Table of Contents

I. Introduction and Executive Summary 3
A. Executive Summary 3
B. Introduction 5
C. Background 5
II. Report Methodology 5
A. Assumptions 5
1. Previous Work Consulted 5
2. Review of the AVSWMP 6
3. Recommended Improvements from the AVSWMP 6
B. Sub-basin approach 6
C. Information Sources for report development 6
1. County Data 7
2. Canal Company Data 7
3. State and Federal Agency Data 7
D. Goals of the Report 7
III. Projects Evaluated 8
A. Northwest Ashley Valley 8
1. Area Overview 8
2. NW Option 1A – Detention Basin & Canal Improvements 9
3. NW Option 1B - Detention Basins & New Canal to Ashley Creek 12
4. NW Option 2 - Detention Basins & Natural Flow Paths Improvements 14
5. NW Option 3 - Piped Storm Drain System 17
B. West and Southwest Ashley Valley 19
1. Area Overview 19
2. WSW Option 1A - Detention Basins & Highline Canal Improvements 21
3. WSW Option 1B - Detention Basins & Highline/Upper Canal Improvements 23
4. WSW Option 2 - Detention Basins & Natural Flow Paths Improvements 25
5. WSW Option 3 - Piped Storm Drain System 28
C. North and East Ashley Valley 31
1. Area Overview 31
2. NE Option 1 - Detention Basins & Rock Point Canal 32

3. NE Option 2 - Detention Basins & Natural Flow Paths Improvements 35
4. NE Option 3 - Piped Storm Drain System 37
D. Central Ashley Valley (Adjacent to Vernal City and Ashley Creek) 39
1. Area Overview 39
2. C Option 1 - Spring Creek Reservoir 42
3. C Option 2 - Ashley Creek Stabilization 44
4. C Option 3 - Ashley Creek Stabilization and Piped Storm Drain System 46
IV. Benefit Analysis 49
A. Benefit Analysis Criteria 49
B. Benefit Areas & GIS Analysis 49
C. Project Ranking 50
V. Summary and Priority List 52
A. Summarized Ranking Results 52
B. Implementation Scheduling and Phasing 52
C. Funding Considerations 53
1. Possible funding sources for project list 53
2. Timelines for funding sources 53
D. Permitting Requirements and Environmental Considerations 53
E. Conclusions and Recommendations 54
VI. Appendices 55
A. Appendix A – Technical Review of AVSWMP 55
B. Appendix B – Public Comments Map 56
C. Appendix C – Proposed Project Maps 57
D. Appendix D – Engineer's Opinion of Probable Cost 58
E. Appendix E – Additional Analysis information 59

I. Introduction and Executive Summary

A. Executive Summary

Flood control in Uintah County has been a topic of discussion during recent years with multiple storms highlighting areas of the county with deficiencies and damages to developed areas. In an effort to plot a course to tackle these drainage challenges, Uintah County commissioned this study in an effort to revisit proposed projects found in the 2008 Ashley Valley Storm Water Master Plan and analyze the costs and benefits for these proposed projects and possible alternatives stemming from recent canal piping proposals. Three of the Ashley Valley Canals (Highline/Upper and Rock Point) have successfully received grants from the Salinity Control program and are in various stages of design and planning for replacing the open channel canals with pressure pipe. The canals provide a ring of protection for Ashley Valley and have historically captured drainage water coming into the valley. These canal piping projects will change the use of the canals and the opportunity and timing of this action triggered the County's response by conducting this analysis prior to any financial participation.

Proposed projects analyzed in this study included canal improvements to utilize canals for storm drainage after irrigation water is removed, construction of detention/debris basins in drainages coming into the Ashley Valley, streambed cleaning and channel improvements on Ashley Creek and other natural drainage channels, storm drain piping, and even a reservoir on Spring Creek. Public input was solicited with a public meeting, as well as multiple meetings with irrigation companies and irrigators who live along the canal and have a firm understanding of the drainage patterns and canal responses. Data from the previous planning efforts was compiled and utilized in determining the benefits that could be realized from each proposed project. Cost estimates were updated and refined for each alternative and a benefit assigned to each action for flood prevention and property protection. The benefit to cost ratios were calculated and refined for comparing each project.

The table below summarizes the findings for each geographic improvement area's top recommended projects (see Section V.A)

Priority	Improvement Area	Project Option	Description	Project Infrastructure Cost
1	Central	3	Ashley Creek Stabilization and Storm Drain	$62,901,000
2	West & Southwest	1A	Yellow Hills Basin and Highline Canal	$2,482,200
3	Northwest	1A	Coal Mine Basin and Highline Canal	$1,121,400
4	North & East	1	Basins and Rockpoint Canal	$4,383,400
			Total:	$70,888,000

The table below shows the summary of projects to address immediate needs in conjunction with the canal piping projects and current funding availability:

Priority	Improvement Area	Project Option	Description	Current Project Infrastructure Cost	Potential Construction Timeline
1a	West & Southwest	1A	Yellow Hills Basin and Highline Canal	$1,775,000	2018 - 2019
1b	Northwest	1A	Coal Mine Basin and Highline Canal	$813,600	2018 - 2019
2	North & East	1	Rockpoint Canal and Some Basins	$1,605,300	2018 - 2019
			Total:	$4,193,900	

Based on the results of this study and the cost-benefit analysis, the projects with the highest benefit to cost ratios included utilizing the Highline and Rock Point Canals along with detention/debris basins in strategic watersheds (Coal Mine, Yellow Hills, and others). With the Highline/Upper and Rockpoint Canal piping projects being funded by the Salinity Control Program with anticipated timelines for construction spanning from 2017 to 2018, the canal improvements could be constructed in conjunction with these piping projects or following closely thereafter. Once canal improvements are made and channels widened and disturbed, the capacity for stormwater conveyance and losses in seepage will provide an immediate benefit while the detention and debris basins are being constructed. Once these initial project needs based on the current land uses and development, the next priority should be Ashley Creek as outlined in the analysis. Other storm drain and natural drainage improvements would follow Ashley Creek improvements where appropriate and as funding is available. It would be beneficial to the County to obtain Section 404 Permitting for improvements involving natural channels and Ashley Creek so that ongoing maintenance to these channels could be done without delay. Proactively cleaning the Ashley Creek streambed prior to runoff events and flash flooding will provide capacity in this important drainage channel.

Aside from construction and on-the-ground improvements, continued planning and review of land use ordinances for compatibility with the overall flood control plan and concepts is highly recommended. Proactively protecting homes and property by preserving natural drainages and requiring drainage improvements to be incorporated in development will go a long ways in preventing future flood control issues and transfer costs to development and not the County. Vernal and Naples would also benefit to go through similar planning measures and coordinate efforts with the County where overlap in benefit occurs.

B. Introduction

This report seeks to provide Uintah County with information building upon the 2008 Ashley Valley Storm Water Master Plan (AVSWMP) and updated and analyzed to provide a list of recommendations that should be completed to provide the highest cost benefit for the residents of Uintah County. Methodology of the proposed analysis is shown in the following section. Subsequent sections then show analysis of alternatives for 4 different geographic areas in Ashley Valley. Each section contains estimated cost information for construction improvements and then subsequent maintenance. Evaluation of the alternative projects is then completed, with a conclusion summary of the results, recommendations and a priority list of the projects identified.

C. Background

In 2008 Uintah County contracted Epic Engineering to complete an Ashley Valley Storm Water Master Plan. This plan modeled storm water in and around Ashley Valley and then identified projects to manage identified storm water issues. In 2016 Uintah County contracted with Jones and DeMille Engineering and Sunrise Engineering to review the AVSWMP, identify portions of the plan that have been completed and then complete estimates and make recommendations on what flood control improvements should be made. Recommendations are based upon updated cost estimates and cost benefit analysis.

II. Report Methodology

A. Assumptions

1. Previous Work Consulted

This report builds upon and incorporates the AVSWMP. In addition, other relevant information has been reviewed and gathered from the following sources:

- Canal Safety reports for the:
  - Highline Canal
  - Upper Canal
  - Central Canal
  - Rock Point Canal
  - Steinaker Service Canal
- Projects completed by the Uintah Transportation Special Service District since 2008
- Work completed by the Uintah County Roads Department
- A public meeting with information received on comment forms and drawn on maps
- Meetings with each of the above listed canal companies
- Follow-up meetings and site visits with individuals requesting such
- Site visits and onsite data collection following a storm event in September 2016

2. Review of the AVSWMP

A review of the content and methodology of the AVSWMP was completed and the report is found to contain sound and reliable information. The methods used and conclusions reached are concurred with for this report and thus the information contained in the AVSWMP will be used as the basis for this report. A summary of the detailed analysis completed on the AVSWMP can be found in the appendix A. As was anticipated, the AVSWMP does contain recommendations that have been completed since the report was finalized and implementation of the plan in relation to current circumstances could not have been anticipated. A cost benefit analysis was not completed with the AVSWMP, but this report will include such analysis in conjunction with recommended (or similar) improvements.

3. Recommended Improvements from the AVSWMP

Contained in the AVSWMP is a list of improvements that were identified and recommended. A portion of those recommendations have been completed since 2008. Recommended improvements that have not been completed were estimated in 2008 to cost over $200 million dollars. $192 million of the remaining projects is accounted for in storage/flood control dams on upper Ashley Creek outside Ashley Valley. The remaining proposed projects include water conveyance structures, improvements to existing waterways, culvert improvements, detention basins and similar improvements. Following the review of the AVSWMP, these suggested improvements remain suggested. Further discussion of the proposed upper Ashley Creek Dams and Ashley Creek can be found in the Central Ashley Valley Section (Section III C) of this report.

B. Sub-basin approach

Upon review of the AVSWMP and the remaining suggested improvements (excepting the Upper Ashley Creek Dams) a sub-basin approach for analysis was determined as the most logical way to group projects and prepare for evaluation. The different areas of Ashley Valley experience flood control issues in different ways and the recommended improvements and proposed solutions are different for each area. The following areas were determined to have similar storm water challenges and proposed solutions will be similar in purpose and scope.

- Northwest Ashley Valley
- West and Southwest Ashley Valley
- North and East Ashley Valley
- Central Ashley Valley

Isolating each of the above listed areas also allows for a more focused approach and evaluation of recommended improvements. Implementation of the selected improvements will also be simplified due to the geographic grouping and decreased cost for each of the areas. Phasing of implementation could also be based upon these geographic areas if such is desired.

C. Information Sources for report development

In addition to the information included in the AVSWMP, this report gathered additional and updated data in a GIS format including:

1. County Data
    a. *Zoning*
    b. *Future land use*
    c. *Address points*
    d. *Assessed land and improvement valuations*
    e. *Previous road and bridge reconstruction projects (UTSSD)*
2. Canal Company Data
    a. *Ashley Central Irrigation Co. - canals, channels, and stormwater entry points*
    b. *Rock Point Canal and Irrigation Co. - canals, channels, and stormwater entry points*
    c. *Steinaker Service Canal - canals, channels, and stormwater entry points*
3. State and Federal Agency Data
    a. *Land Ownership (BLM & SITLA)*
    b. *Demographics (US Census Bureau)*
    c. *Roads (UDOT & AGRC)*
    d. *Streams and lakes (NHD)*
    e. *Flood zones (FEMA)*
    f. *Surface elevation models (AGRC)*
    g. *Precipitation (NOAA)*
    h. *Soils (NRCS)*
    i. *Bridges and road structures (UDOT & USDOT)*
    j. *Dams, dam break areas, points of diversion (Utah DNR)*

D. Goals of the Report

The goal of this report is to assist Uintah County in making decisions based on the flood control needs of the county by providing a cost-benefit analysis of recommended improvements from both the AVSWMP and additional alternatives. The analysis will provide updated cost estimates for each alternative along with other considerations such as annual maintenance costs, protected property and infrastructure, and potential funding sources. The County wishes give priority for funding the highest cost benefit projects as funds become available and this report will provide an engineering and GIS analysis to validate that priority.

III. Projects Evaluated

A. Northwest Ashley Valley

1. Area Overview

This Northwest area of Ashley Valley is characterized mainly by Ashley Creek entering the Valley from Dry Fork Canyon. The mouth of the canyon contains not only Ashley Creek, but developed land, homes and two canals, the Highline and Upper Canals. At the mouth of the canyon, the Thornburgh diversion provides water to the Steinaker Feeder Canal, the Rock Point Canal and the Ashley Central Canal. This area near Ashley Creek has the potential to receive the most impact from spring runoff events due to only minor upstream control structures. Being unregulated upstream, and due to the typical sediment load (sand to cobbles) the path of Ashley Creek has been known to change during flood events. Typically rain events are handled by the existing creek bed unless they occur in conjunction with the runoff.

The remainder of this area is lightly populated agriculture land with a generally high groundwater table near the creek and artificial waterways. Flash flooding has been known to occur from the Coal Mine Basin. Currently, the water produced from flash flood events and extended duration events in Coal Mine Basin are routed through a culvert that bypasses the Highline Canal allowing the water to enter the Upper Canal where it has typically been handled and directed South in the Upper Canal. This culvert has not always been able to handle all flood waters and it has spilled over into the Highline Canal and even overtopped the Highline Canal in this area near 1500 North. Coal Mine Basin is the largest sub basin in this area, flood waters from it and other basins in this area are currently handled by the canals although there has been instance where the Highline Canal has overtopped and homes downstream have been flooded near the base of Yellow Hill. Large storm events in recent years have mainly occurred when the canals were not filled with irrigation water, but if a large storm event occurs when the canals are full, the amount of flood water that could be conveyed before overtopping took place would be greatly reduced.

If the canals were not in place and used as flood control, the natural washes and lower areas would be the natural course for the water to follow. Many of these lower areas and washes have been filled in and developed in this area. This area is mainly agriculture land with low density residential, but there are subdivisions in this area, mainly along 3500 West which are adjacent to the Upper Canal and could receive runoff water if the canals overtopped. The painted hills subdivision is above the Highline Canal, but we received no comment on flood issues from residents there and the subdivision is built on the hillside above the typical runoff pathway in Coal Mine Basin.

Known problem areas include:

- Ashley Creek, mainly during runoff events
- Coal Mine Basin, mainly during long duration and flash flood events
- Yellow Hills Basin, mainly during long duration and flash flood events

Solutions for Ashley Creek issues were discussed in the AVSWMP and will be addressed further in the Central Ashley Valley section of this report.

Solutions for addressing flood events related to Coal Mine Basin were also addressed in the AVSWMP. Multiple detention basins and a new canal directing storm water to Ashley Creek was recommended, as well as looking closer at the canals. While this report concurs that the recommendations made in the AVSWMP for this area are good recommendations, other options are also show here. These additional options are shown as practical implementation strategies and projects to address flood control, they do not replace or devalue the recommendations made in the AVSWMP.

Projects evaluated in this report for the Northwest area of Ashley Valley include the following:

- NW Option 1A – Coal Mine Detention Basin and Highline Canal Improvements
- NW Option 1B – Coal Mine and Yellow Hills Detention Basins and New Canal Parallel to the Highline Canal and Storm Drain to Ashley Creek
- NW Option 2 – Coal Mine Detention Basin and Natural Drainage Enhancements
- NW Option 3 – Coal Mine Detention Basin and Storm Drain System

2. NW Option 1A – Detention Basin & Canal Improvements

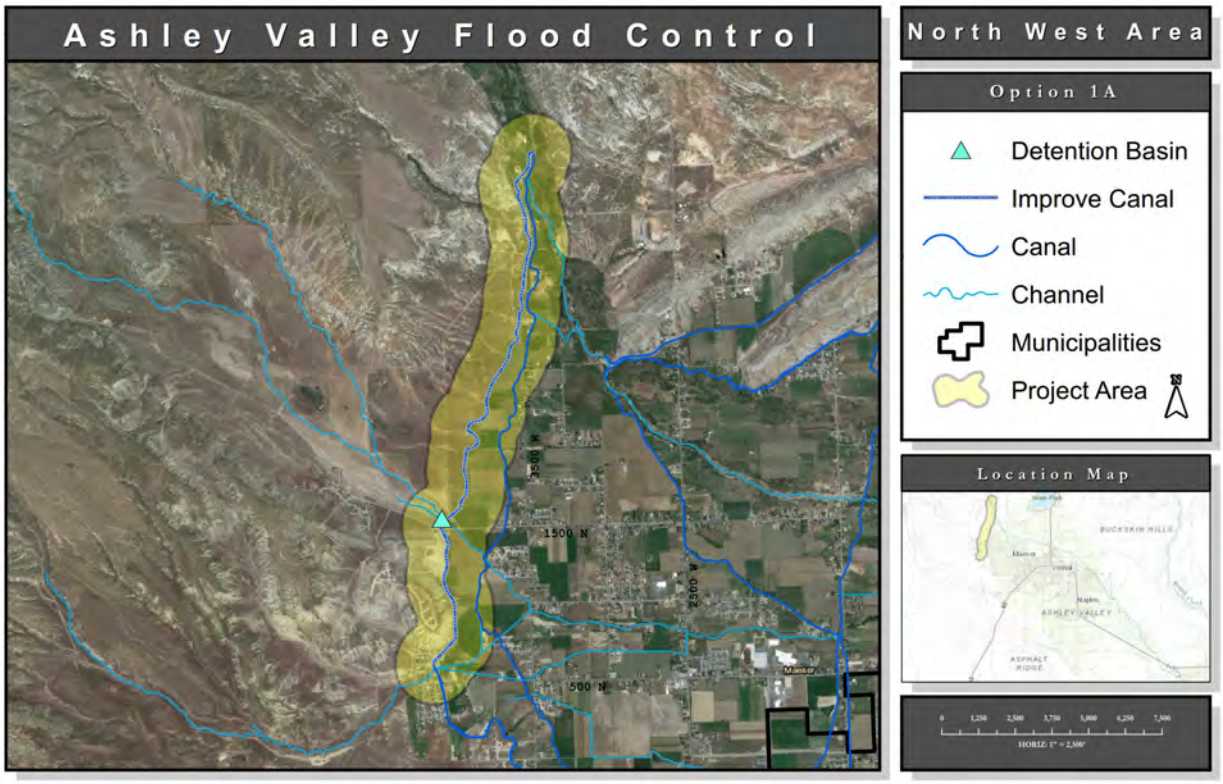
The AVSWMP suggested 2 detention basins in Coal Mine Basin. This report recommends one larger detention basin that would be designed to handle both drainages in the basin. It appears that work has been done to bring the two washes together upstream of the Highline Canal and this combining of drainages would be essential to 1 basin working instead of 2. Given that the watershed upstream of the Highline Canal is undeveloped land the debris typically seen at the current undershot of the Highline Canal is sticks, bushes and tumbleweeds. The watershed also has more slope than the valley floor, the runoff typically caries a heavy sediment load as well. The proposed detention basin should be designed with debris and sediment in addition to the detention purposes. The size of detention basin recommended in the AVSWMP was a 160 acre-ft. detention basin. It is recommended that during the design phase this size is confirmed with the project modeling.

The Highline Canal through this area is in good working condition currently. It is proposed by the Highline Canal Company that the Highline Canal be abandoned and irrigation users be served through pipelines that would connect to a future pipeline in the current Upper Canal alignment. Recommendations in this section of the report rely upon that assumption, that no irrigation water will remain in the Highline Canal after the Upper Canal is piped and that only small diameter irrigation lines will share the Highline Canal alignment in only a few areas. Should this assumption prove false, one of the secondary options listed at the end of this section would need to be considered.

Being the upper end of the canal it is larger in size and carries 60 cfs plus during irrigation season. It is estimated that during storm events this canal can take up

to 90 cfs or more in this section before overtopping is imminent. Smaller flows have been known to overtop the canal when debris and other restrictions prevent larger flows from staying in the canals. The AVSWMP suggests an engineered canal bank with reinforcement included and a typical minimum 10' trapezoidal cross section. The extent and design of the canal improvements should be included in the design of any future flood control projects. For the purposes of this report, a typical 8' trapezoidal channel is recommended with the detention basin in Coal Mine Basin being designed to route outflows to the canal at a rate that will accommodate down canal inflows as well.

Advanced modeling should be used to confirm the size of the detention basin to accommodate the 50 year or 100-year storm and survey data will need to be collected to determine if the typical 8' trapezoidal channel will be sufficient for the entire length or if it will need to be enlarged in the previously mentioned problem area due to slope and existing conditions issues. A portion of the intent to define the 8' trapezoidal channel is due to the existing conditions in the existing canal. Minimal improvements (cleaning and shaping) to the canal would leave it in place and minimize cost and future maintenance while still providing some protection to the downslope improvements. Work on enlarging the detention basin to accommodate the smaller canal is expected to more than offset the cost of enlarging the entire length of the canal in this area. Cost estimates show that earthwork to enlarge the canals would be approximately 25% more costly than earthwork done to enlarge the detention basins and route smaller flows.



Other alternatives considered similar to this option include:

- Construction of a Flood Control Canal parallel to and above the existing Highline Canal to protect downslope improvements similar to how the current Highline Canal protects those same areas. This option could become necessary if the Highline Canal were to remain in operation as it is currently and if the Company were to refuse to allow for a joint project to enlarge the existing canal due to concerns with canal loss, liability and maintenance etc. This option of a parallel flood control canal would be more costly in construction and ROW acquisition. Construction on the uphill side of the existing canal would also be problematic along a good portion of the alignment in this area due to existing development and topography. For these reasons, this option was eliminated from consideration.
- Using the Upper Canal for Flood water conveyance was also considered. There exists more development adjacent to this canal making enlargement more costly and the protection provided to the developed areas of Ashley Valley would be decreased, decreasing the benefit to Uintah County. For these reasons, this option was eliminated from consideration.

a. Construction Cost Estimate

All aspects of this project option need to be designed as a whole to ensure they all work together correctly. Coordination with the selected options for the other areas of the valley also needs to take place. However, it is possible and perhaps easier to construct the various parts of the project independent of each other.

Appendix D contains detailed cost estimates for the different parts of this option as well as a total project cost. The estimate to construct the 160 ac-ft. Coal Mine Detention Basin is $980,000. The estimate to improve the 18,600 feet of Highline Canal is $141,400. These estimates include engineering services but do not include property or easement acquisition. This is a total cost estimate of $1,121,400 for the project.

b. Maintenance Costs/Considerations

It is important that consideration not just be made for the cost of construction of a project but also the cost of maintain the flood control structures. Without proper maintenance, all components of a project will lose its capacity and functionality over time.

The estimate to maintain the 160 ac-ft. Coal Mine Detention Basin is $2,000-10,000 a year, averaging about $8,000 a year. The estimate to maintain the 18,600 feet of Highline Canal is $2,000-12,500 a year, averaging about $6,000 a year. This is a total cost estimate of $14,000 for maintenance of the entire project.

Maintenance of the Coal Mine Detention Basin will be somewhat dependent upon the conditions in any given year, in a normal year with only minimal flows passing through the structure, likely spot checks and

weed control will be needed. If a large flood event or more takes place, likely debris will need to be removed with heavy equipment once or more matching the storm events.

Maintenance of the Highline Canal will need to include yearly vegetation control, usually herbicide treatment and as necessary debris and sediment removal. Depending on the severity of the storms in the area and the damage done, monitoring would be considered the minimum action each year and removal of materials from the canal the upper end of required maintenance.

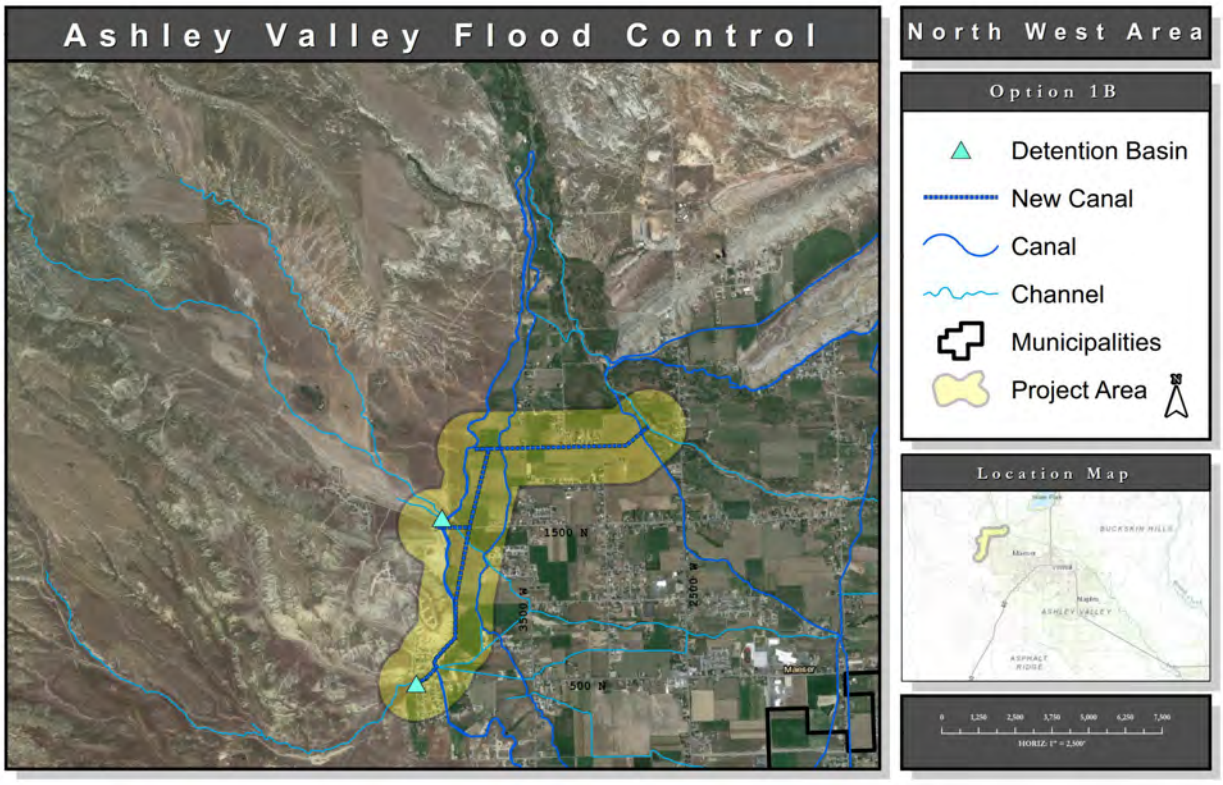
3. NW Option 1B - Detention Basins & New Canal to Ashley Creek

As with the previous listed option, a detention basin in Coal Mine Basin would be the key to the functionality and most cost effective solution for this option. In addition, a detention basin in Yellow Hills Basin would also be needed. Again, similar to the previous option, it may be necessary to design the proposed canal/pipeline to Ashley Creek and determine the feasibility of the size prior to determining the size of the detention basin. This report will assume that the canal size will be minimized to a size of between 8' and 10' trapezoidal channel. The Coal Mine and Yellow Hills Detention Basins also remain similar in size to the AVSWMP recommendations (160 and 112 ac-ft. respectively).

The AVSWMP recommended that storm water be routed from Coal Mine and Yellow Hills Basins back to Ashley Creek through a newly created canal that would parallel the Highline Canal for some portion of the alignment and then turn East and release storm water into the Ashley Creek channel. This alternative also included piping a good portion of the alignment to Ashley Creek, assumedly because it would need to pass through developed and ag land and the slope of the alignment would be better suited for piping instead of open channel near development.

While this option would work hydraulically, it may be difficult to obtain the easements for the implementation of the project. The alignment shown in the AVSWMP would pass through a minimum of 11 different parcels requiring compensation and working around existing infrastructure and development. Adjustments to the proposed alignment could be made, but an increased number of parcels would become affected.

If this option were to be considered for implementation, the design of the project would need to include analysis of the canal and pipe size and the possibility of one or more energy dissipation methods/structures as the water is delivered to Ashley Creek. Water quality would also need to be considered as the delivery would be directly to Ashley Creek and the proposed pathway would open the option of introducing runoff water from developed areas.



Other alternatives considered similar to this option include:

- Alternative alignments, any of which would increase the number of affected parcels. The length could be shortened, but this would limit the availability of the canal to intercept storm and runoff water before it got to developed areas and it would make the alignment bisect parcels rather than running parallel to the majority of the property lines in the area, possibly making easement acquisition more difficult.

a. Construction Cost Estimate

All aspects of this project option need to be designed as a whole to ensure they all work together correctly. Coordination with the selected options for the other areas of the valley also needs to take place. However, it is possible and perhaps easier to construct the various parts of the project independent of each other.

Appendix D contains detailed cost estimates for the different parts of this option as well as a total project cost. The estimate to construct the 160 ac-ft. Coal Mine Detention Basin is $980,000. The estimate to construct the 112 ac-ft. Yellow Hills Detention Basin is $704,500. The estimate to construct the 13,600 feet of new canal and storm drain is $980,000. These estimates include engineering services but do not include property or easement acquisition. This is a total cost estimate of $2,664,500 for the project.

b. *Maintenance Costs/Considerations*

It is important that consideration not just be made for the cost of construction of a project but also the cost of maintain the flood control structures. Without proper maintenance, all components of a project will lose its capacity and functionality over time.

The estimate to maintain the 160 ac-ft. Coal Mine Detention Basin is $2,000-10,000 a year, averaging about $8,000 a year. The estimate to maintain the 112 ac-ft. Yellow Hills Detention Basin is also $2,000-10,000 a year, averaging about $8,000 a year. The estimate to maintain the 13,600 feet of new canal and storm drain is $3,500-27,500 a year, averaging about $6,000 a year. This is a total cost estimate of $22,000 for maintenance of the entire project.

Maintenance of the Coal Mine and Yellow Hills Detention Basins will be somewhat dependent upon the conditions in any given year, in a normal year with only minimal flows passing through the structure, likely spot checks and weed control will be needed. If a large flood event or more takes place, likely debris will need to be removed with heavy equipment once or more matching the storm events.

Maintenance of the Highline Canal will need to include yearly vegetation control, usually herbicide treatment and as necessary debris and sediment removal. Depending on the severity of the storms in the area and the damage done, monitoring would be considered the minimum action each year and removal of materials from the canal the upper end of required maintenance.

4. NW Option 2 - Detention Basins & Natural Flow Paths Improvements

As with the previous option, two detention basins to address storm water from Coal Mine Basin and Yellow Hills Basin are essential to the operation. Because no current development above the Highline Canal and in the natural flow natural paths exists, the detention basin location adjacent to the Highline Canal is recommended for the Coal Mine Detention Basin. There is development above the Highline Canal in the Yellow Hills Basin, so the detention basin would need to be located above this development.

Below the Highline Canal and also the Upper Canal there exists two main natural drainages. Others may have existed at one-time North of 500 North, but the drainage areas above the canals are minor in comparison to Coal Mine and Yellow Hills Basins and may require minor earthwork to route past development towards Ashley Creek. If this option were selected for implementation and the Highline Canal were to be filled in, each of those small drainages North of 500 North should be addressed individually.

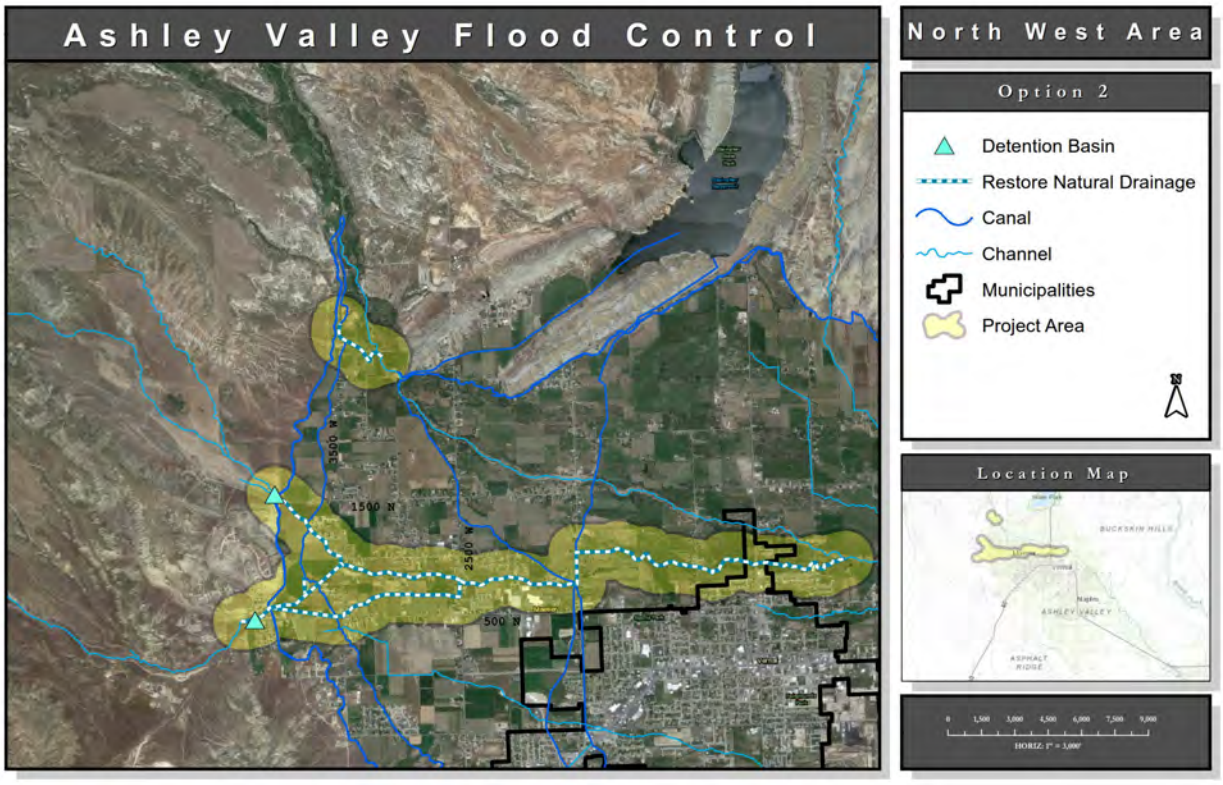
The two main natural drainages in this area are between 500 North and 1500 North. The larger of the two is the extension of the Coal Mine Basin wash and it is currently used to route water from Coal Mine Basin to the Upper Canal, after

the Upper Canal this drainage goes right through a subdivision on 1200 North and 3500 West, crosses 3500 West, and proceeds adjacent to one more subdivision before passing North of the high school, crossing 1500 West and eventually joining what was historically the South fork of Ashley Creek at about 900 West and 900 North. Large trees exist along portions of this alignment and besides the two subdivisions, at least 3 homes exist in the anticipated flood plain if water were routed back into this drainage. In 3 places along the alignment it appears that the drainage has been filled to facilitate agriculture or development.

The smaller natural drainage in this area may historically have handled some of the flows from the Yellow Hills Basin. It passes through a subdivision approximately 750 North and 3700 West, is visible in some locations but has been filled in and left only as a ditch in other locations. It eventually joins with the Coal Mine Basin drainage near the North side of the High School.

This option considers the feasibility of restoring the historic drainages to handle storm water. Improvements to the drainages would at a minimum include an 8’ trapezoidal channel or appropriate size as determined by modeling during the design process. As with previous sections, this report assumes an 8’ trapezoidal channel with the upstream detention basin sized for routing appropriate flows.

A challenge of this option would include addressing the development that has taken place along the drainage alignments as well as the many large trees and other private property concerns. A maintained ROW adjacent to the drainage channel would need to be obtained and maintained to provide access for maintenance and to act as a buffer for development to not encroach upon the drainage in the future.



Other alternatives considered similar to this option include:

- Creating a new drainage alignment, possibly to better avoid development. For the larger drainage in the area, it may be possible to divert the storm water Northward towards the Central Canal alignment where it is also located in a natural drainage. Additional areas not currently prone to flooding could be impacted by such a diversion and the savings with this alternative alignment would be minimal in that development in this area is only slightly less than following the existing drainage.

a. Construction Cost Estimate

All aspects of this project option need to be designed as a whole to ensure they all work together correctly. Coordination with the selected options for the other areas of the valley also needs to take place. However, it is possible and perhaps easier to construct the various parts of the project independent of each other.

Appendix D contains detailed cost estimates for the different parts of this option as well as a total project cost. The estimate to construct the 160 ac-ft. Coal Mine Detention Basin is $980,000. The estimate to construct the 112 ac-ft. Yellow Hills Detention Basin is $704,500. The estimate to enhance the 37,750 feet of natural drainages is $2,748,900. These estimates include engineering services but do not include property or easement acquisition. This is a total cost estimate of $4,433,400 for the project.

b. *Maintenance Costs/Considerations*

It is important that consideration not just be made for the cost of construction of a project but also the cost of maintain the flood control structures. Without proper maintenance, all components of a project will lose its capacity and functionality over time.

The estimate to maintain the 160 ac-ft. Coal Mine Detention Basin is $2,000-10,000 a year, averaging about $8,000 a year. The estimate to maintain the 112 ac-ft. Yellow Hills Detention Basin is also $2,000-10,000 a year, averaging about $8,000 a year. The estimate to maintain the 37,750 feet of natural drainages is $12,000-50,000 a year, averaging about $25,000 a year. This is a total cost estimate of $41,000 for maintenance of the entire project.

Maintenance of the Coal Mine and Yellow Hills Detention Basins will be somewhat dependent upon the conditions in any given year, in a normal year with only minimal flows passing through the structure, likely spot checks and weed control will be needed. If a large flood event or more takes place, likely debris will need to be removed with heavy equipment once or more matching the storm events.

Maintenance of the enhanced drainages will need to include yearly vegetation control, usually herbicide treatment and as necessary debris and sediment removal. Depending on the severity of the storms in the area and the damage done, monitoring would be considered the minimum action each year, and removal of materials from the canal the upper end of required maintenance.

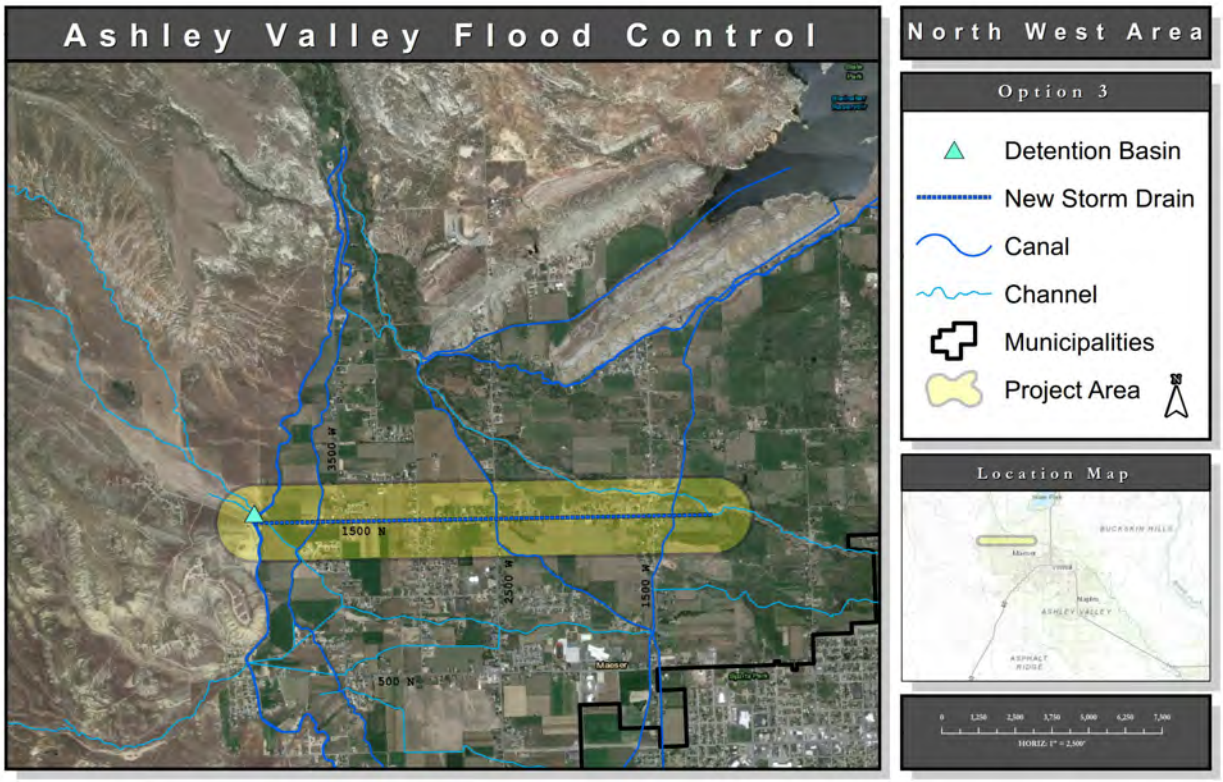
5. NW Option 3 - Piped Storm Drain System

As Ashley Valley continues to grow, consideration should be given to when is the appropriate time to transition from current storm water management methods to more urbanized methods of storm water management. A part of this decision should include discussion with the Planning Commission and County Officials when to implement storm drain impact fees and projects and when to require developers to connect to installed infrastructure. While this method of storm water management is not considered feasible in this report for most of the county areas, as additional development occurs, policies and planning should be put in place to address storm water needs for future development.

Curb, gutter, and underground storm drains implies that storm water would be handled mainly within the existing road rights of ways and routed to downstream basins and Ashley Creek. This report will focus on the most critical portion of this infrastructure, the main storm drains and routing. In general, curb, gutter and storm drains within subdivisions should be considered the responsibility of a developer. As with previous sections, upstream detention basins (where water is coming from areas outside the developed areas) and routing of storm water will allow the infrastructure to be sized smaller than if no

routing or detention basins were used. Detention basins will also reduce the amount of maintenance required for the storm drain infrastructure.

The Northwest area of Ashley Valley has minimal development and thus the storm drain option is also minimal, piping in main roads, routed towards Ashley Creek. This option would be dependent upon putting storm drain in subsequent downstream areas to Ashley Creek.



a. Construction Cost Estimate

All aspects of this project option need to be designed as a whole to ensure they all work together correctly. Coordination with the selected options for the other areas of the valley also needs to take place. However, it is possible and perhaps easier to construct the various parts of the project independent of each other.

Appendix D contains detailed cost estimates for the different parts of this option as well as a total project cost. The estimate to construct the 160 ac-ft. Coal Mine Detention Basin is $980,000. The estimate to construct the 14,200 feet of storm drain is $3,653,000. The estimate to construct the 10 ac-ft. water quality detention basin is $124,300. These estimates include engineering services but do not include property or easement acquisition. This is a total cost estimate of $4,757,300 for the project.

b. Maintenance Costs/Considerations

It is important that consideration not just be made for the cost of construction of a project but also the cost of maintain the flood control structures. Without proper maintenance, all components of a project will lose its capacity and functionality over time.

The estimate to maintain the 160 ac-ft. Coal Mine Detention Basin is $2,000-10,000 a year, averaging about $8,000 a year. The estimate to maintain the 14,200 feet of storm drain is $2,500-15,000 a year, averaging about $7,000 a year. The estimate to maintain the 10 ac-ft. water quality detention basin is $2,500-10,000 a year, averaging about $7,500 a year. This is a total cost estimate of $22,500 for maintenance of the entire project.

Maintenance of the Coal Mine Detention Basin will be somewhat dependent upon the conditions in any given year, in a normal year with only minimal flows passing through the structure, likely spot checks and weed control will be needed. If a large flood event or more takes place, likely debris will need to be removed with heavy equipment once or more matching the storm events.

Maintenance of the storm drain would include monitoring and flushing as required.

Maintenance of the water quality detention basin would include monitoring and cleaning as required.

B. West and Southwest Ashley Valley

1. Area Overview

The West and Southwest area of Ashley Valley outlined in this report includes the areas adjacent to the Highline and Upper Canals from their crossings of SR-121 to their termini or crossing of SR-45. Generally, this area is the foothills of Asphalt Ridge and drainages feeding into Ashley Valley are steep and short providing minimal runoff from the undeveloped areas compared to other areas considered in this report, but problem areas still exist to be addressed in this report.

As with the Northwest Area, this area has historically handled storm water through the canals and continues to do so today. Currently the Highline Canal is approximately the extent of development through this area and the lands above the Highline Canal are mainly BLM and SITLA lands, but in some areas such as Air Village development is above the Highline Canal. The Yellow Hills Basin is at the North end of this area and water from this drainage has historically flowed into the Highline Canal and routed along the canal. Sediment from the Yellow Hills Basin and other drainages have been an issue in filling the canal and contributing to overtopping the canal in the past. Overtopping does not always occur in the location where the drainages introduce water. South of the Yellow Hills Basin drainage, 4 drainages have been known to cause issues to

development, 2 additional drainages were identified in the AVSWMP as potentially needing small detention basins to minimize issues near those drainages.

Known problem areas include:

- Yellow Hills Basin approximately 600 North and 4250 West – This area has flooded roadway s and several homes in the past few years, mainly from storm water that has come from flash flooding. Long duration storms have also caused problems, but not the extent of flash flooding.
- About 1400 South and 2700 West/3200 West – Canals are both silting in and have potential of overtopping.
- 1500 South and about 4200 South – Homes are flooded when the canal overtops, the culvert has plugged in the past.
- South Vernal Avenue about 4800 South – The canal has overtopped in this location and flooded at least one home.
- 500 East and about 5000 South – The road is flooded when the canal overtops

Solutions outlined in the AVSWMP included the 6 proposed detention basins previously mentioned and increasing the size of the Highline/Upper Canals to handle storm water. The proposed channels would be 10' trapezoidal channels instead of the existing channels that currently get smaller as they continue South due to the decreasing irrigation demands downstream in the canals. The AVSWMP suggests using the Highline Canal alignment to about the location where the canals cross under Highway 40, then using the Upper Canal alignment South to near the normal terminus of the canals near SR-45.

Another important characteristic of this area is that the current canals have what is estimated to be a 40% loss rate through this section of the canals. Enlarging and modifying the canals is expected to increase the loss through this area and the Canal Companies have been very clear that they are opposed to a combined solution that would keep the canals in operation and enlarge them to convey storm water, this would decrease the efficiency of their canals. While there have been reports of high groundwater problems below the canals, it is anticipated that should the canals be piped and water only be present in the canals when storm water events occur, the groundwater situation should generally improve. Irrigation and natural groundwater were not analyzed in this report to determine the extent or potential origin of these issues.

This report will compare the following alternative solutions for the Ashley Valley West and Southwest area:

- WSW Option 1A – Basins and Highline Canal Alignment
- WSW Option 1B – Basins and Highline/Upper Canal Alignment
- WSW Option 2 – Basins and Natural Drainage Enhancements
- WSW Option 3 – Basins and Storm Drain

2. WSW Option 1A - Detention Basins & Highline Canal Improvements

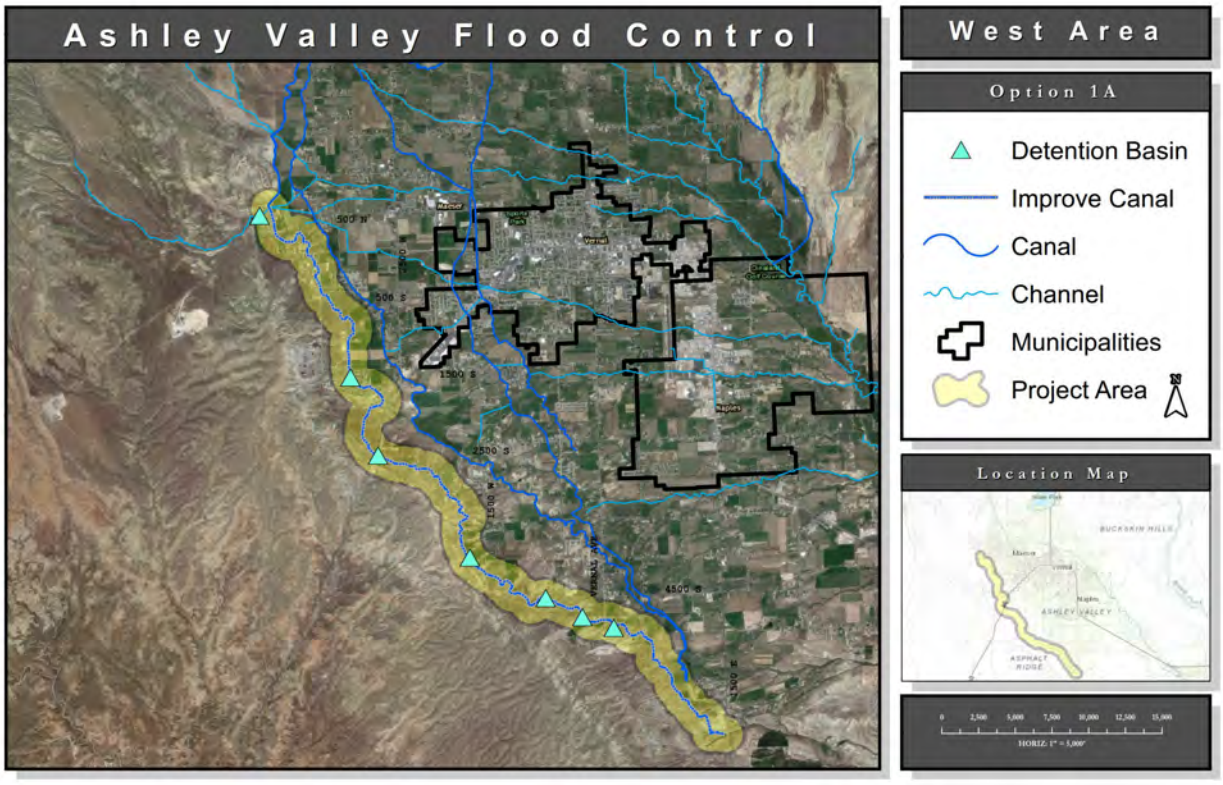
Similar to the situation with the Highline Canal in the Northwest area, the Highline Canal has historically acted as a buffer to the valley from existing drainages and flood water from flash flood and long duration events. The AVSWMP proposed using the Highline Canal alignment and enlarging the existing canal to handle storm water in addition to the irrigation water. The AVSWMP also suggested that the downhill canal bank should be reinforced to provide increased stability for the canal bank.

This report will assume improving the canal to a typical 8' trapezoidal channel and sizing detention basins to route water to this size of canal. The proposed detention basin at Yellow Hill should be designed with debris and sediment in addition to the detention purposes. The size of detention basin recommended in the AVSWMP was a 112 acre-ft. detention basin. It is recommended that during the design phase this size is confirmed with the project modeling and the proposed canal size also confirmed.

The 8' trapezoidal channel will require minimal work to accomplish near the highway 121 crossing, but as the Highline Canal continues South the existing canal decreases in size until there are portions that more resemble a 4' ditch than an established canal. With the extensive linear nature of the Highline Canal the recommended option to keep an 8' channel and modify the size of the detention basin is expected to be approximately 25% less expensive than increasing the size of the canal proportionally. The Highline Canal alignment contains areas that are solid rock which would make future excavation and channel preparation even more expensive. If this option is selected, the design of the canal improvements will need to take these solid rock areas into account.

Slopes along the existing canal vary along the alignment, but there are long sections that are flat or nearly flat. Infiltration through the canal banks is anticipated to be similar to the ditch loss experience by the canal companies and possibly more in places with the expanded channel. With the increased.

Since 2008 there has been significant development between the Upper and Highline Canals, specific examples include the increased number of homes in subdivisions near South Vernal Avenue and 4000 South.



Other alternatives considered similar to this option include:

- Enlarging the existing canal to accommodate irrigation and storm water, the Highline Canal has obtained funding for a portion of a project that would pipe the Highline and Upper Canals and thus vacate the existing alignment. The canal companies have also expressed concern with the concept of enlarging the canals due to a potential increase in water loss and an increase in potential liability, both of which they are unwilling to accept.
- Building a new canal to intercept storm water above all existing development, this alternative was eliminated because the existing development above the Highline Canal has not typically been built in low lying areas, much of the land above the canal is BLM and SITLA land and thus would require additional permitting, and the topography above the Highline Canal would present a challenge for creation of a new flood control structure.
- Constructing a new storm water canal alignment parallel to the Highline Canal, this alternative would require new easements to be obtained and new construction of a canal. The Highline Canal Company is planning to pipe the canal and combine with the Upper Canal for a majority of the alignment meaning that the existing Highline Canal is expected to be vacated when piping occurs.

a. Construction Cost Estimate

All aspects of this project option need to be designed as a whole to ensure they all work together correctly. Coordination with the selected

options for the other areas of the valley also needs to take place. However, it is possible and perhaps easier to construct the various parts of the project independent of each other.

Appendix D contains detailed cost estimates for the different parts of this option as well as a total project cost. The estimate to construct the 112 ac-ft. Yellow Hills Detention Basin is $704,500. The estimate to construct the 60 ac-ft. of smaller detention basins is $671,700. The estimate to improve the 59,000 feet of Highline Canal is $1,106,000. These estimates include engineering services but do not include property or easement acquisition. This is a total cost estimate of $2,482,200 for the project.

b. Maintenance Costs/Considerations

It is important that consideration not just be made for the cost of construction of a project but also the cost of maintain the flood control structures. Without proper maintenance, all components of a project will lose its capacity and functionality over time.

The estimate to maintain the 112 ac-ft. Yellow Hills Detention Basin is $2,000-10,000 a year, averaging about $8,000 a year. The estimate to maintain the 60 ac-ft. of smaller detention basins is $6,000-20,000 a year, averaging about $10,000 a year. The estimate to maintain the 59,000 feet of Highline Canal is $15,000-120,000 a year, averaging about $25,000 a year. This is a total cost estimate of $43,000 for maintenance of the entire project.

Maintenance of the Yellow Hills Detention Basin and smaller detention basins will be somewhat dependent upon the conditions in any given year, in a normal year with only minimal flows passing through the structure, likely spot checks and weed control will be needed. If a large flood event or more takes place, likely debris will need to be removed with heavy equipment once or more matching the storm events.

Maintenance of the Highline Canal will need to include yearly vegetation control, usually herbicide treatment and as necessary debris and sediment removal. Depending on the severity of the storms in the area and the damage done, monitoring would be considered the minimum action each year and removal of materials from the canal the upper end of required maintenance.

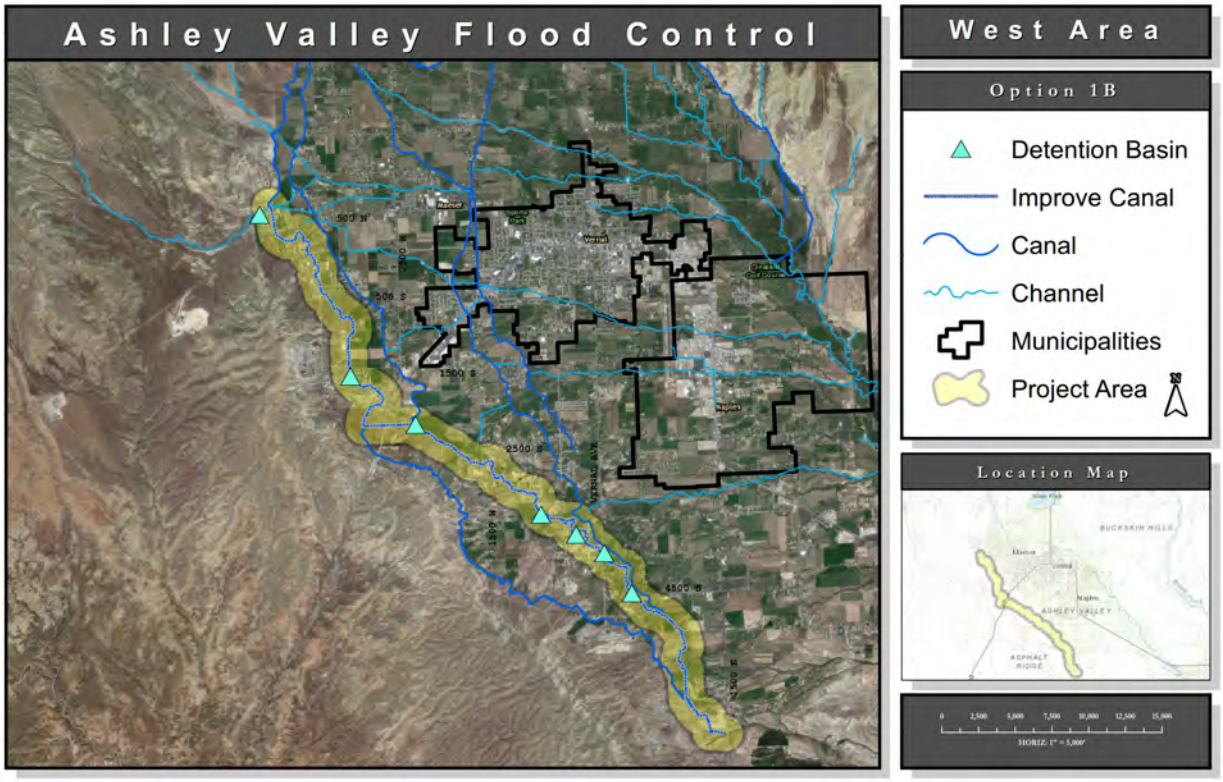
3. WSW Option 1B - Detention Basins & Highline/Upper Canal Improvements

In the AVSWMP, the recommended alternative similar to this option was to utilize the Highline Canal South from SR-121 to approximately the sky village subdivision and then cross over to the Upper Canal. This alignment would be slightly shorter than keeping with the Highline Canal, and the Upper Canal profile is larger for its duration than the Highline Canal, thus it would require

less cost to complete the proposed 8’ trapezoidal channel than keeping with the Highline Canal.

Switching canals near Highway 40 would require construction of a new canal alignment between the two canals, which would include a new crossing of Highway 40 that could handle the proposed storm water flows, obtaining the associated new easements would also be required.

Homes falling between the Highline and Upper Canals South of Highway 40 numbers nearly 250, switching the flood control channel from the Highline to the Upper Canal near Highway 40 would mean that flood waters from Asphalt Ridge would now come past the historic Highline Canal (assuming it is filled in with the piping project or through sedimentation over time) and could possibly cause negative impacts to development in this area if no other mitigation measures are taken. Specifically, homes on 4100 South and approximately 200 West are built in a natural drainage that likely would flow storm water if the Highline Canal did not intercept this water as it currently does. A similar situation would likely happen in the subdivision on 500 West and about 3800 South.



a. Construction Cost Estimate

All aspects of this project option need to be designed as a whole to ensure they all work together correctly. Coordination with the selected options for the other areas of the valley also needs to take place. However, it is possible and perhaps easier to construct the various parts of the project independent of each other.

Appendix D contains detailed cost estimates for the different parts of this option as well as a total project cost. The estimate to construct the 112 ac-ft. Yellow Hills Detention Basin is $704,500. The estimate to construct the 60 ac-ft. of smaller detention basins is $671,700. The estimate to improve the 59,000 feet of Highline and Upper Canals is $1,175,800. These estimates include engineering services but do not include property or easement acquisition. This is a total cost estimate of $2,552,000 for the project.

b. Maintenance Costs/Considerations

It is important that consideration not just be made for the cost of construction of a project but also the cost of maintain the flood control structures. Without proper maintenance, all components of a project will lose its capacity and functionality over time.

The estimate to maintain the 112 ac-ft. Yellow Hills Detention Basin is $2,000-10,000 a year, averaging about $8,000 a year. The estimate to maintain the 60 ac-ft. of smaller detention basins is $6,000-20,000 a year, averaging about $10,000 a year. The estimate to maintain the 59,000 feet of Highline and Upper Canals is $15,000-120,000 a year, averaging about $25,000 a year. This is a total cost estimate of $43,000 for maintenance of the entire project.

Maintenance of the Yellow Hills Detention Basin and smaller detention basins will be somewhat dependent upon the conditions in any given year, in a normal year with only minimal flows passing through the structure, likely spot checks and weed control will be needed. If a large flood event or more takes place, likely debris will need to be removed with heavy equipment once or more matching the storm events.

Maintenance of the Highline and Upper Canals will need to include yearly vegetation control, usually herbicide treatment and as necessary debris and sediment removal. Depending on the severity of the storms in the area and the damage done, monitoring would be considered the minimum action each year and removal of materials from the canal the upper end of required maintenance.

4. WSW Option 2 - Detention Basins & Natural Flow Paths Improvements

The minor drainages that impact this area can be seen on the associated option maps. These drainages while small have been known to carry water in flash flood and long duration events. Specific problem areas, mostly associated with these drainages have been previously outlined in this report. The concept of this option is to explore the impacts and costs associated with using natural flow paths defined by topography to control storm water. For this area this option presents a challenge, concentrated subdivision development has occurred in the drainages at Yellow Hills and near 4000 South. It also appears that a subdivision near 5900 South and SR-45 has been partly abandoned and modified

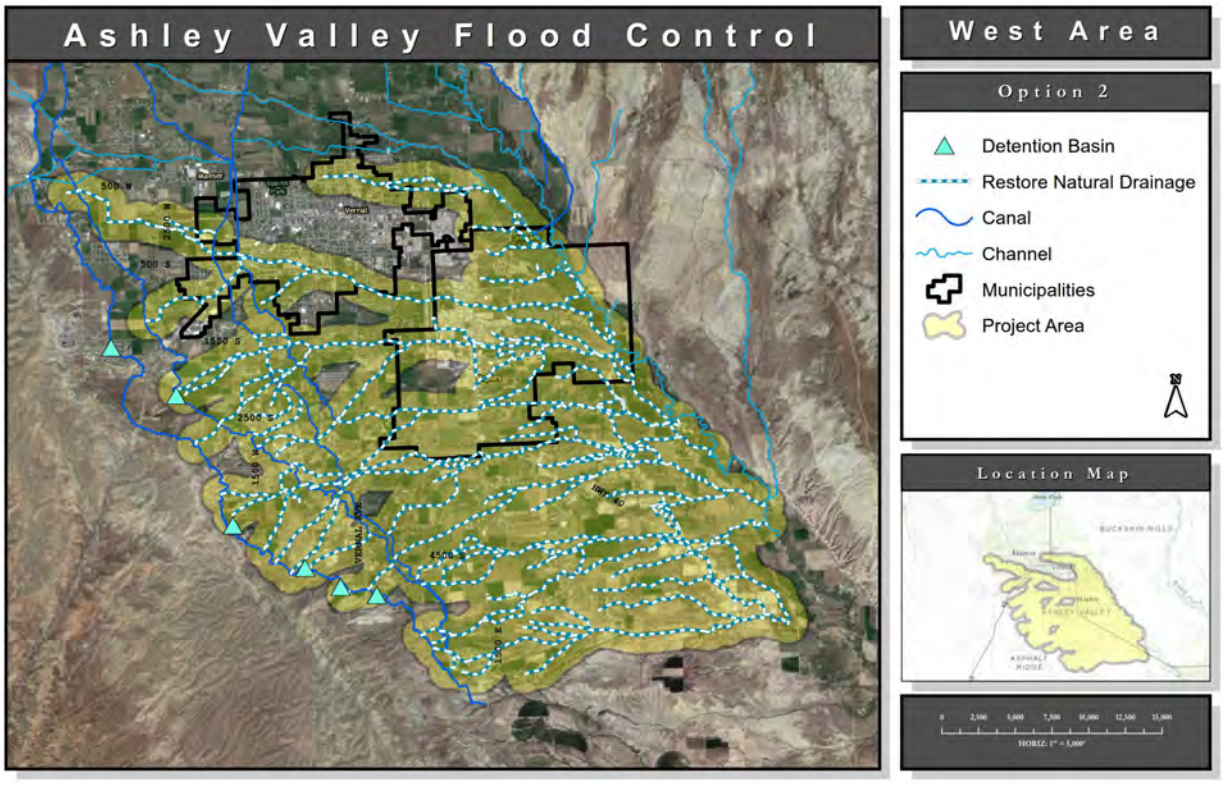
significantly due to development that was to take place in the natural drainage. Other parts of these areas have also seen steady growth near existing roads and as such development continues to encroach upon existing drainages. Near the existing Highline Canal the drainages are more defined and generally do not flow water consistently, but below the Highline, Upper, and Service Canals the drainages become wider and less defined and in some cases these areas currently flow water much of the year. To what extent these flows are due to seepage from the canals or natural ground water is unknown.

Should this option be pursued, controlled channels would need to be constructed mainly around existing development and in a few cases this could present a challenge topographically as there are developments that have monopolized the low areas of some of the existing drainages. Another consideration should be the affects the storm water will have upon groundwater. Downstream of the 3 canals in this area, in the hunter hollow subdivision there are homes that have groundwater issues that appear to be tied to storm events, enhancing the drainage would have to be done through this area in such a way to not increase those current problems.

This report assumes that as with the other options, detention basins (7 in this area, Yellow Hills and 6 smaller ones) will be used in conjunction with the proposed channels to optimized the size and cost of the improvements. Again, an 8’ trapezoidal channel with an adjacent access channel for monitoring and maintenance would be required to be a part of this option.

Beyond the extent of this project area, coordination with downstream areas, including Vernal and Naples Cities would need to be done to address the drainages or other alternatives when the drainages enter those cities. This option would affect Vernal and Naples Cities in every drainage excepting those on the South end of the area.

It should be noted that the South most drainage in this area has historically been used as a drain point for excess water from the Highline, Upper, and Service Canals. There are some measures in this location to address natural drainage flood waters and excess water in the canals, but this area should be further analyzed and planned beyond what is currently there.



Other alternatives considered similar to this option include:

- Combining drainages and requiring fewer paths through developed areas was considered, larger detention basins and/or larger channels would then also be required. This alternative could become a viable option during the design phase of the project, but it is very likely that similar costs and challenges with this option would be found.

a. Construction Cost Estimate

All aspects of this project option need to be designed as a whole to ensure they all work together correctly. Coordination with the selected options for the other areas of the valley also needs to take place. However, it is possible and perhaps easier to construct the various parts of the project independent of each other.

Appendix D contains detailed cost estimates for the different parts of this option as well as a total project cost. The estimate to construct the 112 ac-ft. Yellow Hills Detention Basin is $704,500. The estimate to construct the 60 ac-ft. of smaller detention basins is $671,700. The estimate to enhance the 151,250 feet of natural drainages is $11,019,700. These estimates include engineering services but do not include property or easement acquisition. This is a total cost estimate of $12,671,400 for the project.

b. *Maintenance Costs/Considerations*

It is important that consideration not just be made for the cost of construction of a project but also the cost of maintain the flood control structures. Without proper maintenance, all components of a project will lose its capacity and functionality over time.

The estimate to maintain the 112 ac-ft. Yellow Hills Detention Basin is $2,000-10,000 a year, averaging about $8,000 a year. The estimate to maintain the 60 ac-ft. of smaller detention basins is $6,000-20,000 a year, averaging about $10,000 a year. The estimate to maintain the 151,250 feet of natural drainages is $30,000-130,000 a year, averaging about $50,000 a year. This is a total cost estimate of $68,000 for maintenance of the entire project.

Maintenance of the Yellow Hills Detention Basin and smaller detention basins will be somewhat dependent upon the conditions in any given year, in a normal year with only minimal flows passing through the structure, likely spot checks and weed control will be needed. If a large flood event or more takes place, likely debris will need to be removed with heavy equipment once or more matching the storm events.

Maintenance of the enhanced drainages will need to include yearly vegetation control, usually herbicide treatment and as necessary debris and sediment removal. Depending on the severity of the storms in the area and the damage done, monitoring would be considered the minimum action each year and removal of materials from the canal the upper end of required maintenance.

5. WSW Option 3 - Piped Storm Drain System

For additional context of the proposed Storm Drain System see the Northwest Storm Drain option details. The same recommendations for consideration of planning and timing apply to this section as outlined in the previous storm drain section.

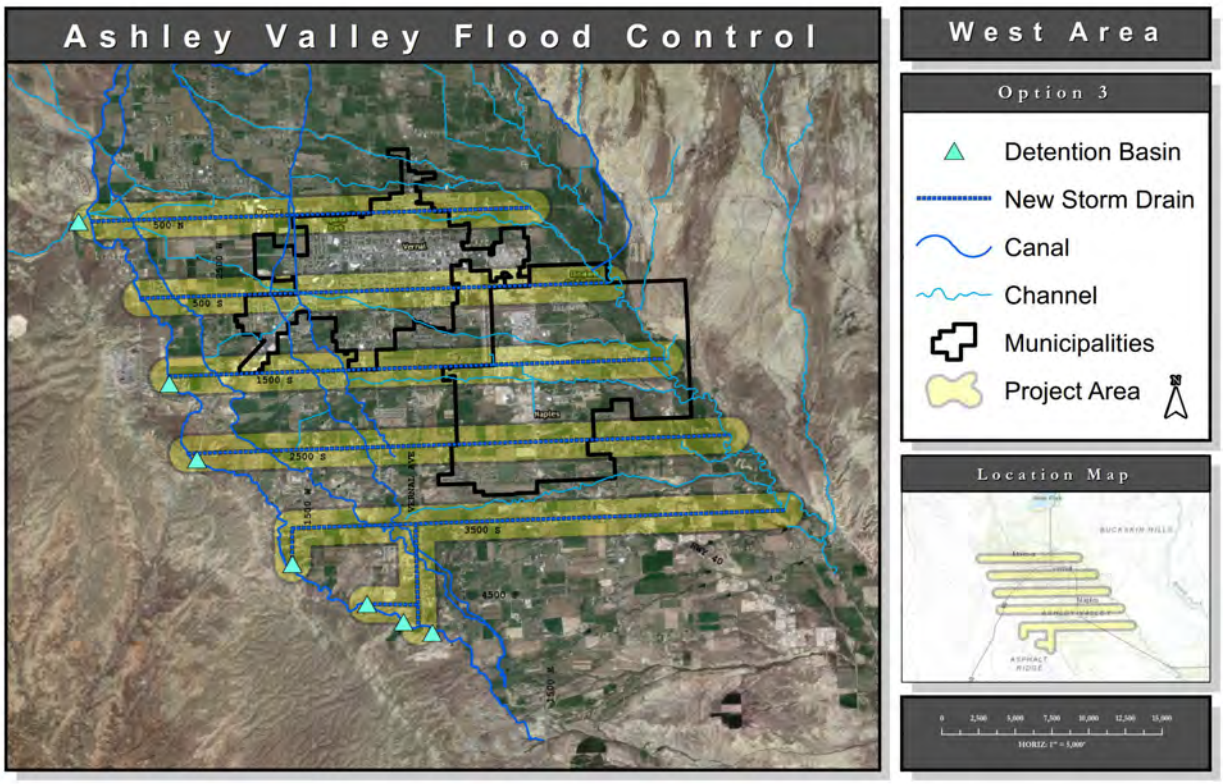
As with the natural drainages option listed above, this option would start with detention basins identified in the AVSWMP, a large basin at Yellow Hills and 6 smaller ones along the base of Asphalt Ridge going South. Sizing of the Storm Drain system would involve modeling the detention basins, anticipated flows and the size of improved drainages would further define the detention basin sizes.

While this West Southwest area of Ashley Valley has similar characteristics which allow for some generalization, design of a final storm water system would involve detailed analysis of the entire area and include both the hydrology aspect and the development aspect for optimum improvements.

For the purposes of this report it is assumed that an average storm drain size of 48” will be needed. It is clear that there are areas within the West Southwest area for which smaller diameter pipe may be possible, but the challenge for this

area will be continuing the storm drain system to Ashley Creek. Portions of this area haved a drainage length of 6 miles from the top to Ashley Creek. Drainage water picked up along these long watersheds through the developed areas of the Valley would affect the pipe sizing and routing. Cost estimates for this option include storm drain through the Central area including Vernal and Naples City. This report shows a limited number of downstream basins that would be used for equalization, water quality and routing to Ashley Creek.

Primarily the alignments for the proposed storm drain would be in County and City Roads. This option would require coordination with Vernal City and Naples City for at minimum routing of the storm drains through each City. The preferred coordination would address storm water issues in each city and combined storm drain systems that address the needs of Uintah County, Vernal City, and Naples City.



Other alternatives considered similar to this option include:

- Additional detention basins in the Valley could be developed and be used to address areas where pipe sizes become larger and more expensive, the challenge with this alternative is that due to the location of the concentrated developed areas in Ashley Valley, the ideal locations for such basins coincide with the higher land values, offsetting the cost savings of using detention basins.

a. *Construction Cost Estimate*

All aspects of this project option need to be designed as a whole to ensure they all work together correctly. Coordination with the selected options for the other areas of the valley also needs to take place. However, it is possible and perhaps easier to construct the various parts of the project independent of each other.

Appendix D contains detailed cost estimates for the different parts of this option as well as a total project cost. The estimate to construct the 112 ac-ft. Yellow Hills Detention Basin is $704,500. The estimate to construct the 60 ac-ft. of smaller detention basins is $671,700. The estimate to construct the 154,400 feet of storm drains is $39,237,000. The estimate to construct the 25 ac-ft. of water quality detention basins is $535,600. These estimates include engineering services but do not include property or easement acquisition. This is a total cost estimate of $41,671,400 for the project.

b. *Maintenance Costs/Considerations*

It is important that consideration not just be made for the cost of construction of a project but also the cost of maintain the flood control structures. Without proper maintenance, all components of a project will lose its capacity and functionality over time.

The estimate to maintain the 112 ac-ft. Yellow Hills Detention Basin is $2,000-10,000 a year, averaging about $8,000 a year. The estimate to maintain the 60 ac-ft. of smaller detention basins is $6,000-20,000 a year, averaging about $10,000 a year. The estimate to maintain the 154,400 feet of storm drains is $30,000-60,000 a year, averaging about $50,000 a year. The estimate to maintain the 25 ac-ft. of water quality detention basins is $5,000-15,000 a year, averaging about $10,000 a year. This is a total cost estimate of $78,000 for maintenance of the entire project.

Maintenance of the Yellow Hills Detention Basin and smaller detention basins will be somewhat dependent upon the conditions in any given year, in a normal year with only minimal flows passing through the structure, likely spot checks and weed control will be needed. If a large flood event or more takes place, likely debris will need to be removed with heavy equipment once or more matching the storm events.

Maintenance of the storm drains would include monitoring and flushing as required.

Maintenance of the water quality detention basins would include monitoring and cleaning as required.

C. North and East Ashley Valley

1. Area Overview

The North and East area of Ashley Valley extends East from the Fort Thornburg diversion, between Steinaker Reservoir and Ashley Creek and then along the East side of the valley below Honda Hills South to where Ashley Creek abuts the East side of the valley near the Dinaland Golf Course. The Rock Point Canal skirts the North and uphill portion of this area.

Vernal and Naples Cities only minimally overlap this area, Vernal along US-191 and Naples City near the Dinaland Golf Course. There are areas of concentrated development, but generally the population density of this area is low. The historic North fork of Ashley Creek runs through this area and surface water is present in some locations following the drainage. Much of this area is agriculture land. The Steinaker Service Canal bisects this area.

Similar to Asphalt Ridge, the North side of this area has a ridgeline with short drainage paths into the valley, this ridge is sandstone and steep, thus runoff from it is an issue. Storm Water from further North that historically came down Steinaker Draw is now detained in Steinaker Reservoir. On the Northeast and East side of the Valley, long narrow drainages funnel storm water into the valley, flash flooding and long duration storms have caused issues in this area in the past. Similar to Coal Mine Basin and Yellow Hills Basin, the Honda Hills area is undeveloped, it also is steeper than the valley floor and has less vegetation.

The Rock Point Canal is slated to be piped, likely in 2017. The proposed alignment along the East side of the valley (also the area of greatest concern) will likely not be in the canal alignment potentially freeing up this easement for other improvements or purposes if agreements could be made. Time may be of the essence, as it is likely that the funding of that project will require the canal prism to be removed in order to realize the actual proposed salt savings of the project. An alternative proposal for the existing canal prism will need to be made in a timely manner if any portion of that prism is to be used for storm water purposes.

Known problem areas include:

- Minor flooding of the roadway and possibly homes along the Rock Point Ridge from about 2000 West to 250 West
- An undershot under the Rock Point Canal currently passes water from the undeveloped lands at approximately 600 East and 3000 North, this infrastructure frequently requires maintenance for operation, otherwise storm water floods into the canal.
- The Rock Point Canal regularly breeches in multiple locations below 1500 East during storm events, flash flood, and long duration events.
- Several homes along 1500 North and 2000 North are flood prone, some of these issue areas are localized while others are caused when the Rock Point Canal overtops or head gates are opened to keep canal levels manageable during storm events.

- Several other areas near 500 East and 2000 North experience storm water issues due to ditches and canals being abandoned, filled in, or otherwise unusable where historically they handled storm water.

Solutions outlined in the AVSWMP for this area included multiple detention basins ranging in size from 75 AF to 130 AF in the drainages coming into the Northeast side of the valley. The Rock Point Canal was also recognized as a potential storm water conveyance structure. Similar to the Highline and Upper Canals, the concept of enlarging the canal to handle irrigation and storm water was discussed. Also similar to the Highline and Upper Canals, the Rock Point Canal is in the process of piping the canal, much of the proposed alignment is slated to be outside the existing canal prism and easement from preliminary designs.

This report will compare the following alternative solutions for the Ashley Valley North and East area:

- NE Option 1 – Basins and Rock Point Canal
- NE Option 2 – Basins and Natural Drainage Enhancements
- NE Option 3 – Basins and Storm Drain

A note on the Basins proposed in each of the options for this area; detention basins are needed to prevent large flows from long duration storms and flash floods from flooding the developed areas below the large drainages in this area. The existing options cannot handle the unmoderated flows that have historically been seen in these drainages (and modeled in the AVSWMP) without damage being done to property and infrastructure. In meetings with the Rock Point Canal, the existence of multiple upstream stock ponds in these area drainages exist which have in the past acted as smaller upstream detention basins. Using multiple smaller upstream detention basins in conjunction with one at the bottom of the drainage may actually be the preferred alternative because of cost and maintenance savings over the proposed larger basin at the bottom of each drainage, but this scenario would need to be modeled in the design of the project and permitting, access, coordination with the BLM and lease owners for each existing pond would need to be included in the design. This report will show the larger basins at the bottom of each large drainage, using the existing stock ponds instead should be explored further when improvements in this area are considered.

Additionally, two basins are shown at the South end of this area, no routing is shown below these basins. We received no comments on issues in this area and the areas between the proposed basins and Ashley Creek is currently agricultural land only. Basins in these South most drainages could be installed in subsequent phases for this area when future development or other needs become warranted.

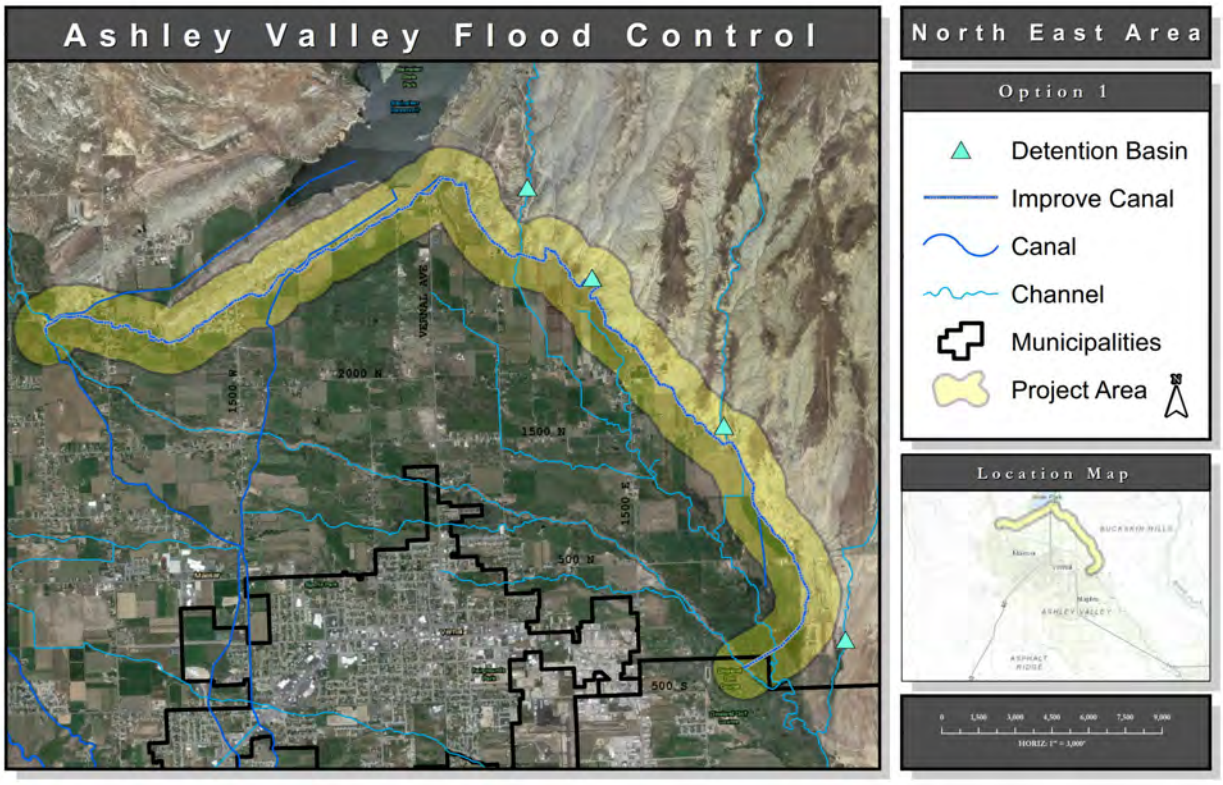
2. NE Option 1 - Detention Basins & Rock Point Canal

The AVSWMP proposed 5 detention basins along the Rock Point Canal where drainages cross the canal. These detention basins would be used to detain and route water from the drainages into the Rock Point Canal and eventually to

Ashley Creek. Using detention basins to detain and then route water below is important to this option and similar previous options, but it is even more important as it relates to the Rock Point Canal. The Rock Point Canal alignment skirts the edge of Ashley Valley and has multiple areas where the canal is built on a hillside causing seepage and stability issues. Adding additional stormwater flows to these problem areas would drastically increase the construction cost of these areas and add to the liability risk should a breach occur.

As with the other canal utilization options, this option would entail cleaning and reshaping the canal with a proposed 8’ trapezoidal channel. This proposed improvement is similar to what is existing on the North extent of the canal, but the South end of the canal will need some enlargement. The detention basins would include outlets to the existing canal alignment and include improvements to route water from the end of the canal South of 500 North to Ashley Creek.

In the design of such a project, the detention basin sizes will need to be confirmed with the proposed 8’ trapezoidal channel and the problem areas where overtopping is known to occur will need to be addressed. Areas where the canal is built on the hillside and topography and existing agriculture land or structures prevent any realignment should include an engineered canal bank as suggested in the AVSWMP. These problem areas are generally as the canal nears a few of the drainages along the route and turns the sharp corners to enter the drainage. Some of these areas will require not only the strengthening of the downhill slope but some realignment to get the canal away from the hill or stabilizing the uphill slope. Each problem area along the canal would need to be addressed separately.



Other alternatives considered similar to this option include:

a. Construction Cost Estimate

All aspects of this project option need to be designed as a whole to ensure they all work together correctly. Coordination with the selected options for the other areas of the valley also needs to take place. However, it is possible and perhaps easier to construct the various parts of the project independent of each other.

Appendix D contains detailed cost estimates for the different parts of this option as well as a total project cost. The estimate to construct the 510 ac-ft. of detention basins is $3,184,300. The estimate to improve the 43,000 feet of Rock Point Canal is $1,199,100. These estimates include engineering services but do not include property or easement acquisition. This is a total cost estimate of $4,383,400 for the project.

b. Maintenance Costs/Considerations

It is important that consideration not just be made for the cost of construction of a project but also the cost of maintain the flood control structures. Without proper maintenance, all components of a project will lose its capacity and functionality over time.

The estimate to maintain the 510 ac-ft. of detention basins is $5,000-25,000 a year, averaging about $15,000 a year. The estimate to maintain the 43,000 feet of Rock Point Canal is $17,500-95,000 a year,

averaging about $25,000 a year. This is a total cost estimate of $40,000 for maintenance of the entire project.

Maintenance of the detention basins will be somewhat dependent upon the conditions in any given year, in a normal year with only minimal flows passing through the structure, likely spot checks and weed control will be needed. If a large flood event or more takes place, likely debris will need to be removed with heavy equipment once or more matching the storm events.

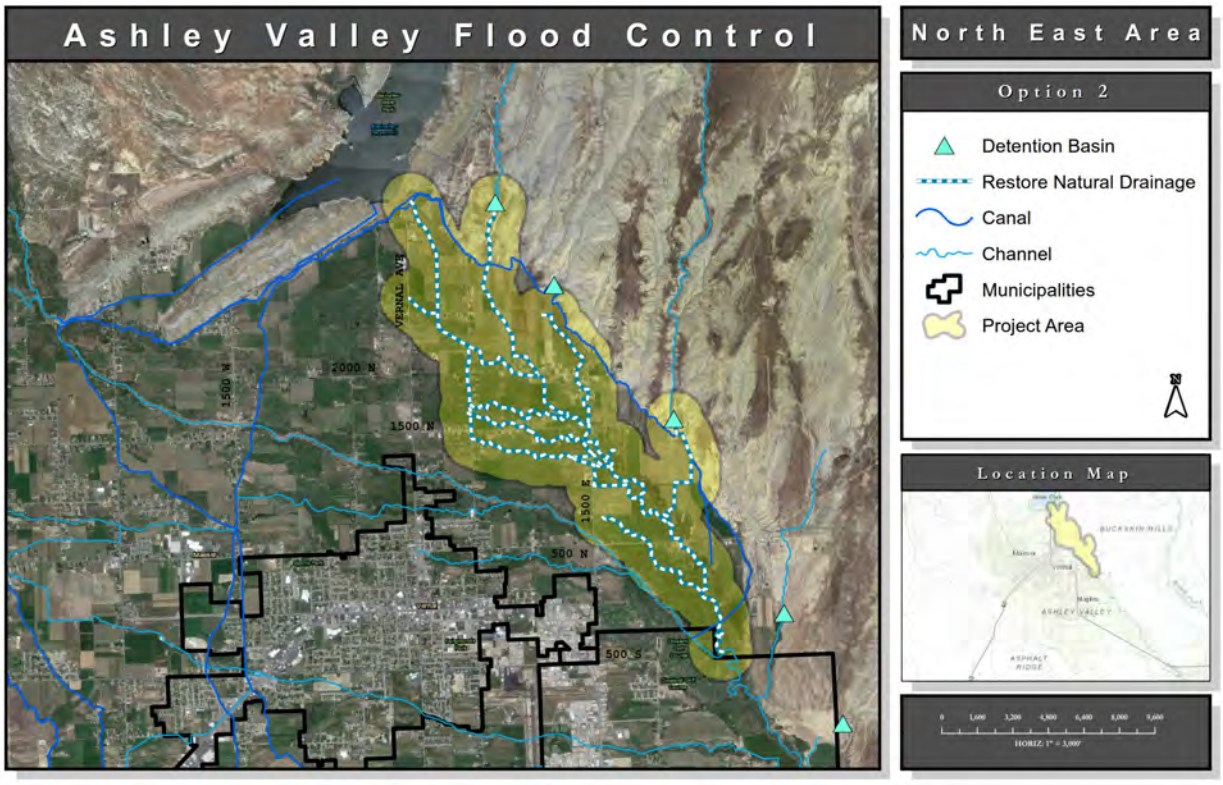
Maintenance of the Rock Point Canal will need to include yearly vegetation control, usually herbicide treatment and as necessary debris and sediment removal. Depending on the severity of the storms in the area and the damage done, monitoring would be considered the minimum action each year and removal of materials from the canal the upper end of required maintenance.

3. NE Option 2 - Detention Basins & Natural Flow Paths Improvements

Each option for this area includes the basins as previously discussed, if the canal were to be abandoned or undershots (culverts) required for each drainage, the natural flow paths would need to be modified to handle the water coming from the existing drainages. While this area is not as densely populated as the other areas in this report, the development that is in this area has seen problems caused by overtopping of the canal during flood events, long duration and flash flood.

Natural drainages in this area would need to be channelized, mainly in the upper parts of the developed lands, because much of the lower parts of this area (near and adjacent to Ashley Creek) already have the former North Ashley Creek channel and other existing pathways that may require less intense improvement to pass required flows.

Typical 8’ trapezoidal channels with energy dissipation measures should be considered in this option, and in some cases it may be advantageous to utilize minor adjustments in the routes to minimize costs due to existing development and infrastructure.



a. *Construction Cost Estimate*

All aspects of this project option need to be designed as a whole to ensure they all work together correctly. Coordination with the selected options for the other areas of the valley also needs to take place. However, it is possible and perhaps easier to construct the various parts of the project independent of each other.

Appendix D contains detailed cost estimates for the different parts of this option as well as a total project cost. The estimate to construct the 510 ac-ft. of detention basins is $3,184,300. The estimate to enhance the 57,750 feet of natural drainages is $4,199,600. These estimates include engineering services but do not include property or easement acquisition. This is a total cost estimate of $7,383,900 for the project.

b. *Maintenance Costs/Considerations*

It is important that consideration not just be made for the cost of construction of a project but also the cost of maintain the flood control structures. Without proper maintenance, all components of a project will lose its capacity and functionality over time.

The estimate to maintain the 510 ac-ft. of detention basins is $5,000-25,000 a year, averaging about $15,000 a year. The estimate to maintain the 57,750 feet of natural drainages is $13,500-55,000 a year,

averaging about $25,000 a year. This is a total cost estimate of $40,000 for maintenance of the entire project.

Maintenance of the detention basins will be somewhat dependent upon the conditions in any given year, in a normal year with only minimal flows passing through the structure, likely spot checks and weed control will be needed. If a large flood event or more takes place, likely debris will need to be removed with heavy equipment once or more matching the storm events.

Maintenance of the enhanced drainages will need to include yearly vegetation control, usually herbicide treatment and as necessary debris and sediment removal. Depending on the severity of the storms in the area and the damage done, monitoring would be considered the minimum action each year and removal of materials from the canal the upper end of required maintenance.

4. NE Option 3 - Piped Storm Drain System

For additional context of the proposed Storm Drain System see the Northwest Storm Drain option details section 3.A.5. The same recommendations for consideration of planning and timing apply to this section as outlined in the previous storm drain section.

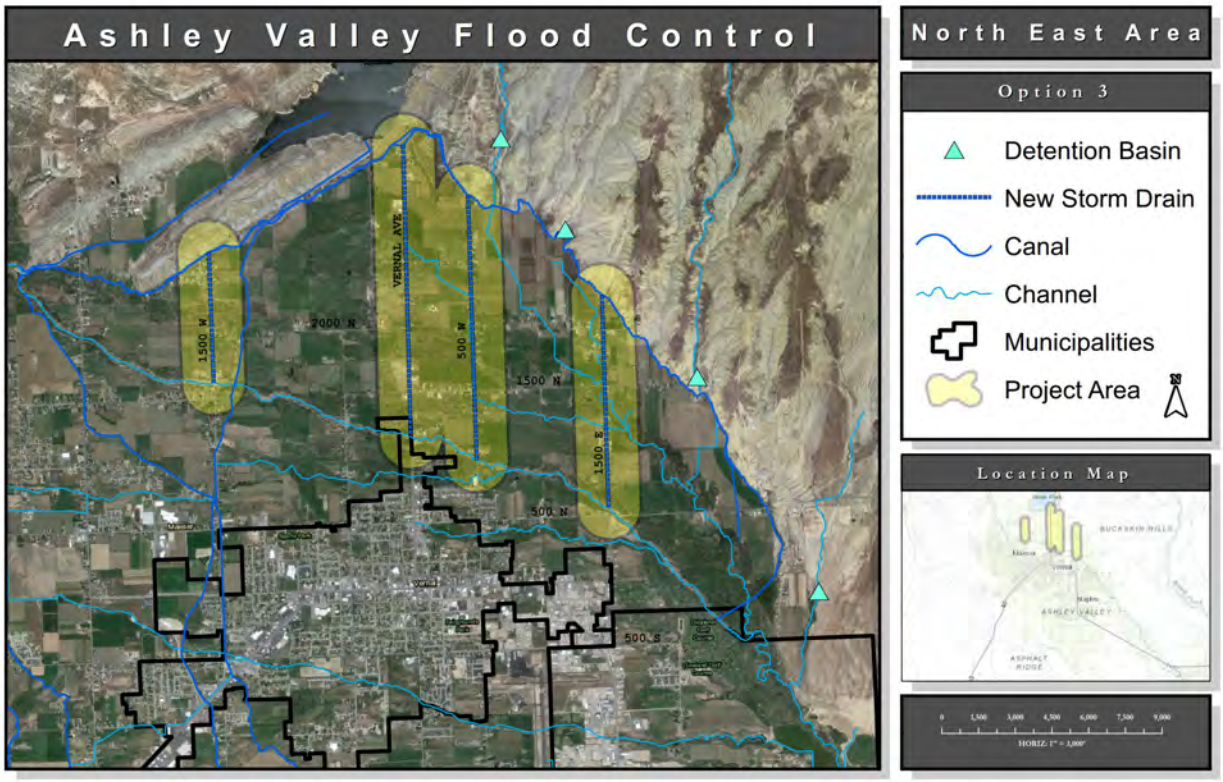
As with the natural drainages option listed above, this option would start with detention basins identified in the AVSWMP, with detention basins at up to 4 of the upstream drainages. Sizing and locations of the Storm Drain system would involve modeling the detention basins, anticipated flows and the size of improved drainages would further define the detention basin sizes.

The north and east areas of Ashley Valley contain some areas with existing high ground water and historic flow paths that have been modified to become agriculture lands. Some of the main roads such as 500 North have been left without proposed storm drains in this option mainly because the existing topography and drainage is sufficient for storm water management in the area or no development exists between the potential flood areas and Ashley Creek. Design of a final storm water system for this area would involve detailed analysis of the entire area and include both the hydrology aspect and the development aspect for optimum improvements.

For the purposes of this report it is assumed that an average storm drain size of 48” will be needed. Storm drains in this area will need to convey water routed from the drainages that feed into the valley from the north and are thus averaged higher than just assumed flows for the valley floor. This report also shows a limited number of downstream basins that would be used for equalization, water quality and routing to Ashley Creek.

Primarily the alignments for the proposed storm drain would be in County Roads. Some minor modifications or a combination of Storm Drain and natural

drainage enhancements (such as areas along 1500 East) would need to be considered and designed if this option were selected.



Other alternatives considered similar to this option include:

- A hybrid of storm drain and natural drainage enhancement would likely work well in this area. For the purposes of this report each of these two options are shown separately, but as mentioned if one of these two options is considered viable, a hybrid could be made to minimize cost and maximize benefit. Additional survey and property owner coordination would need to take place for this to be a viable option for implementation.

a. Construction Cost Estimate

All aspects of this project option need to be designed as a whole to ensure they all work together correctly. Coordination with the selected options for the other areas of the valley also needs to take place. However, it is possible and perhaps easier to construct the various parts of the project independent of each other.

Appendix D contains detailed cost estimates for the different parts of this option as well as a total project cost. The estimate to construct the 510 ac-ft. of detention basins is $3,184,300. The estimate to construct the 44,000 feet of storm drains is $11,229,900. The estimate to construct the 20 ac-ft. of water quality detention basins is $460,200. These estimates include engineering services but do not include

property or easement acquisition. This is a total cost estimate of $14,874,400 for the project.

b. *Maintenance Costs/Considerations*

It is important that consideration not just be made for the cost of construction of a project but also the cost of maintain the flood control structures. Without proper maintenance, all components of a project will lose its capacity and functionality over time.

The estimate to maintain the 510 ac-ft. of detention basins is $5,000-25,000 a year, averaging about $15,000 a year. The estimate to maintain the 44,000 feet of storm drains is $8,000-30,000 a year, averaging about $15,000 a year. The estimate to maintain the 20 ac-ft. of water quality detention basins is $4,000-12,000 a year, averaging about $8,500 a year. This is a total cost estimate of $38,500 for maintenance of the entire project.

Maintenance of the detention basins will be somewhat dependent upon the conditions in any given year, in a normal year with only minimal flows passing through the structure, likely spot checks and weed control will be needed. If a large flood event or more takes place, likely debris will need to be removed with heavy equipment once or more matching the storm events.

Maintenance of the storm drains would include monitoring and flushing as required.

Maintenance of the water quality detention basins would include monitoring and cleaning as required.

D. Central Ashley Valley (Adjacent to Vernal City and Ashley Creek)

1. Area Overview

a. *Character of Sub-basin*

The main components of the Central Area of Ashley Valley are Ashley Creek and Vernal and Naples Cities. This report will not address specific known needs within Vernal and Naples Cities, but there are options listed in this report that would require coordination with these cities to make solutions for the County areas viable. Additionally, some coordination has taken place with each city to try and address areas where storm water from county areas may affect the cities.

Much of the area outside of the Cities limits is agriculture land or dispersed development allowing for much of the storm runoff produced in rain events to infiltrate instead of creating problems such as those seen in more urban areas with a good percentage of hardscape dominating the area.

Vernal and Naples Cities have historically had the Highline and Upper Canals intercepting incoming water from undeveloped lands adjacent to Ashley Valley. The Central and Service canals are also located near the existing city boundaries

and thus also protect the city in some cases from storm water flows from the West (uphill). It should be noted though that neither of the Central or Service canals were designed or are managed to handle storm water yet it is not uncommon for storm water to be introduced to the canals, against the wishes of the Canal owners.

As these canals are piped and they no longer intercept the storm water flows they currently intercept, a contingency plan for conveying these flows will need to be created. The Highline and Upper Canals have obtained at least partial funding for piping of the canals (see sections V.C.1 for additional information). The Service canal was piped in the lower sections of the canal in the fall of 2016. Additional piping is set to take place, but the schedule is currently unknown. The Central canal has expressed interest in piping the canal, but no known time frame exists.

This report takes a no harm approach to interaction with Vernal and Naples Cities and any proposed impacts to the cities be it construction of facilities or pass through structures are addressed in the corresponding options.

Ashley Creek is the main drainage in Ashley Valley which not only drains the valley, but a large watershed that extends miles into the High Uintah Mountains. As such, the most common flood event associated with Ashley Creek is spring runoff. Historically Ashley Creek had multiple drainage paths once it entered the valley which allowed the water to dissipate and spread out through the different flow paths. Through past projects the current single path for Ashley Creek has been developed.

It is not common, but the situation causing the most flows in Ashley Creek has historically come from a cold wet spring followed by a quick warming trend and rainfall. Such has been the case in 1984 and to an extent 2011. Both of those years saw record flows in Ashley Creek that did damage to the existing stream channel and nearby development and infrastructure.

Since the AVSWMP and in some cases since the 2011 flood event, several bridges crossing Ashley Creek have been replaced and upgraded to handle larger flows seen with runoff events. From the AVSWMP the only remaining unimproved bridge is located on 2500 West. Armoring of the channel banks has also taken place in many areas along the exiting alignment.

Currently there are areas where the channel has not been improved and excess flows during runoff events has caused overtopping of the existing channel, usually to areas that were part of one of the other two historic channels on the North and South of today's channel.

The nature of Ashley Creek is such that high sediment loads come with the flood events and it is not uncommon for the low flow channel to be changed within the flood channel dramatically following a runoff event. Often this means cobble rock and silt is deposited in the channel and slowly the elevation of the bottom of the existing channel is raised. During the public input process several places along Ashley Creek were shown to exhibit this ongoing problem of rising channel base from deposited materials.

Specific problem areas within the Central Area of Ashley Valley include:

1. Ashley Creek – Channel depth and vegetation
2. Ashley Creek Bank Stabilization
    a. Approximately 450 East, 900 East
3. Minor culvert issues – Varied locations shown in AVSWMP
4. Natural Drainages filled in and storm water following old lateral ditches – Approximately 800 North from 1500 West to 500 East

This report concurs with the recommendation from the AVSWMP to improve the existing Bridge across Ashley Creek. As with the other bridges, this should be led as a transportation project.

Culverts, the AVSWMP contains an extensive list of culverts that are in need of upsizing to handle anticipated flows. These suggested improvements are found all over Ashley Valley, but the majority of them are in the Central area. Most of the culverts that have been upgraded since the AVSWMP have been part of larger transportation projects. In communication with the Uintah County Roads department, this process is working fine and will eventually lead to upgrading the suggested culverts. The road department regularly consults the AVSWMP when replacement culvert sizing is considered. This report recommends that culvert replacement continue to take place in conjunction with road maintenance or upgrade projects.

b. Major areas of concern

(1) Ashley Creek

Ashley Creek is the main drainage in Ashley Valley which not only drains the valley, but a large watershed that extends miles into the High Uintah Mountains. As such, the most common flood event associated with Ashley Creek is spring runoff. Historically Ashley Creek had multiple drainage paths once it entered the valley which allowed the water to dissipate and spread out through the different flow paths. Through past projects the current single path for Ashley Creek has been developed.

It is not common, but the situation causing the most flows in Ashley Creek has historically come from a cold wet spring followed by a quick warming trend and rainfall. Such has been the case in 1984 and to an extent 2011. Both of those years saw record flows in Ashley Creek that did damage to the existing stream channel and nearby development and infrastructure.

Since the AVSWMP and in some cases since the 2011 flood event, several bridges crossing Ashley Creek have been replaced and upgraded to handle larger flows seen with runoff events. From the AVSWMP the only remaining unimproved bridge is located on 2500 West. Armoring of the channel banks has also taken place in many areas along the exiting alignment.

Currently there are areas where the channel has not been improved and excess flows during runoff events has caused overtopping of the existing channel, usually to areas that were part of one of the other two historic channels on the North and South of today's channel.

The nature of Ashley Creek is such that high sediment loads come with the flood events and it is not uncommon for the low flow channel to be changed within the flood channel dramatically following a runoff event. Often this means cobble rock and silt is deposited in the channel and slowly the elevation of the bottom of the existing channel is raised. During the public input process several places along Ashley Creek were shown to exhibit this ongoing problem of rising channel base from deposited materials.

Specific problem areas within the Central Area of Ashley Valley include:

1. Ashley Creek – Channel depth and vegetation
2. Ashley Creek Bank Stabilization - Approximately 450 East, 900 East
3. Minor culvert issues – Varied locations shown in AVSWMP
4. Natural Drainages filled in and storm water following old lateral ditches – Approximately 800 North from 1500 West to 500 East

This report concurs with the recommendation from the AVSWMP to improve the existing Bridge across Ashley Creek. As with the other bridges, this should be led as a transportation project.

(2) Culverts

Culverts, the AVSWMP contains an extensive list of culverts that are in need of upsizing to handle anticipated flows. These suggested improvements are found all over Ashley Valley, but the majority of them are in the Central area. Most of the culverts that have been upgraded since the AVSWMP have been part of larger transportation projects. In communication with the Uintah County Roads Department, this process is working fine and will eventually lead to upgrading the suggested culverts. The road department regularly consults the AVSWMP when replacement culvert sizing is considered. This report recommends that culvert replacement continue to take place in conjunction with road maintenance or upgrade projects.

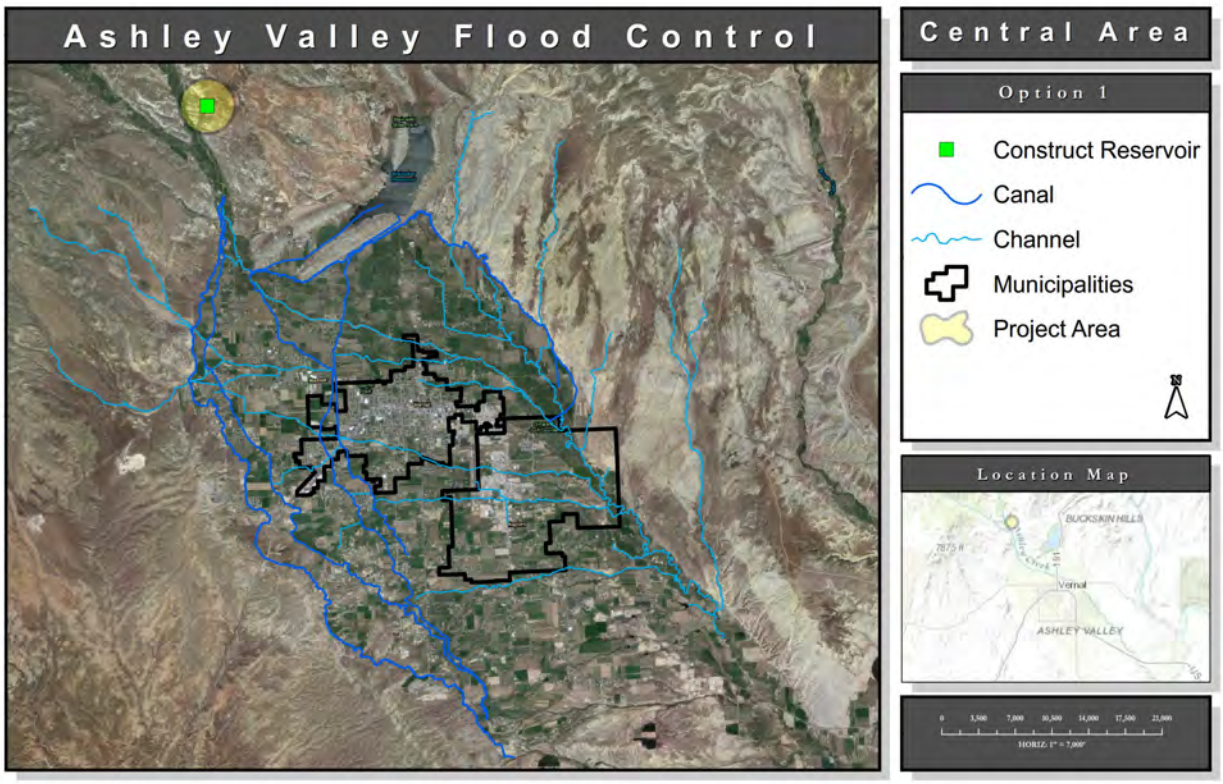
c. Possible Projects

A note about the options for this Area – The AVSWMP is clear (Section 7.2.3) that the existing Ashley Creek alignment does have concerns such as sedimentation and vegetation. That report explores the possibility of using the irrigation canals to divert flood waters from Ashley Creek and lower the Flows in the Creek channel, but then goes on to state that this should not be done because the irrigation canals provide protection to other areas of the county. Several of the options in this report rely upon the assumption that getting storm water to Ashley Creek is the solution, but this section will show that if additional water is introduced to Ashley Creek above the Dinaland Golf Course then measures will need to be taken to insure that these additional flows do not exacerbate a current potential problem.

2. C Option 1 - Spring Creek Reservoir

The Spring Creek Reservoir is shown in the AVSWMP as the preferred alternative to manage storm water in Ashley Creek before it enters the valley.

As with the smaller basins outlined in this report, this concept would allow for the conveyance channel under the reservoir to require less work and have less variation in peak flows. In the AVSWMP this reservoir is located in the Spring Creek drainage just north of the mouth of Dry Fork Canyon. At the time the AVSWMP was completed, some initial investigation took place relating to the site and feasibility of the Reservoir. From speaking with those who were involved with the initial investigations, the fractured bedrock and possibly the cost among other things created insurmountable obstacles, so this plan was abandoned. Additional details on the Spring Creek Reservoir can be found in the AVSWMP. This report will include the concept of the Spring Creek Reservoir for comparative analysis only, given that it was considered the preferred alternative in the AVSWMP.



a. Construction Cost Estimate

Coordination with the selected options for the other areas of the valley needs to take place.

Appendix D contains a detailed cost estimate for the project. The estimate to construct the Spring Creek Reservoir is $62,761,200.

b. Maintenance Costs/Considerations

It is important that consideration not just be made for the cost of construction of a project but also the cost of maintain the flood control

structures. Without proper maintenance, all components of a project will lose its capacity and functionality over time.

The estimate to maintain the Spring Creek Reservoir is $100,000-450,000 a year, averaging about $125,000 a year.

Maintenance impacts to Uintah County for a reservoir such as the proposed Spring Creek Reservoir are difficult to estimate given the complexity of the funding, project partners, purposes of the proposed reservoir etc. Likely discussions with the Uintah Water Conservancy and possibly the Central Utah Project would be part of these discussions. At a minimum it should be assumed that the equivalent of one full time employee with all supporting equipment and documentation required to operate the structure as an agricultural asset should be assumed.

3. C Option 2 - Ashley Creek Stabilization

The AVSWMP includes references to a report completed in May of 2000 by Mussetter Engineering Incorporated that evaluated the Ashley Creek channel and made recommendations. Quoting from the AVSWMP concerning the findings of the 2000 Study: "The study indicated that the increased sediment transport and subsequent downstream deposition will likely continue to modify the river channel and may result in increased flooding potential near and below the golf course. Additionally, excessive erosion between the Thornburgh Diversion and the golf course will eventually result in channel migration and threaten existing structures." Concerning the recommendations of the report and a subsequent report by Franson Noble and Associates the priorities for Ashley Valley include:

1) Creek management to develop a monitoring and maintenance program;

2) Bridge enlargement (discussed in the previous section);

3) Soft Bank Stabilization to control erosion;

4) Riparian restoration to reduce stream velocities and provide numerous other desirable benefits;

5) Provide upstream storage to minimize peak flows and provide water to future riparian zones.

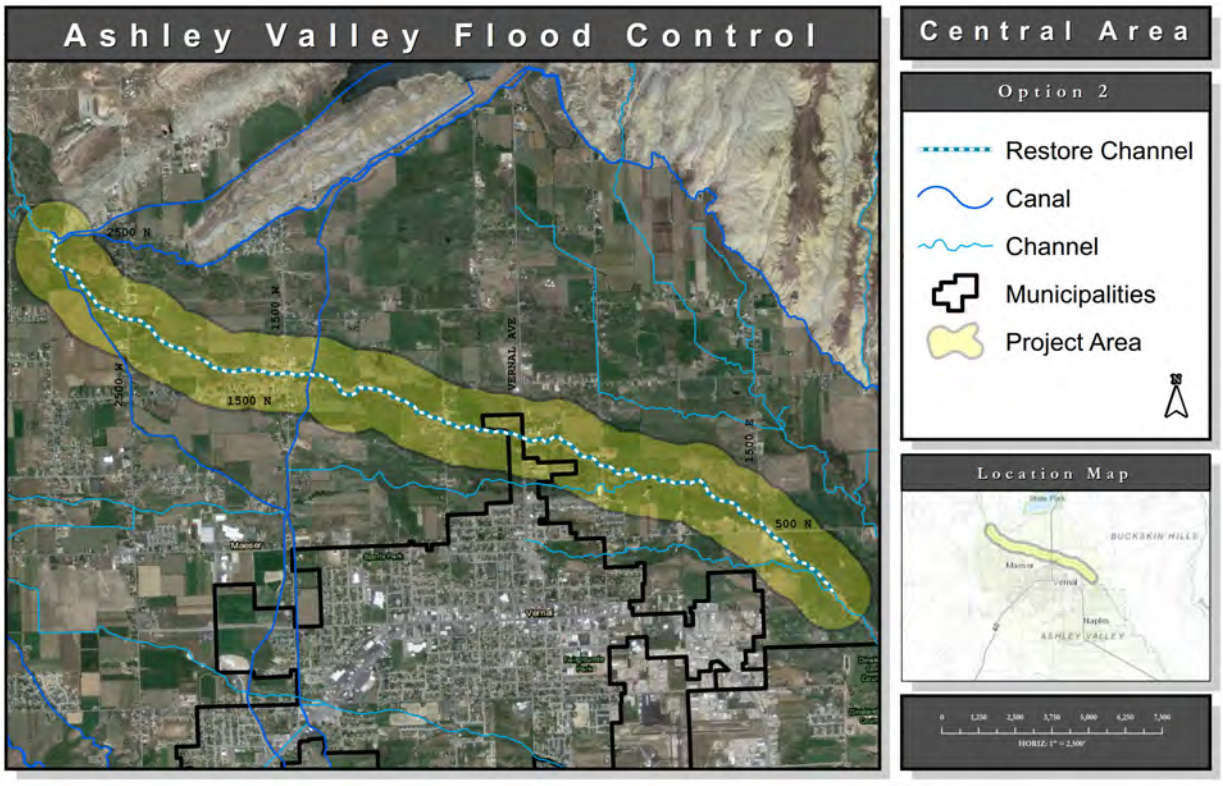
Bridges and upstream storage are addressed previously in this report, but this option seeks to address the recommendation for Creek Management, Bank Stabilization and Restoration efforts. For the purposes of this report, the area from the Fort Thornburgh Diversion to the Golf Course will be specifically addressed due to the potential for damage to existing development and infrastructure and specifically identified improvements that can be made. Downstream from the golf course the river channel decreases in slope and the

existing creek meanders. For this area a mitigation or management approach will be more productive as few other options exist due to topography.

Since the AVSWMP was completed, several areas along Ashley Creek have been improved, mainly bank stabilization including adjacent to the new bridges and above 1500 West. Since those improvements have been made, only minor problems have been seen, but the area has not seen as large of runoff events as previously recorded. Of concern is the amount of vegetation that has grown in the channel and not been removed. Three and four inch diameter trees are located in some spots and sedimentation is filling in the channel.

Specific areas of concern along the existing creek channel are shown on the attached Public Comment Maps in Appendix, but it should be noted that this option includes improvements along the channel where improvements do not currently exist due to the potential for future improvements causing issues in areas that may not have current problems.

It should be noted that several of the other options included in this report are dependent upon improvements to the Ashley Creek Channel being made because they would add flow to the channel where it is already considered to be only marginally adequate. Other options direct storm water below the golf course and are thus not dependent upon this project for functionality.



a. *Construction Cost Estimate*

Coordination with the selected options for the other areas of the valley needs to take place.

Appendix D contains a detailed cost estimate for the project. The estimate to construct the Ashley Creek Channel Stabilization is $10,715,300.

b. *Maintenance Costs/Considerations*

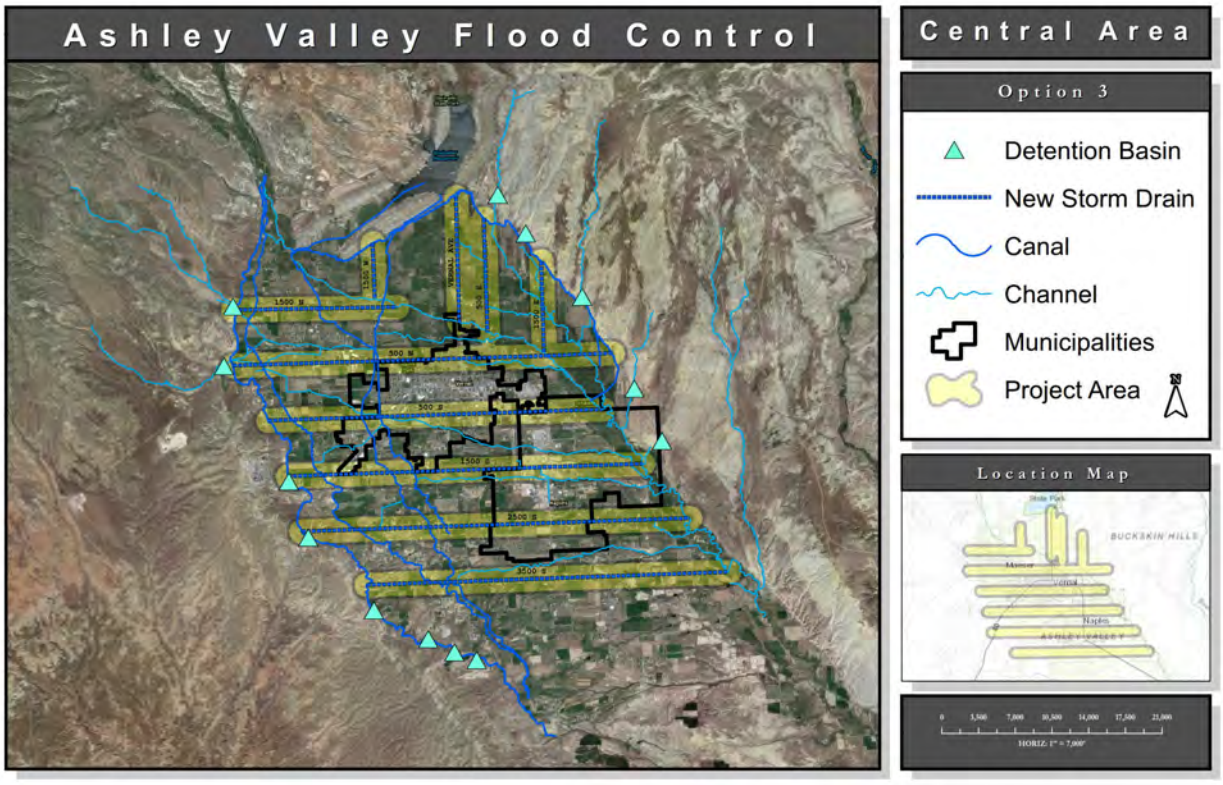
It is important that consideration not just be made for the cost of construction of a project but also the cost of maintain the flood control structures. Without proper maintenance, all components of a project will lose its capacity and functionality over time.

The estimate to maintain the Ashley Creek Channel Stabilization is $18,500-135,000 a year, averaging about $75,000 a year.

The AVSWMP suggests that a Watershed Management Plan be created that addresses how the Ashley Creek Channel should be managed for flood water conveyance. This plan should address the ongoing monitoring of the channel, the vegetation control schedule and methods and monitoring and maintenance of control structures. Efforts to create this plan in conjunction with the Uintah Water Conservancy District, the United States Forest Service, and other stakeholders in Ashley Creek should be used to develop this plan and the associated costs and methods.

4. C Option 3 - Ashley Creek Stabilization and Piped Storm Drain System

This option addresses the need to bring all areas together to create a complete urban piped storm drain system that delivers storm water to an improved Ashley Creek Channel. This option incorporates and facilitates all of the other Storm Drain Options for the different areas outlined in this report. It also includes the previous option in this area to facilitate those increased flows.



a. Construction Cost Estimate

All aspects of this project option need to be designed as a whole to ensure they all work together correctly. Coordination with the selected options for the other areas of the valley also needs to take place. However, it is possible and perhaps easier to construct the various parts of the project independent of each other.

Appendix D contains detailed cost estimates for the different parts of this option as well as a total project cost. The estimate to construct the Ashley Creek Channel Stabilization is $10,715,300. The estimate to construct the 842 ac-ft. of detention basins is $5,540,500. The estimate to construct the 212,600 feet of storm drains is $45,525,100. The estimate to construct the 55 ac-ft. of water quality detention basins is $1,120,100. These estimates include engineering services but do not include property or easement acquisition. This is a total cost estimate of $62,901,000 for the project.

b. Maintenance Costs/Considerations

It is important that consideration not just be made for the cost of construction of a project but also the cost of maintain the flood control structures. Without proper maintenance, all components of a project will lose its capacity and functionality over time.

The estimate to maintain the Ashley Creek Channel Stabilization is $18,500-135,000 a year, averaging about $75,000 a year. The estimate to maintain the 842 ac-ft. of detention basins is $15,000-65,000 a year, averaging about $41,000 a year. The estimate to maintain the 212,600 feet of storm drains is $40,000-120,000 a year, averaging about $75,000 a year. The estimate to maintain the 55 ac-ft. of water quality detention basins is $11,500-37,000 a year, averaging about $26,000 a year. This is a total cost estimate of $217,000 for maintenance of the entire project.

The AVSWMP suggests that a Watershed Management Plan be created that addresses how the Ashley Creek Channel should be managed for flood water conveyance. This plan should address the ongoing monitoring of the channel, the vegetation control schedule and methods and monitoring and maintenance of control structures. Efforts to create this plan in conjunction with the Uintah Water Conservancy District, the United States Forest Service, and other stakeholders in Ashley Creek should be used to develop this plan and the associated costs and methods.

Maintenance of the detention basins will be somewhat dependent upon the conditions in any given year, in a normal year with only minimal flows passing through the structure, likely spot checks and weed control will be needed. If a large flood event or more takes place, likely debris will need to be removed with heavy equipment once or more matching the storm events.

Maintenance of the storm drains would include monitoring and flushing as required.

Maintenance of the water quality detention basins would include monitoring and cleaning as required.

IV. Benefit Analysis

A. Benefit Analysis Criteria

A benefit analysis was completed in order to weigh each project option and establish a prioritized list of projects. The criteria for the benefit analysis was established considering the priorities, needs and concerns of the county. A weighting factor was then applied to these criteria depending on the criteria's importance. The criteria, weighting factors and criteria descriptions are shown below in Table 1.

Table 1. Benefit Analysis Criteria and Weighting Factors

Criteria	Weighting Factor	Criteria Description
Benefit to Cost Ratio	10	The ratio of the cost benefit (property value in project benefit area) to the total cost of the project (infrastructure cost and maintenance over 30 years)
Homes Protected	5	The number of homes in the project benefit area

B. Benefit Areas & GIS Analysis

GIS software was used to create a benefit area for each project option and to analyze the value of land and improvements (structures) potentially benefitted by each project. Benefit areas were developed for each type of improvement using a defined set of parameters. The benefit areas for all components of a project were then merged to create a single, non-redundant benefit area for each project option. Some project benefit areas were further segmented to account for changes in an improvement's effectiveness as the distance from the improvements increases. Benefit areas were weighted during the analysis to reflect each project option's ability to mitigate storm water impacts.

The benefit areas for canal improvements consist of the area within 0.25 miles of the downslope side of the canals along the entire improvement length, as well as the area within 0.25 miles of the natural drainages from immediately below the canal to Ashley Creek. The natural drainage areas were segmented at 1 mile intervals from the canal to Ashley Creek.

The benefit areas for natural drainage and storm drain improvements consist of the area within 0.25 miles of the improvement from their beginning points (typically a canal for storm drain improvements) to their termini in Ashley Creek. Stream channel improvement benefit areas also consist of the area within 0.25 miles of the entire length of the improvement.

The benefit areas for reservoir improvements consist of the area immediately adjacent to the reservoir site, as well as the area within 0.25 miles of the downstream channel for a distance consistent with the length of the Ashley Creek improvement project. Benefit areas for detention basins were determined to be redundant with other project components and were not developed separately.

After the benefit areas were developed for each project option, they were spatially analyzed against two datasets to assess the level of benefit each project would provide to the County and its residents. An address point dataset developed by the County was used as a proxy for identifying the number and distribution of residential and commercial structures within each benefit area. In general, projects with a larger number of structures within their benefit area have a greater benefit opportunity, or ability to mitigate against storm water damage.

County parcel data containing assessed values for raw land and improvements (structures) were also analyzed within each benefit area. First, a value per acre was calculated based on the assessed values and the recorded acreage of the parcels. Parcel data were then clipped to each benefit area. Acreages of the clipped parcels were recalculated in GIS, and then multiplied by the value per acre to determine the value of the land and improvements within the benefit areas.

The GIS structures and assessed value analysis results were summed by benefit area and used to determine the benefit of each project option in the cost to benefit ratio calculations. A weighting factor was applied to the benefit calculation to reflect the differences between project types in storm water mitigation potential. Segments within canal project benefit areas were maintained in the reporting to provide flexibility in applying weighting factors for areas farther away from the improvement project.

C. Project Ranking

The benefit analysis criteria and weighting factors were used to score each project option within each improvement area. Table 2 shows an overview of the project option rankings within each improvement area. A final ranking was then completed on the highest ranking project option in each improvement area. The final rankings by improvement area are shown in Table 3. Refer to Appendix E for a full breakdown of these rankings.

Table 2. Project Option Rankings within each Improvement Area

Improvement Area	Project Option	Description	Benefit Area Property Value	Total Project Cost Over 30 Years	Benefit to Cost Ratio	Homes in Benefit Area	Project Ranking per Improvement Area
Northwest	1A	Coal Mine Basin and Highline Canal	$98,231,917	$1,541,400	64	391	1
Northwest	1B	Coal Mine & Yellow Hills Basins and New Stormwater Canal	$103,773,641	$3,324,500	31	416	2
Northwest	2	Natural Drainage Enhancements	$112,551,973	$5,663,400	20	472	3
Northwest	3	Storm Drain	$30,728,943	$5,432,300	6	137	4
West & Southwest	1A	Yellow Hills Basin and Highline Canal	$527,171,248	$3,772,200	140	1,680	1
West & Southwest	1B	Yellow Hills Basin and Highline/Upper Canals	$534,978,313	$3,842,000	139	1,727	2

West & Southwest	2	Natural Drainage Enhancements	$697,507,332	$14,411,400	48	2,296	2
West & Southwest	3	Storm Drain	$572,138,839	$43,488,800	13	2,070	4
North & East	1	Basins and Rockpoint Canal	$66,429,194	$5,583,400	12	224	1
North & East	2	Natural Drainage Enhancements	$34,186,395	$8,583,900	4	115	2
North & East	3	Basins and Storm Drains	$46,824,236	$16,029,400	3	185	3
Central	1	Spring Creek Reservoir	$68,910,345	$66,511,200	1.04	265	3
Central	2	Ashley Creek Stabilization	$56,566,465	$12,965,300	4	233	2
Central	3	Ashley Creek Stabilization and Storm Drain	$674,376,170	$69,411,000	10	2,473	1

Table 3. Final Project Rankings by Improvement Area

Improvement Area	Project Option	Description	Benefit Area Property Value	Total Project Cost Over 30 Years	Benefit to Cost Ratio	Homes in Benefit Area	Project Ranking per Improvement Area
Northwest	1A	Coal Mine Basin and Highline Canal	$98,231,917	$1,541,400	64	391	3
West & Southwest	1A	Yellow Hills Basin and Highline Canal	$527,171,248	$3,772,200	140	1680	2
North & East	1	Basins and Rockpoint Canal	$66,429,194	$5,583,400	12	224	4
Central	3	Ashley Creek Stabilization and Storm Drain	$674,376,170	$69,411,000	10	2473	1

V. Summary and Priority List

A. Summarized Ranking Results

As shown in the ranking analysis presented in Table 2 and 3, for the Northwest, West, and Northeast improvement areas, the projects including the canals ranked the highest. This is in part due to the fact that the canals collect drainage from the large mountainous watersheds and divert it around the majority of the developed part of Ashley Valley, thus benefiting a large area. The highest ranking project is the Ashley Creek Stabilization and Storm Drain project which covers most of the developed part of Ashley Valley resulting in a high number of benefited homes. A summary of the total costs and prioritization is shown in Table 4.

Table 4. Summary of Project Prioritization and Costs

Priority	Improvement Area	Project Option	Description	Project Infrastructure Cost	Yearly Maintenance Cost
1	Central	3	Ashley Creek Stabilization and Storm Drain	$62,901,000	$217,000
2	West & Southwest	1A	Yellow Hills Basin and Highline Canal	$2,482,200	$43,000
3	Northwest	1A	Coal Mine Basin and Highline Canal	$1,121,400	$14,000
4	North & East	1	Basins and Rockpoint Canal	$4,383,400	$40,000
			Total:	$70,888,000	$314,000

B. Implementation Scheduling and Phasing

During the course of this study and benefit analysis, a series of meetings were held with the public, canal companies, and County Commission in which timelines and current available funding was discussed. Modifications were made to some of the projects recommended in the report to break out elements such as detention basins for installation prior to future development. Table 5 below shows the revised priority with consideration to immediate needs (existing infrastructure and property) and timeline for implementation based on related projects and funding.

Table 5. Summary of **Current** Project Needs

Priority	Improvement Area	Project Option	Description	Current Project Infrastructure Cost	Potential Construction Timeline
1a	West & Southwest	1A	Yellow Hills Basin and Highline Canal	$1,775,000	2018 - 2019
1b	Northwest	1A	Coal Mine Basin and Highline Canal	$813,600	2018 - 2019
2	North & East	1	Rockpoint Canal and Some Basins	$1,605,300	2018 - 2019
			Total:	$4,193,900	

C. Funding Considerations

1. Possible funding sources for project list

The current projects under consideration are being proposed to be included in a grant/loan mix obtained by Uintah County through the Permanent Community Impact Board (PCIB) and an NRCS Regional Conservation Partnership Program (RCPP) grant obtained by the Uintah Water Conservancy District. Money from both is appropriated for flood control improvements in the County.

Additional resources for flood control include NRCS Emergency Watershed Protection (EWP) funding if a catastrophic event occurs and a letter of notification sent to the NRCS within 60 days. Previous site visits with NRCS staff to the Yellow Hill and Coal Mine Basin area have made them aware of the potential flooding issues experience by the residents.

In conjunction with the canal piping projects, funds from those projects could be used towards making improvements on the canal channels. They are funded in part through the Basin States Salinity Control Program based on salinity reduction from piping the canals and eliminating high seepage loss and transfer of salinity to open waters and eventually the Colorado River system.

2. Timelines for funding sources

The NRCS RCPP funding has been announced to the UWCD and they have accepted the offer for cost sharing. Once a Watershed Plan is completed, this funding will be appropriated and available for the UWCD and the County. It is anticipated that this will happen by Fall 2017.

PCIB Grant and loans are available in this construction season as well. Irrigation companies will be required to obtain a loan from the Board of Water Resources and grant from the Salinity Control program.

D. Permitting Requirements and Environmental Considerations

Permitting for the projects included in the AVSWMP and this study is discussed in Chapter 8 of the AVSWMP. In general, it is assumed that work in natural drainages and Ashley Creek will require Section 404 permitting from the Army Corps of Engineers. It is recommended that a permit be obtained in 2017 to cover work in Ashley Creek preparatory for the 2017 runoff season. Timeline may be difficult to obtain permitting in time for this year's event, however, a permit that could be used over multiple years would be beneficial.

The canal piping projects receiving grant money from the Bureau of Reclamation and also the NRCS will require NEPA permitting and channel improvements could likely be included in the permitting. Cultural, wetlands, threatened and endangered species surveys as well as a habitat assessment will be required for the piping projects and would cover the canal footprints as well as the proposed canal pipeline alignments. A

Environmental Assessment and a Habitat Replacement Plan will also be a part of these Salinity piping projects and partnering on this effort will be beneficial to all parties.

Permitting for the detention basins is somewhat dependent upon the location (private or BLM) and the funding used for their construction. NRCS RCPP funds would require NEPA permitting while CIB funding and County funding on private property likely would not require the same level of permitting.

E. Conclusions and Recommendations

Based on the findings of this study and the cost-benefit analysis, the projects with the highest benefit to cost ratios included utilizing the Highline and Rock Point Canals along with debris basins in strategic basins (Coal Mine, Yellow Hills, and others). With the Highline/Upper and Rockpoint Canal piping projects being funded by the Salinity Control Program with anticipated timelines for construction spanning from 2017 to 2018, the canal improvements could be constructed in conjunction with these piping projects or following closely thereafter. Once canal improvements are made and channels widened and disturbed, the capacity for stormwater conveyance and losses in seepage will provide an immediate benefit while the detention and debris basins are being constructed. Once these initial project needs based on the current land uses and development, the next priority should be Ashley Creek as outlined in the analysis. Other storm drain and natural drainage improvements would follow Ashley Creek improvements where appropriate and as funding is available. It would be beneficial to the County to obtain Section 404 Permitting for improvements involving natural channels and Ashley Creek so that ongoing maintenance to these channels could be done without delay. Proactively cleaning the Ashley Creek streambed prior to runoff events and flash flooding will provide capacity in this important drainage channel.

Aside from construction and on-the-ground improvements, continued planning and review of land use ordinances for compatibility with the overall flood control plan and concepts is highly recommended. Proactively protecting homes and property by preserving natural drainages and requiring drainage improvements to be incorporated in development will go a long ways in preventing future flood control issues and transfer costs to development and not the County. Vernal and Naples would also benefit to go through similar planning measures and coordinate efforts with the County where overlap in benefit occurs.

VI. Appendices

A. Appendix A – Technical Review of AVSWMP

B. Appendix B – Public Comments Map