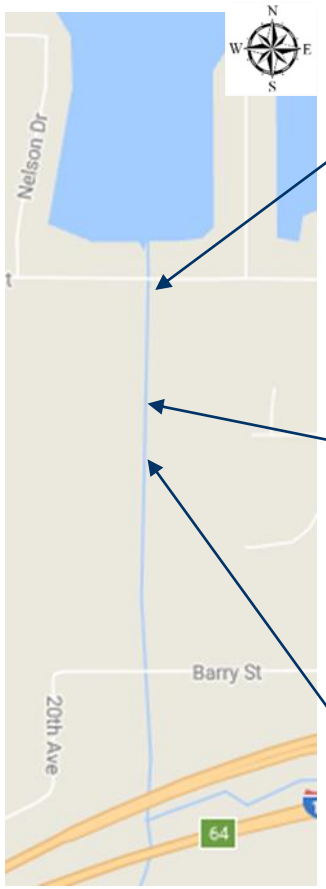
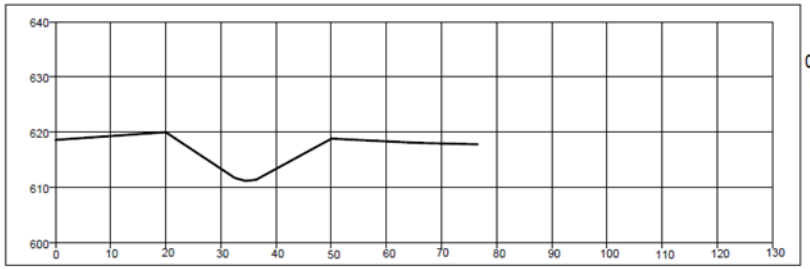
CROSS SECTION ANALYSIS:

FLOW

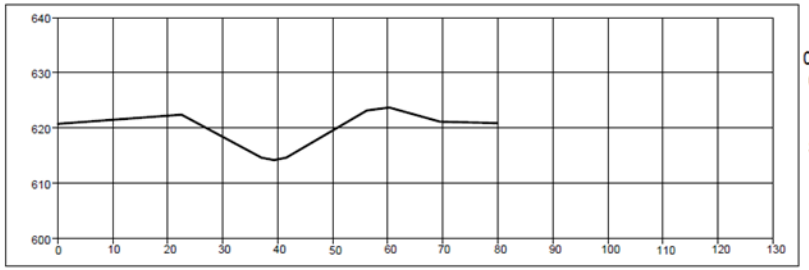


Drain Channel Cross Sections (looking north)



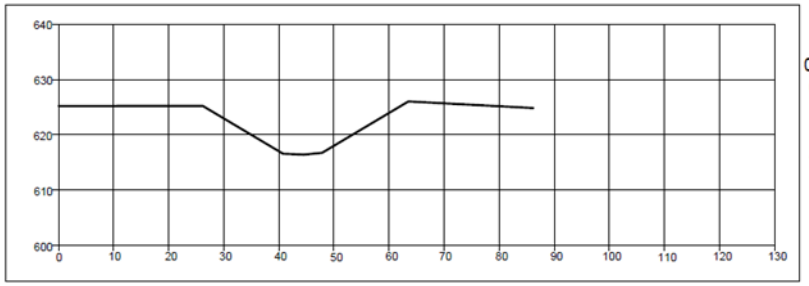
n	Q(cfs)
0.045	592.55
0.06	444.41

A = 126.89 ft^2
Slope = 0.34%



n	Q(cfs)
0.045	711.24
0.06	533.43

A = 146.85 ft^2
Slope = 0.34%



n	Q(cfs)
0.045	1234.81
0.06	926.11

A = 187.94 ft^2
Slope = 0.52%

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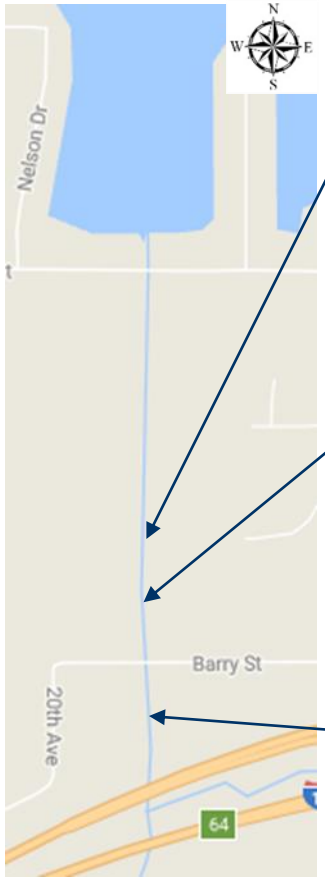
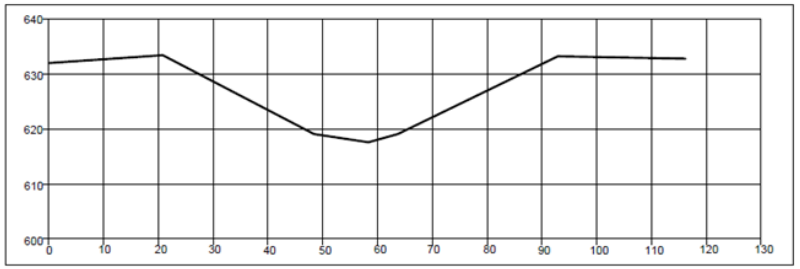
CROSS SECTION ANALYSIS:

FLOW

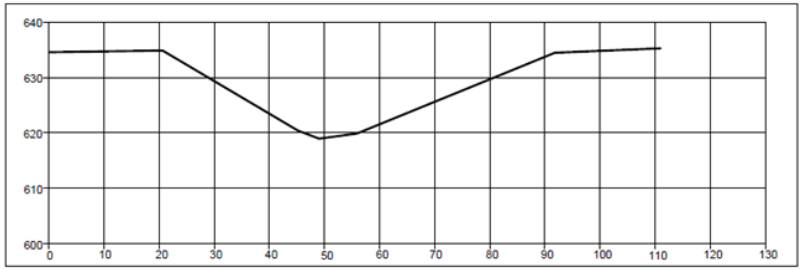


Drain Channel Cross Sections (looking north)



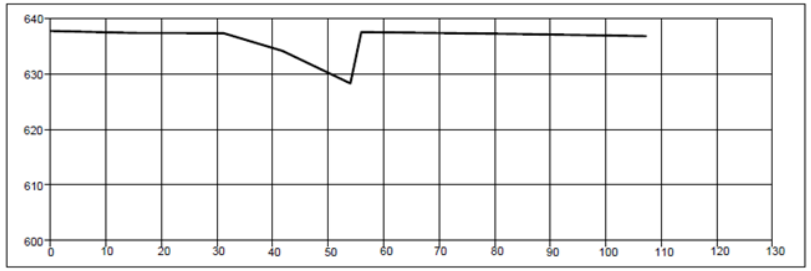
n	Q(cfs)
0.045	2525.02
0.06	3366.69

A = 670.14 ft^2
Slope = 0.14%



n	Q(cfs)
0.045	5520.90
0.06	4140.68

A = 647.21 ft^2
Slope = 0.42%



n	Q(cfs)
0.045	404.27
0.06	303.20

A = 119.73 ft^2
Slope = 0.2%

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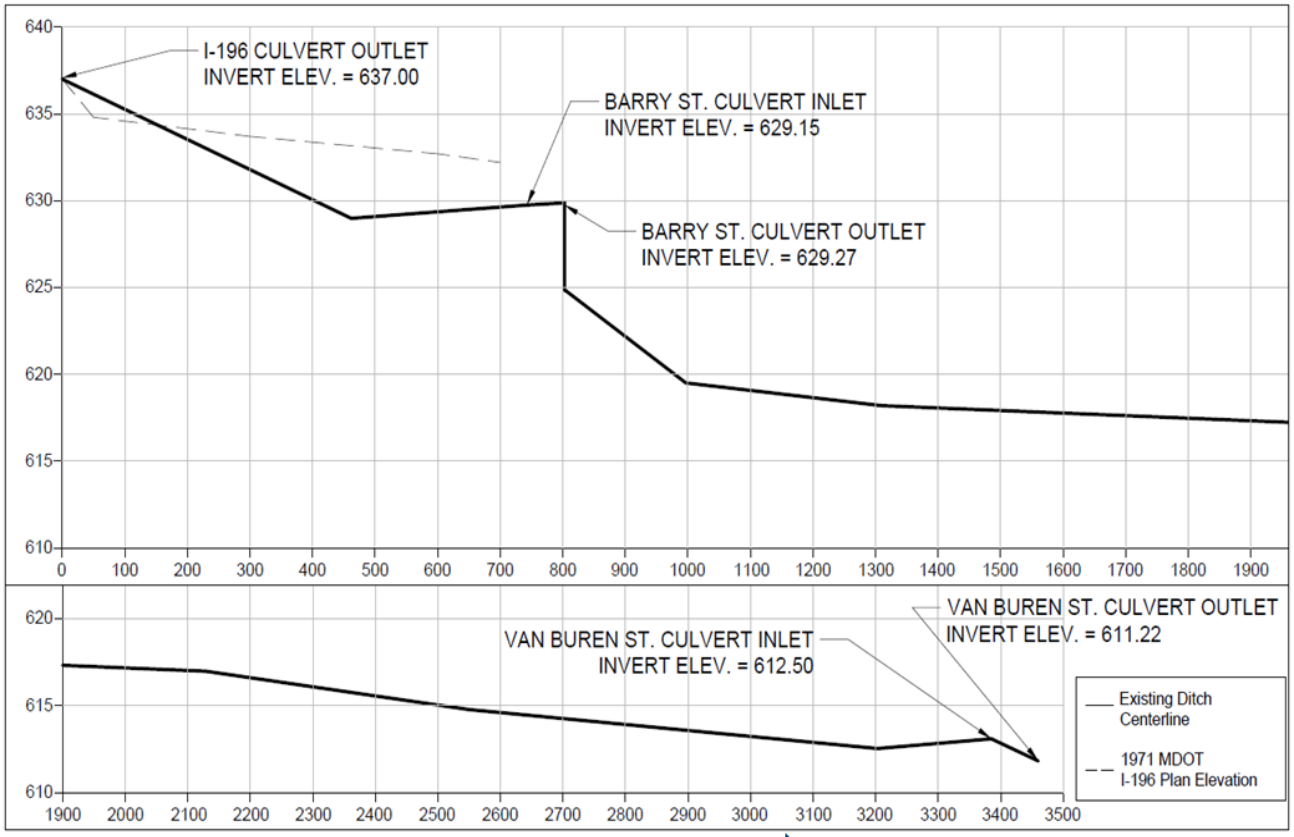
DRAIN CENTERLINE PROFILE: I-196 to Van Buren St. culvert outlet

Major Issues:

- Large amount of fall over first 1000 feet from the I-196 culvert outlet to just downstream of the Barry Street culvert
- Improper channel grading between I-196 and Barry St. reducing flow capacity by 4000-5000 cfs and leaves the capacity barely above the 10-year 24-hour event flow of 167.13 cfs
- Scour pool directly north of Barry St. box culvert



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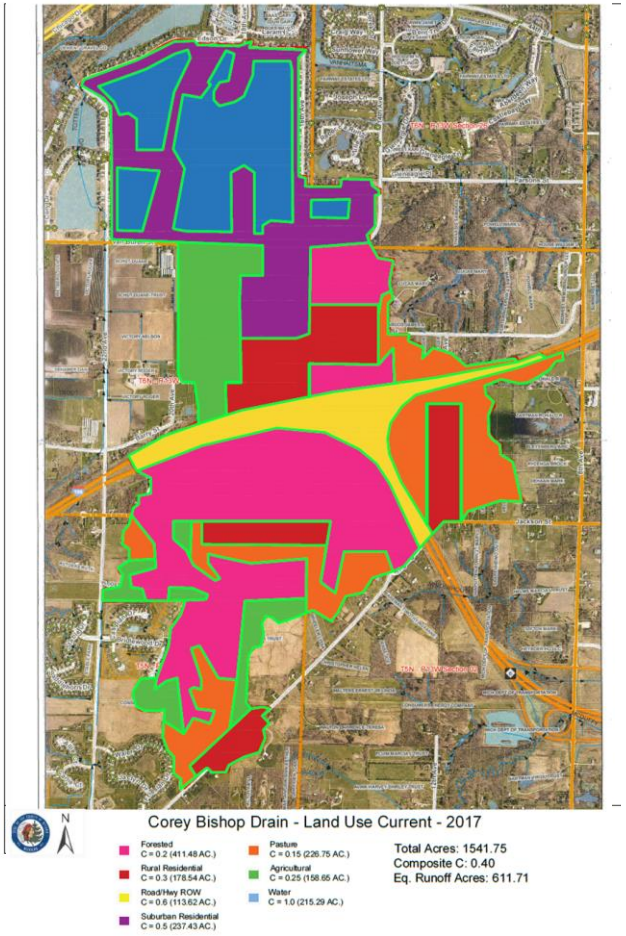
DRAINAGE DISTRICT LAND USE OVER TIME:

Notable Changes:

- 1997 – Georgetown Lake expansion begins
- 1999-2017 – Suburban Residential development around Georgetown Lake
- 2003 – M-6 connected to I-196



1994

1999

2004

2008

2017

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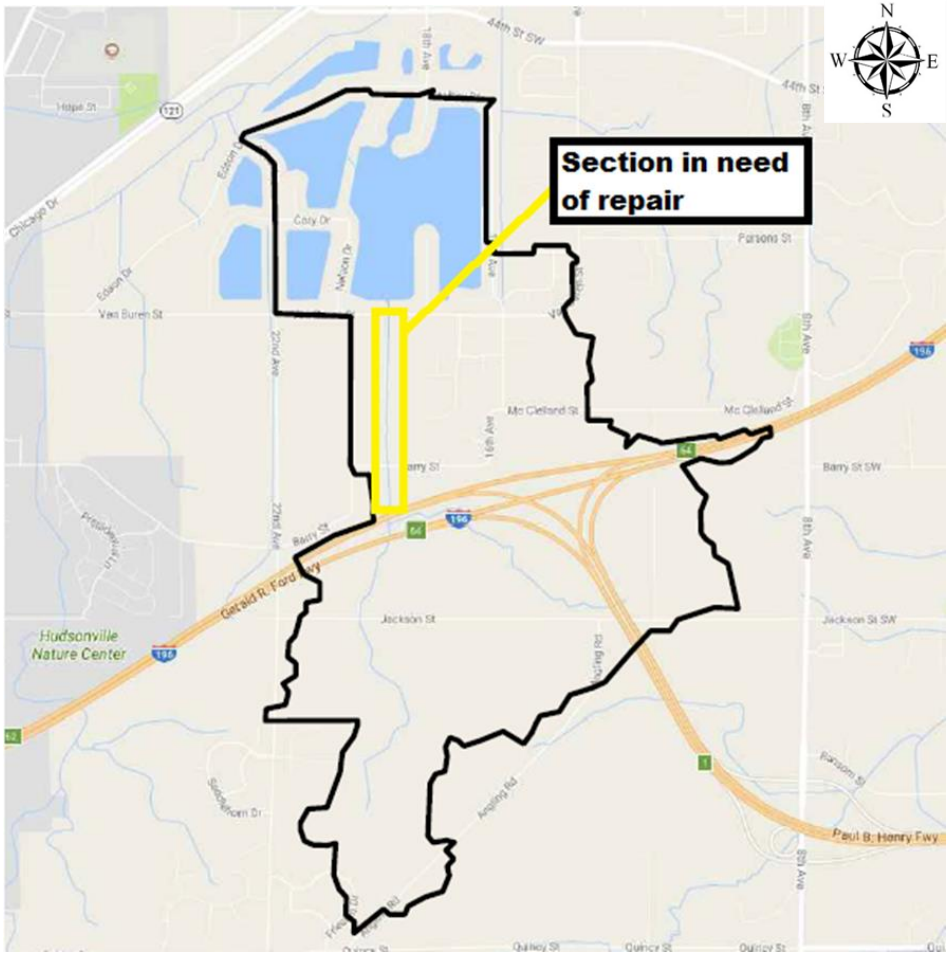
RECOMMENDATIONS:

- Based on the analysis of the Corey Bishop Drain and the associated issue of sedimentation into Georgetown Lake, we recommend focusing rehabilitation efforts on the section of drain detailed in the figure on the severe disrepair and is the probable cause right. This section of the Drain is in of the high sediment load being carried into Georgetown Lake.

- We recommend that washout repair directly downstream of Barry Street and drain cleanout with bank regrading be performed regardless of design options chosen as these are seen as necessary repairs.



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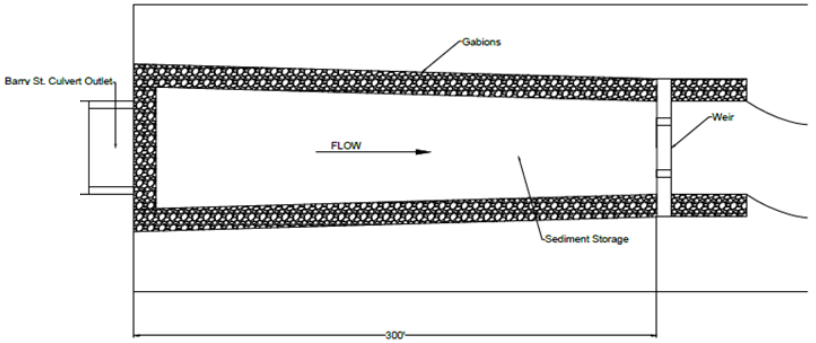
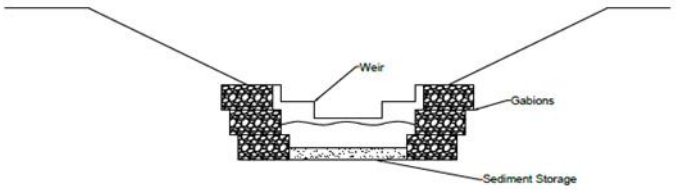
PROPOSED DESIGN OPTIONS – Washout Repair

The first issue which should be addressed is the washout and erosion immediately downstream of the Barry Street culvert. We recommend that gabions be placed along the culvert and extended downstream to help prevent washout and erosion of the banks.



Washout Repair (Plan View)



Washout Repair (Cross Section)

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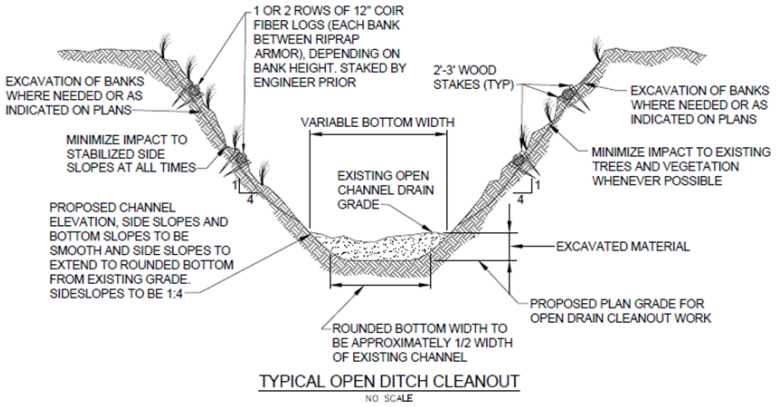
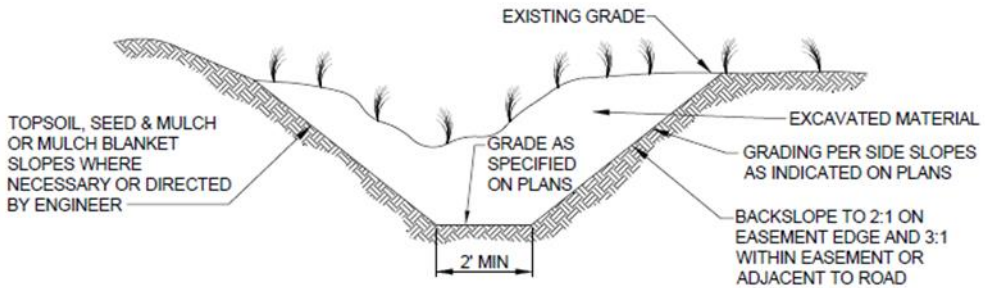
PROPOSED DESIGN OPTIONS – Drain Cleanout with Bank Regrading

This is another repair which is seen as essential to restoration of the Corey Bishop Drain. Cleanout and regrading will restore an appropriate drain bottom and drain slopes and should be paired with a erosion control option as well to ensure the problem does not recur.



TYPICAL OPEN DITCH CLEANOUT
NO SCALE



OPEN DITCH CONSTRUCTION & OPEN DITCH CONSTRUCTION FOR IN-LINE DETENTION DETAIL
NO SCALE

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PROPOSED DESIGN OPTIONS – Erosion Control Option 1

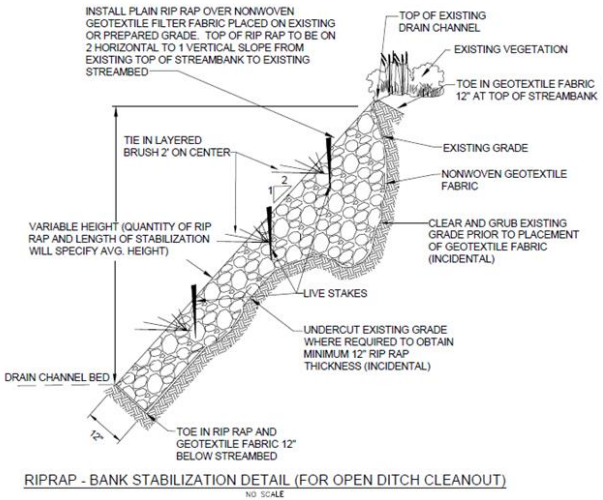
Use erosion control mats, coir logs, riprap, and wattles to help keep the soil in place while vegetation is allowed to take root. These measures are typically temporary and will be removed or naturally degrade over several years to create an aesthetic, natural vegetated slope.

Pros:

- Allows for a more natural aesthetic

Cons:

- Most expensive erosion control option from a construction costs standpoint



RIPRAP - BANK STABILIZATION DETAIL (FOR OPEN DITCH CLEANOUT)

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PROPOSED DESIGN OPTIONS – Erosion Control Option 2

Use permanent turf reinforcement mats that are permanently embedded in the soil to provide continuous support and protection. Due to the easily eroded nature of the native soil throughout this section (sand), it may be of greater benefit to implement a more permanent solution to the erosion problem.

Pros:

- Least expensive erosion control option from a construction cost standpoint
- Provides long lasting erosion prevention

Cons:

- Does not allow for as natural of an aesthetic as Option 1

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PROPOSED DESIGN OPTIONS – Sediment Control Option 1

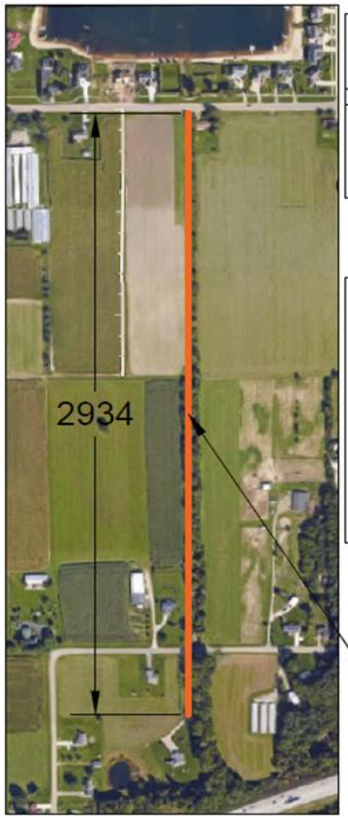
Use in-line sediment sumps to slow or limit the flow of water through the channel so that sediment can settle out of the water, reducing the turbidity.

Pros:

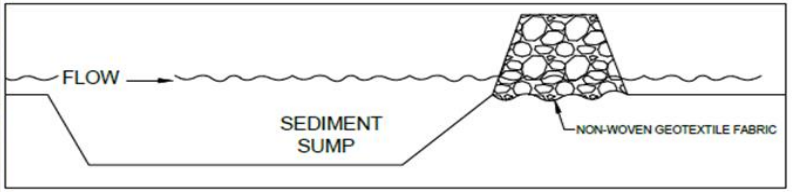
- Relatively inexpensive from a construction costs standpoint

Cons:

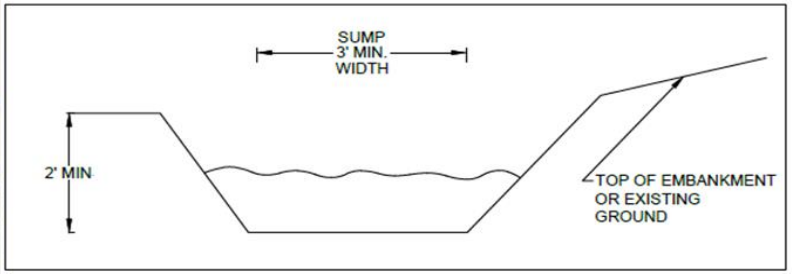
- Requires frequent maintenance
- Can be less effective during periods of high flow



PROP. SEDIMENT SUMP LOCATION



CROSS SECTION A-A



CROSS SECTION B-B

SEDIMENT SUMPS ARRANGED IN SERIES ALONG LENGTH OF DRAIN

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PROPOSED DESIGN OPTIONS – Sediment Control Option 2

Installation of a sediment basin at the furthest downstream stretch of this section of drain would allow for sediment capture of all of the sediment being washed into the drain from this section.

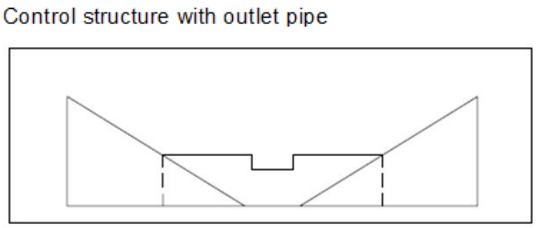
Pros:

- Provides the greatest amount of sediment storage

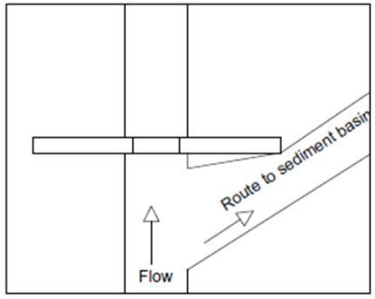
Cons:

- Most expensive sediment control option from a construction cost standpoint

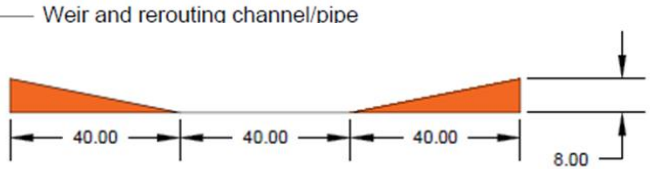
Sediment Basin (Plan View)
(Volume = 6.405 acre-ft)



Rectangular Weir (Cross Section Example)



Rectangular Weir (Plan View Example)



Sediment Basin (Cross Section)

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PROPOSED DESIGN OPTIONS – Sediment Control Option 3

Installation of 6 check dams throughout this section of drain would decrease the flow of the drain allowing more sediment to settle out before reaching Georgetown Lake.

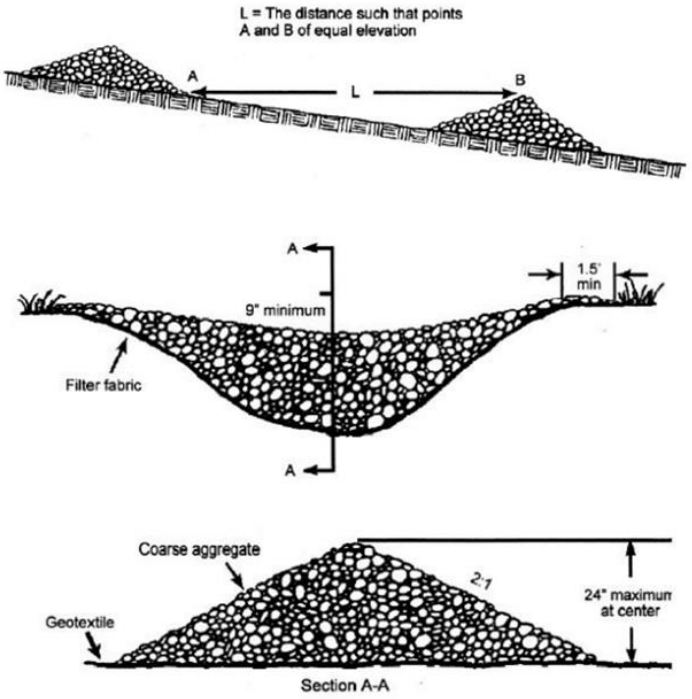
Pros:

- Most inexpensive sediment control option from a construction cost standpoint

Cons:

- Requires frequent maintenance
- Most susceptible to damage during high flow events

PROP. CHECK DAM LOCATION



Check dams installed in series along length of drain

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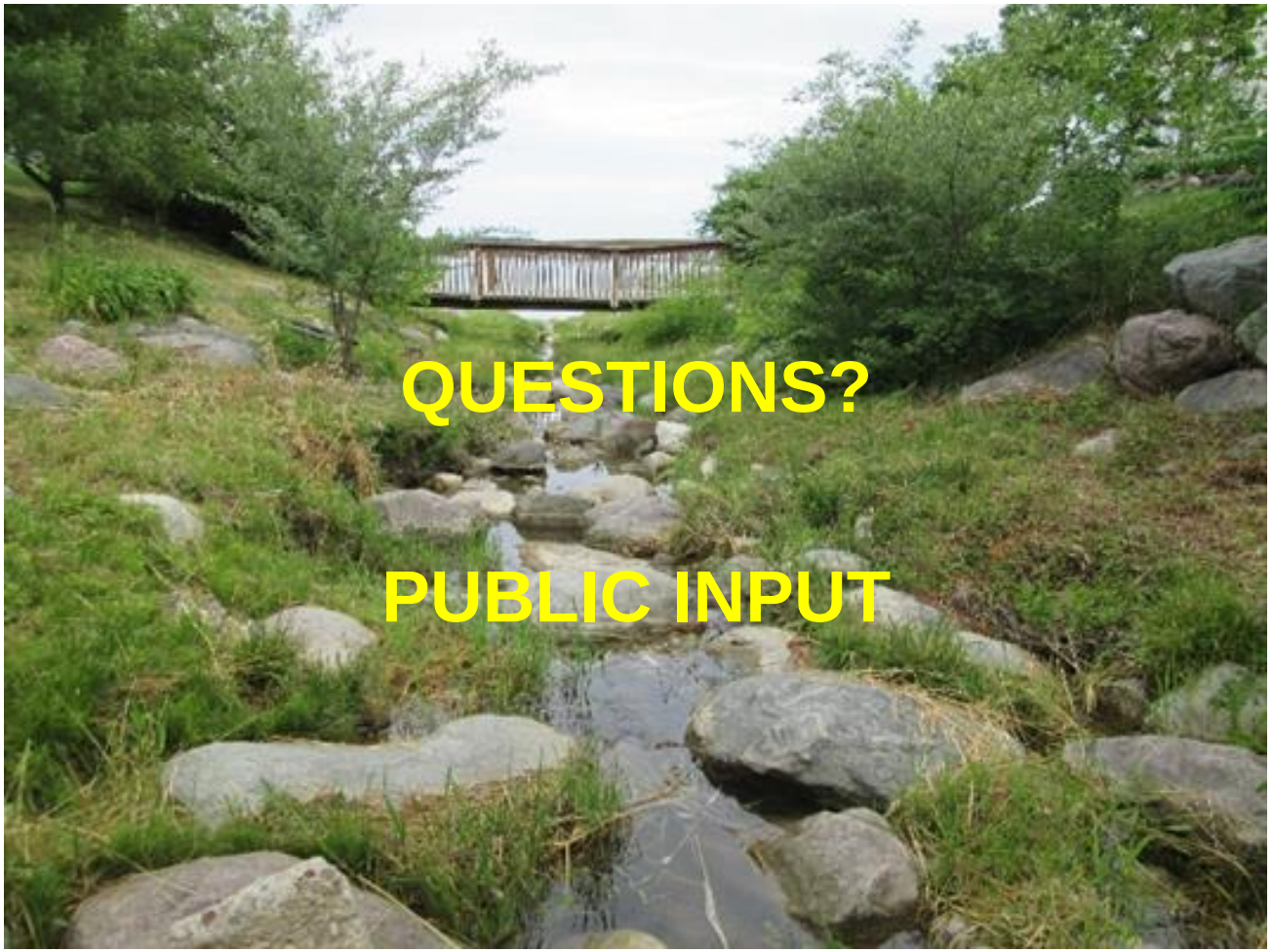

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