

**BERRYVILLE TOWN COUNCIL STREETS AND UTILITIES COMMITTEE
MEETING AGENDA
Berryville-Clarke County Government Center
101 Chalmers Court, Second Floor
Main Meeting Room
Regular Meeting
August 27, 2019
10:30 a.m.**

Item

Attachment

- | | | |
|------------------------------|---|---|
| 1. Call to Order | Diane Harrison, Chair | |
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| 2. Approval of Agenda | | |
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| 3. Discussion | Northwest Quadrant Storm Study
- Overview by Town staff
- Presentation by Pennoni Associates
- Committee/Town staff discussion
- Public comment / questions
- Committee discussion | 1 |
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| 4. Closed Session | No Closed Session Scheduled | |
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| 5. Other | | |
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| 6. Adjourn | | |

‡ Denotes an item on which a motion for action is included in the packet

ATTACHMENT 1

Pennoni Associates, Inc. has completed their report on several drainage issues in the northwestern quadrant of Town.

Mr. Mislowsky from Pennoni Associates will be in attendance and will present the report to the Committee.

It is important to note that this study is a preliminary engineering report and the project designs shown are schematic. The purpose of this report is to examine whether projects are warranted/feasible and to provide project budget estimates. If the Town Council sees merit in a project and decides to proceed, then the next step in the process will be budgeting for design, easement acquisition, and construction.

Please find attached:

- Northwest Quadrant Storm Study report
- Schematic design exhibit
- Memorandum – Keith Dalton to Town Council dated 8/7/19

Staff met with the Mr. Mislowsky 8/13/19 to discuss the report and clarify a few issues that were highlighted in the Town Manager's 8/7/19 memorandum to the Council. The following updates to the memorandum are provided to clarify a few issues:

- In general:
 - o The estimates provided do not include legal costs (associated with acquisition, development, and recordation of easements). Estimates will have to be adjusted to include this expense prior to the study being submitted to the Town Council.
- Ashby Court and Walnut:
 - o Staff asked whether the proposed underdrain could be extended further north and west in order to reduce the effect changes will have on Ashby Court properties. Mr. Mislowsky stated that the underdrain could likely be extended further. Such a change, if possible, practical, and helpful, could be addressed at time of design.
 - o Staff recommends that the Council examine whether another 450-500 feet of drainage improvement should be added to this project to convey the water all the way to North Buckmarsh Street. Pennoni has not studied this improvement. Using Pennoni's unit prices and making allowances for the cost of work near North Buckmarsh Street, staff estimates that this additional work would cost \$70,000.
- Jackson Pond:
 - o Staff continues to question whether this improvement would be worth the expense. Mr. Mislowsky will review various scenarios with the Committee to assist them in formulation of their recommendation in this regard.
- Academy Street-
 - o The only concern that staff has at this point is whether the outlay for this project is worth the benefit derived from its completion. At the end of the day, what leads staff to lean toward saying this is a project worth completing is the fact that ponding in this area has extended over both Academy and Dorsey Streets.
- Dorsey and Treadwell-
 - o Staff remains convinced that this project, as conceptualized, should not be constructed. This opinion is of course based on what staff expects will be the opinion of area

property owners, cost, benefit, and long-term maintenance issues. The Committee and Council will receive input from area property owners and will have more information on which to base their decision.

- Drainage Swale B-1-

- o In his 8/7/19 memorandum, the Town Manager noted that he was not certain regarding the full reach of the swale improvements. According to Mr. Mislowsky, the project calls for cleaning the drainage swale just east of Dorsey Street but no other improvements until you get to "Swale B-1". Staff recommends that if the Town Council determines that it will move forward with this project, the design engineer be instructed to examine the area between the Dorsey Street culvert and "Swale B-1" to determine whether improvements should be made to move water to the east in a more expeditious fashion.

The Northwest Quadrant Storm Study and the rest of the Agenda packet for the August 27, 2019 Streets and Utilities Committee meeting were posted on the Town's website on August 16, 2019. Further, on the same day, notice of this meeting was mailed to the owners of properties directly affected by the improvements outlined in the study.

The Committee is asked to review the study and provide recommendations on this matter to the Town Council. It would be helpful if the Town Council completed its review of this matter by mid-November so that any projects slated for construction in FY21 could be included in the budget submitted by the Town Manager.

Memorandum

Date: 7 August 2019

To: Streets and Utilities Committee

From: Keith Dalton, Town Manager 

Cc: Town Council
Christy Dunkle
Rick Boor

Subject: Ashby/Archer, Jackson Drive SWMA, Academy Street, and Dorsey/Treadwell Storm Water Report

Pennoni Associates, Inc. submitted their report on several drainage issues in the northwestern quadrant of Town. The written report contains recommendations and budget estimates. The report package also includes a 5-page schematic design exhibit.

Staff has performed a cursory review of the report and has the following initial comments regarding Pennoni's recommendations (please note that this memorandum follows the format of the engineer's recommendations):

1) Ashby Court and Walnut –

The engineer recommends altering the existing level spreader from which the water from Archer Court is currently released. This alteration would blend the flow from Archer Court with the flow from Ashby Court. The combined flow would release onto the rear of Walnut Street lots. The engineer further recommends that, from the point of the Ashby/Archer Court release, an underdrain be installed to convey water approximately 1,000 feet to the east. It is important to note that the plan does not provide for releasing the water into the storm drain system in North Buckmarsh Street.

In staff's opinion, the recommended approach has merit and deserves additional evaluation. The proposed project would require the establishment of approximately twelve easements. Where the proposed improvement extends along the north side of Walnut Street the effect on most properties would be minimal. The three properties through which the water would be conveyed from the Ashby/Archer Court area to Walnut Street would have more significant encumbrance and experience more intrusive construction activity. With that said, the properties experiencing most of the activity should benefit most from the project.

The estimated cost of this work is \$82,000.

2) Jackson Pond-

The engineer recommends that the existing drainage structure be replaced in order to provide for a larger orifice and increase the discharge rate. They also recommend that a second discharge structure be installed at a higher elevation near West Main Street in order to shift flow (in certain conditions) into the storm drain system on the south side of West Main Street (Town Run water shed).

In staff's opinion, the Council should move cautiously on this project and discuss it at length with the engineer. Staff's questions on this project include: a) what is the value of the work on the pond (how much will it improve conditions on the properties below) and b) what are the potential risks of this diversion?

It appears unlikely that any easements would need to be secured to complete this project but the Town would need to work closely with the corporation responsible for maintaining the pond.

The estimated cost of this work is \$13,000

3) Academy Street-

The engineer recommends installation of a culvert from the northwest corner of the intersection of Academy and Dorsey Streets to a point approximately 140 feet to the south.

In staff's opinion, the recommended approach has merit and deserves additional evaluation. It is noted that this work should not be a stand-alone project. In staff's opinion, this project should be an element of a larger project that will facilitate the flow of water from the area in question to the east and into the storm drain system near the intersection of Main and Smith Streets (between 5 Smith Street and 304 Main Street). That larger project is addressed in recommendation # 5 of the engineer's report (see below).

At this stage of design/review, staff does not know whether the work in question can be completed within the limits of the existing street right-of-way but it seems unlikely. Staff estimates that no more than three easements will need to be secured to complete this project.

The estimated cost of this work is \$12,000

4) Dorsey and Treadwell –

The engineer recommends replacement of three culverts, regrading of roadside ditches, and construction of a level spreader.

In staff's opinion, this approach will be very disruptive and may not be necessary. At this point, water ponds temporarily on both the northwest and southwest corners of the intersection but the ponding does not encroach on the road or to the best of our knowledge cause any significant problems. The roadside ditch regrading, as staff envisions it, would be rather disruptive to several property owners. The Council should move cautiously and discuss this option at length with both the engineer and area property owners.

The engineer also provided an option (an extension of the project described above) that would extend culverts from the outfall of the level spreader. This alternate would reroute the water the currently flows through the lot at 31.1 Treadwell Street.

In staff's opinion, this alternate would be a costly alteration to a drainage pattern that was anticipated when the lot in question was graded and its house sited.

Staff estimates that no more than six easements will need to be secured to complete this project.

The estimated cost of this work is \$51,000 or \$88,000 if the project includes additional culverts to the east and south (extension option).

5) Drainage Swale B1 –

The engineer recommends construction of an underdrain from the point at which the culvert just south of 2 Dorsey Street releases and the point at which the proposed level spreader just west of 311 Treadwell Street releases to the storm drain system near the intersection of Main and Smith Streets (between 5 Smith Street and 304 Main Street).

In staff's opinion, this approach has merit and deserves additional evaluation.

Staff estimates that no more than eight easements will need to be secured to complete this project.

The estimated cost for this work is \$99,000*.

* It is unclear whether the estimate includes the full length of the drain (the estimate does not appear to include Swale B2). Further, staff has placed all of the "survey, design and easement, and bidding and construction administration" costs for several projects (#2 Jackson Pond, #3 Academy Street, #4 Dorsey and Treadwell, and #5 Drainage Swale B1) on this aspect of the proposed improvements in the study area.

Staff will review the report in more detail in the coming days and work with the engineer to: 1) clarify whether Swale B2 costs are included and 2) how best to apportion "survey, design and easement, and bidding and construction administration costs" to specific options or sub-projects.

As previously directed, staff will place this matter on the 27 August Streets and Utilities Committee meeting agenda.

Town of Berryville, Virginia
Northwest Quadrant Storm Study
Evaluation of Alternatives

June 20, 2019
Revised August 5, 2019

RECEIVED

AUG 05 2019

Prepared By:
Town of Berryville, VA

Pennoni Associates, Inc.
Winchester VA



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Executive Summary

In 2018, from May through December, the Town of Berryville received 54.4 inches of rain. The average rainfall for this same period is 26.5 inches. So far in 2019, 27.5 inches have fallen in Berryville, the average January through July rainfall is 22.1 inches. Prompted by this record rainfall from May 2018 through June of 2019, the Town of Berryville has initiated a storm water management study in the northwest quadrant of the Town. Pennoni Engineering has reviewed five sites identified by citizens, Town elected officials and staff:

1. Ashby and Archer courts and impacts to Walnut Street (Area A);
2. Jackson Pond and downstream properties (Area C);
3. The intersection of Dorsey and Academy streets (Area B);
4. Properties along Dorsey and Treadwell streets (Area B); and,
5. Drainage swale 311 Treadwell to 304 West Main Street (Area C).

After reviewing several options for mitigation in each location, Pennoni recommends the following actions:

1. Ashby Court and Walnut– In order to avoid prolonged ponding and provide for positive drainage from the area, two improvements should be considered
 - A. At the end of Ashby Ct, the west trap discharge weir should be relocated to drain to the east and a second trap which currently overflows to the south.
 - B. Below that discharge, install an underdrain through three lots on Walnut Street and then along the shoulder on the north side Walnut Street. The new conveyance system will discharge directly to the existing storm inlet above and area impacted by a 100-year flood plain.
2. Jackson Pond – Since the current peak flow rates into and out of the Pond are currently far below the original condition two improvements that increase the discharge rate should be considered:
 - A. The discharge structure should be replaced to provide a larger control orifice which will significantly reduce the detention time in the pond and only increase the discharge rate for a short period.
 - B. A second discharge structure can be installed at a higher elevation, near West Main Street, to shift additional stormwater volume to the Town Run watershed.
3. Academy Street – To cure a ponding issue on the west side of Dorsey, north of Academy, a storm sewer system should be extended across that intersection discharging to the 12” culvert, 140 feet to the south.
4. Dorsey and Treadwell – Though two of the culverts that drain the area under Dorsey have been cleared, the runoff flow is hindered by roadside ditches and a downstream culvert which have been filled with sediment. The Town should consider replacement of the three culverts which drain the intersection and re-grading the Treadwell roadside ditches. To mitigate the flow now making it way south of Treadwell, a level spread should also be installed.

5. Drainage Swale B1 – in order to address the ponding within the swale which drains over 50 acres, the Town should consider installation of an underdrain and concrete ditch from below the discharge proposed below Treadwell in Item #4 above, to a 24” culvert under West Main Street. Installation of this improvement will smooth the contours at the ditch invert and provide a means to drain the flatter areas which currently cannot drain.

This document contains a detailed description of each of the mitigation options identified by Pennoni; maps of the respective locations; and detailed cost estimates. The Study scope did not include survey but relied on the available property line information from the Clarke County GIS. During your review it is important to remember that this is not a final design plan. We would recommend surveys be conducted to establish existing drainage facility elevations and right of way and easement locations. This will allow the design of the actual improvements to be completed. In all the locations studied, because of the limited difference in elevation across the site, a project that provides for conveyance of the two- or ten-year frequency storm event would include major storm sewer extensions and road reconstruction. The scope of our Study was to suggest improvements that would convey flows from the more frequent, nuisance, storm events. We would suggest therefore that the scope of the final design plan should be conditioned on no negative impact on existing residential lots and avoidance of road construction to allow larger culvert crossings.

Pennoni looks forward to meeting with the Town staff to discuss out findings and recommendations in more detail. In the meantime, please feel free to let us know if you have questions.

Introduction

The Town of Berryville has engaged Pennoni Associates to study the drainage situation at two areas in the northwest quadrant of Town. All of these are generally downstream of Battlefield Estates and the runoff conveyed originates in those relatively new areas. This area of Town is developed as mostly older single-family homes, though some new homes have been approved in the area. Generally, the issue which causes most of the problems is the lay of the land. The ditches that drain the area are flat and shallow and many of the roadside ditches and culverts have become silted in over time. This results in lower velocities, backwaters and ponding. The Town is interested to see if some of the main areas of concern can be addressed.

We were asked to prepare reports on conditions just south of the Ashby Court cul-de-sac and the Jackson Pond discharge routing, which crosses Dorsey and theoretically drains down to the 24" culvert at 304 West Main Street. We have attached a map showing these study areas, the attached Overall Area Plan. Additionally, as a part of the Jackson Pond evaluation, the drainage conditions at Dorsey and Treadwell was to be reviewed to see if a solution can be found to the ponding experienced at that intersection. Each of these areas is discussed here and exhibits provided as attachments to the report. In order to support our preliminary design and supplement the existing five-foot contour mapping available on the County GIS, we have obtained two-foot contour Lidar based mapping. Lidar is airborne laser mapping that creates a digital elevation model of the Earth's surface. This data is available to the public through the Virginia Geographic Information Network (VGIN).

Ashby Court Cut-de-sac

As a part of the Battlefield Estates project, Ashby Court was developed on the south side of Mosby Blvd. At the south end of the cul-de-sac, behind 300 and 301 Ashby Ct., two permanent sediment trap/level spreading devices were installed. The cul-de-sac to the west, Archer Ct, drains to the trap at the west end of 301 Ashby and the common drainage area between the rear yards on Archer and Ashby drains directly to the trap on the east end of 300 Ashby. Both are covered by the 30 ft drainage easement which runs along the rear property line. The drainage areas and trap locations are shown on Study Area Plan, Area A.

The west trap was designed and constructed to discharge to the rear yard of 308 Walnut Street. Based on a review of the available topographic mapping, that flow eventually would run across the rear yard of 306 Walnut, making its way through the side yards to Walnut Street. The eastern trap discharges directly to the rear yard of 306 Walnut Street, and then through the side yard to Walnut Street.

The owner of 308 Walnut (downstream of the west trap), placed fill in their rear yard a number of years ago which caused the western trap to back water and pond continuously. The Town asked that Pennoni recommend a solution to his issue.

We recommend utilizing the existing 30' drainage easement, located at the rear of 300 and 301 Ashby Ct, to relocate the overflow weir on the west trap, which now drains to the south, to drain to the east as shown on Study Area Plan, Area A. This would continue to take advantage of the peak flow mitigation provided by the west trap but direct the discharge across the drainage easement to the eastern trap. That eastern facility would continue to discharge to the south through 300 Walnut.

Since the discharge is to unimproved channels, the evaluation storm event would be that occurring every two years. During the two-year storm the peak discharge from the western trap to 308 Walnut is estimated at 6.0 cfs. The flow from the eastern trap to 306 Walnut is estimated at 5.7 cfs. With the suggested grading revision, the flow from the western trap would no longer discharge to 308 Walnut, but to the eastern trap and the total discharge from that corner would be 11.7 cfs. We have increased the time of concentration for that Archer Ct drainage area to try and account for the effect on travel time caused by needing to run through two trap devices instead of one. It is important to note that though the peak flow to 306 Walnut is increased at the east trap discharge, this is the same volume that makes it way to this point under the current condition. The flow quantity which drained to Walnut will be the same before and after this suggested diversion.

There are however two concerns with the discharge from Ashby Court. It appears that there is a depression in the existing swale that drains through 306 Walnut and thence to the north side of Walnut. A roadside inspection confirmed the presence of a mild depression in the rear yard of 300-306 Walnut. The nearest storm sewer is located to the east, approximately 800 feet from this low area. There is an estimated 18" deep grated inlet near the corner of 214 and 216 Walnut. We estimated the inlet rim at elevation 701 feet. The average slope of this "swale" is about 0.9%, though the upper reach slopes at about 0.6%. Additionally, we need to point out that over a majority of the road length there exists a paved/gravel shoulder to support parallel parking on the north side of Walnut. To install a storm sewer along this area would be very difficult due to the elevation of the downstream inlet, the flat ditch slope and the existing paved parking area. Because of the shallow and flat ditch, there is no room to provide cover on a new storm pipe. In order to avoid the standing water situation, we believe an underdrain would work best and not interfere with the off-street parking area. We have shown that drain on the Walnut Street profile, Sheet 3. It would be installed at the north edge of the parallel parking area. An easement is required. That underdrain detail is shown on Sheet 4.

We have estimated the cost of the diversion through 300 Ashby and 301 Ashby at \$2,261. The underdrain from 306 Walnut to the 18" grate inlet is estimated to cost \$51,316. The total cost of the construction project is estimated at \$53,577. The estimate of the total cost is attached at the end of this report.

Dorsey and Treadwell

The intersection of Dorsey and Treadwell has recently been subject to ponding water on the roadway. This area is plagued by roadside ditches with almost no slope. Ditches on either side of Treadwell appear to have been silted in over the years causing the existing culverts to become non-effective. There is a significant drainage area to this point. Land that is north of Treadwell, both east and west of Dorsey drain to the intersection. The drainage areas are shown on Study Area Plan, Area B. Runoff arrives at the intersection from three points. A large area from the northwest, a smaller area from the northeast and basically the Treadwell right of way from the southwest. There are existing corrugated metal pipe (CMP) culverts under Dorsey, on both the north and south side of Treadwell. Though some flow may enter the culverts on the west, the ditch elevations on the east side prevent any quantifiable discharge to flow to a roadside ditch. From Dorsey the flow should be making its way east to the low point of Treadwell at the western (rear) property line of 106 Dorsey which is common to the western side property line of 311 Treadwell. The area from both the northwest and northeast should flow along the north side of Treadwell and cross to the south of Dorsey through an existing CMP. This culvert is silted in on the south side and we assume allows no flow to discharge.

We believe the issue is the ditch elevations along the south side of Treadwell between Dorsey and the Treadwell low point. There is in fact no ditch there. Though based on the installation depth of the existing culverts, there probably once was.

To correct the drainage situation along these roadways, we would recommend 12" RCP pipes be installed in place of the existing CMPs and the ditches between Dorsey and the Treadway low point, on both sides of Treadwell, be regraded to provide positive flow from the intersection to the east and south. The existing culvert elevations should be matched as closely as possible. We are recommending concrete pipe due to the limited cover available to distribute wheel loads.

The issue then is what to do with this stormwater which now arrives at the western, side property line, of 311 Treadwell. This is basically where the drainage runs now, but with very limited success. There is indication of some low areas and ditch flows along the side property line but not much flow control is provided. In theory a ditch should be graded along that side property line allowing this flow from Treadwell and Dorsey to run to the south,

eventually reaching the long flat, west to east, channel that drains Dorsey and Academy (and the Jackson Street Detention Pond discharge) to the east. This downstream channel is evaluated in the next "Jackson Pond" section of this report. The other issue is the development in the rear yard of 311 Treadwell. There are typical yard fixtures and an existing shed in the back that would make controlled routing of the flow through the yard difficult without impact to the yard. However, that is where the runoff goes now.

There is one alternative to running down the west side of 311 Treadwell. That would be to run this flow east along Treadwell, across the front of 311, and then turn down the eastern side property line, discharging at the back of the lot. Because of the cut required, we would recommend extension of a storm sewer around the lot. A ditch would need to be at least 3-4 ft deep at the northeast lot corner and that final grading would seriously impact the adjacent properties. This diversion, like any other solution evaluated, would end up concentrating flow at some point, where there is not currently concentrated discharge. Therefore, a level spreader would need to be installed at that outlet as well. These locations are shown on the Study Area Plan, Area B.

The cost estimate for this works is as follows.

To replace CMP culvert, required ditches and install level spreader	\$50,111
To Divert the flow around the northeast corner of 311 Treadwell	\$37,980
Total Cost	<hr/> \$88,091

We would recommend the least expensive option which is to replace the culverts and regrade the ditches as suggested above, bringing drainage area runoff to the south side of Treadwell at the west side of 311 Treadwell. At that point we would recommend a level spreader be provided to allow concentrated flow to dissipate and slow velocities prior to flowing to the south along the property line and working its way through the rear yard area. Easements would need to be acquired to allow the level spreader to be installed on 311 Treadwell. This location is shown on Study Area Plan, Area B. The cost estimate detail for this proposal is provided. The estimate breaks down the construction cost of the suggested improvement at \$50,111. It also provides the detail on the diversion alternative and the Plan design fees.

In the following "Jackson Pond" section we address the conveyance of this flow, from the level spreader to West Main Street. The ditch through 311 Treadwell is at the upper reach of Swale B1. The slope of this section is 0.9%, which is generally able to support overload flow. Swale B1 is for the evaluated below.

Jackson Pond and conveyance to 304 West Main.

The Dorsey and Treadwell area, and the improvement recommended there, would drain directly to Swale B1. Below the upper reach described above, there is a broad 700 ft long swale that drains directly to West Main Street. At that point a 24" culvert conveys it across West Main Street to Town Run. This channel profile is shown on Sheet 3 and labelled Swale B1. The average slope of the lower 700 ft reach is 0.6%. A grass channel at this slope would have difficulty passing low flows.

The other areas which drain to this Swale extend from West Main to Dorsey and from the Battlefield Estates boundary in the west, to Smith Street. Most of this area, to the north and south, is direct runoff from the residential lots. This is basically sheet and shallow concentrated flow across areas with adequate slope. There is also a point source discharge from the Jackson Street Detention Pond which was originally constructed as a part of the Battlefield Estates subdivision. This pond discharges near the west end of Academy and then drains via a shallow ditch to Dorsey, then across the rear of a few lots to Swale B1. The shallow channel from Jackson Pond to Swale B1 has also been profiled and is labelled Swale B2. See Sheet 3.

The discharge from Jackson Pond has undergone changes since its installation. Originally configured as a sediment basin through construction, it actually retained that set up until just recently converted to its final design status in 2018. The flow to the pond never reached actual design capacity. The original plan called for about 109 acres of future Battlefield Estates development to drain to Jackson Pond. The ten-year peak inflow to the pond would be 130 cfs and using two 3" control orifices and riser provided in the original design, the pond would detain that flow releasing it at a rate of 82 cfs. The total volume of runoff passed through the pond for the two-year frequency storm would be 546,516 CF. Of course, the final sections of Battlefield Estates were never developed as intended and instead the new Clarke County High School was constructed on that land. That High School design included its own detention pond and instead of discharging to the Jackson Pond and our Swale B2 as originally planned, that discharge was taken to the south side of West Main and eventually flows directly to Town Run. Based on the available information, we estimate that 29 ac now drain to Jackson Pond. We have estimated that if the Jackson Pond conditions remains as it is now, the revised inflow to the pond for that same ten-year storm would be 80 cfs. The reduced discharge would be 1.2 cfs and the total volume through the pond would be 213,899 CF. The construction of the high school property has reduced the total volume of runoff to Swale B2 by about 61%.

Currently the lower reaches of Swale B1 are susceptible to water ponding largely due to the generally level, softly sloping terrain which characterizes this length of ditch. During 2018, there were observed longer periods of higher

flows and extended periods of ponding. Much of this can be attributed to twice the normal annual rainfall for that year, but the Town also wants to identify anything that can be done to reduce the flooding impacts to the area.

Pennoni first looked at the Jackson Pond. With the diversion of the runoff from the 80 acres west of Jackson Drive (High School Site) to Town Run as discussed above, the flow to the pond is significantly reduced. We originally considered installing a new outlet structure and providing only one 3" discharge orifice. Modeling this change showed basically no change in the ten-year discharge as the detained water surface elevation overflows the riser structure, which is typical for a ten-year storm design. Because the ten-year flow overtops the riser, the orifice size has little impact on discharge. The total volume discharged to the swale below would remain the same at 213,899 CF regardless of the outlet control provided. We also checked the time for the pond to completely drain. Typically, the drawdown period is kept around 48 hours. The current condition, with two 3" orifices, resulted in a draw down period of 4.1 days. If we go to only one 3" orifice, the draw down period would extend to 7.1 days. The longer water remains in the pond, the higher the risk of sinkholes forming or mosquito breeding. One option to reduce the detention time would be to increase the orifice size. With a 6" orifice, the detention time would be reduced to 2.5 days, but the tradeoff is that the discharge for the two-year storm would increase from 1.2 cfs to 1.66 cfs. The volume discharged would remain the same.

In order to try and reduce the total volume to Swale B2, we have also looked at diverting some portion of the flow to the south side of West Main and Town Run. The existing storm sewer which was installed in West Main with the School construction is higher than the pond bottom, but the elevations would allow some portion of the Jackson Pond discharge to be shifted south. We have estimated that a new outlet structure, with a 6" orifice at West Main about 109,402 CF of runoff could be shifted out of the Swale B2 drainage area over to Town Run. This by itself would slightly increase the ponding period to 4.8 days if the existing control outlet was to remain unchanged at 3". Under this scenario, the peak two-year discharge to B2 would be still be 1.2 cfs, since the riser would be overtopped. The volume of flow to B2 would be 104,497 CF, a reduction of 109,402 CF.

The Town should be careful with this transfer. The scope of this study did not include an analysis of Town Run's condition. We understand that there are portions of Town Run which are prone to flooding now. By adding new flow, to that previously diverted from the high school site, those Town Run conditions would probably not improve. But, the flow to be diverted is very small relative to the total Town Run watershed and may be able to be accommodated. This diverted discharge to B2 would eventually reach Town Run, but much lower in the channel, near the Smith Street intersection. The final design of any improvement should include an analysis of the downstream storm sewer. Going with this diversion, there is a slight increase to the detention time to 4.8 days, since the discharge would not crest the riser under this scenario.

After the Jackson Pond discharges to Swale B2, this ditch drains within an existing easement through the residential lots between West Main and Academy. The channel does come out of the easement just below the pond discharge and crosses over 411 Academy. Currently there is a 1% slope through the backyard. If the ditch is regraded to follow the alley and easement, the slope would be reduced in this area to about 0.8%. The Town should consider obtaining an easement to cover the existing flow path as it appears the existing ditch works well. Beyond 411 Academy, the ditch appears to stay within the easement until Dorsey. A 12" culvert does carry this flow across Dorsey. This culvert appears to operate satisfactorily. Below the pipe a "V" ditch does exist, centered on the property line. At the center of the ditch, a fence has been installed and dense vegetation has grown up through the fence on both sides. We believe that while the fence alone may not be a major restriction, the additional landscaping does impede flow through the backyards of 332 West Main and 12 Dorsey. We would recommend that the Town clean out the fence growth to allow the runoff to pass more easily. B2 then continues, following the easement to an intersection with B1. The slope of this swale is about 0.8%

There is also a drainage area which should drain to the Dorsey culvert from the north. At Academy, however, there is currently no way for this runoff to cross Academy and drain to the Dorsey culvert. To avoid major disturbance of yards, we would propose a small, 8" diameter HDPE pipe, to run from the north side of Academy all the way to the Dorsey culvert. This would avoid a need for a graded ditch across 11 Dorsey, and a major disturbance in the front yard 404 Academy. This new pipe could be installed within the existing right-of-way, although a temporary construction easement should be obtained.

Because of the flat slope of the Swale B1 below the intersection with B2, there is not enough depth from the invert of the culvert at West Main to the invert of the channel to install some sort of storm sewer system which could convey the storm flow underground. In order to have the peak flows pass as quickly as possible, we need to maintain whatever slope is available on the channel. One option to prevent ponding is to construct a concrete channel lining along the length of the swale. This type of improvement is sometimes installed within detention ponds with very flat bottom slopes. The concern we have is that the concrete channel slope can only be as steep as the existing grade, so portions of its length will be as flat as what exists now, and water will continue to pond in those areas as it does currently. The benefit is that it will eventually drain. It should be noted that, it is not unusual to have differential settlement of the yard areas outside of the concrete lining take place, preventing the yard runoff from flowing directly to the channel. We've provided a schematic detail of the concrete invert on Sheet 4.

We also looked at a berm system to contain the flows from upstream through the lower yard areas and confine any ponding between the berms. The challenge with this scenario is how to drain the yard areas as any break in the berm will allow the channel flow to back up into the yards. We detailed this option schematically on Sheet 4.

It does appear that there is some slope on the existing channel and that the higher peak flows can pass through to West Main. The primary issue is the ponding. We recommend that the Town consider an underdrain system which leaves the existing channel intact and would provide a subsurface drain that would allow ponding water to seep into the underdrain to be carried to West Main. The construction of the underdrain will also regrade the invert of the existing channel to remove any intermittent high spots and improve overall flow conditions.

We have estimated the costs of the various improvements as follows:

Jackson Pond

- Provide new outlet control structure to West Main storm sewer with a new outlet to B2 - \$12,600

Swale B1

- Install underdrain and concrete ditch lining along channel invert - \$53,066
- Academy Street Diversion - \$12,040

Based on these costs we believe the most effective approach on swales B2 & B1 is to provide two new outlets at Jackson Pond, one to discharge to West Main, and one to discharge to B2 (\$12,600); extend the HDPE along Dorsey (\$12,040) and install the underdrain along the lower reach of B1, from the B2 connection to 304 West Main for a Total Cost Estimate of \$77,706.

Pennoni Associates Inc.
 Project: Town of Berryville - NW Stormwater Study
 Ashby Court Sediment Trap Conversion
 Walnut Street Drainage Improvements

EXHIBIT
Study Area A, Cost Estimate
 Date 8/5/2019

EARTHWORKS

REGULAR EXCAVATION	CY	20	\$18	\$360
UNSUITABLE MATERIAL DISPOSAL	CY	15	\$17	\$255
GRADING	SY	50	\$8	\$400
PERMANENT SEED	SY	50	\$3	\$150

EROSION AND SEDIMENT CONTROL

SILT FENCE (EC-5, TYPE A)	LF	100	\$3	\$250
SOIL STABILIZATION BLANKET, (EC-2, TYPE 3)	SY	50	\$4	\$200

SUB TOTAL \$1,615

Ashby Trap Diversion Total with Mobilization And Contingency - \$2,261

UNDERDRAIN

VDOT #57 STONE	TN	85	\$18	\$1,530
UNSUITABLE MATERIAL DISPOSAL	CY	37	\$12	\$444
6" PERF. PVC	LF	945	\$30	\$28,350
CLEANOUTS	EA	4	\$125	\$500
FILTER FABRIC	SY	160	\$3	\$480
GRADING	SY	50	\$12	\$600
PERMANENT SEED	SY	50	\$3	\$150
STABILIZE POWER POLE/GUY	LS	1	\$2,500	\$2,500
CONNECTION TO EXISTING INLET	LS	1	\$350	\$350
INLET PROTECTION	LS	1	\$250	\$250
TREE TRIMMING	LS	1	\$1,500	\$1,500
SUB TOTAL				\$36,654

MOBILIZATION @ 20% \$7,654

CONTINGENCIES @ 20% \$7,654

TOTAL COST ESTIMATE \$53,577

OTHER COSTS ASSOCIATED WITH THE PROJECT

SURVEY	\$8,000
DESIGN AND EASEMENTS	\$12,000
BIDDING AND CONSTRUCTION ADMINISTRATION	\$6,000
TOTAL	\$26,000

Pennoni Associates Inc.
 Project: Town of Berryville - Stormwater Study
 Subject: Dorsey and Treadwell Renovation

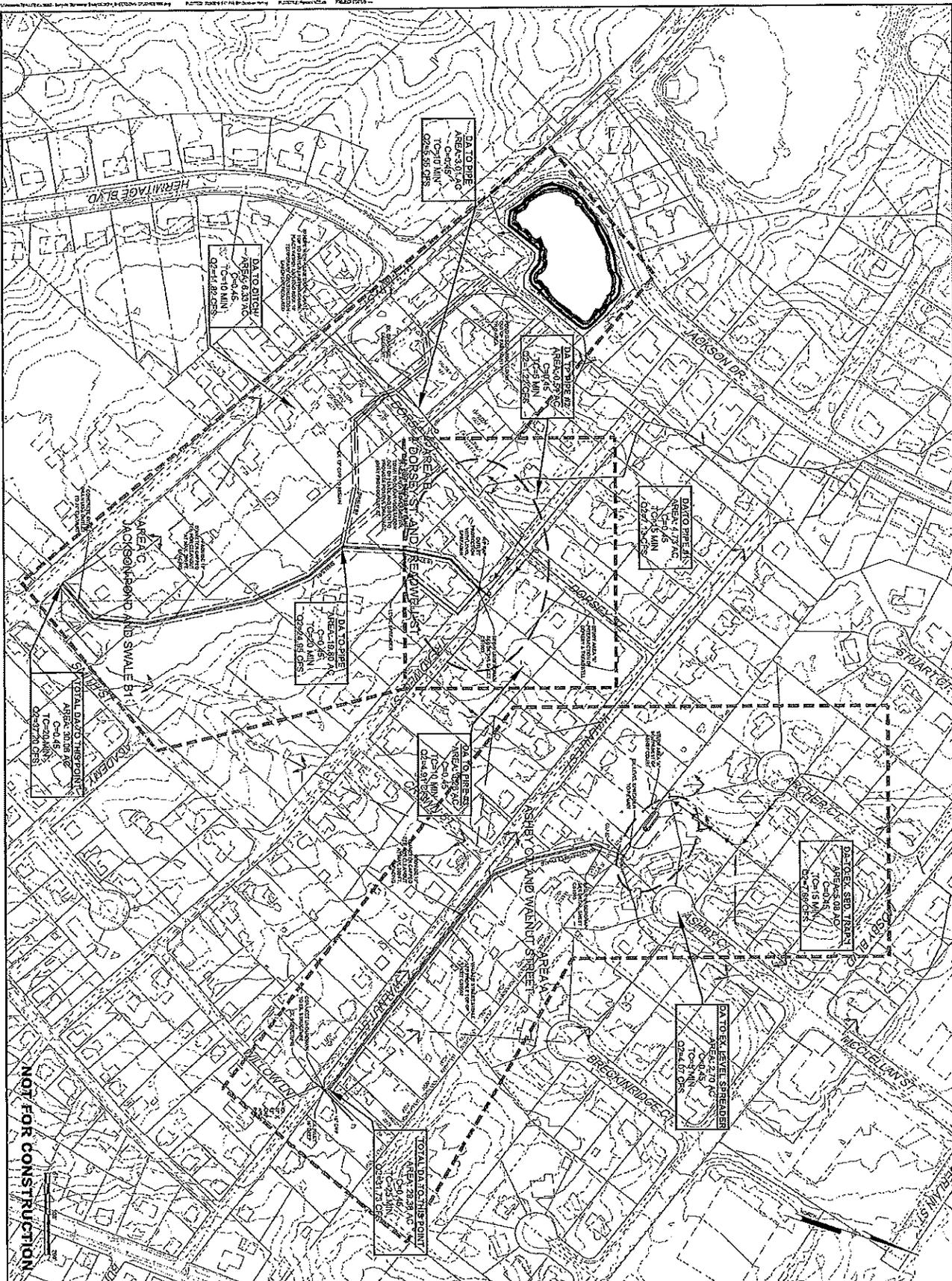
EXHIBIT
Study Area B, Cost Estimate
 Date 8/5/2019

	UNIT	QTY	PRICE PER	PRICE TOTAL
DEMOLITION				
REMOVAL OF EXISTING DRAINAGE PIPE(3 CMP)	LF	66	\$45	\$2,970
PAVEMENT				
SURFACE COURSE - SM-9.5D	TON	9	\$85	\$765
INTERMEDIATE COURSE - IM-19.0D	TON	9	\$100	\$900
AGGREGATE BASE - NO.21B	TON	20	\$18	\$368
TACK COAT	GAL	3	\$4	\$11
EARTHWORKS				
REGULAR EXCAVATION	CY	50	\$18	\$900
UNSUITABLE MATERIAL DISPOSAL	CY	40	\$17	\$680
GRADING	SY	180	\$8	\$1,440
PERMANENT SEED	SY	180	\$3	\$540
TRAFFIC CONTROL				
LANE CLOSURE	LS	1	\$4,500	\$4,500
DRAINAGE				
STORM SEWER, CONC. PIPE, 12"	LF	66	\$45	\$2,970
VDOT STD ES-1, 12"	EA	6	\$700	\$4,200
EROSION AND SEDIMENT CONTROL				
SILT FENCE (EC-5, TYPE A)	LF	20	\$3	\$50
SOIL STABILIZATION BLANKET, (EC-2, TYPE 3)	SY	400	\$4	\$1,600
CULVERT INLET PROTECTION	EA	3	\$300	\$900
LEVEL SPREADER	EA	1	\$5,000	\$5,000
UTILITIES				
RELOCATE STABILIZE POWER POLE/GUY	LS	1	\$5,000	\$8,000
TOTAL BID AMOUNT				\$35,794
CONTINGENCIES @ 20%				\$7,159
CONTINGENCIES @ 20%				\$7,159
SUB TOTAL				\$50,111
ADDITIONAL COST TO EXTEND CULVERTS TO EAST AND SOUTH				
STORM SEWER, CONC. PIPE, 15"	LF	230	\$115	\$26,450
VDOT STD ES-1, 12"	EA	2	\$850	\$1,700
VDOT MH-1	EA	1	\$3,500	\$3,500
TOTAL BID AMOUNT				\$31,650
CONTINGENCIES @ 20%				\$6,330
SUB TOTAL				\$37,980
TOTAL COST ESTIMATE				\$88,091
OTHER COSTS ASSOCIATED WITH THE PROJECT				
SURVEY				\$8,000
DESIGN AND EASEMENTS				\$12,000
BIDDING AND CONSTRUCTION ADMINISTRATION				\$5,000
TOTAL				\$25,000

Pennoni Associates Inc.
 Project: Town of Berryville - NW Stormwater Study
 Jackson Pond, Swale B1

EXHIBIT
Study Area B, Cost Estimate
 Date 8/5/2019

ACADEMY LANE CULVERT EXTENSION				
ROAD CROSSING				
SURFACE COURSE - SM-9.5D	TON	2	\$150	\$300
AGGREGATE BASE	TON	5	\$22	\$110
TACK COAT	GAL	2	\$4	\$7
EXCAVATION				
REGULAR EXCAVATION	CY	5	\$18	\$90
UNSUITABLE MATERIAL DISPOSAL	CY	3	\$12	\$36
GRADING	SY	12	\$8	\$96
PERMANENT SEED	SY	12	\$3	\$36
TRAFFIC CONTROL				
LANE CLOSURE	LS	1	\$2,500	\$2,500
RELOCATE STREET SIGN	LS	1	\$350	\$350
DRAINAGE				
8" HDPE	LF	135	\$35	\$4,725
INLINE TEE WITH GRATE	EA	1	\$350	\$350
SUB TOTAL				\$8,600
Academy Street Total with Mobilization And Contingency -			\$12,040	
DRAINAGE SWALE B1				
VDOT #57 STONE	TN	88	\$18	\$1,584
UNSUITABLE MATERIAL DISPOSAL	CY	50	\$12	\$600
6" PERF. PVC	LF	1,010	\$30	\$30,300
CLEANOUTS	EA	5	\$125	\$625
FILTER FABRIC	SY	170	\$3	\$510
GRADING	SY	75	\$12	\$900
PERMANENT SEED	SY	75	\$3	\$225
CONCRETE INVERT	SY	6	\$60	\$360
VEGETATION REMOVAL	LS	1	\$750	\$750
EROSION AND SEDIMENT CONTROL				
ROCK FILL CHECK DAMS	EA	5	\$250	\$1,250
SOIL STABILIZATION BLANKET, (EC-2, TYPE 3)	SY	100	\$4	\$400
CULVERT INLET PROTECTION	EA	1	\$400	\$400
SUB TOTAL				\$37,904
SUB TOTAL				\$46,504
MOBILIZATION @ 20%				\$9,301
CONTINGENCIES @ 20%				\$9,301
TOTAL COST ESTIMATE				\$65,106
ADD ALTERNATE FOR REDUCED VOLUME				
JACKSON POND				
4 FT DIA. MH	EA	1	\$3,500	\$3,500
TRASH RACK AND DEBRIS CAGE	EA	1	\$650	\$650
GROUT EX. CULVERT	CY	4	\$300	\$1,050
STABILIZATION	LS	1	\$350	\$350
DIVERSION TO WEST MAIN				
4 FT DIA. MH	EA	1	\$3,500	\$3,500
TRASH RACK AND DEBRIS CAGE	EA	1	\$650	\$650
12" PVC CULVERT	LF	80	\$50	\$4,000
CONNECTION TO EXISTING STRUCTURE	EA	1	\$500	\$500
STABILIZATION	LS	1	\$350	\$350
SUB TOTAL				\$9,000
CONTINGENCIES @ 20%				\$1,800
MOBILIZATION @ 20%				\$1,800
TOTAL COST ESTIMATE				\$12,600
TOTAL COST ESTIMATE WITH ALTERNATE				\$77,706
OTHER COSTS ASSOCIATED WITH THE PROJECT				
SURVEY				\$10,000
DESIGN AND EASEMENTS				\$18,000
BIDDING AND CONSTRUCTION ADMINISTRATION				\$6,000
TOTAL				\$34,000



NOT FOR CONSTRUCTION

PROJECT	TOWN OF BERRYVILLE, VIRGINIA
	NORTHWEST QUADRANT STORM STUDY
SHEET	1 OF 5
	CS1000
DATE	11/15/2012
BY	ADAMSON
CHECKED	ADAMSON
SCALE	AS SHOWN
PROJECT NO.	2012032
DATE	11/15/2012
BY	ADAMSON
CHECKED	ADAMSON
SCALE	AS SHOWN
PROJECT NO.	2012032
DATE	11/15/2012
BY	ADAMSON
CHECKED	ADAMSON
SCALE	AS SHOWN
PROJECT NO.	2012032
DATE	11/15/2012
BY	ADAMSON
CHECKED	ADAMSON
SCALE	AS SHOWN

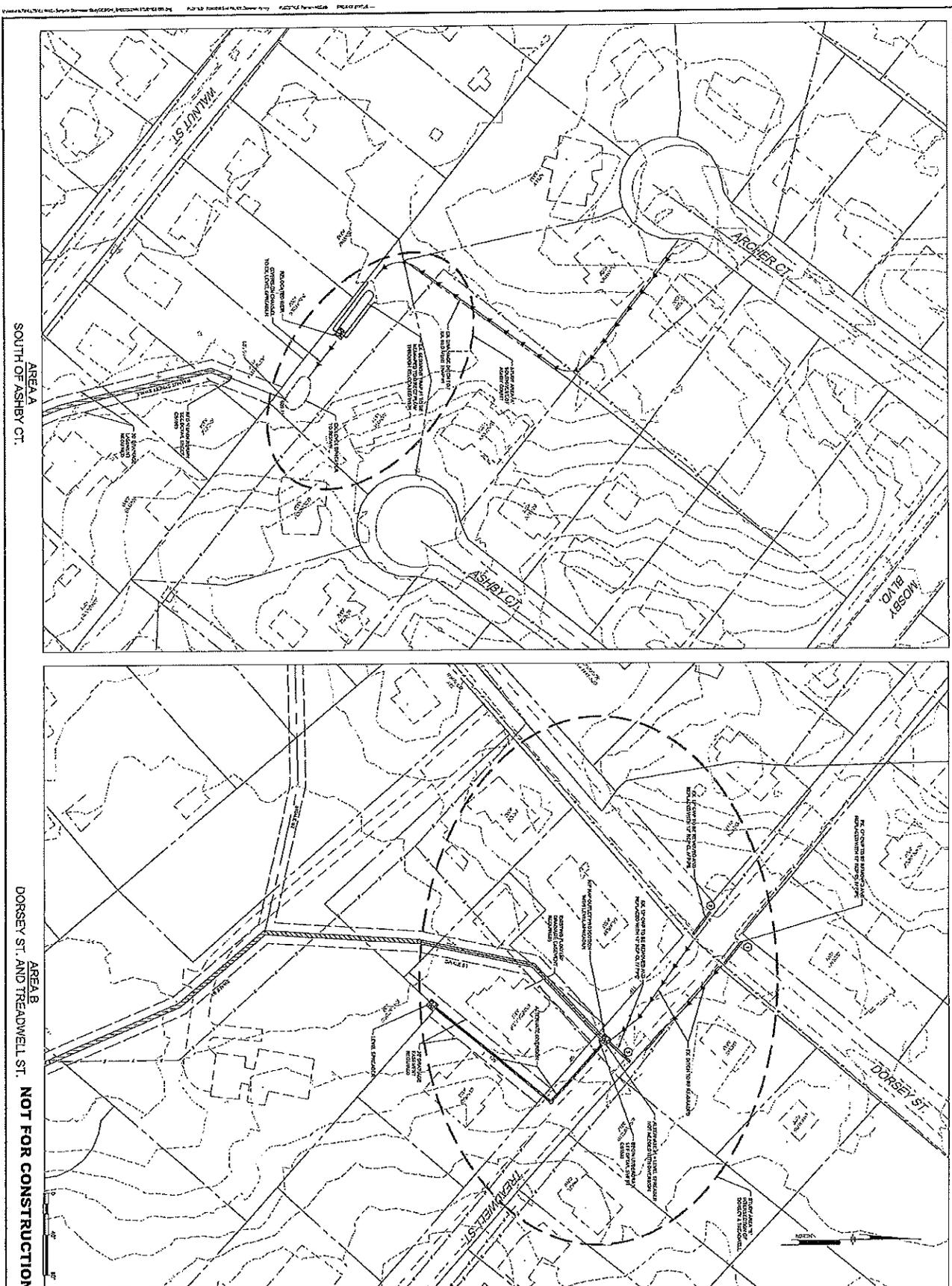
TOWN OF BERRYVILLE, VIRGINIA
NORTHWEST QUADRANT STORM STUDY

OVERALL AREA PLAN

ALL DIMENSIONS MUST BE VERIFIED BY CONTRACTOR
AND CHECKED AGAINST THE RECORDS OF ANY
DISCREPANCIES BEFORE PROCEEDING WITH WORK



PENNONI ASSOCIATES INC.
117 East Prosperity Street
Winchester, VA 22601
T 540.667.2130 F 540.665.0493



AREA A
SOUTH OF ASHBY CT.

AREA B
DORSEY ST. AND TREADWELL ST. **NOT FOR CONSTRUCTION**

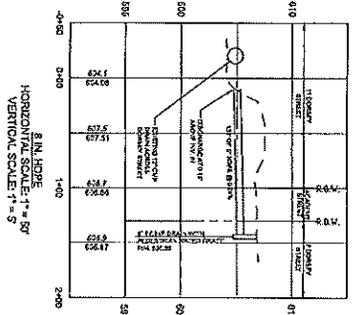
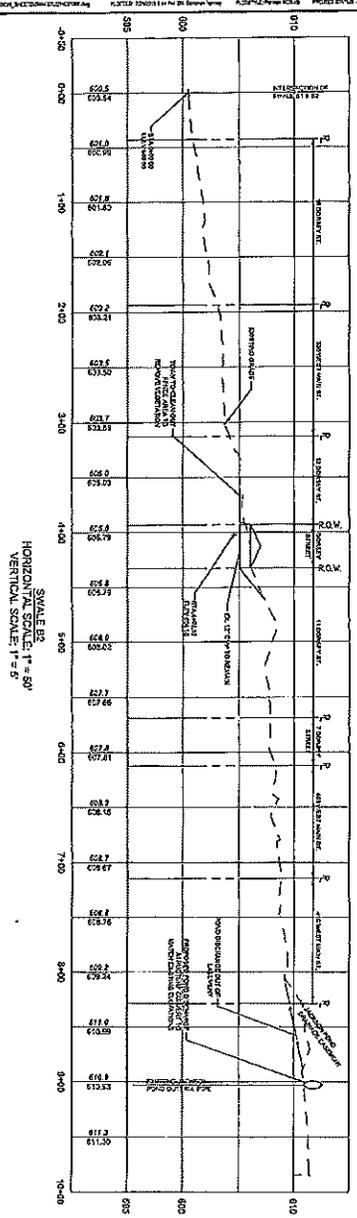
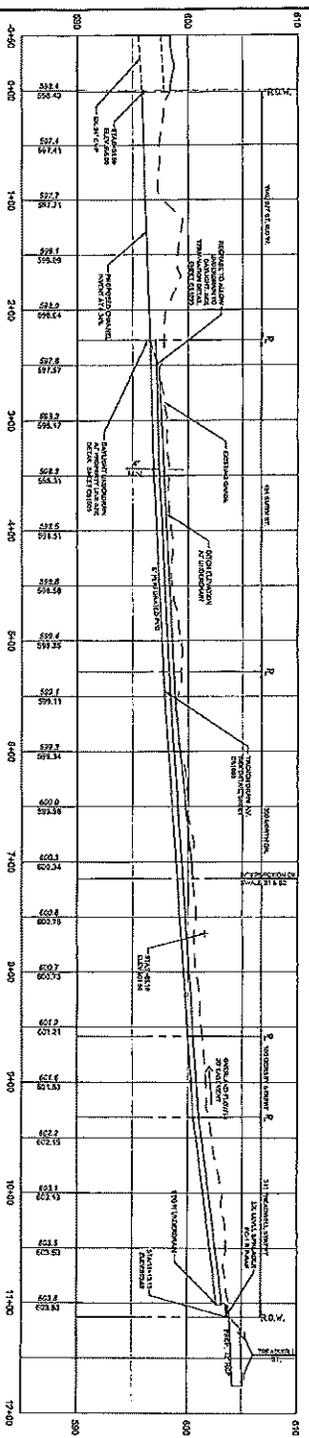
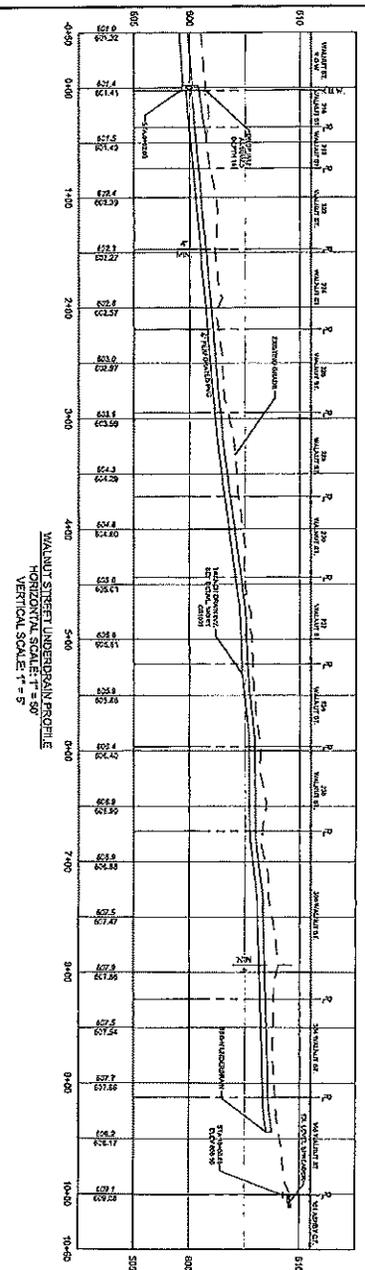
PROJECT	TOWN OF BERRYVILLE
DATE	2/20/2020
DESIGNED BY	AS SHOWN
CHECKED BY	AS SHOWN
DATE OF PLOT	2/20/2020
SCALE	AS SHOWN
PROJECT NO.	CS1001
SHEET NO.	2 OF 5

TOWN OF BERRYVILLE, VIRGINIA
NORTHWEST QUADRANT STORM STUDY

STUDY AREA PLAN

ALL DIMENSIONS MUST BE VERIFIED BY CONTRACTOR AND OWNER MUST BE ADVISED BY ANY DISCREPANCIES BEFORE PROCEEDING WITH WORK

Pennoni
 PENNONI ASSOCIATES INC.
 517 East Pocastry Street
 Winchester, VA 22601
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NOT FOR CONSTRUCTION

PROJECT	TOWN OF BERRYVILLE, VIRGINIA NORTHWEST QUADRANT STORM STUDY
DATE	02/20/05
BY	AF
NO.	

**TOWN OF BERRYVILLE, VIRGINIA
NORTHWEST QUADRANT STORM STUDY**

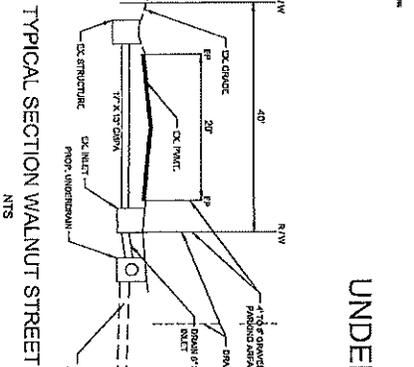
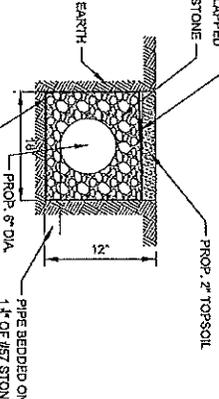
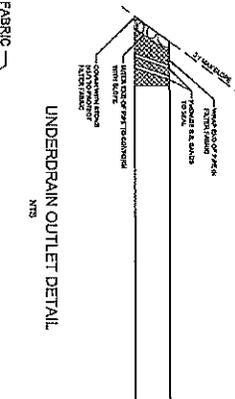
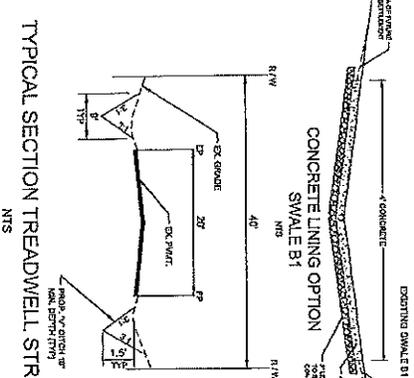
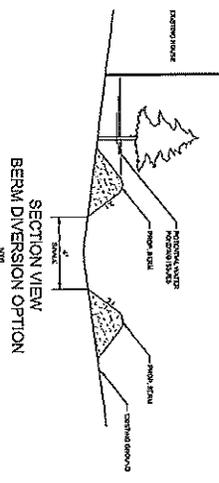
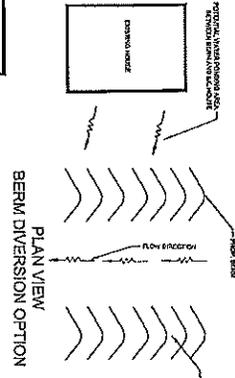
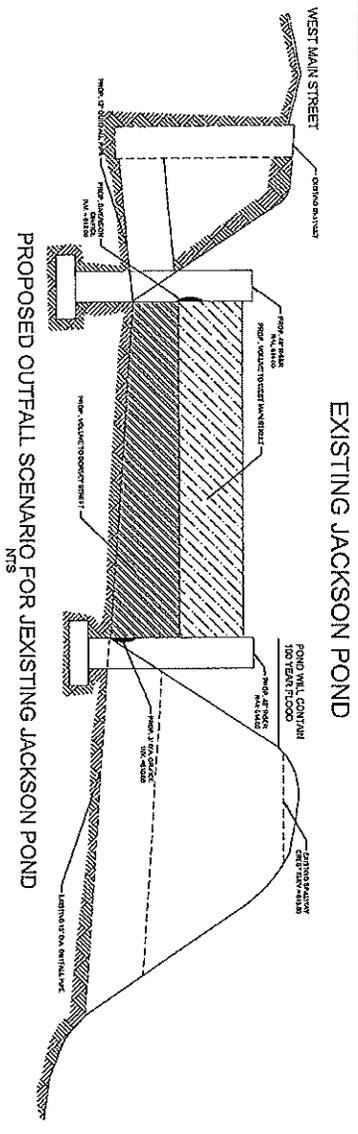
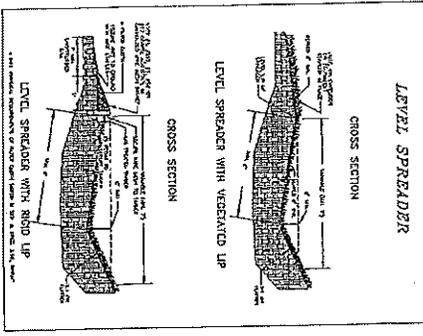
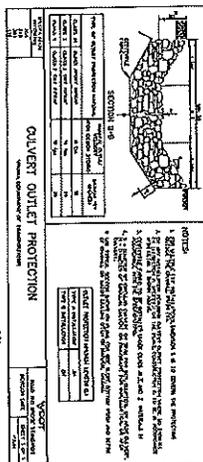
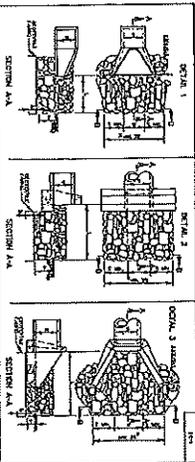
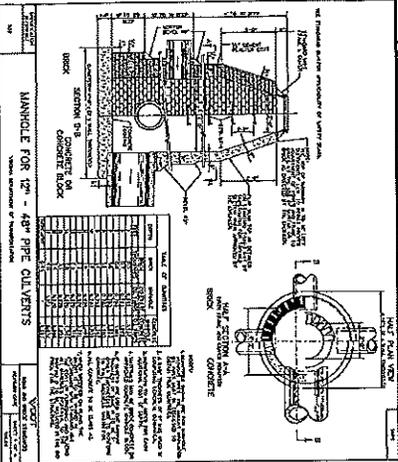
SWALE PROFILES

ALL DIMENSIONS MUST BE VERIFIED BY CONTRACTOR
AND DISCREPANCIES BE RECORDED WITH WORK



PENNONI ASSOCIATES INC.
117 East Piccadilly Street
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CS1002
SHEET 3 OF 5



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TOWN OF BERRYVILLE, VIRGINIA
NORTHWEST QUADRANT STORM STUDY

SWALE DETAILS

ALL DIMENSIONS MUST BE VERIFIED BY CONTRACTOR AND DIMENSIONS MUST BE NOTED ON ANY DISCREPANCIES BEFORE PROCEEDING WITH WORK

Pennoni

PENNONI ASSOCIATES INC.
117 East Pocomoke Street
Worcester, VA 22691
T 640.667.2133 F 540.855.6493

PROJECT	TWILL LANE
DATE	2/20/2020
DESIGNED BY	ASHERMAN
CHECKED BY	ASHERMAN
SCALE	AS SHOWN
DATE	2/20/2020
PROJECT	TWILL LANE
DATE	2/20/2020
DESIGNED BY	ASHERMAN
CHECKED BY	ASHERMAN
SCALE	AS SHOWN
DATE	2/20/2020

CS1003
SHEET 4 OF 5

