Addendum No. 01
STORMWATER MASTER PLAN UPDATE
CITY OF WILSONVILLE PROJECT #7064

ISSUE DATE:  8/13/2020

TO:   PLAN HOLDERS

FROM:   Khoi Q. Le, PE – Development Engineering Manager

RE:   REQUEST FOR ADDITIONAL INFORMATION - RESPONSE

The following Request for Additional Information (RFI) were received on August 12, 2020 regarding the Stormwater Master Plan Update Project RFP. This addendum regarding the RFI and its response shall be considered merged with the original bid package as if they were whole. Consultants shall acknowledge receipt of this Addendum associated with Tasks 6, 8, 9 and 10 under Section II – Scope of Work of the RFP.

BID DATE & TIME: No change to the original bid date and time

CLARIFICATIONS

Question 1: Would it be possible to provide the 2015 Hydro-modification Assessment and the Retrofit Plan?

Response: Wilsonville Hydromod Report Final, Wilsonville Retrofit Assessment Final, and Coffee Creek Stormwater Facility Study are attached.
Coffee Creek Stormwater Facility Study
Wilsonville, Oregon

Facility Siting Alternatives Report

<table>
<thead>
<tr>
<th>Date:</th>
<th>June 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client:</td>
<td>City of Wilsonville – Engineering Division</td>
</tr>
<tr>
<td></td>
<td>29799 SW Town Center Loop East</td>
</tr>
<tr>
<td></td>
<td>Wilsonville, OR 97070</td>
</tr>
<tr>
<td>City Job Number:</td>
<td>7060</td>
</tr>
<tr>
<td>Engineering Contact:</td>
<td>John Christiansen, PE</td>
</tr>
<tr>
<td></td>
<td>(503) 563-6151</td>
</tr>
<tr>
<td>Engineering Firm:</td>
<td>AKS Engineering &amp; Forestry, LLC</td>
</tr>
<tr>
<td></td>
<td>12965 SW Herman Road</td>
</tr>
<tr>
<td></td>
<td>Suite 100</td>
</tr>
<tr>
<td></td>
<td>Tualatin, OR 97062</td>
</tr>
<tr>
<td>AKS Job Number:</td>
<td>7076</td>
</tr>
</tbody>
</table>
Table of Contents

1.0 Introduction ............................................................................................................................... 1
2.0 Project Location ......................................................................................................................... 1
3.0 Data Gathering and Concept Development ................................................................................ 1
   3.1 DOCUMENT REVIEW ................................................................................................................ 1
   3.2 NATURAL RESOURCES DESKTOP REVIEW ........................................................................... 2
   3.3 GEOTECHNICAL DESKTOP INVESTIGATION ........................................................................... 2
   3.4 HAZARDOUS MATERIALS CORRIDOR ASSESSMENT (HMCA) ................................................ 2
   3.5 CULTURAL RESOURCES DESKTOP REVIEW ........................................................................... 3
   3.6 LAND USE ................................................................................................................................... 3
   3.7 SITE CONSTRAINTS ......................................................................................................................... 3
       3.7.1 Utility Poles and Towers ........................................................................................................ 3
       3.7.2 Limited Pipe Capacity .......................................................................................................... 3
       3.7.3 Reverse Slope and Flat Topography ....................................................................................... 4
       3.7.4 The Willamette Water Supply Program: .............................................................................. 4
       3.7.5 New Kinsman Road Extension .............................................................................................. 4
   3.8 HYDROLOGIC AND HYDRAULIC MODEL ............................................................................... 4
4.0 Facility Siting Concepts: Option A and Option B .......................................................................... 4
   4.1 OPTION A AND OPTION B ......................................................................................................... 4
   4.2 OPTION A ..................................................................................................................................... 5
   4.3 OPTION B ..................................................................................................................................... 5
   4.4 OPTIONAL DESIGN ELEMENTS ................................................................................................. 6
   4.5 MODELING RESULTS .................................................................................................................. 6
   4.6 100-YEAR STORM ...................................................................................................................... 6
       4.6.1 Modeling Update .................................................................................................................... 6
       4.6.2 Results .................................................................................................................................... 7
   4.7 LONG-TERM MAINTENANCE CONSIDERATIONS ................................................................ 7
5.0 Cost Estimates ............................................................................................................................ 7
6.0 Evaluation of Alternatives .......................................................................................................... 8
7.0 Conclusion and Recommendations ............................................................................................ 8

Tables
Table 1: Summary of Options and Design Elements ........................................................................ 6
Table 2: Engineers Estimate Total .................................................................................................. 7

Appendices
APPENDIX A: Facility Siting Concepts
APPENDIX B: Cost Estimates
APPENDIX C: Profile Along Existing Channel
APPENDIX D: Preliminary Stormwater Report

Supplemental Information
1. Basis of Design Report
2. Wetlands/Waters Desktop Review
3. Cultural Resources Reconnaissance Survey
4. Preliminary Geotechnical Desktop Study
5. Hazardous Materials Corridor Assessment (HMCS)
Facility Siting Alternatives Report
Coffee Creek Stormwater Facility Study
Wilsonville, Oregon

1.0 Introduction
The City of Wilsonville’s 2012 Stormwater Master Plan (SWMP) identifies the Coffee Creek Industrial Area as an existing problem area due to its poor drainage and its tendency to flood during moderate storm events. Basalt Creek (also referred to as Tapman Creek), which has been constructed into channels and culverts, overtops its banks and floods the adjacent parking area on the west side of the Commerce Circle Business Park, beginning at the 2-year, 24-hour storm event. The creek has negative slopes in this area that contribute to flooding while also preventing flooding from occurring downstream (2012 SWMP 6.6.1).

Commerce Circle was identified in the 2012 SWMP as one of four general areas to experience flooding. The 2012 SWMP states that the area “is known to flood, and the parking lots in the development were originally designed to flood and provide additional detention volume. Therefore, some flooding is to be expected in this area. Portions of the open channel system have a reverse slope, contributing to the predicted and observed flooding. The reverse slope has not been removed so as to avoid moving the flooding to a downstream location.”

The Coffee Creek Regional Stormwater Facility Project (Project) is intended to meet the following goals for this portion of Basalt Creek:
1. Functional
2. Maintainable
3. Uplifted habitat

The 2012 SWMP includes the capital improvement project (CIP) Channel Project – Commerce Circle (CLC-3) as a recommended project, which is the basis of design for this project. More information about the basis of design can be found in the Basis of Design Report included as Supplemental Information to this report.

This report summarizes and describes the tasks completed for the pre-design effort for this project.

2.0 Project Location
This project is located to the west and south of the Commerce Circle industrial area and follows Basalt Creek in a straightened, incised channel between SW Day Road to the north, and SW Ridder Road to the south. Approximately 1,050 acres of surrounding drainage area contributes stormwater runoff to the system. This drainage area is shown on Figure 2 in the Basis of Design Report, included as Supplemental Information to this report.

3.0 Data Gathering and Concept Development
3.1 DOCUMENT REVIEW
To get an accurate understanding of the existing site conditions, AKS first reviewed relevant documents provided by the City, including the 2007 Coffee Creek Master Plan; 2012 SWMP; the documents used in the creation of the 2012 SWMP such as the CIP CLC-3 and InfoSWMM model; and the 2018 Draft Basalt Creek Concept Plan. A more detailed review of these documents can be found in the attached Basis of Design Report included as Supplemental Information to this report.
AKS analyzed the drainage basin and subbasins contributing stormwater runoff to the project site using DOGAMI LIDAR topography and stormwater GIS data provided by the City. This phase also included site visits by AKS’ engineering team, natural resources team, and survey team, as well as Shannon & Wilson’s geotechnical and environmental teams and Willamette Cultural Resources Associates.

In January 2019, AKS utilized drone technology to collect high-resolution imagery of the project area. This imagery was processed with survey-grade ground control to create an orthomosaic and elevation data of the site. This was especially useful for confirming areas of suspected ponding and digitally locating utility poles, as they were not a part of the preliminary topographic survey. While the resolution and accuracy of the data is quite high, there are inherent limitations to a photogrammetric workflow. Heavy shadowing, dense vegetation and surface water obstruct the visibility of the terrain in the imagery and therefore impede the creation of any derived elevation data. To confirm accuracy and reliability, the AKS drone topography was cross-referenced with the DOGAMI LIDAR and was found to be precise.

In addition to the drone survey and DOGAMI LIDAR analysis, a preliminary topographic survey took place in January 2019. The preliminary topographic survey included only critical elements, such as the culvert inlets and select channel cross-sections, to supplement the DOGAMI LIDAR. This survey effort was limited to the level of detail needed to validate the viability of CIP CLC-3. A more comprehensive topographic survey, including a tree survey, will need to be completed for construction-level drawings.

3.2 NATURAL RESOURCES DESKTOP REVIEW
As part of the Wetlands/Waters Desktop Review, AKS’ natural resources department reviewed previous wetland delineation concurrences and visited the site in February 2019 to confirm the presence and absence of wetland conditions in the study area. The study confirmed that much of the project area is wetlands and/or jurisdictional waters.

The complete Wetlands/Waters Desktop Review is included as Supplemental Information to this report.

3.3 GEOTECHNICAL DESKTOP INVESTIGATION
Shannon & Wilson provided preliminary geotechnical services for this project. They reviewed borehole logs in the vicinity of the project and recommended that no excavation be proposed within 15 feet of any existing utility poles. Shannon & Wilson also noted that the Bonneville Power Administration (BPA) will need to be asked to review any proposed work in the vicinity and that the BPA should be the ultimate authority on proposed excavations adjacent to their utility poles.

More detailed information about the geotechnical study can be found in the Preliminary Geotechnical Desktop Study included as Supplemental Information to this report.

3.4 HAZARDOUS MATERIALS CORRIDOR ASSESSMENT (HMCA)
Shannon & Wilson provided the HMCA for this project. They found four Environmental Conditions (ECs) that exist for the Project Corridor and recommend a Phase II ESA be performed along the proposed channel alignment.

More detailed information about the Environmental Conditions and Shannon & Wilson’s recommendations can be found in the HMCA included as Supplemental Information to this report.
3.5 CULTURAL RESOURCES DESKTOP REVIEW
Willamette Cultural Resources Associates provided cultural resources services for this project and identified the undeveloped portions of the study area as having a moderate to high probability for precontact archaeological resources based on proximity to Tapman Creek. Willamette Cultural Resources Associates recommends these areas receive a systematic pedestrian survey and shovel probing.

More detailed information about the cultural resources study can be found in the Cultural Resources Reconnaissance Survey included as Supplemental Information to this report.

3.6 LAND USE
The project limits extend through properties located within and outside of the Wilsonville City limits. For the segments outside city limits, Washington County is the authority having jurisdiction on land use matters. Construction of the improvements would require either annexation of the affected properties into Wilsonville or obtaining land use approval from Washington County. Given that the project could potentially affect five properties outside of City limits, pursuing land use approval for the improvements under County review, rather than annexation, is likely the most efficient path for permitting. All affected properties are zoned Future Development 20-acre District (FD-20) as defined by the Washington County Community Development Code. The project would likely be reviewed under a Type III procedure as a Public Utility in accordance with Section 308-4.8 of the Washington County CDC. If the City wishes to obtain fee simple ownership of the land within the open channel portions of the project, then a series of property line adjustments and partitions may be required. Land use requirements for properties within City limits should be reviewed internally with City of Wilsonville Planning staff. Each of the proposed channel improvement options will require similar procedures for land use entitlement; therefore, land use process is not considered a factor in the siting study.

3.7 SITE CONSTRAINTS
Several constraints were noted during the data gathering and concept development stage that guided the final conceptual plans. These constraints are described below.

3.7.1 Utility Poles and Towers
The project area runs north to south, mostly along a BPA easement, and includes areas along a Portland General Electric (PGE) easement. As such, there are many utility poles and towers along the project corridor.

The BPA utility poles have an excavation setback that is described in Shannon & Wilson’s Preliminary Geotechnical Desktop Study, attached to this report. There is currently maintenance access to these poles along a dirt and gravel road, and access to these poles must remain.

The new channel design must take into consideration the access road and utility pole/tower setbacks.

3.7.2 Limited Pipe Capacity
Just north of SW Ridder Road, Basalt Creek (Tapman Creek) enters two 36-inch stormwater pipes that run beneath the access drive and parking lot for Tax Lot 500, Tax Map 3S102CD. These two 36-inch stormwater pipes have limited capacity and are a constraint on the system.
3.7.3 Reverse Slope and Flat Topography
Some sections of Basalt Creek (Tapman Creek) have reverse slope in the project area, as shown in the existing profile attached in an appendix to this report. For the purposes of this analysis, the reverse slope is proposed to be corrected.

The channel restoration is proposed to extend approximately 3,300-linear feet between the southern outlet of the SW Day Road culverts and the 36-inch pipes beneath the parking area of Tax Lot 500, Tax Map 3S102CD. The elevation difference through this segment is only ±1.1 feet with a slope of 0.0003 (0.03%). Correcting the reverse grade in this area creates a nearly flat creek channel and floodplain.

3.7.4 The Willamette Water Supply Program:
Section PLM_1.3 of the Willamette Water Supply Program is proposed within SW Ridder Road. Construction is currently estimated to occur between 2020 and 2022. Coordination with the entities involved in this project may be required if improvements within SW Ridder Road are selected (e.g. Option B).

3.7.5 New Kinsman Road Extension
The Coffee Creek Industrial Area Infrastructure Analysis, dated 2011, indicates plans for a new road directly adjacent to the project site.

Originally this was considered a potential constraint that would need to be taken into consideration during final design of the new channel. After discussions with the City, it was determined that this planned roadway is no longer being considered for construction and is no longer a potential constraint.

3.8 HYDROLOGIC AND HYDRAULIC MODEL
Once data was sufficiently gathered and analyzed, AKS adjusted the City’s existing InfoSWMM model to estimate the capacity that proposed design elements of CLC-3 would have on the system. Modeling the 25-year storm, it was apparent that the proposed design of CLC-3 was incapable of reducing flood levels in the channel and that more would need to be done to reduce flooding within the industrial area.

The Facility Siting Concepts were developed with the goal of maximizing conveyance and capacity while considering the project constraints.

4.0 Facility Siting Concepts: Option A and Option B
The designs for Options A and B are described in this section. Plans, profiles, and cross-sections are attached to this report.

4.1 OPTION A AND OPTION B
Beginning in the north at SW Day Road (STA 44+00), Option A and Option B are identical up to the point that they veer apart at approximately station 14+50, at which point Option A continues east, along the existing channel, while Option B splits to the south. These differences will be described below.

To maximize conveyance, both options include removing negative slopes and culverts that are constraints on the system. The slope is limited to about 0.03%, with the vertical elevation fall, from the SW Day Road culvert to the stormwater pipes beneath Tax Lot 500, Tax Map 3S102CD, only being ±1.1 foot, over a horizontal distance of ±3,000 feet.
The primary channel is designed with a 5-foot wide bottom that is 1-foot to 6-feet deep, on average. To maximize storage and capacity, the channel is widened at elevation 223.0 to create a floodplain, where feasible. Side slopes are designed at 2:1 to minimize the excavation footprint. In some locations, structural earth walls (see detail, Sheet 7 of the Facility Siting Concepts) are proposed to further minimize the project footprint and to avoid constraints such as existing utility poles.

Open-bottom or box culverts are proposed to provide access to the existing utility poles while also maximizing conveyance. The existing maintenance road will be relocated to allow for the excavation of the channel and floodplain.

In two locations, there is not enough width in the original project area to construct a new channel while also meeting the excavation setbacks. In these locations, the restored channel is proposed on neighboring agricultural properties to the west. To limit the disturbance footprint in these areas, structural earth walls are proposed, similar to the detail on Sheet 7 of the Facility Siting Concepts sheets attached to this report. These walls will be vegetated.

Maintenance access will be preserved by relocating a gravel access road and utilizing open-bottom or box culverts for channel crossings.

Both options include a detention pond for additional storage capacity on Tax Lots 704 and 790, Tax Map 3S102B, adjacent to SW Day Road. The bottom elevation of this pond is designed at 223.0, equal to the floodplain designed in the channel portion of the project. The side slopes are designed at 4:1. The detention pond will be connected to the existing detention pond and channel with an open-bottom or box culvert beneath the existing maintenance road.

4.2 OPTION A
Option A continues east at approximately station 14+50, through an existing wetland. To minimize the excavation footprint in this area, from approximately station 14+50 through station 12+50, structural earth walls are proposed to allow for steeper slopes, designed at 0.25:1.

The channel will continue to the two existing 36-inch stormwater pipes that are located beneath the parking lot of Tax Lot 500, Tax Map 3S102CD, within a City stormwater easement. To increase conveyance, a third 36-inch stormwater pipe is proposed to be constructed parallel to the two existing pipes, within the existing parking lot. If space allows, the existing easement will be used although it is likely that the City will require an easement extension.

4.3 OPTION B
Option B veers south from Option A at approximately station 14+50, through a proposed channel on Tax Lot 600, Tax Map 3S102CD. To minimize the footprint necessary to create a positive slope to SW Ridder Road, the channel does not include floodplain. The channel side slopes are designed at 2:1.

At the southern terminus of this channel, the creek will be piped in two parallel 42-inch stormwater pipes installed in the north lane of SW Ridder Road. Two 42-inch pipes were chosen to convey the same amount of water as the potential three 36-inch pipes proposed in Option A. These pipes will connect to the existing western 48-inch culvert beneath SW Ridder Road. A concrete vault is proposed to make this connection. The existing 12-inch stormwater pipe and existing manholes in SW Ridder Road will be removed.
The two existing 36-inch stormwater pipes that are located beneath the parking lot of Tax Lot 500, Tax Map 3S102CD, will remain in place to convey stormwater from Commerce Circle.

As stated earlier in this report, the future Willamette Water Supply Program is proposed to be installed in SW Ridder Road. Coordination with the entities involved with this pipeline project will be necessary.

4.4 OPTIONAL DESIGN ELEMENTS

For modeling and cost estimating purposes, Options A and B were broken down further to allow a more detailed look at the effects of some of the design elements, notably the detention pond and the additional 36-inch pipe beneath Tax Lot 500, Tax Map 3S102CD. Breaking these options down to smaller elements allowed for a better understanding of where the costs were receiving the most benefits for the project goals.

The model for Option A was evaluated with: neither the detention pond nor the additional 36-inch pipe (A-1); with one of each of those elements separately (A-2 and A-3); and with both the detention pond and the additional 36-inch pipe included (A-4).

The model for Option B was evaluated without the detention pond (B-1), and with the detention pond (B-2).

These six options are summarized in the table below.

<table>
<thead>
<tr>
<th>Option</th>
<th>Additional 36-inch Pipe</th>
<th>Detention Pond</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>A-2</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>A-3</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>A-4</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>B-1</td>
<td>n/a</td>
<td>No</td>
</tr>
<tr>
<td>B-2</td>
<td>n/a</td>
<td>Yes</td>
</tr>
</tbody>
</table>

4.5 MODELING RESULTS

The elevation of the parking lot on the west side of Tax Lot 400, Tax Map 3S102CA was used as a baseline flood elevation for the modeling study. This elevation was determined to be 226.5 and the peak hydraulic grade line (HGL) of the adjacent proposed channel improvements was used as a determining factor in the final recommendations.

More information about the HGL can be found in the attached Preliminary Stormwater Report.

4.6 100-YEAR STORM

4.6.1 Modeling Update

The Facility Siting Concepts, modeling results, and recommendations were presented to the City in May 2019. The City requested AKS to add the 100-yr storm to the modeling to determine how adjacent properties would be affected by the channel improvements.
The cross-sections of each modeled conduit were refined and expanded to include a wider surface area for more accurate modeling results. The model was then run for the 100-year storm model under existing development conditions and calculated the HGL along each conduit for Options A-3 and B-1. Option A-4 was run only to determine an estimated HGL for the detention pond.

Finished floor elevations (FFE) were estimated using DOGAMI Bare Earth LiDAR topography (2014), aerial photography, and photographs from AKS site visits. Loading docks were estimated at 4.0 feet above existing ground, where applicable.

Once the HGL of each conduit was determined by the updated model, the Facility Siting Concepts (Appendix A) were updated to include the 100-year and 25-year flood storage areas.

4.6.2 Results
Both Options A-3 and B-1 were studied and compared. Both options result in flooding on private properties during the 100-year storm, with the HGL for Option B-1 between 0.3 and 0.5 feet lower than the HGL for Option A-3.

The results of the modeling updates indicate that in a few locations the 100-year storm event will have flood waters abutting existing buildings. However, due to the locations of loading docks, the HGL of the 100-year storm did not rise to the level of the FFEs of the existing buildings. In the worst-case scenario, the HGL rises to approximately 2.4 feet below FFE. This scenario occurs on Tax Lot 500, Tax Map 3S102CD at 9685 SW Ridder Road. A cross-section (Cross-Section F) in this location can be found on Sheet 14 of the Facility Siting Concepts (Appendix A).

As part of this analysis, the existing detention pond adjacent to SW Ridder Road, on the north side, was also analyzed. The results indicate that the existing culverts beneath SW Ridder Road are adequately sized to convey the 100-year storm and dissipate any ponding of water in the detention pond.

4.7 LONG-TERM MAINTENANCE CONSIDERATIONS
The long-term maintenance of the new channel, culverts, and stormwater pipes would be mostly limited to the City’s regular maintenance of the stormwater system. Visual inspections of the creek channel and culverts are recommended to determine if there is any erosion of the channel or blockages. Planting maintenance will be ongoing for the first few years.

5.0 Cost Estimates
Cost estimates have been prepared for both Concepts Option A and Option B and the additional elements (detention pond and additional 36-inch stormwater pipe). These are included as an attachment to this report and summarized in the table below. Note: Property acquisition is not included.

<table>
<thead>
<tr>
<th>Facility Siting Concept</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1</td>
<td>$3.0 million</td>
</tr>
<tr>
<td>A-2</td>
<td>$5.2 million</td>
</tr>
<tr>
<td>A-3</td>
<td>$3.2 million</td>
</tr>
<tr>
<td>A-4</td>
<td>$5.4 million</td>
</tr>
<tr>
<td>B-1</td>
<td>$4.4 million</td>
</tr>
<tr>
<td>B-2</td>
<td>$6.5 million</td>
</tr>
</tbody>
</table>
6.0 Evaluation of Alternatives
In addition to cost, we analyzed six non-financial criteria to determine the recommended option: property impacts, public impacts, environmental impacts, risk/constructability, operations and maintenance, and conveyance improvement. The criteria can be described as follows:

Property Impacts
The anticipated impact to private property, including requiring easements or property acquisition, and construction impacts.

Public Impacts
The anticipated disruption to traffic on neighboring streets during construction.

Environmental Impacts
The anticipated amount of work in environmental, cultural resource, or hazardous materials areas that could impact project schedule or cost, and the potential for impacts to the land use permitting schedule and costs.

Risk/Constructability
The difficulty level of construction and anticipated risk of discovering unknowns. The depth and/or difficulty of excavations, haul-off, construction access, dewatering, proximity to adjacent utilities, and road/sidewalk repair were all taken into consideration.

Operations and Maintenance
The anticipated operations and maintenance that will be required, including access to manholes, pipes, and the proposed channel, as well as the level of planting maintenance that will be required.

Conveyance Improvement
The anticipated improvement the proposed elements will have on conveyance and reduced flood risk.

Cost
In addition to the non-financial criteria, the estimated costs were weighed against the anticipated benefit to the project goals.

7.0 Conclusion and Recommendations
Option A-3
Based on the studies of the six different options (A-1, A-2, A-3, A-4, B-1, and B-2) described earlier in this report, AKS recommends Option A-3 for further consideration.

In addition to the channel improvements, Option A-3 includes the additional 36” pipe beneath Tax Lot 500, Tax Map 3S102CD but does not include the detention pond.

This option maximizes conveyance while minimizing cost and non-financial impacts. It is anticipated to convey the existing 25-year event when analyzing the hydraulic grade line adjacent to the industrial area parking lot (Tax Lot 400, Tax Map 3S102CA).
Additional 36” Pipe beneath Tax Lot 500, Tax Map 3S102CD
We recommend including this element in the design due to the relatively low cost and large positive impact on conveyance. The two existing 36” stormwater pipes are constraints on the system and are anticipated to cause flooding even with the reverse grade of the existing channel removed.

Detention Pond
The detention pond would be more efficiently sited as part of CLC-1, north of SW Day Road. In its currently proposed location, the amount of excavation needed to obtain the depth required is much larger than the estimated capacity of the pond. Specifically, it would require over 36,000 cubic yards of excavation and haul-off, while only providing approximately 7,500 cubic yards of storage. This is caused by the higher elevations in the western portion of the site, where there is almost 15 feet of cut required to construct the facility.

Options B-1 and B-2
While Options B-1 and B-2 would provide greater conveyance and lessen the flood risk, these options may be too costly considering the property acquisition through BPA property, as well as coordination with the entities responsible for the Willamette Water Supply Program proposed in SW Ridder Road.
ESTIMATED FFE: 230

LEGEND

ENGINEERING
SURVEYING
FORESTRY
NATURAL RESOURCES
LANDSCAPE ARCHITECTURE

COFFEE CREEK
STORMWATER FACILITY
WILSONVILLE
OREGON

NOT FOR CONSTRUCTION

FACILITY SITING CONCEPTS
PLAN AND PROFILE
STA 19+50 - 25+50
# Coffee Creek Stormwater Facility Study

## Engineer's Estimate - Siting Concept

### OPTION A - Channel

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Spec. Section</th>
<th>Description</th>
<th>Unit</th>
<th>Unit Price</th>
<th>Qty</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Mobilization</td>
<td>LS</td>
<td>$177,000</td>
<td>1</td>
<td>$177,000</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Erosion And Sediment Control</td>
<td>ACRE</td>
<td>$12,000</td>
<td>5.7</td>
<td>$68,400</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Removal of Structures and Obstructions</td>
<td>LS</td>
<td>$20,000</td>
<td>1</td>
<td>$20,000</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Clearing and Grubbing</td>
<td>ACRE</td>
<td>$5,000</td>
<td>5.7</td>
<td>$28,500</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>General Excavation</td>
<td>CY</td>
<td>$10</td>
<td>26,500</td>
<td>$265,000</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Haul-off</td>
<td>CY</td>
<td>$20</td>
<td>26,500</td>
<td>$530,000</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Fine Grading</td>
<td>SQYD</td>
<td>$1</td>
<td>27,600</td>
<td>$27,600</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Structural Earth Wall</td>
<td>SQFT</td>
<td>$10</td>
<td>16,900</td>
<td>$169,000</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>Jute Mat</td>
<td>SQYD</td>
<td>$1</td>
<td>4,950</td>
<td>$4,950</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Streambed Cobble</td>
<td>TON</td>
<td>$70</td>
<td>900</td>
<td>$63,000</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>Loose Riprap, Class 50</td>
<td>CY</td>
<td>$120</td>
<td>125</td>
<td>$15,000</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>Planting and Seeding</td>
<td>ACRE</td>
<td>$100,000</td>
<td>3.2</td>
<td>$320,000</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>Plant Establishment Period</td>
<td>ACRE</td>
<td>$6,500</td>
<td>3.2</td>
<td>$20,800</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>Temporary Irrigation System</td>
<td>ACRE</td>
<td>$13,000</td>
<td>3.2</td>
<td>$41,600</td>
</tr>
<tr>
<td>16</td>
<td></td>
<td>Aggregate Base and Shoulders (3/4&quot; minus)</td>
<td>TON</td>
<td>$46</td>
<td>1,100</td>
<td>$50,600</td>
</tr>
<tr>
<td>17</td>
<td></td>
<td>Open Bottom Culvert (10x3)</td>
<td>LF</td>
<td>$2,600.00</td>
<td>200</td>
<td>$520,000</td>
</tr>
</tbody>
</table>

Subtotal = $2,321,450

Contingency (30%) = $696,435

OPTION A - Channel TOTAL = $3,017,885
## OPTION A - Pipe

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Spec. Section</th>
<th>Description</th>
<th>Unit</th>
<th>Unit Price</th>
<th>Qty</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Sawcut</td>
<td>LF</td>
<td>$1</td>
<td>1,070</td>
<td>$1,070</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>36&quot; Storm Pipe</td>
<td>LF</td>
<td>$190</td>
<td>575</td>
<td>$109,250</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>60&quot; Flat Top Manhole</td>
<td>EA</td>
<td>$15,000</td>
<td>2</td>
<td>$30,000</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Riprap Outfall</td>
<td>EA</td>
<td>$1,500</td>
<td>1</td>
<td>$1,500</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Trench Patch (4&quot; thick)</td>
<td>SY</td>
<td>$70</td>
<td>475</td>
<td>$33,250</td>
</tr>
</tbody>
</table>

Subtotal = $175,070  
Contingency (30%) = $52,521  
OPTION A - Pipe TOTAL = $227,591

## Pond

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Spec. Section</th>
<th>Description</th>
<th>Unit</th>
<th>Unit Price</th>
<th>Qty</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Mobilization</td>
<td>LS</td>
<td>$145,000</td>
<td>1</td>
<td>$145,000</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Erosion And Sediment Control</td>
<td>ACRE</td>
<td>$12,000</td>
<td>2.8</td>
<td>$33,600</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Clearing and Grubbing</td>
<td>ACRE</td>
<td>$10,000</td>
<td>2.8</td>
<td>$28,000</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>General Excavitation</td>
<td>CY</td>
<td>$10</td>
<td>36,100</td>
<td>$361,000</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Haul-off</td>
<td>CY</td>
<td>$20</td>
<td>36,100</td>
<td>$722,000</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Fine Grading</td>
<td>SQYD</td>
<td>$1</td>
<td>10,700</td>
<td>$10,700</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Loose Riprap, Class 50</td>
<td>CY</td>
<td>$120</td>
<td>40</td>
<td>$4,800</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Planting and Seeding</td>
<td>ACRE</td>
<td>$100,000</td>
<td>2.2</td>
<td>$220,000</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>Plant Establishment Period</td>
<td>ACRE</td>
<td>$6,500</td>
<td>2.2</td>
<td>$14,300</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Temporary Irrigation</td>
<td>ACRE</td>
<td>$13,000</td>
<td>2.2</td>
<td>$28,600</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>Open Bottom Culvert (10x3)</td>
<td>LF</td>
<td>$2,600</td>
<td>30</td>
<td>$78,000</td>
</tr>
</tbody>
</table>

Subtotal = $1,646,000  
Contingency (30%) = $493,800  
Pond TOTAL = $2,139,800
**OPTION B - Channel/Pipe**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Spec. Section</th>
<th>Description</th>
<th>Unit</th>
<th>Unit Price</th>
<th>Qty</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Mobilization</td>
<td>LS</td>
<td>$274,000</td>
<td>1</td>
<td>$274,000</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Erosion And Sediment Control</td>
<td>ACRE</td>
<td>$12,000</td>
<td>6.5</td>
<td>$78,000</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Removal of Structures and Obstructions</td>
<td>LS</td>
<td>$30,000</td>
<td>1</td>
<td>$30,000</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Clearing and Grubbing</td>
<td>ACRE</td>
<td>$5,000</td>
<td>6.5</td>
<td>$32,500</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>General Excavation</td>
<td>CY</td>
<td>$10</td>
<td>33,000</td>
<td>$330,000</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Haul-off</td>
<td>CY</td>
<td>$20</td>
<td>33,000</td>
<td>$660,000</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Fine Grading</td>
<td>SQYD</td>
<td>$1</td>
<td>31,500</td>
<td>$31,500</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Structural Earth Wall</td>
<td>SQFT</td>
<td>$10</td>
<td>15,000</td>
<td>$150,000</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>Jute Mat</td>
<td>SQYD</td>
<td>$1</td>
<td>7,850</td>
<td>$7,850</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Streambed Cobble</td>
<td>TON</td>
<td>$70</td>
<td>930</td>
<td>$65,100</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>Loose Riprap, Class 50</td>
<td>CY</td>
<td>$120</td>
<td>145</td>
<td>$17,400</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>Planting and Seeding</td>
<td>ACRE</td>
<td>$100,000</td>
<td>3.8</td>
<td>$380,000</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>Plant Establishment Period</td>
<td>ACRE</td>
<td>$6,500</td>
<td>3.8</td>
<td>$24,700</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>Temporary Irrigation System</td>
<td>ACRE</td>
<td>$13,000</td>
<td>3.8</td>
<td>$49,400</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>Sawcut</td>
<td>LF</td>
<td>$1</td>
<td>1,030</td>
<td>$1,030</td>
</tr>
<tr>
<td>16</td>
<td></td>
<td>42” Storm Pipe</td>
<td>LF</td>
<td>$452</td>
<td>1,080</td>
<td>$488,160</td>
</tr>
<tr>
<td>17</td>
<td></td>
<td>72” Flat Top Manhole</td>
<td>EA</td>
<td>$18,000</td>
<td>4</td>
<td>$72,000</td>
</tr>
<tr>
<td>18</td>
<td></td>
<td>Tie into Existing Culvert (SW Ridder Road)</td>
<td>LS</td>
<td>$15,000</td>
<td>1</td>
<td>$15,000</td>
</tr>
<tr>
<td>19</td>
<td></td>
<td>Pre-cast Stormwater Vault</td>
<td>EA</td>
<td>$25,000</td>
<td>1</td>
<td>$25,000</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>Trench Patch (8&quot; thick)</td>
<td>SY</td>
<td>$110</td>
<td>700</td>
<td>$77,000</td>
</tr>
<tr>
<td>21</td>
<td></td>
<td>Aggregate Base and Shoulders (3/4&quot; minus)</td>
<td>TON</td>
<td>$46</td>
<td>1,100</td>
<td>$50,600</td>
</tr>
<tr>
<td>22</td>
<td></td>
<td>Open Bottom Culvert (10x3)</td>
<td>LF</td>
<td>$2,600</td>
<td>200</td>
<td>$520,000</td>
</tr>
</tbody>
</table>

**Subtotal** = $3,379,240

**Contingency (30%)** = $1,013,772

**OPTION B - Channel TOTAL** = $4,393,012
Assumptions
1. This estimate was developed for the purpose of comparing two design alternatives and may not be inclusive of all work necessary to install the improvements.
2. The unit prices shown are based on engineering experience and do not represent actual contractor bids. Actual contractor bids may vary significantly.
3. Units that are in L.F., S.F., or S.Y. are based on 1-dimensional (linear) or 2-dimensional (horizontal plan) measurements. Units are not 3-dimensional (slope) measurements.
4. This estimate does not include:
   - City, County, State, or Federal Permit Fees
   - Consulting Services
   - Hard Rock/Boulder Excavation
5. Volumes and quantities listed are approximate.
6. This estimate does not include items not specifically listed.
7. This estimate is based on Concept Level Plans (Not Final Approved Construction Plans).
8. All items, quantities, volumes, etc. listed are based on “in-place” measurements.
9. All items listed include materials and installation.
10. Estimate is based on 2019 dry weather construction.
11. Grading volumes and quantities shown in this estimate are subject to significant change pending final engineering design requirements.
12. Estimates are intended for Client’s general project feasibility purposes only. Actual contractor bids may vary significantly.
13. All costs assume dry weather construction.
Facility Siting Alternatives Report, Appendix C:
Profile Along Existing Channel
PROFILE ALONG EXISTING CHANNEL

VERT. 1" = 20'

WHT. 1" = 200'
Coffee Creek Stormwater Facility Study
Wilsonville, Oregon

Preliminary Stormwater Report

Date: June 2019

Client: City of Wilsonville – Engineering Division
29799 SW Town Center Loop East
Wilsonville, OR 97070

Engineering Contact: John Christiansen, PE
(503) 563-6151 | johnc@aks-eng.com

Engineering Firm: AKS Engineering & Forestry, LLC
12965 SW Herman Road
Suite 100
Tualatin, OR 97062

AKS Job Number: 7076
Table of Contents

1.0 Purpose of Report.......................................................................................................................... 1
2.0 Project Location/Description........................................................................................................... 1
3.0 Regulatory Design Criteria............................................................................................................. 1
   3.1 STORMWATER QUANTITY........................................................................................................... 1
   3.2 STORMWATER QUALITY............................................................................................................ 1
4.0 Design Methodology......................................................................................................................... 1
5.0 Design Parameters .......................................................................................................................... 1
   5.1 DESIGN STORMS....................................................................................................................... 2
6.0 Stormwater Analyses ....................................................................................................................... 2
   6.1 PROPOSED STORMWATER CONDUIT SIZING ........................................................................ 2
   6.2 ELEVATION OF ADJACENT INDUSTRIAL AREA PARKING LOT ........................................... 2
   6.3 MODEL RESULTS.................................................................................................................... 2
   6.4 HYDRAULIC GRADE LINE PROFILES .................................................................................... 3
   6.5 DOWNSTREAM IMPACTS ......................................................................................................... 4

Tables
Table 1: 24-Hour Design Storms for the City of Wilsonville............................................................... 2
Table 2: Summary of Options and Design Elements ........................................................................... 3

Appendices
APPENDIX A: HYDRAULIC GRADE LINE PROFILES AT PEAK EXISTING 25-YEAR
APPENDIX B: HYDRAULIC GRADE LINE PROFILES AT PEAK EXISTING 100-YEAR FOR OPTIONS A-3 & B-1
1.0 Purpose of Report
This report advances the design of capital improvement project (CIP) CLC-3: Channel Project – Commerce Circle using the parameters set forth in the Basis of Design Report, dated March 2019.

The purpose of this report is to analyze the effects of the design concepts developed during the Stormwater Analysis phase of the project on the existing stormwater conveyance system; document the criteria, methodology, and informational sources used to design the stormwater improvements; and present the results of the preliminary hydraulic analysis.

2.0 Project Location/Description
This project is located to the west and south of the Commerce Circle industrial area and follows Basalt Creek in a straightened, incised channel between SW Day Road to the north, and SW Ridder Road to the south. Approximately 1,050 acres of surrounding drainage area contributes stormwater runoff to the system. This drainage area is shown on Figure 2 in the Basis of Design Report.

The goal of the project is to address flooding that occurs during existing storm events and that is predicted during future storm events (beginning at the 2-year, 24-hour storm event), and to restore and enhance an existing straightened, incised channel. The channel has negative slopes in some areas which contribute to flooding.

3.0 Regulatory Design Criteria
3.1 STORMWATER QUANTITY
This project is intended to address a conveyance and capacity constraint and does not specifically address water quantity management for future development.

3.2 STORMWATER QUALITY
This project is intended to address a conveyance and capacity constraint and does not specifically address water quality management. The conveyance improvements may have water quality benefits.

4.0 Design Methodology
As described in the 2012 Stormwater Management Plan (SWMP), the Green-Ampt method was used to estimate runoff and infiltration in the InfoSWMM model. The Green-Ampt method calculates infiltration of stormwater into soils using antecedent moisture conditions (initial moisture deficit), water depth, and the hydraulic conductivity of the soil. The values of these three parameters were based on soil types in the City of Wilsonville. A more detailed description of this methodology, as well as a table of Green-Ampt Infiltration Parameters by Soil Type, can be found in the Basis of Design Report.

AKS ran the model using the infiltration parameters matching those from the 2012 SWMP InfoSWMM model.

5.0 Design Parameters
For input and analysis purposes, the following hydrologic parameters were included for each subbasin in the InfoSWMM model:
- Subbasin name or number
- Subbasin (acres)
- Impervious surface percentage (percent)
- Average ground slope (percent)
- Subbasin width (feet)
- Manning’s roughness coefficient for impervious areas
- Manning’s roughness coefficient for pervious areas
- Depression storage for impervious areas (inches)
- Depression storage for pervious areas (inches)
- Green-Ampt soil infiltration parameters: initial moisture deficit of soil, hydraulic conductivity of soil, and suction head at the wetting front

The 2012 SWMP provides a description for each user-defined hydrologic parameter entered into the InfoSWMM model. These parameters were used for scenarios modeled for this project as well. Detailed descriptions can be found in the Basis of Design Report.

5.1 DESIGN STORMS
The 2012 SWMP lists rainfall in inches for the 24-hour design storms. These rainfall amounts are listed in Table 1 and were used for the models developed in this project.

<table>
<thead>
<tr>
<th>Storm Event</th>
<th>Rainfall (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-year</td>
<td>2.50</td>
</tr>
<tr>
<td>5-year</td>
<td>3.00</td>
</tr>
<tr>
<td>10-year</td>
<td>3.45</td>
</tr>
<tr>
<td>25-year</td>
<td>3.90</td>
</tr>
<tr>
<td>50-year</td>
<td>4.25</td>
</tr>
<tr>
<td>100-year</td>
<td>4.50</td>
</tr>
</tbody>
</table>

6.0 Stormwater Analyses
6.1 PROPOSED STORMWATER CONDUIT SIZING
The proposed stormwater system will be sized using Manning’s equation to maximize conveyance of the peak flows from the 25-year storm event under the existing site constraints.

6.2 ELEVATION OF ADJACENT INDUSTRIAL AREA PARKING LOT
As one of the goals of the project is to address flooding that occurs in the Commerce Circle Industrial Area, the elevation of flooding needed to be determined. Based on LIDAR topography and the preliminary topographic survey conducted by AKS, the lowest elevation adjacent to the project site is approximately 226.50 feet. This elevation was used a baseline flood elevation to determine the effectiveness of the conceptual designs. The industrial area parking lot on Tax Lot 400, Tax Map 3S102CA was studied specifically.

6.3 MODEL RESULTS
The model results can be summarized by studying the hydraulic grade line (HGL) of the system, specifically in the area adjacent to the parking lot that has seen the most flooding, along the west side of Tax Lot 400, Tax Map 3S102CA. The model was run for the existing 10-year, 25-year, and 50-year events,
and the HGL elevations of the adjacent channel section were calculated for each of the six conceptual designs described in the Facility Siting Alternatives Report. The HGL elevations were then compared with elevation 226.50 and plotted on the graph below.

For reference, the Summary of Options and Design Elements is provided below. See the Facility Siting Alternatives Report for more detail about the six design options.

### Table 2: Summary of Options and Design Elements

<table>
<thead>
<tr>
<th>Option</th>
<th>Additional 36-inch Pipe</th>
<th>Detention Pond</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>A-2</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>A-3</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>A-4</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>B-1</td>
<td>n/a</td>
<td>No</td>
</tr>
<tr>
<td>B-2</td>
<td>n/a</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### 6.4 HYDRAULIC GRADE LINE PROFILES

The full HGL Profiles were run for the 25-year storm event and each of the six options, beginning upstream at SW Day Road and ending at the channel south of SW Ridder Road. These are provided as an attachment to this report.

Following the presentation of the Facility Siting Concepts, modeling results, and recommendations to the City in May 2019, AKS updated the model to include wider conduit cross-sections that represent existing flood plain above the proposed channel improvements. This approach allowed a more realistic
look at the potential effects on existing buildings a 100-year storm would have. The 100-year storm HGL Profiles are provided in the appendix of this report.

6.5 DOWNSTREAM IMPACTS

As described in the Basis of Design Report, the intent of this project is to increase conveyance capacity and provide storage of stormwater runoff, reducing the flooding that occurs in the Commerce Circle Industrial Area. As stated in the 2012 SWMP, the current conveyance channel has negative slopes that prevent the occurrence of flooding downstream. The 2012 SWMP states that this reverse slope has not been removed in order to avoid moving the flooding to a downstream location (2012 SWMP 6.6.1).

Modeling results for the existing City model and Option A-3 were compared downstream from SW Ridder Road to the Coffee Lake Wetlands to determine if the channel improvements would result in increased flooding potential downstream of SW Ridder Road. The modeling shows that immediately south of SW Ridder Road, the HGL raises approximately 1.2 feet post-improvements; however, this flood level remains within the defined channel south of SW Ridder Road.

Further downstream, the HGL is lower post-improvements than existing conditions by approximately 0.1-0.2 feet. This remains consistent in both the 25-year storm and 100-year storm scenarios.

The final design recommendations for this project include removing the reverse grade and providing storage capacity.
Appendix A: Hydraulic Grade Line Profiles at Peak Existing 25-year
Option A-1
Hydraulic Grade Line Profile at Peak Existing 25-year

SW DAY ROAD

CHANNEL ADJACENT TO INDUSTRIAL AREA PARKING LOT

SW RIDDER ROAD
Option A-3
Hydraulic Grade Line Profile at Peak Existing 25-year

SW DAY ROAD

CHANNEL ADJACENT TO INDUSTRIAL AREA PARKING LOT

SW RIDDER ROAD
Option A-4
Hydraulic Grade Line Profile at Peak Existing 25-year

SW DAY ROAD
CHANNEL ADJACENT TO INDUSTRIAL AREA PARKING LOT
SW RIDDER ROAD
Option B-1
Hydraulic Grade Line Profile at Peak Existing 25-year

SW DAY ROAD
SW RIDDER ROAD
CHANNEL
ADJACENT TO
INDUSTRIAL AREA
PARKING LOT
Option B-2
Hydraulic Grade Line Profile at Peak Existing 25-year
Appendix B: Hydraulic Grade Line Profiles at Peak Existing 100-year (Options A-3 & B-1)
Option B-1
Hydraulic Grade Line Profile at Peak Existing 100-Year