METROPOLITAN SEWER DISTRICT of greater CINCINNATI

Mt. Washington Source Control Implementation

Business Case Evaluation

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10172940

Final Revision 1 - Sewers Chief Engineer Approval

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Section 1 – Executive Summary

Purpose and Justification:

This project was initiated to address a series of Sewage Back Ups (SBUs) in the Woodlark Drive, Mayland Drive, and Lusanne Terrace area of Mount Washington (hereinafter referred to as the neighborhood). After large storm events in 2011, 2012, 2016, and 2019, between 28 and 47 homeowners (the actual number depends on the specific event) reported an SBU during at least one of the listed events, with most homeowners reporting three or more occurrences across these four storms. Modelling of the combined sewer in the neighborhood indicated the system can convey flows up to the 10-year, 24-hour storm, but that SBUs are possible for larger or more intense storm events.

Metropolitan Sewer District of Greater Cincinnati (MSD) investigated potential partial separation solutions and storage solutions in the neighborhood to remedy the SBU problem. However, MSD concluded that an in-neighborhood solution was not practical because of site constraints, utility conflicts, and significant construction costs. Based on this conclusion, MSD expanded the study area. This expanded study area included areas downstream of the neighborhood and extended to combined sewer overflow (CSO) 182 where it discharges into Berkshire Creek.

The expanded study area included: the neighborhood and the area immediately downstream of the neighborhood to a connection to the CSO 182 Trunk Sewer (Phase 1), and a proposed stormwater conveyance to parallel the existing CSO 182 Trunk Sewer that extends from the connection point to the discharge point on Berkshire Creek (Phase 2).

The overall design and construction of Phase 2 is a separate project and is briefly identified in this BCE. A conceptual plan for Phase 2 is presented in a separate updated CSO 182 Opportunities Assessment report. Phase 2 will be designed and implemented after Phase 1 as a separate project.

Recommended Alternative:

The recommended alternative in this BCE consists of installing a new storm sewer in the neighborhood to collect and convey surface runoff in the area and to convey this separated storm water in a new storm sewer that will be extend eastward along Glade Avenue and then north on Beacon Street and connect to the 66-inch CSO 182 Trunk Sewer in during Phase 1 as described in Alternative 2 – Beacon Street.

This connection to the existing combined CSO 182 Trunk Sewer is anticipated to be temporary while the design and construction of Phase 2 is completed as a separate future project.

Project Location:

This project is in the Little Miami sewer shed of the East Basin in the City of Cincinnati's Mount Washington neighborhood, Hamilton County, Ohio.

The existing combined sewers in the neighborhood and project area drain to CSO 182 and the 21" underflow pipe. The underflow from CSO 182 flows to the Little Miami WWTP for treatment; overflows from CSO 182 discharge into Berkshire Creek. CSO 182 is located just west of an existing bridge carrying Beechmont Avenue over Berkshire Creek.

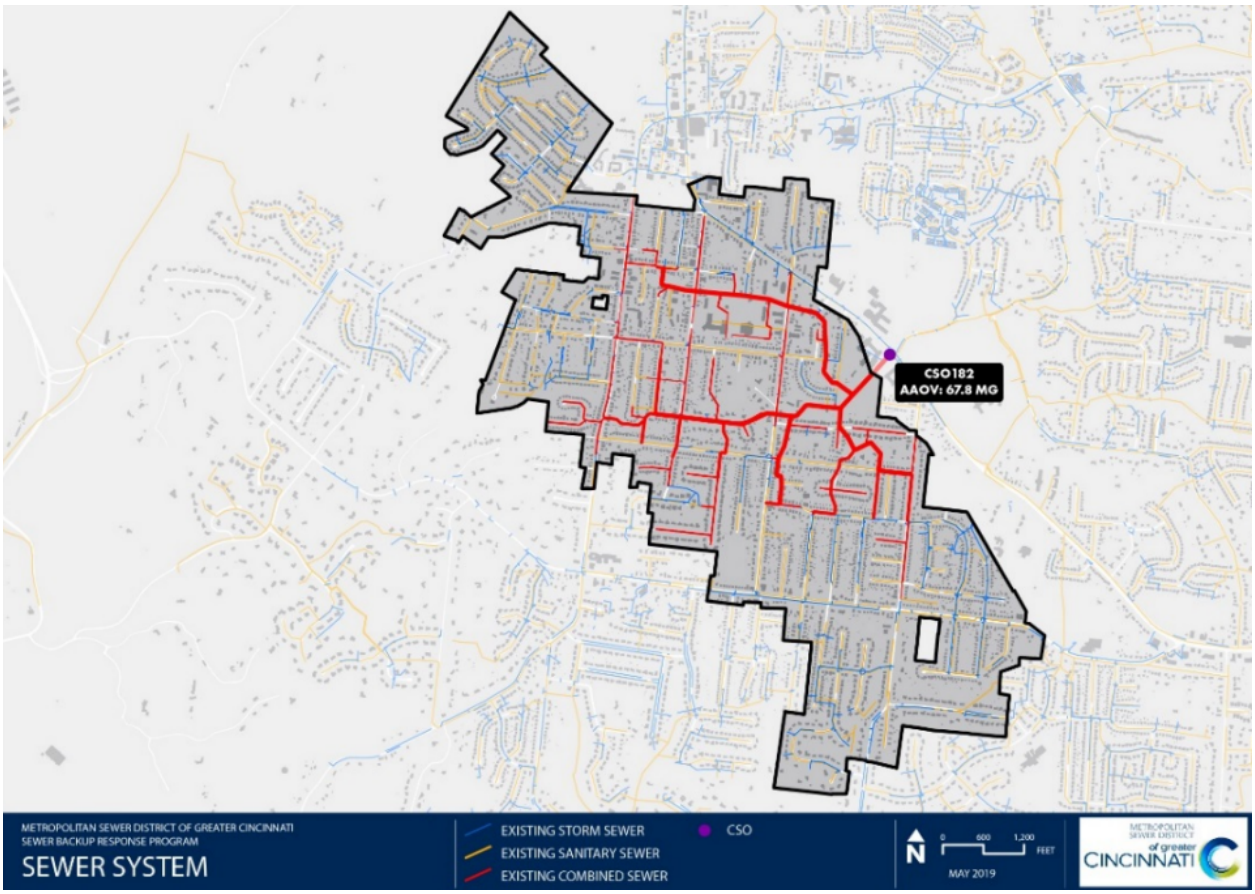

Figure 1: CSO 182 Basin

How:

The proposed work described in this BCE will be implemented as a Capital Improvement Project. It is estimated to cost approximately $4,172,930 (2024 dollars) in construction costs with a total project cost of $5.13M.

When

The Phase 1 work proposed in this BCE will require approximately four to five years to implement. This includes at least one year for design, two years for ROW acquisition, and one year for construction.

Section 2 – The Problem

Section 2.1 Problem Statement

Four separate large storm events (2011, 2012, 2016, and 2019) produced widespread basement flooding in the Mt. Washington Source Control Implementation Project area along Mayland Drive, Lusanne Terrace, and Woodlark Drive (the neighborhood). If left unresolved, future storms are likely to cause additional SBUs which may cause personal property damages, structural damages, and create health risks associated with sewer discharges. To meet Consent Decree requirements under the Sewer Backup Prevention Program (SBUPP), MSD is required to address sewer backups (SBUs) in basements and propose a solution that reduces future damage and health risks.

In addition, the Consent Decree requires that Metropolitan Sewer District of Greater Cincinnati (MSD) reduce combined sewer overflow volumes throughout the District. Based on initial model results for the 1970 Typical Year (June 2019 Analysis), rainfall generated volumes in the CSO 182 sewershed include approximately 71 Million Gallons (MG) of annual stormwater runoff and 83 MG of rainfall derived inflow and infiltration (RDII). Model results show that CSO 182 contributes an annual overflow volume of approximately 67.8 MG in the Typical Year, which discharges to the headwaters of Berkshire Creek.

Section 2.2 Condition Assessment

There are no known significant structural or other condition problems associated with the sewers in the project area. Existing sewers were constructed in 1951 and inspections conducted in 2011 found them to be in good condition. Field notes from MSD personnel indicate that no blockages or structural deficiencies were found in private laterals during site visits following SBU complaints in 2011 and 2012. The primary CSO 182 Trunk Sewer segments (36” and up) are constructed of brick and date from the late 1940s. No additional condition assessment information was provided or reviewed within the CSO 182 sewershed.

Section 2.3 Problem Diagnosis

Modeling indicates that the existing combined sewers along Mayland and Woodlark Drives did not have sufficient capacity to pass the storm flows experienced in 2011, 2012, 2016 or 2019. The largest of these storms, based both on rainfall data and SBU observations was the event on July 28th, 2016 which was between a 25- and 50-year recurrence 24-hour storm with a peak 3-hour rainfall above 100-year recurrence interval.

The limited capacity resulted in an increased hydraulic grade line within the sewer and produced widespread basement flooding. Figures 2 to 4 display the cumulative rainfall depths for three of the four reported back up events.

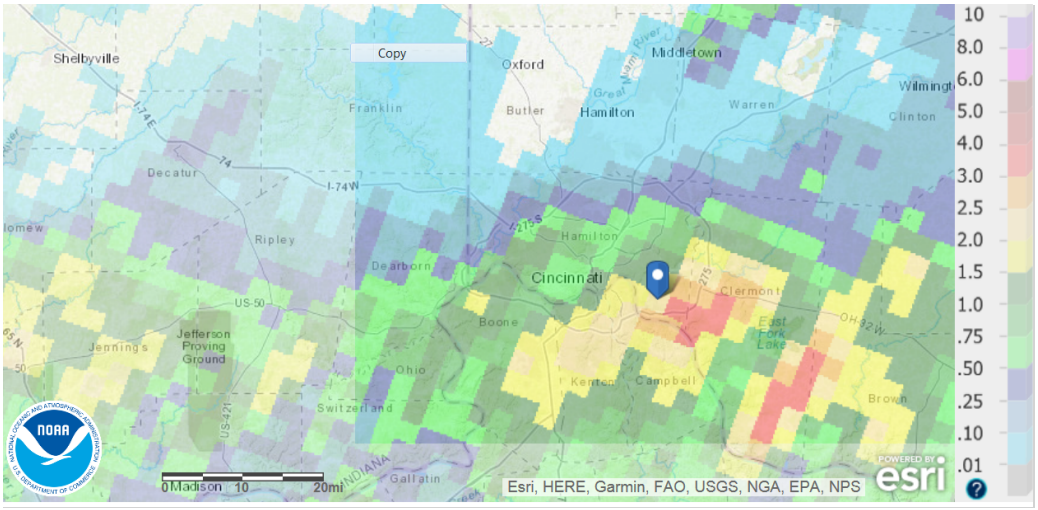

Figure 2: Cumulative Rainfall: June 22, 2011

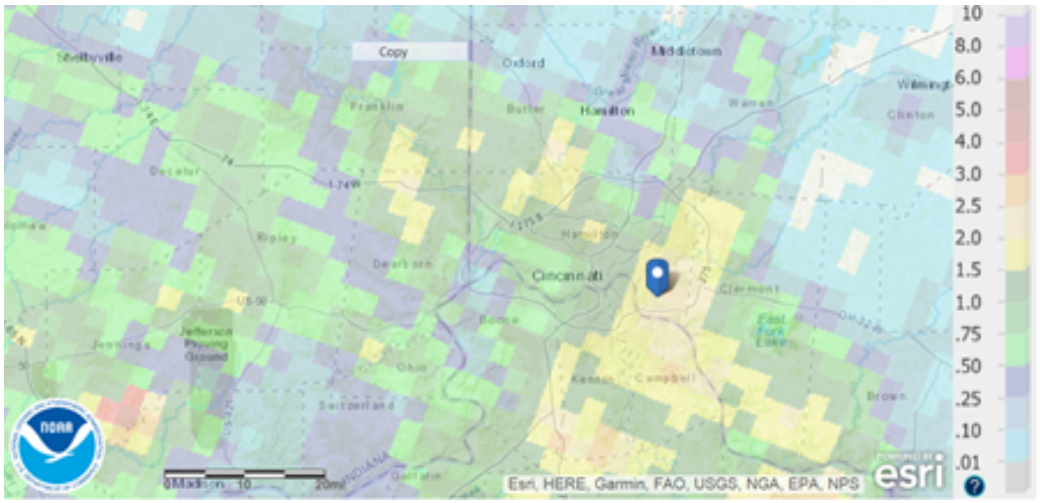

Figure 3: Cumulative Rainfall: July 19, 2012

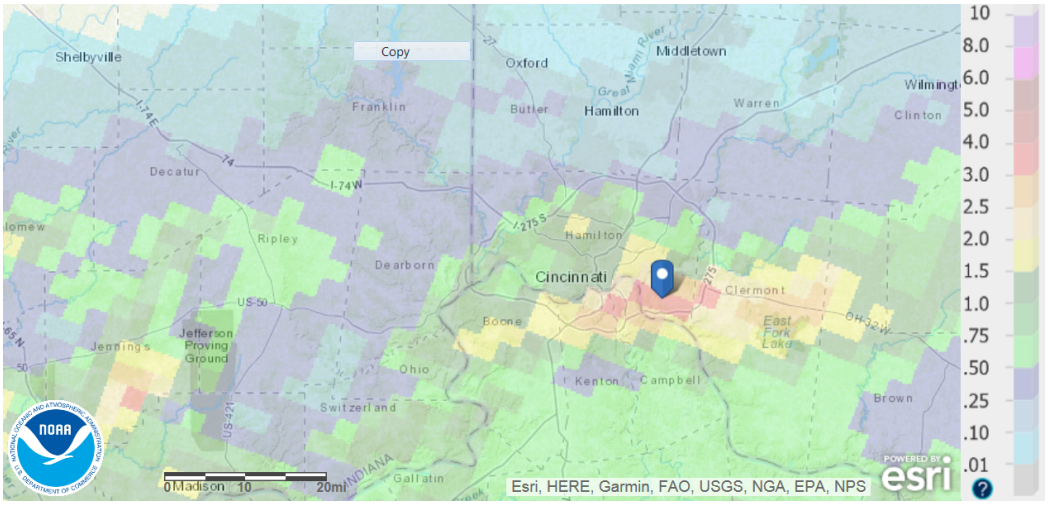

Figure 4: Cumulative Rainfall: July 28, 2016

The previous project team developed and calibrated an existing conditions hydrologic and hydraulic model for the project area. The Stantec team revised and adapted the calibrated MSD hydraulic model to focus on the Mt Washington SBU area. The model indicates that homes within the project area may be subject to basement flooding for rain events that exceed a 10-year, 24-hour recurrence interval. Figure 4 presents the hydraulic grade line along Woodlark Drive for the 25-year, 24-hour storm event.

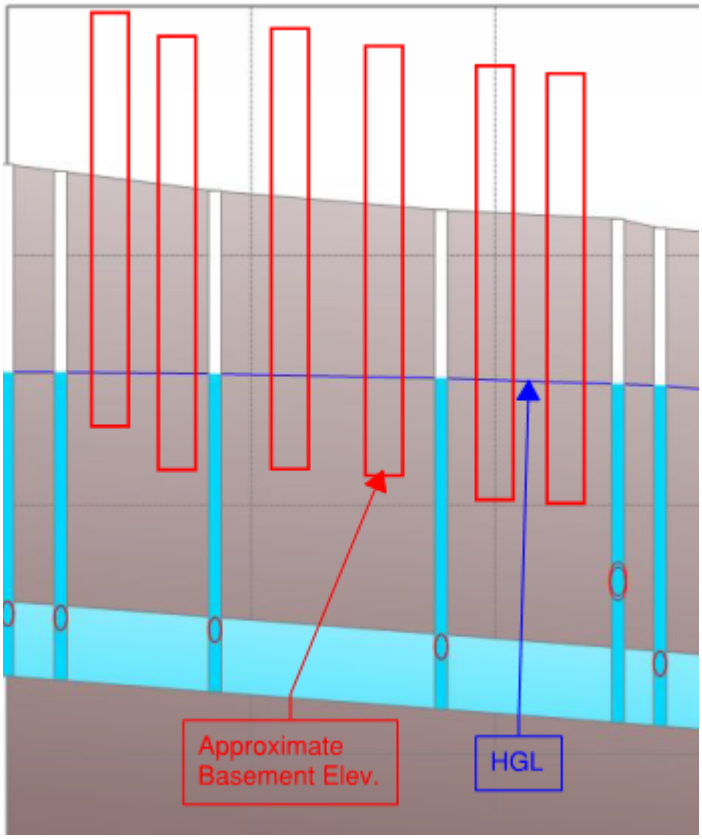

Figure 5 Hydraulic Grade Line Woodlark Drive 25-year, 24-Hour Storm Event

Section 3 – Project Objectives

Section 3.1 The "Big Picture"

The MSD Sewer Backup Prevention Program (SBUPP) was initiated in January 2004. The program started as a part of the Consent Decree between MSD and Hamilton County, and federal and state agencies. The Consent Decree requires MSD to address SBUs in basements that occur two times or more in a 5-year period. There were widespread SBU complaints on multiple properties within the project area during four separate storm events between 2011 and 2019, qualifying many of the homes for the program. The SBUPP can install household sewer pumps to eliminate SBU for each house; however, this would result in an increase in combined sewer flow downstream, likely passing the SBU issue down the line to additional houses that previously were not experiencing this issue. This also does not address the systemic issue of a high Hydraulic Grade Line in the combined sewer, leaving unprotected homes vulnerable in the future.

In addition to the significant SBU issues, this neighborhood is part of the CSO 182 sewershed, for which reduction in combined sewer overflow volume is required as part of the MSD Consent Decree. Other high-level studies have been completed in the area to identify options to reduce the overflow volumes by means of targeted separation, storage, added conveyance, or green infrastructure. Sewer separation can eliminate SBUs for the Mt Washington Source Control Implementation Project in the modeled storm events and reduce annual overflow volume as measured in the 1970 Typical Year. This project will begin partial sewer separation, reducing the total wet weather flow capture in the combined sewer system and allowing MSD and Hamilton County to right-size future improvements, including the potential future Berkshire High-Rate Treatment (HRT) facility. This project is included in the WWIP Phase 2A Schedule of Work from the Board of County Commissioners of Hamilton County to the Regulators.

Section 3.2 Project Objectives

3.2.1 Project Objectives Established Prior to the Planning Effort

The objective of the overall project is to reduce SBUs in the Mayland Avenue area (the neighborhood) of Mount Washington and install a new drainage system that is compatible with the WWIP requirement to reduce combined sewer overflows from CSO 182. This will include separation of surface storm flow in the neighborhood from the combined sewer constructed in two phases.

The objective of Phase 1 is to alleviate SBU risk by separating storm flow in the neighborhood and allowing it to reenter the combined system at a point downstream with more hydraulic capacity. The second phase will convey this partially separated flow from the terminus of Phase 1, farther down in the sewershed by constructing a separated storm sewer to a new outfall near Berkshire Creek. The objective of the Phase 2 is to achieve substantial reduction in overflow volumes at CSO 182. A plan of action will be developed on how to bridge the two phases efficiently.

The new storm sewers across both phases will be sized to capture the runoff from the existing sub catchments for each alternative under 10-yr design storm rainfall (City of Cincinnati SMU Rules and Regs) conditions.

3.2.2 Additional Project Objectives Established During the Planning Effort

Conveyance of storm flow from areas of partial separation, designated as Direct Entry Points, to a location closer to a separated discharge point is achieved in some alternatives.

3.2.3 Unique Project Constraints, Influences, or Issues affecting the Project

A previous design effort in 2019 proposed increased capacity in the area by constructing oversized storm sewers to capture and detain stormwater flow. This design encountered utility conflicts and Right of Way acquisition issues. There were also concerns about the rising cost for the project and a desire to expand the goals to include additional sewer separation to assist in meeting WWIP requirements. While oversized sewers provide short term benefits to address SBU issues, they provide little additional benefit over smaller pipes when the area can be fully separated to the downstream creek. This storage approach would not meet Hamilton County WWIP Phase 2A objective to eliminate unnecessary costs toward meeting Consent Decree requirements.

Partial separation of the Mt. Washington neighborhood is included in the WWIP Phase 2A schedule of work and should be completed as quickly as practicable to achieve completion goals set for Phase 2A.

Section 3.3 Boundary of the Analysis

For the purposes of this evaluation, the boundary for review and alternatives analysis has been described in two parts. The first phase for design and construction is the Mt. Washington Source Control Implementation Phase 1, and it includes:

- **Alternatives 1 – 4 (Phase 1):** The first Phase of each alternative includes the streets heavily impacted by SBUs over the last decade as well as the possible alignments for a new storm sewer to convey the flow further downstream.

  The evaluation area includes Thornbird Drive, Woodlark Drive, Mayland Drive, and Lusanne Terrace and the homes adjacent to the road, referred to as the neighborhood throughout this report. This area is common to each alternative and was evaluated and discussed accordingly. Beyond the intersection of Glade Avenue and Mayland Drive, the first Phase of each alternative diverges and continues as unique alignments along Glade Avenue, Beacon Street, and Ambar Avenue as well as routes outside of the right of way.

  Each Phase 1 alignment conveys separated stormwater to a new discharge point located somewhere along the existing combined sewer, hereafter referred to as the CSO 182 Trunk Sewer, where additional hydraulic capacity exists. Each alternative follows a different route and has a different discharge location to the CSO 182 Trunk Sewer. These alternatives generally flow north and east along Glade Avenue, Beacon Street, and Ambar Avenue.

The second phase is the Mt. Washington Source Control Implementation Phase 2 – CSO 182 Strategic Sewer Separation, and it includes:

- **Alternative 1 – 4 (Phase 2):** The second phase of each alternative continues the sewer separation beyond the Phase 1 terminus at the CSO 182 Trunk Sewer and conveys the flow further northeast to a new discharge location on Berkshire Creek. All Phase 2 alternatives begin at a different location based on the associated Phase 1 alternative, however they all discharge to Berkshire Creek at the same location. The primary location of Phase 2 is along an existing west to east running ravine north of Dawes Lane and Ambar Avenue and continuing across an athletic field for the Guardian Angels Catholic Church.

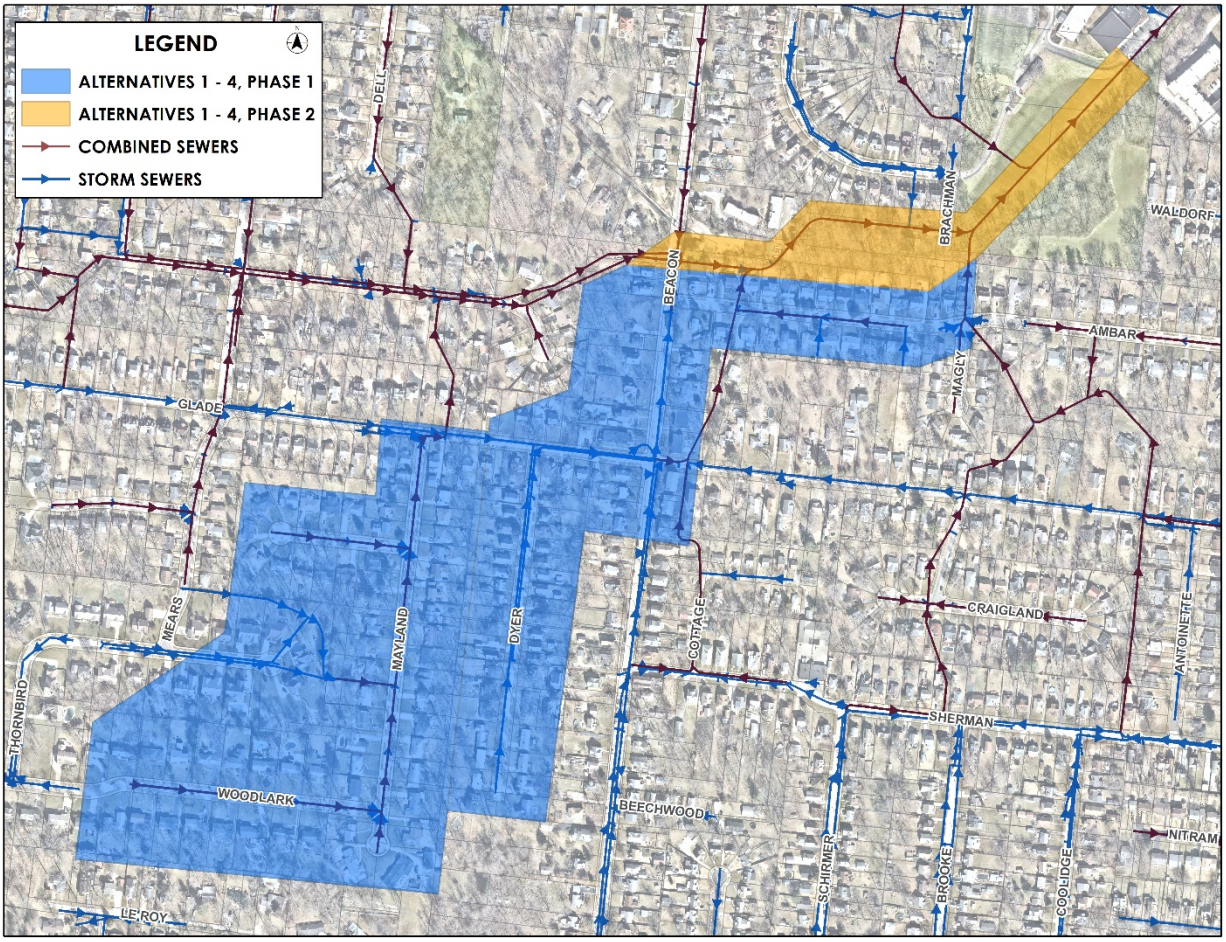

Figure 6: Phase Boundaries – Red and Blue areas to be designed and constructed as one project

Figure 7: SBU area Separations

Section 3.4 Project Coordination

3.4.1 MSD Project Dependencies and Coordination Requirements

The Mt. Washington Source Control Implementation project does not have any known dependencies on other MSD projects. Each Phase of the project is dependent on the other to achieve their overall separation goals, however the timeframes required for each are as follows:

Phase 1 Alternatives: This project has no dependency with other projects. Construction phasing may require that installation of the proposed storm sewer be constructed starting at the new combined sewer discharge point. This project is required to alleviate the SBU risk along Woodlark Drive, Mayland Drive, and Lusanne Terrace. Other utilities, may need to be moved in order to accommodate new storm sewer construction, including water, gas, electric, and sanitary sewers.

Phase 2 Alternatives: The Phase 2 alternatives are required to achieve stormwater separation from the combined system. A reduction in the overall CSO 182 overflow volume is not realized without the completion of one of the Phase 2 alternatives. The schedule driver for this project is likely the same as the timeline for the proposed Berkshire HRT as described in the Phase 2A WWIP. The schedule for this project is currently under negotiation.

3.4.2 Intergovernmental Coordination Requirements

The Phase 1 alternatives will require coordination with the City of Cincinnati Department of Transportation and Engineering (DOTE) for any work within the Right of Way (ROW) that will require removal or replacement of pavement on Lusanne Terrace, Mayland Drive, Woodlark Drive, Glade Avenue, Beacon Street, or Ambar Avenue.

All phases of the project will also need to coordinate with the Stormwater Management Utility (SMU) and Greater Cincinnati Waterworks (GCWW) to ensure that utility relocates can be properly anticipated and incorporated into the schedule. It is anticipated that several water services will be impacted and may need to be lowered as well as small sections of water line.

If the project impacts street trees, coordination with the City of Cincinnati Urban Forestry will be required. This alignment will require removal of many trees for storm sewer installation to Berkshire Creek, almost entirely within the Phase 2 segments of the project. Tree removal should be approved by the City.

Phase 2 alternatives for this project will require coordination and permits from the Ohio EPA (OEPA) and US Army Corps of Engineers (USACE) as well as a potential floodplain permit from the Federal Emergency Management Agency (FEMA).

Section 4 – Alternatives

Section 4.1 Strategy Development and Analysis

4.1.0 Strategy 0: Do Nothing

Do Nothing maintains the status quo and does not provide a solution to address the ongoing risk of SBUs or any benefit for the reduction of CSO 182. Strategy 0 fails to meet Consent Decree SBUPP program requirements by providing protection for homes within the program. Failure to meet the Consent Decree SBUPP requirements is unacceptable, and this Strategy was screened out at this stage.

4.1.1 Strategy 1: Traditional SBU Prevention Installation

Traditional SBU Prevention Installation includes individual house solutions consisting of a backflow prevention device, pump with battery backup and separation of stormwater drains to the downstream side of the backflow prevention device. This strategy is an effective means of preventing SBUs at properties on the individual level however it provides no systemwide benefit. Installation of household SBU prevention devices may create an increase in peak flows in the existing combined sewer if no additional detention volume for combined sewage or stormwater is incorporated into the project. Furthermore, extensive discussion with this community has been completed and more global solutions to the SBU issues were determined to be favored by the community. Due to the community input, and the fact that traditional SBU prevention installations do not protect the neighborhood as a whole, this Strategy was screened out at this stage.

4.1.2 Strategy 2: Oversized sewer for storage

Previous planning efforts identified a potential solution to develop a new oversized sewer in the neighborhood for stormwater storage during wet weather events. This solution was not feasible due to significant and unforeseen utility conflict and escalating project costs. This solution would only address local SBU issues without significant impact on combined sewer overflow volumes and had a high cost relative to the benefits achieved.

As the overall goal for the CSO 182 sewershed is to eliminate or significantly reduce the size of the WWIP proposed HRT, targeted separation has been identified as a strategy for volumetric reduction. The Strategy of oversizing sewers in upstream areas would therefore be a temporary solution that would lead to unnecessarily large underground infrastructure for the remainder of its design life. MSD will likely be completing additional storm sewer improvements in the vicinity to reduce combined sewer overflow volumes that would leave the new storm sewer significantly oversized. A solution that can address both SBU and CSO issues permanently is preferred, therefore this Strategy was screened out at this stage.

4.1.3 Strategy 3: Separate Neighborhood Storm and Tie into CSO 182 Trunk Sewer Downstream

A separated storm sewer can be built from the neighborhood to a tie-in point downstream on the CSO 182 Trunk Sewer. This will provide the neighborhood with a right-sized storm sewer and will eliminate SBUs in the design storm event. It will also allow for the immediate implementation of the Strategy without eliminating future downstream improvements. Due to the flexibility and ability to immediately implement this Strategy, it will be further evaluated.

4.1.4 Strategy 4: Fully Separate Storm from Neighborhood to Berkshire Creek

A fully separated storm sewer can be built from the neighborhood to Berkshire Creek. This will eliminate SBUs in the design storm event and reduce CSO overflow volumes. This Strategy has significant costs associated with it, however it has the potential to achieve the highest benefit to MSD and the community. As it is implementable in connection with Strategy 3, and because it solves multiple issues required by the Consent Decree, it will be evaluated further.

Section 4.2 Alternative Analysis Methodology

4.2.1 Design Criteria

The design of proposed separate stormwater infrastructure followed the requirements of the City of Cincinnati municipal Stormwater Management Rules and Regulations as it related to sizing. Per the SMU Rules and Regulations: "Storm sewer sizing shall be based on the just full capacity for a 10-year frequency rainfall. After initial sizing, a hydraulic grade line (HGL) check shall be made for a 25-year frequency rainfall. If the check shows water flowing out of the system, then the system needs to be revised to contain the rainfall." Storm sewers will be sized to collect both the existing catch basins and existing inflow from Thornbird Drive stormwater detention basin, as well as roof drains which are primarily connected to the combined sewer via private laterals at this time. The existing detention basin is proposed to remain with no modifications being completed to the outfall beyond rerouting the stormwater from the combined sewer to a new storm sewer.

For all infrastructure both existing and proposed, the 25-year, 24-hour storm will not flood streets or adjacent infrastructure. In addition, each alternative must not increase the peak flow within the combined sewer for the 25-year, 24-Hour storm event and may not increase frequency of combined sewer overflow volumes for the typical year at the CSO 182 outfall. Finally, to safely meet the SBU risk reduction in the neighborhood, basements must not backup in the July 2016 rain event which had a 3-hour peak over a 200-year recurrence.

4.2.2 Hydrologic and Hydraulic Modeling

Each of the four alternatives were developed within the System Wide Model (SWM) to meet the established design criteria. Methods and results from the alternatives evaluation are provided below. The project team used the calibrated SWM as provided by MSD for the development of proposed alternatives and the modification of catchments. The project team used this model to compare the 25-year, 24-hour storm event peak flows for the alternatives versus the existing conditions to verify the projects did not increase downstream discharge. Furthermore, the model was checked against the July 2016 storm to confirm SBUs as verified in the field to gauge effectiveness in the small sub-sewershed in the neighborhood.

4.2.3 Existing Utility Impacts

The proposed alternatives each take different routes and will vary in the amount they impact existing utilities. There are multiple large diameter (36"-72") combined sewers in the area which present obstacles to new stormwater infrastructure which is mostly proposed to be larger than 36" in diameter from Mayland Drive downstream. Additionally, many of these existing combined sewers were constructed with limited cover, although additional overburden has been added in a few locations since the combined sewers were initially constructed. Due to the size of the existing combined sewers, their criticality, and the densely developed nature of the project area, any required modifications to these sewers will be difficult. For the purposes of this analysis, alternatives that require any existing combined sewer larger than 36" to be moved or lowered will be considered impractical. Existing storm sewers of similar size if encountered, would be similarly difficult to modify and would also cause an alternative to be rejected.

Smaller diameter combined, sanitary, and storm sewer exist throughout the project area and serve the residents on both sides of each street. These small diameter sewers were evaluated for lowering or relocation if necessary and this work was included in the cost estimates for each alternative. Unknown information related to the elevations of existing sanitary sewer laterals other than at the connection to the combined/sanitary sewer required assumptions to be made with regard to the lowering of existing sewers. Additional data collection during detailed design may require revisions to the proposed plan and profile and existing sewer relocations shown in the appendices to this BCE.

Elsewhere, natural gas (Duke Energy), potable water, (Greater Cincinnati Waterworks), and overhead Electric (Duke Energy) all exist within the project area, but are identified as primarily of the size used for residential distribution, not transmission. These utilities, while best avoided, are not considered to be immovable if new storm infrastructure requires it. The natural gas line previously under the east side of the road on Mayland Drive has already been relocated under the west sidewalk to minimize impacts of new sewer to front yards and street trees.

The costs associated with any proposed utility relocates will be included in the cost for each alternative.

4.2.4 Constructability and Phasing Requirements

Phasing:
The alternatives are all split into 2 phases. The first is to provide separate storm sewer from the neighborhood to a tie-in point downstream on the CSO 182 Trunk Sewer. The second phase is to pick up the separated storm sewer at the Phase 1 terminus and provide sewer down to Berkshire Creek. The ease of tie-in to the CSO 182 Trunk Sewer and effect this has on the efficiency of both phases is evaluated.

Phase 1: All alternatives will be proposed to be relatively shallow to reduce costs and public disturbance if other utilities can also be avoided. Open cut sewer work is expected for most of the alternatives with support provided to other utilities with trench boxes or site-specific shoring. Where existing utility or residential conflicts impede the ability to open cut, alternative construction methods will be considered, including Horizontal Directional Drilling, Jack and Boring, and Microtunneling. If it is anticipated that alternative construction methods will be necessary to mitigate impacts to existing structures, the estimated cost of this method will be included with the opinion of probable cost for the installation of the sewer. Unless otherwise specified, it is assumed that open cut construction will be possible and will be the baseline assumption for the cost estimate.

Phase 2: All Phase 2 alternatives include a significant amount of sewer constructed outside of the Right of Way, along slopes, and through existing wooded areas. The Phase 2 alternatives will also need to be constructed at a very low slope, and at a shallow elevation to enable the storm sewer to tie in at grade with the existing creek. This will make crossing the CSO 182 Trunk Sewer difficult outside of a few specific areas, including along Beacon Street, and just upstream of the existing CSO. The current conduit for Berkshire Creek flow across OH-125/ Beechmont Avenue is undersized for the anticipated increase in storm flow through the separate storm sewer. Each alternative will include the necessary modifications to culverts and storm conduits to convey flow to the east side of Beechmont Avenue. Impacts to Beechmont will be assessed to recommend level of coordination required with ODOT.

Due to construction off-road, along wooded slopes, and through areas of added fill across the athletic fields, geotechnical investigations of the Phase 2 areas would be prudent.

4.2.5 Easement Acquisitions

Easement acquisition in developed neighborhoods can increase time required to gain rights to construction on private land. They also increase the price of the project and can add complexity with restoration of surface conditions. The total area and number of easements required are compared to estimated cost of those easements and included in the triple bottom line analysis for selection of the preferred alternative. A Phase 1 ESA is required prior to any easement acquisition to evaluate potential environmental impacts. Where possible, easements will be minimized across all alternatives. Where easement acquisition is unavoidable, the proposed

alignments will be placed in locations which minimize the impact of the proposed easement as much as is reasonable while still accomplishing the project goal.

4.2.6 Residential Impacts

Many of the streets proposed for sewer construction are two-way residential streets. Traffic impacts and neighborhood accessibility may be an issue during construction. Beacon Street and Glade Avenue are residential thoroughfares and excavation within those roads may impact some through traffic as well. Critical traffic impacts and maintenance of traffic estimates for each alternative will be included in the triple bottom line analysis.

For all alternatives, local noise ordinances should be observed. This project spans Cincinnati and Anderson Township municipal boundaries. Cincinnati residential noise restrictions without special permits are between the hours of 9:00 p.m. to 7:00 a.m. the following day within 500 feet of places of residence. Anderson Township construction noise restrictions are in place between the consecutive hours of 11:00 p.m. and 7 a.m. local time. Construction work for all alternatives should be viable during normal working hours however detours for traffic will be needed if roads are fully closed. Flaggers will be necessary otherwise as the size of the proposed sewers will likely require one of the two available traffic lanes for construction.

The Mt. Washington neighborhood has many mature trees in the treelawn and cross country within the proposed route for the storm sewer. Requirements for tree removal and scrub and brush clearing are included in the triple bottom line analysis for each alternative. Removal of large trees outside of the right of way is to be avoided.

The neighborhood has seen significant SBU impacts during four separate events since 2011, which elevated its priority for meeting Consent Decree requirements. Alternatives that can produce the desired results more expeditiously and in a cost-effective manner are prioritized in the triple bottom line analysis. Reducing the risk of future SBUs will have a strong positive residential impact.

4.2.7 Regulatory Permitting

This project seeks to remove storm flow from the CSO 182 Trunk Sewer to reduce SBUs and annual combined sewer overflow volumes. As a result, creek flow in wet weather events will increase. This will require several permits and environmental reviews as described below.

A new discharge location to Berkshire Creek will require a National Pollutant Discharge Elimination System (NPDES) permit from the Ohio EPA Division of Surface Water (DSW) and coverage under the Small MS4 permit currently used for Cincinnati and Hamilton County storm sewers. Construction work for all Phases of the project will need to be covered under the Construction General Stormwater Permit.

Wetland and Waterbody Delineation and Report

The discharge location of the new storm sewer is to an existing named creek. Construction work will require the delineation of the project area to delineate Waters of the U.S. (WOUS), including wetlands and waterbodies, in accordance with the U.S. Army Corps of Engineers (USACE) 1987 Wetland Delineation Manual and the Midwest Regional Supplement to the 1987 Wetland Delineation Manual. This work will identify locations of all wetlands and waterbodies that occur in the project area.

U.S. Army Corps of Engineers CWA Section 404 Permit

The project may require authorization under the Section 404 of the Clean Water Act (CWA) for any proposed impacts to jurisdictional WOUS. The United States Army Corps of Engineers (USACE) regulates activities in WOUS, including wetlands, under Section 404 of the CWA (33 U.S.C. §1344), Section 10 of the Rivers and Harbors Act of

1899 (33 U.S.C. §403), and Section 103 of the Marine Protection Research and Sanctuaries Act of 1972 (33 U.S.C. §1413).

The project is in the USACE Huntington Regulatory District and may be eligible for Nationwide Permitting (NWP), provided that all conditions of the NWP are met. If the project impacts cannot meet the conditions of the NWP, an Individual CWA Section 404 Permit from the USACE may be required. If impacts to WOUS occur on the project, an **NWP Pre-Construction Notification (PCN) permit** application may be required, which includes a full wetland delineation report, to be submitted to the USACE. The USACE has a review period of 45 to 60 days to review an applicable NWP application and make a determination on the project. There are no permitting fees associated with a NWP, however, there would be a fee associated with any mitigation required by the USACE.

In addition, an NWP would require Endangered Species Act (ESA) Section 7 consultation with the US Fish and Wildlife Service (USFWS) to determine if the project will adversely affect any threatened and/or endangered species. The NWP would also require coordination with Ohio State Historic Preservation Office (SHPO) to determine if any historic structures or archaeological resources will be impacted, and approval of any mitigation under Section 106 of the National Historic Preservation Act (NHPA), as required.

If the final Project design is not able to minimize impacts to meet the requirements of a NWP, an Individual CWA Section 404 Permit may be required. An Individual CWA Section 404 Permit would require a detailed alternatives analysis to be completed for the Project in addition to a PCN application and wetland delineation report. The USACE has a review period of one year to review an Individual CWA Section 404 permit application. There are no permitting fees associated with an Individual CWA Section 404 permit, however, there would be a fee associated with any mitigation required by the USACE.

Section 7 Threatened and Endangered Species Coordination

As required by Section 404 of the CWA, MSD will need to coordinate with the USFWS and ODNR for preliminary threatened and/or endangered species screening for the project and communicate with the agencies regarding additional actions that may be required (i.e., detailed habitat assessments and/or specific species surveys) depending on the comments received from USFWS and ODNR. Based on the proposed construction method to open cut for the project, it is assumed that species-specific surveys for threatened and endangered fish and mussel species may be necessary as well as bat species for any planned tree removal.

Section 106 Cultural Resources Coordination

As required by Section 404 of the CWA, a Phase 1 cultural resource survey and a Phase 1 cultural resource report will be needed in order to demonstrate compliance with Section 106 of the National Historic Preservation Act (NHPA). A literature survey should be completed initially with recommendations for survey if deemed necessary.

CWA Section 401 Water Quality Certification

In Ohio, Section 401 of the CWA (33 U.S.C. §1344) mandates that a Section 401 Water Quality Certification (WQC) be obtained from the State of Ohio prior to any discharge of dredged or fill material into WOUS that does not meet the state conditions for an NWP. The OEPA administers the WQC program in Ohio. As indicated above, the project may qualify for authorization by the USACE under NWP, provided that the conditions of the permit are met. The OEPA has certified many of the USACE 404 NWPs by automatically granting state 401 WQC to activities covered under NWPs, provided that the project meets special limitations and conditions.

As indicated on the OEPA Stream Eligibility Web Map, the project area may be eligible for coverage under an NWP, therefore an Individual 401 WQC or an OEPA Director's Authorization (DA) may be required. Since the project is within a possibly eligible watershed, any proposed stream channel impacts need to be evaluated using the Stream

Eligibility Determination Process flow chart in Appendix C of the USACE NWP conditions for Ohio to determine if an Individual 401 WQC is required or if the project is eligible under an NWP. The applicant would submit the stream eligibility results with the Preconstruction Notification (PCN) or notification to OEPA if a PCN is not required. The Stream Eligibility Determination review by OEPA does not have a regulated review timeline, however it is anticipated that it take up to three months to receive a response from OEPA.

If OEPA determines the proposed stream impacts are not eligible for coverage under an NWP, then a Director's Authorization may be required. Examples of conditions that would require a Director's Authorization to avoid an Individual WQC include stream with pH < 6.5, Qualitative habitat Evaluation Index (QHEI) score of either ≥ 50 (drainage area < 3 miles) or QHEI score ≥ 55 (if drainage area > 3 miles), or a wetland rated a Category 3 on the Ohio Rapid Assessment Methods for wetlands (ORAM). If the conditions are met to require a Director's Authorization, an application is sent to OEPA, at an additional cost of $2,000 and the OEPA makes the final decision about whether the project impacts are more likely to influence high quality resources. The Director's Authorization review by OEPA does not have a regulated review timeline, however it regularly may take up to three months to receive a response from OEPA.

Ohio EPA Isolated Wetland/Ephemeral Stream Permit

The Federal Navigable Waters Protection Rule (NWPR), effective June 22, 2020, defines federally jurisdictional waters to exclude ephemeral streams. In response to the change in jurisdictional status of ephemeral streams, the OEPA finalized the Isolated Wetland and Ephemeral Stream General Permit on June 25, 2020. The Isolated Wetland and Ephemeral Stream General Permit allows up to 300 linear feet of disturbance to ephemeral streams. Ephemeral stream impacts 300 linear feet in length or less do not require notification to OEPA as long as the impacts are temporary (2 years or less), and the stream channel is restored to pre disturbance contours. If impacts to isolated wetlands occur on the project, an Isolated Wetland and Ephemeral Stream General Permit would be required.

An approved jurisdictional determination (AJD) would need to be obtained from the USACE to confirm the jurisdiction of wetlands within the project area and the streams classification as ephemeral. The Isolated Wetland and Ephemeral Stream General Permit review timeline varies based upon acreage of wetland impact but for impacts to less than 0.5 acre, the review timeline is 30 days. The OEPA permit review fee is $200.

Floodplain Permit

A floodplain development permit may be required when construction activities consisting of above ground facilities occur within a mapped Federal Emergency Management Agency (FEMA) special flood hazard area. Coordination with county and local officials will be required to determine the extent of coordination and permits that will be required when working within their jurisdiction.

4.2.8 Project Schedule and Impact to WWIP Schedule/ Other Work in the Sewershed

This project is critical to meeting Consent Decree requirements as one of the WWIP Phase 2A draft schedule items. This will kick off other work in the sewershed, including a combination of grey and green infrastructure with continued sewer separation and additional source control. It will also significantly decrease the size required for the Berkshire HRT, which was a component of the original WWIP to meet combined sewer overflow volume reduction.

The alternative selected should allow for additional separated sewer connections from the rest of the sewershed. Viable alternatives to accomplish this are limited by the size and number of existing combined sewers and the existing residential development in the area.

4.2.9 Key Stakeholders

The Archbishop of Cincinnati is a major private stakeholder for all proposed alternatives. Most of the Phase 2 cross-country alignments for the new storm sewer will be on the south side of the Guardian Angels school property crossing existing athletic fields. As design progresses, proposed work should be coordinated with the school to provide notification and solicit input.

4.2.10 Project Risks

Project Risks are divided between risks associated with the actual construction of proposed infrastructure, and the risks that may occur afterwards. Risks associated with the actual construction include cost overruns, schedule overruns, significant utility disruption or damage to existing infrastructure, traffic disruption, unknown geotechnical conditions (including but not limited to destabilized hillsides), construction accidents, unknown environmental conditions, and damage to private property during the installation of new infrastructure.

Long term risks include continuing instability of slopes causing damage to private or public infrastructure, new or additional SBUs, and surface or private property flooding that may be blamed on the new work.

Many of these risks can be mitigated during detailed design with a more thorough investigation of the project area via environmental site assessments, permit review, geotechnical investigations, and property survey.

Section 4.3 Alternatives

Each Alternative will include a significant amount of work common to all as is required to address the SBU issues throughout the project area. This work, including new storm sewers on Woodlark Drive, Mayland Drive, Lusanne Terrace, and across side yards from Thornbird Drive to Mayland Drive will be discussed in the “Neighborhood separation” area below and will not be a factor in the alternative analysis which will focus on the differences between each alternative. This “Neighborhood separation” area is included as part of Phase 1 of every alternative.

Neighborhood Separation

The Neighborhood stormwater separation is proposed as the culmination of multiple studies, design efforts, and discussions with homeowners. The density of the verified SBU complaints and entrance into the SBUPP by multiple homes in the neighborhood has shown that individual home protection devices will not be an effective use of MSD funds, and will leave unprotected homes open to future backups and claims. It was therefore determined that a partial separation of the stormwater in this area was the most effective way to reduce SBU risk and provide a future benefit towards the reduction of combined sewer overflow within the CSO 182 basin.

Building off a previous design effort in 2019 and utilizing additional SWM hydraulic modeling in the neighborhood affected by the sewer backups, proposed storm sewers were sized for conveyance of stormwater flow to be collected by existing (reconstructed) catch basins along Woodlark Drive, Mayland Drive, and Lusanne Terrace. The proposed sizing of the new storm sewers is shown in the figure below (diameters are indicated in feet). Where possible, the neighborhood alignment has been restricted to within the roadway to limit construction inconvenience to residents and the general public. The neighborhood has existing gas, overhead electric, combined sewer, and water mains within the right of way, and sidewalks on both sides of the street. After eliminating conflicts with these utilities and the proposed storm line, and with a focus on keeping construction within the roadway, there is only one reasonable alignment alternative. This alignment is laid out in a preliminary plan and profile included as an appendix to this BCE.

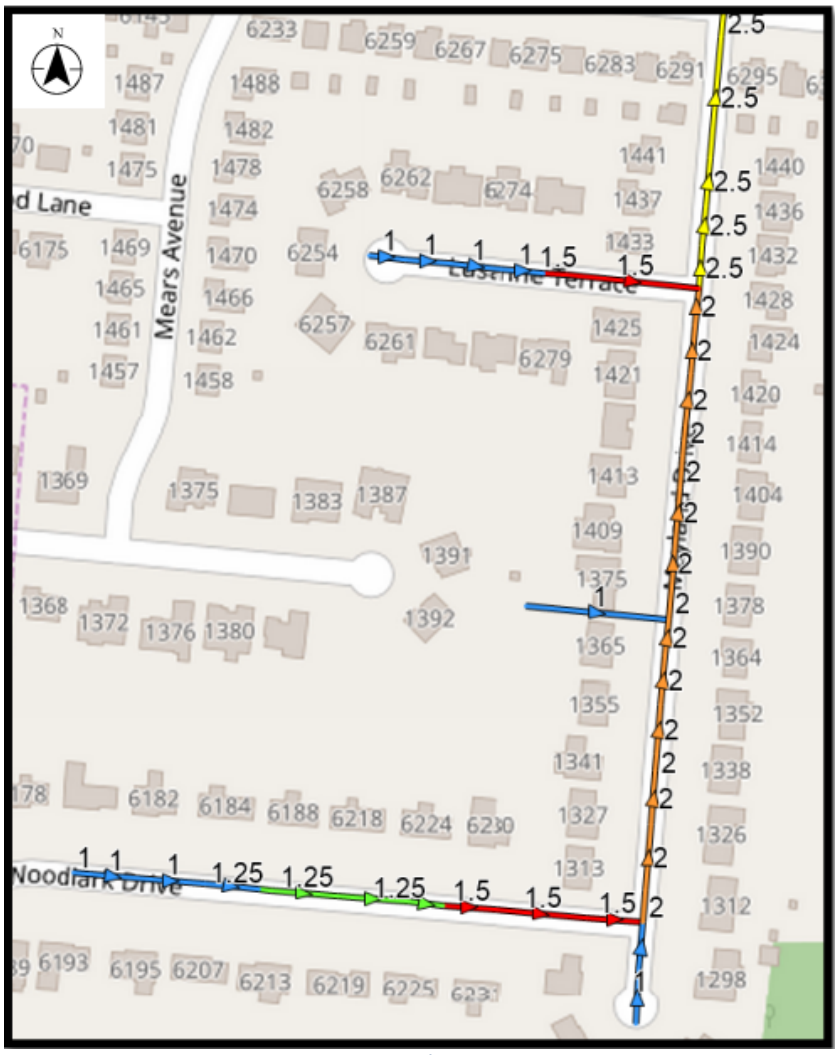

Figure 8: Neighborhood Separation/SBU Mitigation - Project Boundary

The new storm sewers are sized to collect 10-year rainfall and convey stormwater within the pipe to a downstream connection point with any of the proposed Phase 1 storm sewer alternatives. The storm sewers are designed to keep the 25-year storm underground, although the pipes themselves surcharge. The new storm sewers are located within the approximate location as anticipated in the 2019 design project, however the sizing has been reduced to handle conveyance only, and not storage. This reduced costs and utility conflicts, and increased future system flexibility. The proposed storm sewers within the neighborhood area also have capacity to handle the flow from roof drains that may be directly tapped to the storm sewer, or drained to the street in the future. It is not proposed to disconnect roof drains from the combined system at this time.

4.3.1 Alt 1 – Backyard Alternative

Alt 1 – Backyard Alternative is a proposed alignment to achieve a combination of Strategies 3 and 4. This alignment collects storm water from the neighborhood separation area and conveys it via 42” and 48” storm sewers to the existing 60” CSO 182 Trunk Sewer along Dawes. Figure 8 shows this proposed alignment.

Phase 1 is proposed to be completed from a new storm manhole on the southeast corner of the intersection of Glade Avenue and Mayland Drive and run east along Glade before turning north across residential backyards to the tie in point with the CSO 182 Trunk Sewer northeast of Dawes Lane. This phase of construction would include

new 42” and 48” sewers and would pick up relatively little additional stormwater flow on its route to the CSO 182 Trunk Sewer. The location of the proposed alignment is primarily through the wooded backyards of homes that face Beacon Street from the west. This alternative would require 8 permanent easements and would require significant disruption to the properties of the residents throughout construction. The construction would furthermore require the removal of many mature trees, as well as smaller vegetation which provide screening between the homes and those on the lots to their west. The terminus of Phase 1 would require significant modification or reconstruction of an existing manhole on the CSO 182 Trunk Sewer to allow for the new 48” line to be tied in. The proposed storm sewer would descend towards the CSO 182 Trunk Sewer at a relatively steep slope and manhole armoring, energy dissipation, or construction of a larger connection vault will be needed to allow the new flow to be introduced to the existing pipe less dramatically.

Phase 2 of this alternative picks up in the vicinity of the Phase 1 discharge to the CSO 182 Trunk Sewer, and would roughly parallel the existing combined sewer, crossing from the south to the north side of the existing pipe beneath Beacon Street. The new storm sewer would then continue all the way to a new discharge point at the existing headwaters of Berkshire Creek. The size of the proposed sewer was determined to be between 48” and 60” as it approaches Berkshire Creek, however that sizing is only sufficient to handle the flows from The neighborhood separation as well as a limited number of catch basins adjacent to the new alignment. **Future separations that may be necessary to allow for the reduction or elimination of CSO 182 will require a significantly larger Phase 2 storm sewer. The sizing of the Phase 2 storm sewer will need to be reevaluated prior to its construction to allow it to be right-sized for additional stormwater separation.**

Finally, modifications at CSO 182 and the upper reaches of the CSO 182 Trunk Sewer will be necessary to allow the separated stormwater flow entering Berkshire Creek to move underneath Beechmont Avenue. The proposed discharge location of the Phase 2 storm sewer is on a stretch of creek upstream of the existing 12-foot-wide culvert beneath Beechmont Avenue. To access the culvert, the headwaters of the stream enter a 15” storm sewer at a headwall just west of Beechmont Avenue, and then meets the combined sewer overflow downstream of the diversion dam. In order for additional separated stormwater to follow this route, the existing 15” pipe will need to be removed and replaced with a new one matching the proposed stormwater flow that is anticipated within the CSO 182 basin.

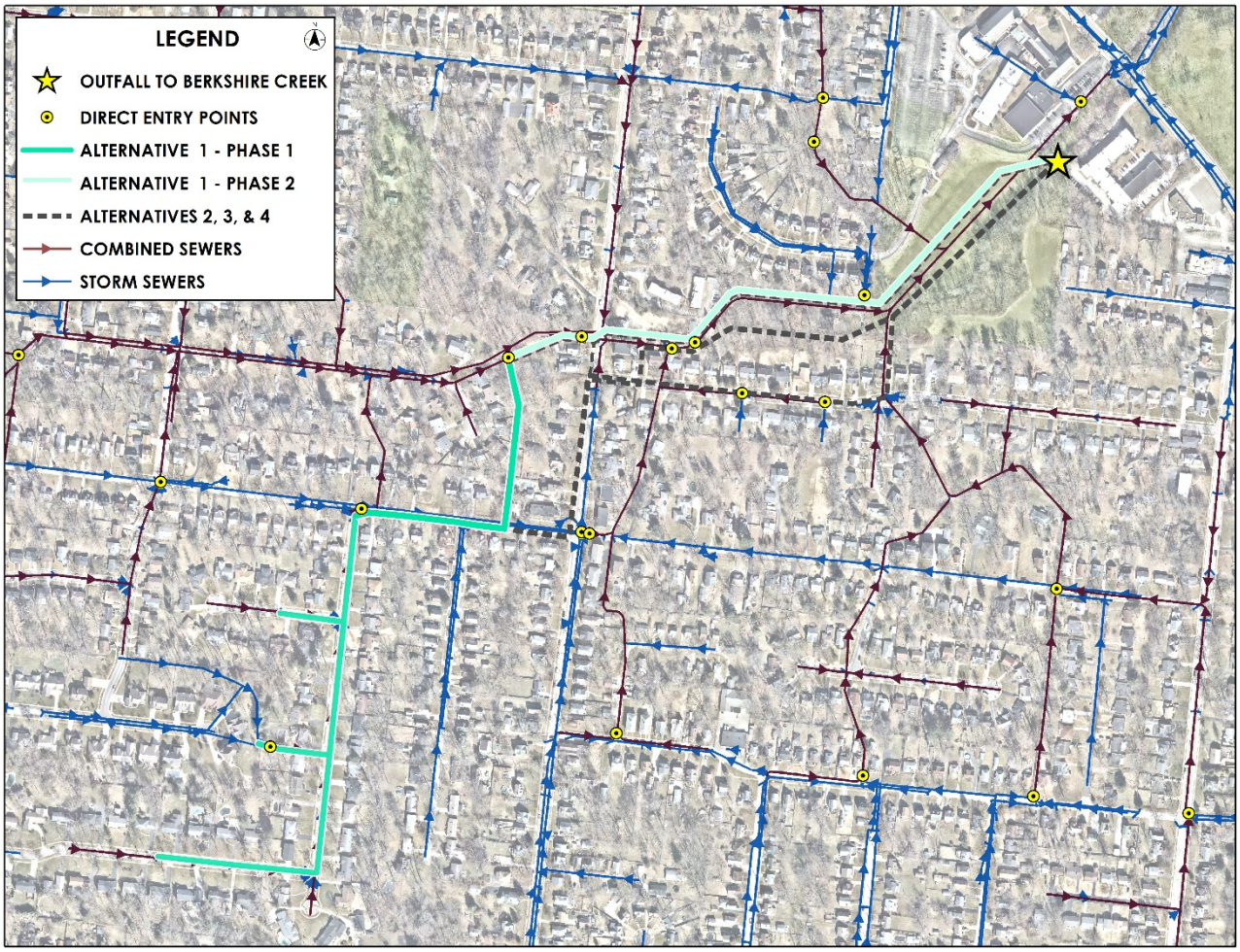

Figure 9: Alt 1 – Backyard Alternative – Phases 1 and 2

Regulatory requirements/restrictions

This alternative will require a Permit to Install (PTI) from the Ohio EPA and a street opening permit from the City of Cincinnati. It will also require 10 permanent easements. Another 15 easements will be required for the construction of Phase 2.

Regulatory requirements are further discussed for the in section 4.2.6.

Impact to WWIP schedule/Impact on other work in the sewershed

Phase 1 of this alternative is necessary to allow for the Neighborhood separation to be constructed, reducing SBU risk which is the primary driver of the schedule for this project. Phase 2 will be required to allow for future CSO 182 WWIP requirements to be met.

Phase 2 of this project will likely serve as the primary conduit for separated stormwater within the CSO 182 sewershed to be conveyed to Berkshire Creek. Phase 2 of this alternative therefore requires careful coordination with overall basin goals and the CSO 182 WWIP project to ensure that the Phase 2 storm sewer is properly sized for future separation.

Key Stakeholders

Neighborhood residents along Mayland and Woodlark Drives, Lusanne Terrace, Glade Avenue, and multiple homeowners on the west side of Beacon Street will have their properties impacted by Phase 1 of this project, including new permanent easements. Phase 2 of the project will impact the larger community as it crosses Beacon Street as well as additional homeowners along the second phase of the alignment. It will also heavily impact the Guardian Angels Catholic Church and School athletic fields which lie along the proposed route of the Phase 2 construction.

1546 and 1600 Beacon Street will be significantly impacted during Phase 2 construction as well as 6501 and 6516 Alcor Terrace as all four properties are adjacent to the alignment with structures constructed close to the proposed trench.

TBL analysis

The primary Environmental TBL impacts of this alternative is through the reduction in Sewer Backups which will lower the risk to human health and safety by eliminating significant contacts with human sewage. This alternative scores lower for the impacts to hillsides and existing vegetative ground cover. Phase 2 of this alternative scores significantly higher as the reduction in combined sewer overflow volume will have a positive impact to surface and groundwaters via the reduction in pollutant loading. It is anticipated that the aquatic habitat downstream from CSO 182 would also see some benefit from this work over time.

Positive Social scores come from improved Housing and Property values through the elimination of SBUs. This alternative will also have a construction benefit as it lays the backbone for additional stormwater separation, freeing up sanitary capacity within the CSO 182 sewershed.

Risk

The risk of not completing these improvements is unacceptable to MSD and would require additional action to be taken. Per the Consent Decree and the status of many homes within the SBUPP, MSD is required to provide backup protection to the impacted homes. Multiple alternatives have already been evaluated in depth, and the proposed separation was selected to move forward.

Risks associated with completing this project alternative include:

- Delays to downstream Phase 1 alternatives, rendering the Neighborhood separation incomplete and unable to provide the intended level of protection.
- Disturbance to private utilities or property in excess of what is anticipated.
- Construction risks typically associated with work in public ROW. These risks include impacts to transportation and potential impacts to utility service or private service relocations.
- Schedule risk from slow easement acquisition
- Geotechnical risks for construction of large diameter storm sewer down a substantial slope in an off-road wooded ravine. Hillside slippage could undermine the new sewer or other structures constructed on the hill.
- Unknown elevation of rock and the existing water table. Substantial excavation of rock would increase the project budget, as would significant dewatering requirements during construction.
- CSO 182 Trunk Sewer tie-in. The existing 66” CSO 182 Trunk Sewer is approximately 80 years old and constructed of brick. The condition of this sewer and its manholes is unknown. A new 48” connection to this sewer would require significant excavation and modification of the sewer which may increase the risk of collapse.

4.3.2 Alt 2 – Beacon Alternative

Alt 2 – Beacon Alternative is a proposed alignment to achieve Strategies 3 and 4. Phase 1 of this alignment collects storm water from the neighborhood through 12-30" sewers along Woodlark, Thornbird, Lusanne, and Mayland. This Neighborhood flow is then conveyed via 42", 48", and 56" sewers from the intersection of Glade Avenue and Mayland Drive generally east along Glade and north along Beacon Street to a new connection point on the existing 66-inch combined north of the intersection of Beacon and Ambar. There are two potential alignment routes along Beacon Street that generally follow the same route. The first is on the west side of the right of way, partially constructed within new easements that would need to be acquired. This route would require permanent easements from the front yards of 8 properties along Beacon Street, and the likely removal of one large tree. The second route option is entirely within the roadway raising restoration costs and disruption to the public; however, this alignment requires only 2 properties along Beacon to have easements acquired. This in-road alignment should mostly avoid significant utility relocations, but does not meet Ten State standards for horizontal separation between sewers and potable water lines of 10 feet. The proposed storm sewer would be between 5 and 7 feet off the existing 8" water line running north within the west lanes of Beacon Street.

Phase 2 of Alt 2 starts at the proposed cross connection into the CSO 182 Trunk Sewer below Beacon Street and continues north and east across multiple private properties as shown in Figure 9. The proposed alignment roughly follows the CSO 182 Trunk Sewer on its north side, crossing back to the south for a new discharge point to Berkshire Creek. The size of the proposed sewer was determined to be between 56" and 60" as it approaches Berkshire Creek, however that sizing is only sufficient to handle the flows from The Neighborhood separation as well as catch basins adjacent to the new alignment and two Direct Entry Points. **Future separations that may be necessary to allow for the reduction or elimination of CSO 182 will require a significantly larger Phase 2 storm sewer. The sizing of the Phase 2 storm sewer will need to be reevaluated prior to its construction to allow it to be right-sized for additional stormwater separation.**

Finally, modifications at CSO 182 and the upper reaches of the CSO 182 Trunk Sewer will be necessary to allow the separated stormwater flow entering Berkshire Creek to move underneath Beechmont Avenue. The proposed discharge location of the Phase 2 storm sewer is on a stretch of creek upstream of the existing 12-foot-wide culvert beneath Beechmont Avenue. To access the culvert, the headwaters of the stream enter a 15" storm sewer at a headwall just west of Beechmont Avenue, and then meets the combined sewer overflow downstream of the diversion dam. In order for additional separated stormwater to follow this route, the existing 15" pipe will need to be removed and replaced with a new one matching the proposed stormwater flow that is anticipated within the CSO 182 basin.

A key benefit of Alt 2 – Beacon Alternative over Alt 1 – Backyard Alternative, is the increased stormwater flow that can be separated along the route. Alt 2 passes two stormwater Direct Entry Points that will allow for partially separated stormwater to be collected and moved closer to a new discharge point to Berkshire Creek. This will lead to slightly larger storm sewers being proposed in Phase 1, but will provide additional acreage of already separated stormwater to the Phase 2 benefits. The end result of picking up this additional flow will be that the net cost of the project will only marginally be increased (slightly larger pipe sizing), however almost 17 more acres of separated flow can be collected and conveyed downstream. Those 17 acres represent almost 2% of the overall tributary area for CSO 182 and will likely need to be separated to achieve the 2010 WWIP requirements for the sewershed. This will provide additional volumetric reduction at CSO 182 upon completion of Phase 2 with minimal added cost.

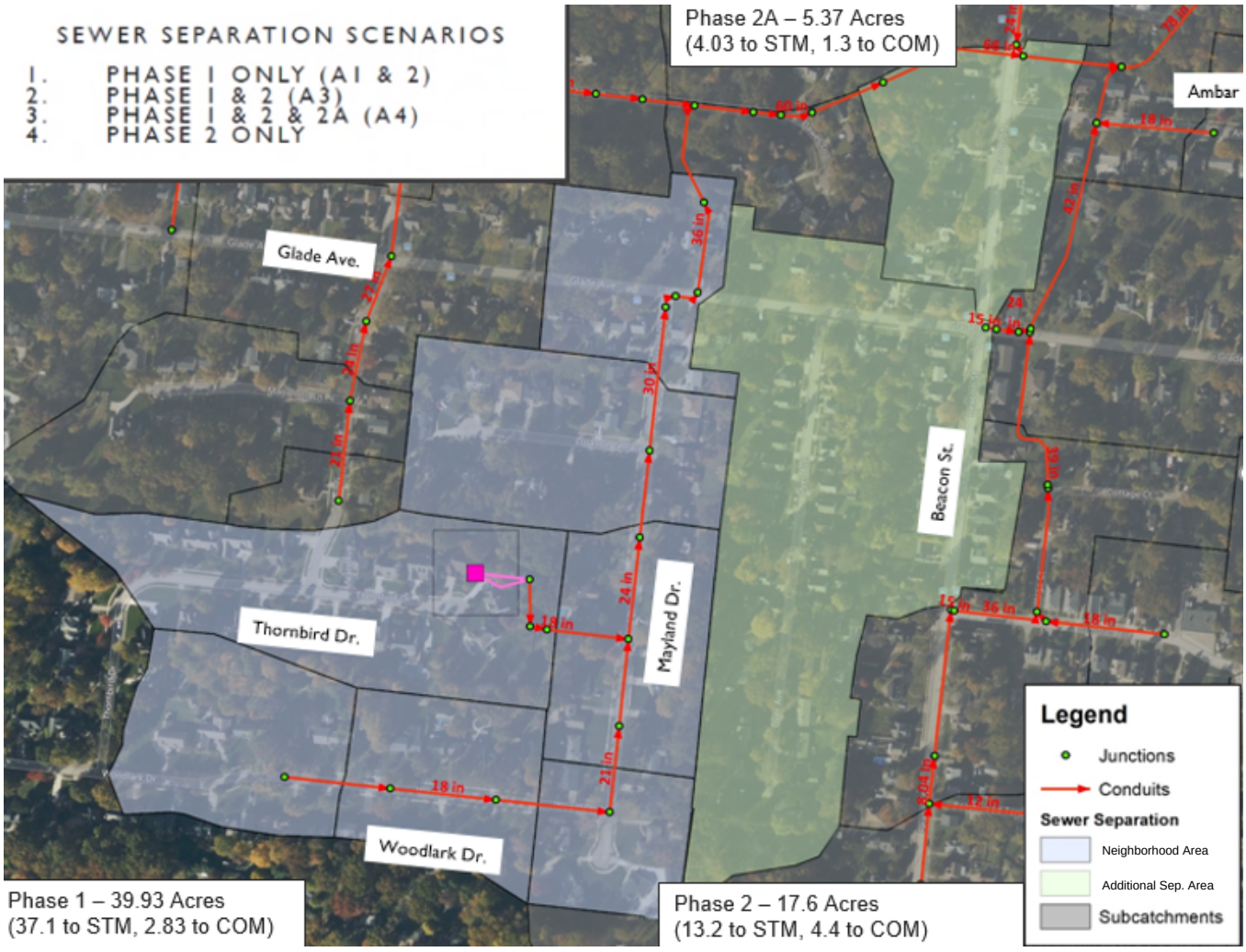

Figure 10: Alt 2 – 4 (additional separation)

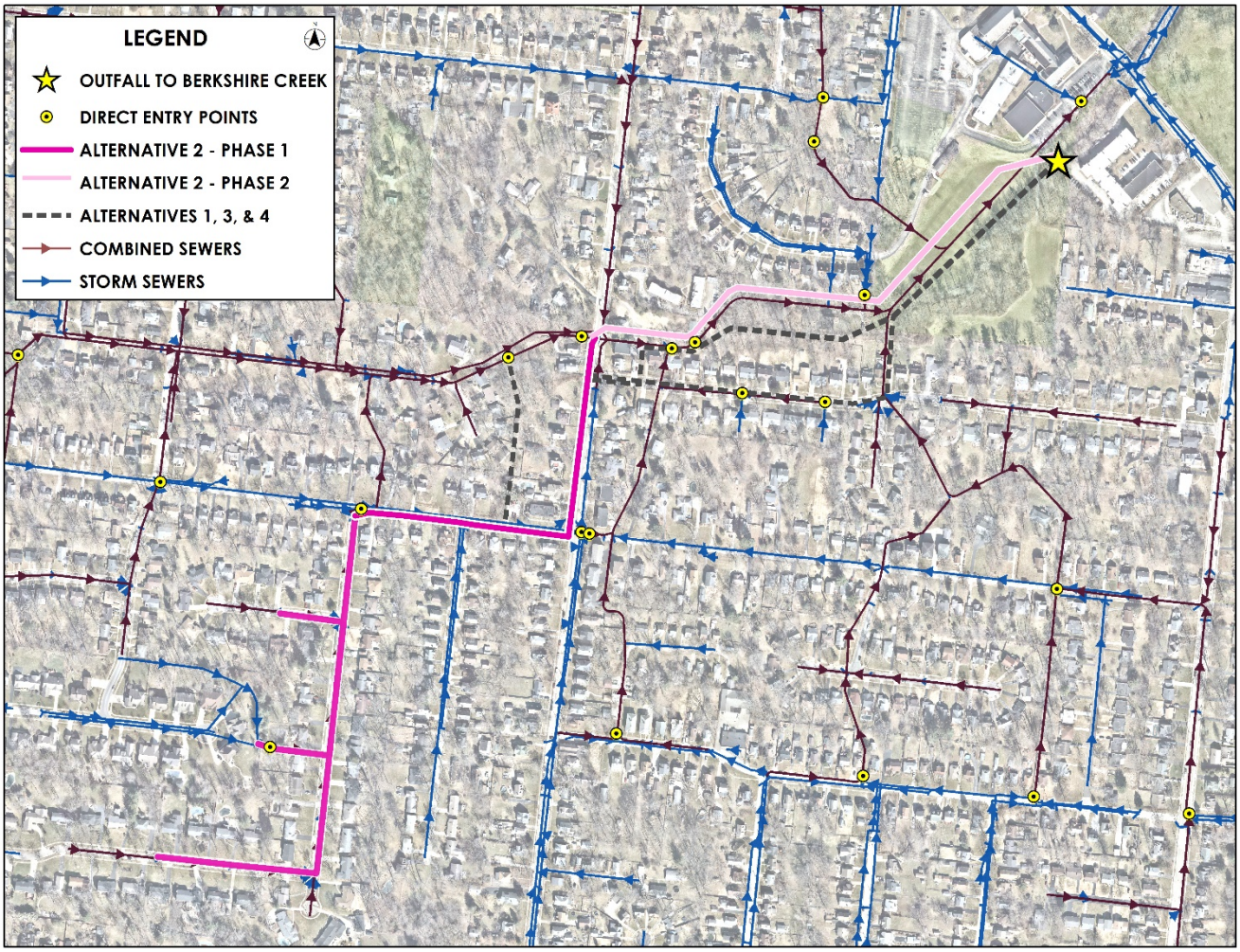

Figure 11: Alt 2 – Beacon Alternative– Phases 1 and 2

Regulatory requirements/restrictions

This alternative will require a Permit to Install (PTI) from the Ohio EPA and a street opening permit from the City of Cincinnati. It will also require between 5 and 11 permanent easements depending on the proposed route taken along Beacon Street. Another 14 easements will be required for Phase 2.

Regulatory requirements are further discussed for the in section 4.2.6.

Impact to WWIP schedule/Impact on other work in the sewershed

Phase 1 of this alternative is necessary to allow for the Neighborhood separation to be constructed, reducing SBU risk which is the primary driver of the schedule for this project. Phase 2 will be required to allow for future CSO 182 WWIP requirements to be met.

Phase 2 of this project will likely serve as the primary conduit for separated stormwater within the CSO 182 sewershed to be conveyed to Berkshire Creek. Phase 2 of this alternative therefore requires careful coordination with overall basin goals and the CSO 182 WWIP project to ensure that the Phase 2 storm sewer is properly sized for future separation.

Key Stakeholders

Neighborhood residents along Mayland and Woodlark Drives, Lusanne Terrace, Glade Avenue, and multiple homeowners on the west side of Beacon Street will have their properties impacted by Phase 1 of this project, including new permanent easements in the front yards. Phase 2 of the project will impact the larger community as it crosses Beacon Street as well as additional homeowners along the second phase of the alignment. It will also heavily impact the Guardian Angels Catholic Church and School athletic fields which lie along the proposed route of the Phase 2 construction.

1546 and 1600 Beacon Street will be significantly impacted during Phase 2 construction as well as 6501 and 6516 Alcor Terrace as all four properties are immediately adjacent to the alignment and proposed trench.

TBL analysis

The primary Environmental TBL impacts of this alternative is through the reduction in Sewer Backups which will lower the risk to human health and safety by eliminating significant contacts with human sewage. Phase 2 of this alternative scores significantly higher as the reduction in combined sewer overflow volume will have a positive impact to surface and groundwaters via the reduction in pollutant loading. It is anticipated that the aquatic habitat downstream from CSO 182 would also see some benefit from this work over time.

Positive Social scores come from improved Housing and Property values through the elimination of SBUs. This alternative will also have a construction benefit as it lays the backbone for additional stormwater separation, freeing up sanitary capacity within the CSO 182 sewershed.

Risk

The risk of not completing these improvements is unacceptable to MSD and would require additional action to be taken. Per the Consent Decree and the status of many homes within the SBUPP, MSD is required to provide backup protection to the impacted homes. Multiple alternatives have already been evaluated in depth, and the proposed separation was selected to move forward.

Risks associated with completing this project alternative include:

- Delays to downstream Phase 1 alternatives, rendering the Neighborhood separation incomplete and unable to provide the intended level of protection.
- Disturbance to private utilities or property in excess of what is currently anticipated.
- Construction risks typically associated with work in public ROW. These risks include impacts to transportation and potential impacts to utility service or private service relocations.
- Schedule risk from slow easement acquisition, although this can be somewhat mitigated by utilizing alignment routes which require fewer easements
- Geotechnical risks for construction of large diameter storm sewer down a substantial slope in an off-road wooded ravine. Hillside slippage could undermine the new sewer or other structures constructed on the hill. These risks are primarily in the Phase 2 elements of this project.
- Unknown elevation of rock and the water table. Substantial excavation of rock would increase the project budget, as would significant dewatering requirements during construction.
- CSO 182 Trunk Sewer tie-in. The existing 66” CSO 182 Trunk Sewer is approximately 80 years old and constructed of brick. The condition of this sewer and its manholes is unknown. A new 56” connection to this sewer would require significant excavation and modification of the sewer which may increase the risk of collapse.
- Additional SBUs or increased HGL at connection point.

4.3.3 Alt 3 – East Beacon Alternative

Alt 3 – East Beacon Alternative is a proposed alignment to achieve Strategies 3 and 4. This alignment collects storm water from the neighborhood through 12-30" sewers along Woodlark, Thornbird, Lusanne, and Mayland. This flow is then conveyed via 42", 48", and 56" sewers from the intersection of Glade and Mayland east along Glade and north along Beacon to the existing 78-inch CSO 182 Trunk Sewer northeast of the intersection of Beacon & Ambar, just downstream of the proposed connection for Alt 2 – Beacon Alternative.

There are two potential alignment routes along Beacon Street that generally follow the same route prior to this alternative turning east on Ambar Avenue. The first is on the west side of the right of way, partially constructed within new easements that would need to be acquired. This route would require permanent easements from the front yards of 6 properties along Beacon Street, and the likely removal of one large tree. The second route option is entirely within the roadway raising restoration costs and disruption to the public; however, this alignment requires only 2 properties along Beacon to have easements acquired. This in-road alignment should mostly avoid significant utility relocations, but does not meet Ten State standards for separation between sewers and potable water lines. The proposed storm sewer would be between 5 and 7 feet off the existing 8" water line running north within the west lanes of Beacon Street.

Phase 2 of Alternative 3 starts at the proposed cross connection into the CSO 182 Trunk Sewer east of Beacon, and continues east across the backyards of multiple private properties as shown in Figure 10. The proposed alignment roughly follows the CSO 182 Trunk Sewer on its south side and continues northeast across existing athletic fields to new discharge point to Berkshire Creek. The size of the proposed sewer was determined to be between 56" and 60" as it approaches Berkshire Creek, however that sizing is only sufficient to handle the flows from the Neighborhood separation as well the catch basins adjacent to the new alignment and additional flow from two Direct Entry Points. **Future separations that may be necessary to allow for the reduction or elimination of CSO 182 will require a significantly larger Phase 2 storm sewer. The sizing of the Phase 2 storm sewer will need to be reevaluated prior to its construction to allow it to be right-sized for additional stormwater separation.**

Finally, modifications at CSO 182 and the upper reaches of the CSO 182 Trunk Sewer will be necessary to allow the separated stormwater flow entering Berkshire Creek to move underneath Beechmont Avenue. The proposed discharge location of the Phase 2 storm sewer is on a stretch of creek upstream of the existing 12-foot-wide culvert beneath Beechmont Avenue. To access the culvert, the headwaters of the stream enter a 15" storm sewer at a headwall just west of Beechmont Avenue, and then meets the combined sewer overflow downstream of the diversion dam. In order for additional separated stormwater to follow this route, the existing 15" pipe will need to be removed and replaced with a new one matching the proposed stormwater flow that is anticipated within the CSO 182 basin.

A key benefit of Alt 3 – East Beacon Alternative over Alt 1 – Backyard Alternative, is the increased stormwater flow that can be separated along the route. Alt 3 passes two stormwater Direct Entry Points that will allow for partially separated stormwater to be collected and moved closer to a new discharge point to Berkshire Creek. This will lead to slightly larger storm sewers being proposed in Phase 1, but will provide additional acreage of already separated stormwater to the Phase 2 benefits. The end result of picking up this additional flow will be that the net cost of the project will only marginally be increased (slightly larger pipe sizing), however almost 17 more acres of separated flow can be collected and conveyed downstream. Those 17 acres represent almost 2% of the overall tributary area for CSO 182 and will likely need to be separated to achieve the 2010 WWIP requirements for the sewershed. This will provide additional volumetric reduction at CSO 182 upon completion of Phase 2 with minimal added cost.

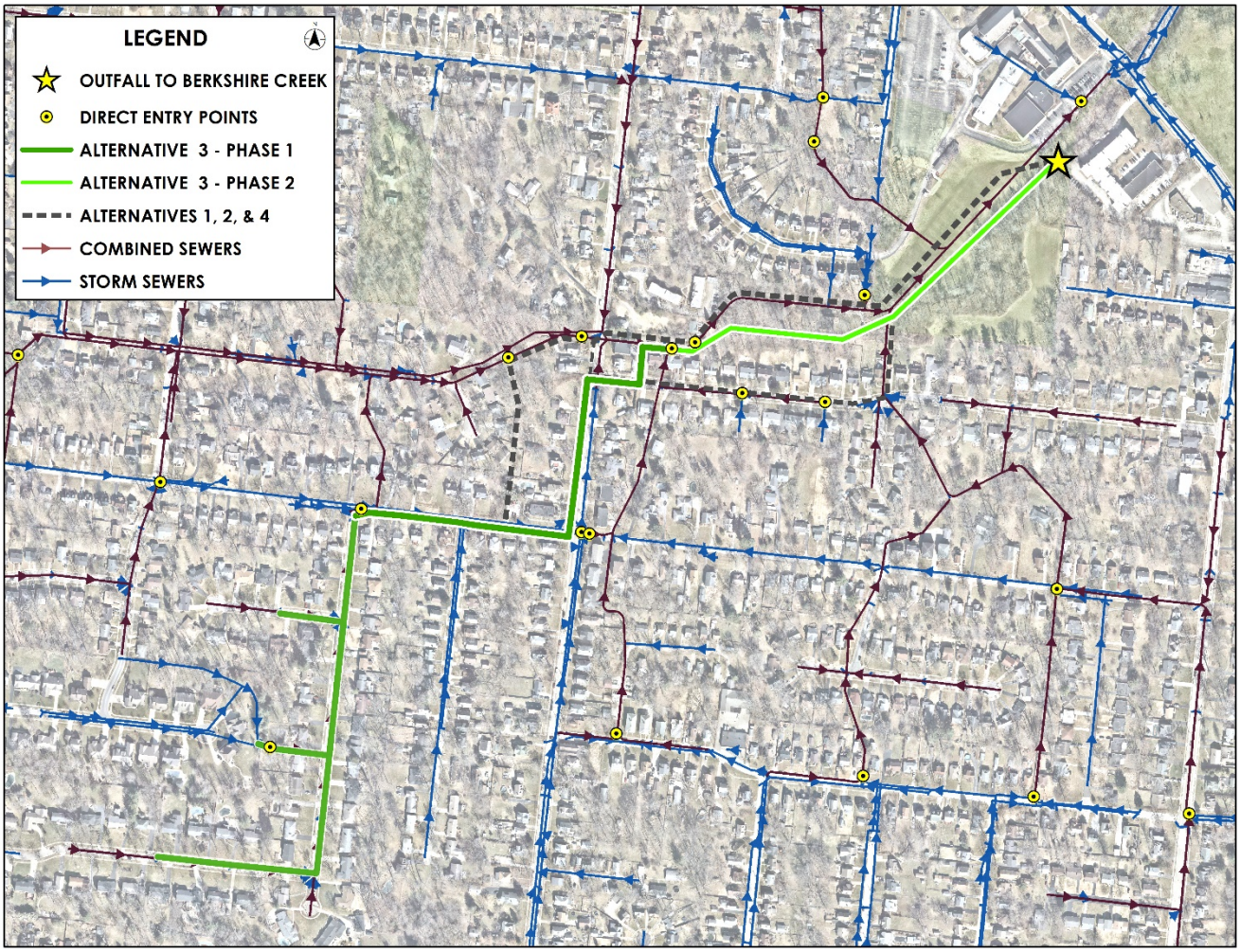

Figure 12: Alt 3 – East Beacon Alternative – Phases 1 and 2

Regulatory requirements/restrictions

This alternative will require a Permit to Install (PTI) from the Ohio EPA and a street opening permit from the City of Cincinnati. It will also require between 12 and 14 permanent easements depending on the proposed route taken along Beacon Street in Phase 1. Another 6 easements will be required for Phase 2

Regulatory requirements are further discussed for the in section 4.2.6.

Impact to WWIP schedule/Impact on other work in the sewershed

Phase 1 of this alternative is necessary to allow for the Neighborhood separation to be constructed, reducing SBU risk which is the primary driver of the schedule for this project. Phase 2 will be required to allow for future CSO 182 WWIP requirements to be met.

Phase 2 of this project will likely serve as the primary conduit for separated stormwater within the CSO 182 sewershed to be conveyed to Berkshire Creek. Phase 2 of this alternative therefore requires careful coordination with overall basin goals and the CSO 182 WWIP project to ensure that the Phase 2 storm sewer is properly sized for future separation.

Key Stakeholders

Neighborhood residents along Mayland and Woodlark Drives, Lusanne Terrace, Glade Avenue, and multiple homeowners on the west side of Beacon Street will have their properties impacted by Phase 1 of this project, including new permanent easements. Phase 2 of the project will impact the larger community as it crosses Beacon Street as well as additional homeowners along the second phase of the alignment. It will also heavily impact the Guardian Angels Catholic Church and School athletic fields which lie along the proposed route of the Phase 2 construction.

6502, 6508, and 6512 Ambar Avenue will be significantly impacted during Phase 1 construction and will have easements required. During Phase 2, 6501 and 6516 Alcor Terrace will be significantly impacted as they are adjacent to the alignment.

TBL analysis

The primary Environmental TBL impacts of this alternative is through the reduction in Sewer Backups which will lower the risk to human health and safety by eliminating significant contacts with human sewage. Phase 2 of this alternative scores significantly higher as the reduction in combined sewer overflow volume will have a positive impact to surface and groundwaters via the reduction in pollutant loading. It is anticipated that the aquatic habitat downstream from CSO 182 would also see some benefit from this work over time.

Positive Social scores come from improved Housing and Property values through the elimination of SBUs. This alternative will also have a construction benefit as it lays the backbone for additional stormwater separation, freeing up sanitary capacity within the CSO 182 sewershed.

Risk

The risk of not completing these improvements is unacceptable to MSD and would require additional action to be taken. Per the Consent Decree and the status of many homes within the SBUPP, MSD is required to provide backup protection to the impacted homes. Multiple alternatives have already been evaluated in depth, and the proposed separation was selected to move forward.

Risks associated with completing this project alternative include:

- Delays to downstream Phase 1 alternatives, rendering the Neighborhood separation incomplete and unable to provide the intended level of protection.
- Impacts to private property in excess of what is anticipated. Three homes will require significant construction within 15-20 feet of their foundation. Particularly in areas downhill (north) of the homes along Ambar Avenue, there is a risk that destabilizing the hillside through construction could cause homeowner claims of damages if foundations are impacted.
- Construction risks typically associated with work in public ROW. These risks include impacts to transportation and potential impacts to utility service or private service relocations.
- Schedule risk from slow easement acquisition, although this can be somewhat mitigated by utilizing alignment routes which require fewer easements
- Geotechnical risks for construction of large diameter storm sewer down a substantial slope in an off-road wooded ravine. Hillside slippage could undermine the new sewer or other structures constructed on the hill. These risks are primarily in the Phase 2 elements of this project.
- Unknown elevation of rock and the water table. Substantial excavation of rock would increase the project budget, as would significant dewatering requirements during construction.
- CSO 182 Trunk Sewer tie-in. The existing 66” CSO 182 Trunk Sewer is approximately 80 years old and constructed of brick. The condition of this sewer and its manholes is unknown. A new 56” connection to

this sewer would require significant excavation and modification of the sewer which may increase the risk of collapse.

4.3.4 Alt 4 – Ambar Alternative

Alt 4 – Ambar Alternative is a proposed alignment to achieve Strategies 3 and 4. This alignment collects storm water from the neighborhood through 12-30" sewers along Woodlark, Thornbird, Lusanne, and Mayland. This flow is then conveyed from the intersection of Glade and Mayland east along Glade and north along Beacon. At the intersection of Beacon Street and Ambar Avenue, the proposed alignment turns east down Ambar, passing Magly Court, and turning north across 6566 Ambar Avenue, parallel and to the east of the existing combined sewer. Upon reaching the bottom of the hill at the north side of 6566 Ambar, the alignment would terminate into the existing 78" CSO 182 Trunk Sewer.

There are two potential alignment routes along Beacon Street that generally follow the same route prior to this alternative turning east on Ambar Avenue. The first is on the west side of the right of way, partially constructed within new easements that would need to be acquired. This route would require permanent easements from the front yards of 6 properties along Beacon Street, and the likely removal of one large tree. The second route option is entirely within the roadway raising restoration costs and disruption to the public; however, this alignment requires only 2 properties along Beacon to have easements acquired. This in-road alignment should mostly avoid significant utility relocations but does not meet Ten State standards for separation between sewers and potable water lines. The proposed storm sewer would be between 5 and 7 feet off the existing 8" water line running north within the west lanes of Beacon Street.

Alt 4 – Ambar Alternative differs from all others considered by continuing east on Ambar, collecting additional stormwater catch basins as elevation permits. It also requires the smallest number of easements compared to other alternatives; however, it does this at a higher cost for pavement restoration and possible utility relocates.

Phase 2 of Alternative 4 starts at the proposed cross connection into the existing combined sewer behind 6566 Ambar and continues northeast across the property of the Guardian Angels Catholic Church as shown in Figure 11. The proposed alignment roughly follows the existing combined sewer on its south side and continues to a new discharge point at the headwaters of Berkshire Creek. The size of the proposed sewer was determined to be between 56" and 60" as it approaches Berkshire Creek, however that sizing is only sufficient to handle the flows from The Neighborhood separation as well the catch basins adjacent to the new alignment and additional flow from two Direct Entry Points. **Future separations that may be necessary to allow for the reduction or elimination of CSO 182 will require a significantly larger Phase 2 storm sewer. The sizing of the Phase 2 storm sewer will need to be reevaluated prior to its construction to allow it to be right-sized for additional stormwater separation.**

Finally, modifications at CSO 182 and the upper reaches of the existing CSO 182 Trunk Sewer will be necessary to allow the separated stormwater flow entering Berkshire Creek to move underneath Beechmont Avenue. The proposed discharge location of the Phase 2 storm sewer is on a stretch of creek upstream of the existing 12-foot-wide culvert beneath Beechmont Avenue. To access the culvert, the headwaters of the stream enter a 15" storm sewer at a headwall just west of Beechmont Avenue, and then meets the combined sewer overflow downstream of the diversion dam. In order for additional separated stormwater to follow this route, the existing 15" pipe will need to be removed and replaced with a new one matching the proposed stormwater flow that is anticipated within the CSO 182 basin.

Key benefits of Alt 4 – Ambar Alternative over other alternatives under consideration include:

- Fewest required easements,

- Largest quantity of stormwater separated,
- Least impact to private property owners.

Alternative 4 passes two stormwater Direct Entry Points that will allow for partially separated stormwater to be collected and moved closer to a new discharge point to Berkshire Creek as well as additional catch basins along Ambar Avenue. This will lead to slightly larger storm sewers being proposed in Phase 1 but will provide additional acreage of already separated stormwater to the Phase 2 benefits. The end result of picking up this additional flow will be that the net cost of the project will only marginally be increased (slightly larger pipe sizing), however almost 17 more acres of separated flow can be collected and conveyed downstream. Those 17 acres represent almost 2% of the overall tributary area for CSO 182 and will likely need to be separated to achieve the 2010 WWIP requirements for the sewershed. This will provide additional volumetric reduction at CSO 182 upon completion of Phase 2 with minimal added cost.

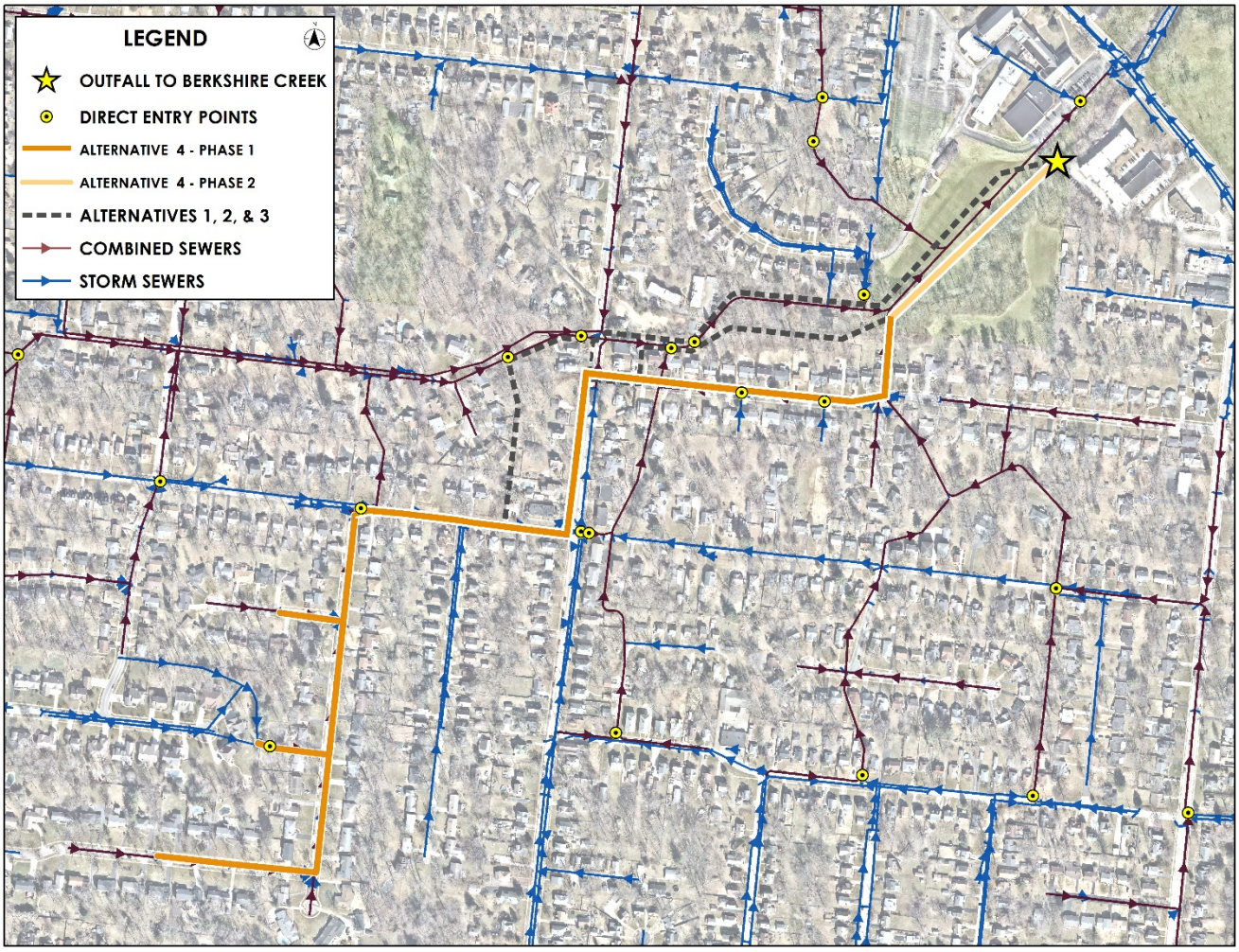

Figure 13: Alt 4 – Ambar Alternative – Phases 1 and 2

Regulatory requirements/restrictions

This alternative will require a Permit to Install (PTI) from the Ohio EPA and a street opening permit from the City of Cincinnati. It will also require between 4 and 10 permanent easements depending on the proposed route taken along Beacon Street in Phase 1. One additional easement will be required for Phase 2

Regulatory requirements are further discussed for the in section 4.2.6.

Impact to WWIP schedule/Impact on other work in the sewershed

Phase 1 of this alternative is necessary to allow for the Neighborhood separation to be constructed, reducing SBU risk which is the primary driver of the schedule for this project. Phase 2 will be required to allow for future CSO 182 WWIP requirements to be met.

Phase 2 of this project will likely serve as the primary conduit for separated stormwater within the CSO 182 sewershed to be conveyed to Berkshire Creek. Phase 2 of this alternative therefore requires careful coordination with overall basin goals and the CSO 182 WWIP project to ensure that the Phase 2 storm sewer is properly sized for future separation.

Key Stakeholders

Neighborhood residents along Mayland and Woodlark Drives, Lusanne Terrace, Glade Avenue, and multiple homeowners on the west side of Beacon Street will have their properties impacted by Phase 1 of this project, including new permanent easements. Phase 2 of the project will impact the larger community as it crosses Beacon Street as well as additional homeowners along the second phase of the alignment – notably 6566 Ambar Avenue. It will also heavily impact the Guardian Angels Catholic Church and School athletic fields which lie along the proposed route of the Phase 2 construction. The property at 6566 Ambar Avenue will require an easement crossing the length of the property from front to back. This required easement will parallel an existing combined sewer easement which currently bisects the property.

TBL analysis

The primary Environmental TBL impacts of this alternative is through the reduction in Sewer Backups which will lower the risk to human health and safety by eliminating significant contacts with human sewage. Phase 2 of this alternative scores significantly higher as the reduction in combined sewer overflow volume will have a positive impact to surface and groundwaters via the reduction in pollutant loading. It is anticipated that the aquatic habitat downstream from CSO 182 would also see some benefit from this work over time.

Positive Social scores come from improved Housing and Property values through the elimination of SBUs. This alternative will also have a construction benefit as it lays the backbone for additional stormwater separation, freeing up sanitary capacity within the CSO 182 sewershed. Additional stormwater separation in the future will also provide a reduction in sewage odor as overflows from the CSO 182 Trunk Sewer become smaller and less frequent.

Risk

The risk of not completing these improvements is unacceptable to MSD and would require additional action to be taken. Per the Consent Decree and the status of many homes within the SBUPP, MSD is required to provide backup protection to the impacted homes. Multiple alternatives have already been evaluated in depth, and the proposed separation was selected to move forward.

Risks associated with completing this project alternative include:

- Delays to downstream Phase 1 alternatives, rendering the Neighborhood separation incomplete and unable to provide the intended level of protection.
- Disturbance to private utilities or property in excess of what is currently anticipated.
- Construction risks typically associated with work in public ROW. These risks include impacts to transportation and potential impacts to utility service or private service relocations.

- Schedule risk from slow easement acquisition, although this can be somewhat mitigated by utilizing alignment routes which require fewer easements
- Geotechnical risks for construction of large diameter storm sewer down a substantial slope in an off-road wooded ravine. Hillside slippage could undermine the new sewer or other structures constructed on the hill.
- Unknown elevation of rock and the water table. Substantial excavation of rock would increase the project budget, as would significant dewatering requirements during construction.
- CSO 182 Trunk Sewer tie-in. The existing 78” CSO 182 Trunk Sewer is approximately 80 years old and constructed of brick. The condition of this sewer and its manholes is unknown. A new 56” connection to this sewer would require significant excavation and modification of the sewer which may increase the risk of collapse.

Section 4.4 Summary Comparison of Alternative Construction Costs

Alternative	Phase 1 (2021 $)	Phase 2 (2021 $)	Total Cost (2021 $)	Phase 1 Easements	Phase 2 Easements	Total Easement	Phase 1 TBL	Phase 2 TBL	Notes
1 – Backyard Alternative	$3,440,530	$2,183,610	$5,612,610	10	15	25			
2 – Beacon Alternative	**$3,821,084**	$1,873,214	$5,682,698	11	14	25	Most flexible		6 easements eliminated in Phase 1 with alternate route
3 – East Beacon Alternative	$3,968,619	$1,585,613	$5,542,632	14	6	20			
4 – Ambar Alternative	$4,716,056	$912,819	$5,617,275	10	1	11	Fewest Easements	Most stormwater separation	

Level of Cost Estimate

The foundation of the evaluation is the Association for the Advancement of Cost Engineering (AACE) International Class IV estimate. The details of this estimate are presented in the 2016 AACE International document: "Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries (TCM Framework 7.3 – Cost Estimating and Budgeting)".

Section 4.5 Recommendation

Based on both the short- and long-term goals for the project area, regulatory and public perception, schedule drivers, cost effectiveness of the alternatives, and input from the MSD project team – **this BCE recommends that Alt 2 – Beacon Alternative, (Phase 1) for immediate design and construction**. Alt 4 – Ambar Alternative, (Phase 2) is also recommended as the preferred Phase 2 alternative to be further analyzed as part of later sewer separation projects. This collection of projects has the lowest total cost for Phase 1 of the alternatives that preserve the most flexibility for future work.

A new storm sewer and discharge manhole to the larger CSO 182 Trunk Sewer would immediately provide protection to the SBU impacted properties on Mayland Drive, Woodlark Drive, and Lusanne Terrace. This would meet the primary project goal in the most practical manner, impacting the fewest private properties, and collecting two additional stormwater Direct Entry Points to facilitate more effective sewershed separation in the future.

The second Phase of design and construction is recommended to be the elements of Alt 4 - Ambar (both Phases 1 and 2) along Ambar Avenue east of Beacon Street and including a new stormwater outfall to Berkshire Creek. This alternative will also require modifications to the storm sewers that convey the existing creek headwaters beneath Beechmont Avenue.

Alt 2 – Beacon Alternative and Alt 4 – Ambar Alternative are compatible in that Alternative 2 may be constructed for short term SBU relief, and Alternative 4 constructed for long term CSO reduction. The junction between these two alternatives is proposed to be a single manhole/diversion chamber at the intersection of Beacon Street and Ambar Avenue. In the short term, separated stormwater flow will be directed north through this manhole as shown in Alternative 2, Phase 1 to a new connection to the CSO 182 Trunk Sewer beneath Beacon Street. The second Phase of design and construction will pick up at that same manhole and run east along Ambar, thereafter following Alternative 4. Upon construction of the second Phase of this project, the existing storm sewer constructed in Phase 1 between Ambar and the CSO 182 Trunk Sewer will be filled, sealed, and abandoned and the inlet structure to the CSO 182 Trunk Sewer closed. Future storm separations on Beacon (north of the CSO 182 Trunk Sewer) may utilize this structure, so it should not be demolished.

The completion of Phase 2 of this project, including the new stormwater outlet and sewer work around the Beechmont culvert will provide measurable reduction in Combined Sewer Overflow volumes in a Typical Year. This phased approach allows time for additional investigation of the CSO 182 sewershed, the identification of other viable separation opportunities, and the completion of environmental reviews and easement acquisition. **Due to the role of the Phase 2 elements of this project as a conduit for substantial additional upstream separation, more planning is necessary prior to the design and construction on any Phase 2 alternative.** Once constructed, the Phase 2 component of this project will have a significant impact on the sizing for the proposed Berkshire HRT as referenced in the WWIP.

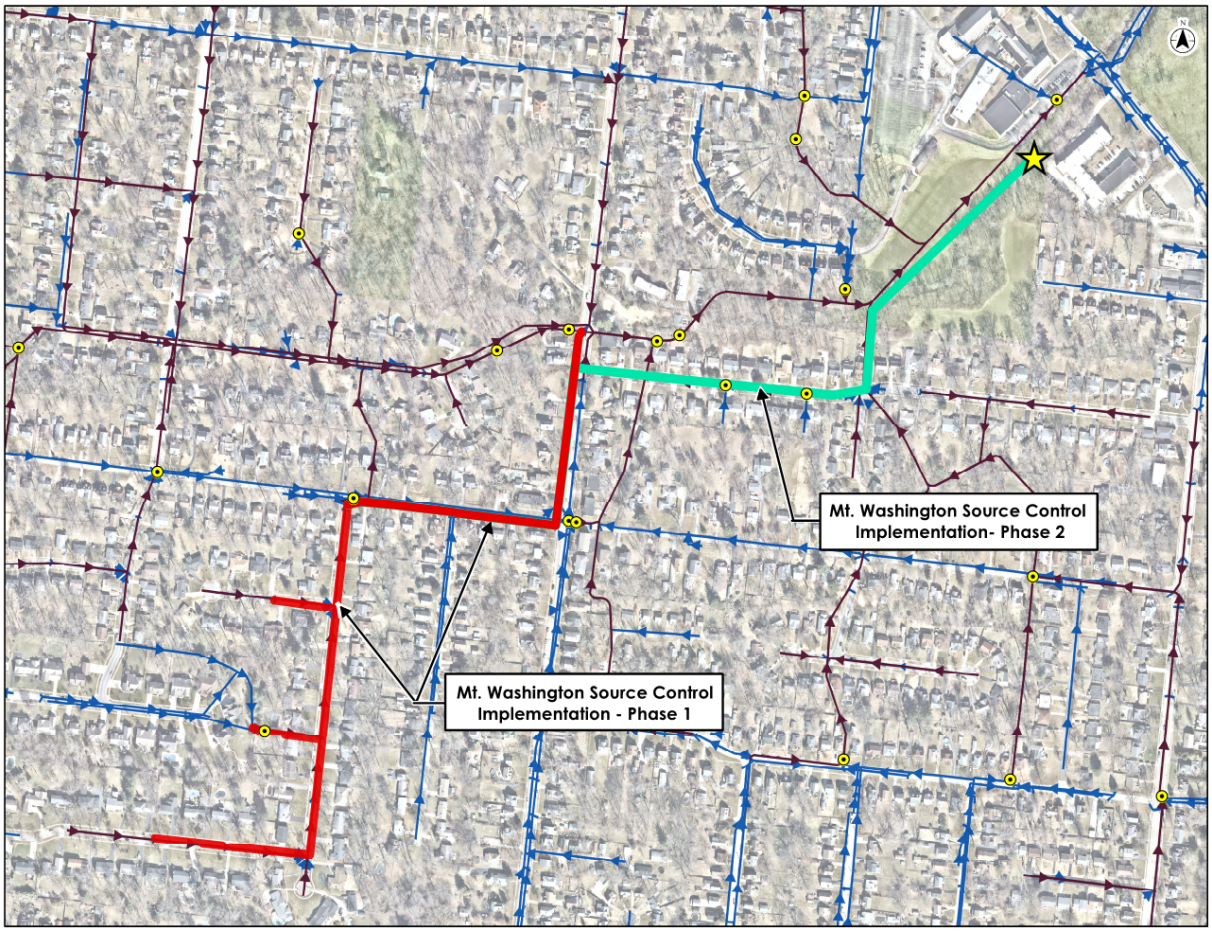

Figure 14: Alt 4 – Recommended Alternatives

A final Opinion of Probable Costs has not been developed for this Hybrid Scenario. The total estimated construction cost of the first Phase of Alt 2 – Beacon Alternative is $3.8M (2021 $). The total estimated (2024 $) construction cost for the Recommended project to move immediately into design and construction is $4.17M.

Section 5 – Execution Plan

Section 5.1 Probable Opinion of Project Costs

5.1.1 Cost Estimate

A planning level (class IV) estimate was completed for the recommended Neighborhood and selected Phase 1 alternative:

Planning/Study (2021 $)	$231,511
Design (2021 $)	$355,654
Miscellaneous Expense (2024 $)	$55,915
Right-of-Way (2024 $)	$87,228
Construction (2024 $)	$4,172,930
Construction Services (2024 $)	$124,165
Capitalized Interest (2024 $)	$104,323
Total Project Cost (combined 2021 & 2024 dollars)	**$5,131,725**

Right-of-Way costs have not been provided by the Right-of-Way Section, but have been reviewed for concurrence

5.1.2 Legislative History

Planning Funding for this project was allocated from a supplemental Subtask 7.6 of the Program Management Contract.

5.1.3 Proposed Legislation & Funding Sources

Design and construction funding will for the recommended first phase of work (as included in the recommendation) is to be legislated as a Capital Improvement Project under project number 10172940 Mt Washington Source Control Implementation (Phase 1).

Section 5.2 Schedule

The Phase 1 work proposed in this BCE will require approximately four to five years to implement. This includes at least one year for design, two years for ROW acquisition, and one year for construction

Section 5.3 Scope

5.3.1 Summary of Project Scope

This project consists of the installation of approximately 4,200LF of new storm sewer, and 800 LF of 8” and 10” sanitary sewer as part of Alt 2 – Beacon Alternative, Phase 1. The new sewer will vary in size from 8” to 48” in diameter and will require approximately 27 new manholes, and 32 new catch basins.

5.3.2 Functional Requirements and Design Basis

Design Criteria

The new storm sewer design shall maintain or reduce peak from the 25-year, 24-hour rainfall downstream of the project area. Flow shall be maintained within the pipe for the 10-year, 24-hour rainfall. The project shall not increase the combined sewer overflow volumes at CSO 182 above pre-project conditions in the Typical Year. The new storm sewer shall also reduce the Hydraulic Grade Line in the existing combined sewer on Mayland and Woodlark Drives such that the July 2016 rainfall does not cause modeled SBUs.

Alignment and Depth of Sewer

The approximate alignment is shown in Figure 9. Alternative alignments that reduce easement acquisition costs are available. The depth of the storm sewer will vary across its length and be dependent upon the locations of existing utilities.

Easement Requirements/Property Acquisition

Between 4 and 10 permanent easements are necessary based on the desktop level design of the alternatives. The remainder of Phase 1 is anticipated to be constructed within the right of way.

Permits Anticipated

Phase 1 of the project will require a PTI and City of Cincinnati Street Opening Permit.

Temporary By-Pass Plan

No by-passes are anticipated as the proposed work will include new storm sewers. Minor bypass pumping may be necessary depending on the phasing of the proposed sanitary relocations.

5.3.3 Work Performed in Planning/Anticipated Work in Design

Utility Information/Survey and Fieldwork

No survey was completed during planning. Survey data collected for the 2019 design effort was utilized where available, and GIS was otherwise used as provided by MSD. Record plans for other public and private utilities were collected via the Ohio Utilities Protection Service and were reviewed, however the provided plans did not provide the required level of detail to advance the design beyond 30%. No other field work was completed as part of this planning effort.

Geotechnical

No soil borings or geotechnical investigations were completed during the planning phase.

Monitoring and Modeling

The flow modeling associated with this project was completed in accordance with MSD's Modeling Guidelines and Standards, and performed utilizing the most updated calibrated model. The model was last updated on 6/12/2018 and last calibrated on 6/12/2018.

No additional flow monitoring was performed as part of this planning effort.

Environmental Site Assessment

A Phase 1 ESA is necessary for the acquisition of new easements associated with all alternatives. The bulk of the easements are adjacent to public right of way in residential neighborhoods and are unlikely to trigger a Phase 2 ESA.

The downstream component of each alternative requires construction through a former creek which was partially filled in for the construction of the CSO 182 Trunk Sewer in the mid-1900s. Geotechnical investigations will be required to better understand the underlying conditions for the construction of the new storm sewer and may yield results that would trigger a broader investigation of the area via a Phase 2 ESA. Based on a desktop analysis performed as part of this BCE, there does not appear to be a history of commercial or industrial land uses within the project area which is currently residential and was previously used for agriculture.

Section 5.4 Roles and Responsibilities

The proposed construction will include a significant length of new large diameter storm sewer and new catch basins. They would be constructed by MSD, with the goal of providing them to SMU for long term maintenance and ownership. The new discharge to Berkshire Creek would also be transferred to SMU if possible. MSD would retain ownership of the combined sewers, connection manhole from Phase 1 to the existing CSO 182 Trunk Sewer, and Combined Sewer Overflow 182 as well as the remainder of the combined sewer pipe beyond the overflow. This transfer of assets may be performed after the Neighborhood and Phase 1 separations are complete, or could be delayed until the full sewer separation is achieved with a new permitted stormwater outfall.

WWC would maintain ownership and maintenance responsibilities for the new assets if they are not accepted by SMU.

The Technical Review Committee for the Planning effort included the following:

- Tony Klimek – MSD PM
- Matt Spidare – MSD Principal Engineer
- Mark Belcik – MSD QA
- David Siegert – MSD QA
- Deron Beer – MSD WWC
- Donald Morehead – MSD Cost Estimating
- David Moughton – MSD Modeling
- Sam Lewis – Jones Warner Consulting

Section 5.5 Project Risks

Key risks are identified below. Additional risks are further discussed in the BCE Risk Register.

5.5.1 Wet Weather Flows

Conveyance of wet weather flows during construction shall be the responsibility of the contractor. It is recommended that sewer installation and connections be performed in dry weather, and the site left in a condition that will drain by gravity at the end of each working day. Erosion control devices shall be maintained in good working order and cleaned as necessary or as required by permit.

5.5.2 Easements

Easements are required for this project, however the specific size and location requirements will not be fully understood until survey is complete, and detailed design is undertaken. It is recommended that easement acquisition begin immediately upon completion design to reduce the time required.

5.5.3 Geotechnical

Geotechnical risks for the Neighborhood and Alt 2 – Beacon Alternative (Phase 1) are minor as the proposed sewer is either within the right of way or directly adjacent. Risks increase substantially in Phase 2 as the proposed alignment runs cross-country. Geotechnical and Environmental investigations are recommended prior to Phase 2. Geotechnical review of the existing slopes along the proposed Phase 2 alignment is recommended.

5.5.4 Noise, Odor, and Traffic

Traffic control will be required for the duration of the project due to the trenching within the limits of Woodlark Drive, Mayland Drive, Lusanne Terrace, Glade Avenue, and Beacon Street. Two way, one lane traffic will likely be required along all impacted roadways, with flaggers potentially being necessary on Beacon and Glade. Due to the residential nature of the project area, night work will be prohibited by noise ordinance.

5.5.5 Future Separation

Prior to the design and installation of any Phase 2 element of this project, a thorough review of existing opportunities for CSO reduction and remaining allowable combined sewer overflow volumes should be conducted. The correct sizing of the Phase 2 elements of this project is essential for allowing multiple future separation projects to go forward, with the goal of meeting the WWIP requirements.

5.5.6 Higher HGL at Connection Point

The terminus of Phase 1 is at the existing CSO 182 Trunk Sewer beneath Beacon Street which is in close proximity to existing structures. Under the 10-year storm conditions, the HGL of the CSO 182 Trunk Sewer remains within the pipe and close to the pre-construction conditions. Under a 25-year storm, the HGL is raised beyond the crown of the pipe and beyond the baseline pre-construction scenario, however the increase is less than 3 feet and is still contained below ground. A detailed survey of basement elevations in the vicinity of the CSO 182 Trunk Sewer near the proposed tie in point is necessary to determine the risk of future SBUs under 25-year and larger storms.

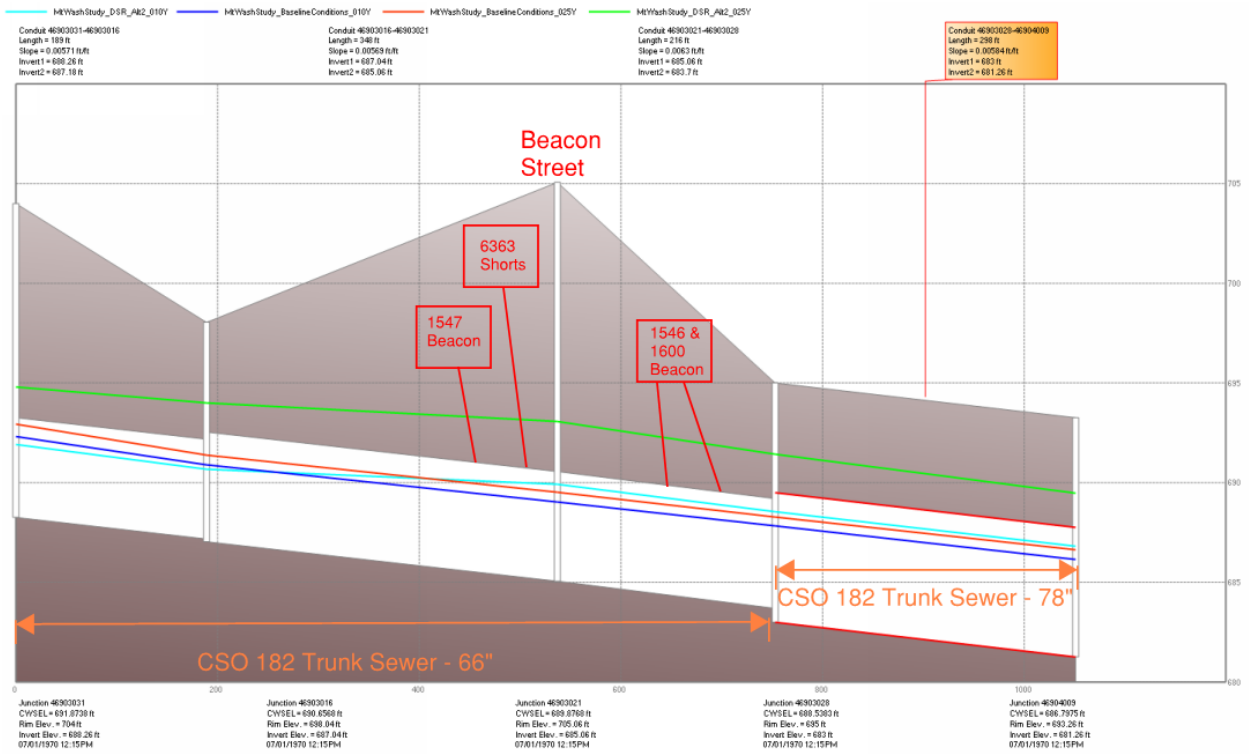

Figure 15: HGL changes at Alt 2 – Beacon Alternative (Phase 1) connection point

Section 6 – MSD Review Signature Sheet

Wastewater Engineering Division:

Submitted for Approval: Anthony P. Klimek June 8, 2021

Anthony Klimek, Project Manager Date

Wastewater Engineering Division:

Concurrence: _____ 6/8/21

Matt Spidare, Principal Engineer Date

(Design Phase)

Operating Division:

Concurrence: _____ 6/9/2021

Jenny Richmond, Superintendent Date

Engineering Management Division:

Approval: _____ 06/09/2021

Ryan Welsh, Sewers Chief Engineer Date

Section 7 – Appendices