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**APPENDIX F**

**HYDRAULIC AND HYDROLOGY ANALYSIS**

## **Hydrologic and Hydraulic Analysis**

### F.0 Project Description

PM&E proposes to improve Edward Street between Debarr Road and 6<sup>th</sup> Avenue. The purpose of this improvement project is to upgrade the road to current standards for a neighborhood collector.

### F.1 Purpose

The purpose of the Edward Street drainage study is to achieve three interrelated goals:

1. Evaluate the existing drainage system;
2. Properly size and locate any replacement components that may be proposed; and
3. Generate recommendations for meeting water quality treatment requirements.

Achieving these goals requires several steps:

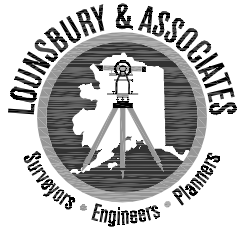
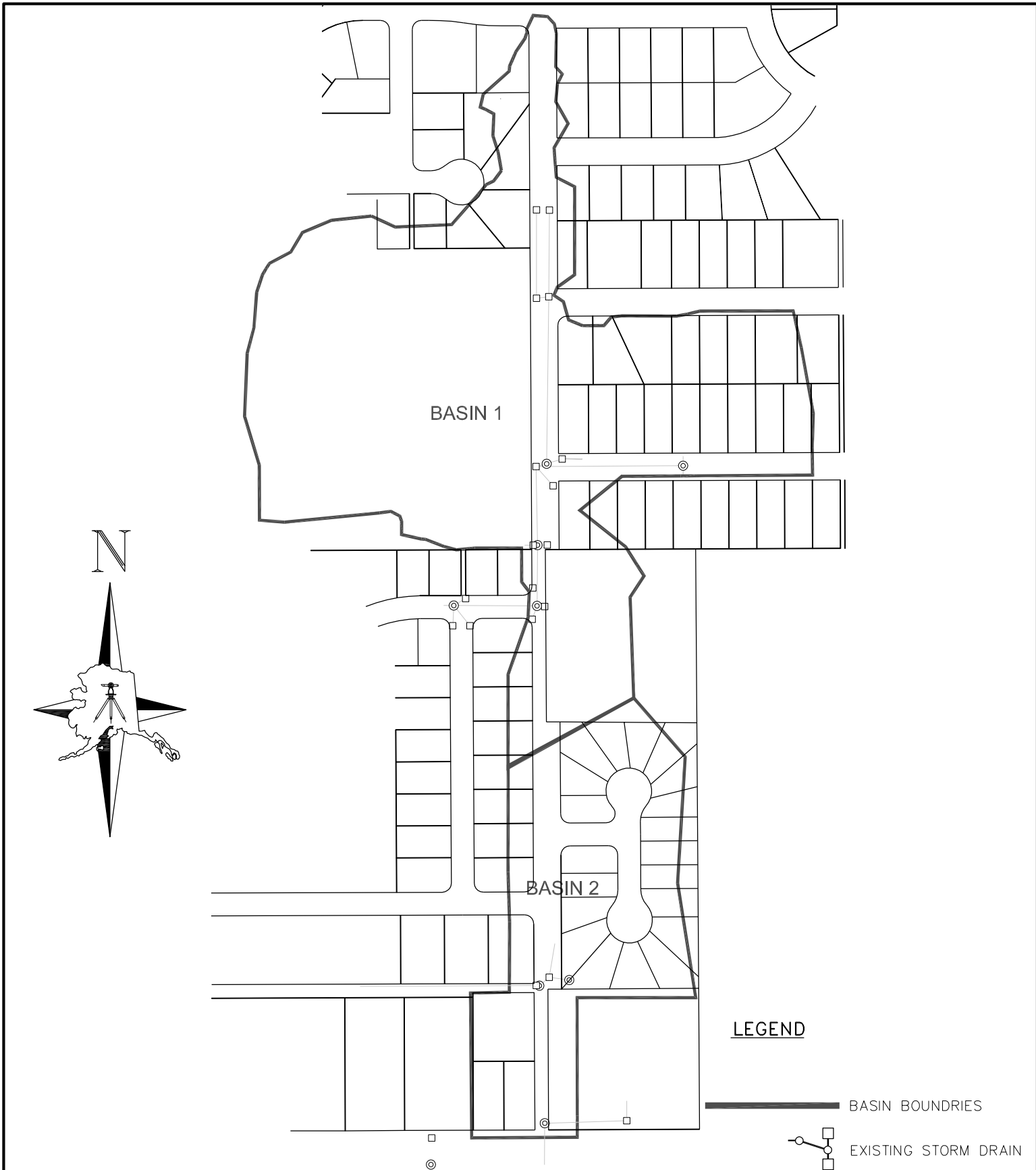
1. Define the drainage collection areas and routes for drainage systems within the drainage analysis boundaries;
2. Employ the Illinois Drainage Area Simulator (ILLUDAS) program to evaluate the flow characteristics of the existing system and generate sizing requirements for proposed pipes; and
3. Evaluate Best Management Practices (BMP's) for drainage improvements in the project area.

### F.2 Description of Drainage Areas

The Edward Street drainage basin was determined to encompass approximately 26 acres and consists of two drainage basins. The basins are shown in Figure F1. The basin boundaries were developed from field investigation, MOA topographical maps, street improvement as-built drawings, aerial photography, and MOA storm water collection system maps. For the purpose of this report, the analysis was limited to the drainage basins that route storm water flow into the collection systems along Edward Street.

Basin No. 1 encompasses the area along Edward Street, south of 6<sup>th</sup> Avenue to a break point north of Bintree Circle. It includes the Ptarmigan Elementary School and the residential area between 8<sup>th</sup> and 9<sup>th</sup> Avenues. It is approximately 19 acres in size.

Basin No. 2 encompasses Edward Street south of Basin No. 1 to Debarr Road and Bintree Circle. It encompasses approximately 6.75 acres of mostly residential development, with some commercial area near Debarr Road.



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FIGURE F1  
 EDWARD STREET UPGRADE  
 PM&E PROJECT 00-026  
 ILLUDAS MODEL SCHEMATIC  
 BASIN BOUNDARIES

F.3 Existing Conditions

For Basin No. 1 the runoff is conveyed through a drainage system consisting of ditches, curb and gutter, catch basins and storm drain pipes. The piping in Basin No.1 ranges in size from 6” plastic to 15” CMP. This piping runs along Edward Street beginning north of 8<sup>th</sup> Avenue, continuing past the school and then to Winding Way, where it turns west and leaves Basin No. 1 as it continues down Winding Way. The pipe grades along Edward Street vary from 5.0% plus at the north end to 0.2% at the south end of the system.

For Basin No. 2 the runoff is currently conveyed along curb and gutter in Bentree Circle, and ditches along Edward Street into the collection system of catch basins and storm drain pipes. Once in the storm drain pipe, the runoff is conveyed out of the drainage basin area and into the system in the alley way south of 12<sup>th</sup> Avenue. The pipe grade is 0.4% along the pipe in the alley way.

F.4 Drainage Evaluation Criteria

The following table presents the standard design criteria for MOA drainage projects.

<b>Table F1: Drainage Evaluation Criteria</b>		
<b>Design Element</b>	<b>Criterion</b>	<b>Reference</b>
Rainfall Intensity Information	Ted Steven’s Int’l Airport	DCM Section 2.5, P.2-9
Runoff Analysis Method	ILLUDAS	DCM Section 2.5, P.2-9
Design Storm	10 year, 3 hour	DCM Section 2.8, P.2-35
Rainfall intensity Multiplier	1.15	DCM Section 2.5, Figure 2-2
Min. Storm Drain Pipe Diameter	12 Inches	DCM Section 2.7, P.2-25
Min. Catch Basin Lead Diameter	10 Inches	DCM Section 2.7 B, P.2-25
Minimum Pipe Slope	0.30%	DCM Section 2.7 B, P.2-25
Min. Pipe Flow Velocity	.2 ft/sec	DCM Section 2.7 B, P.2-25
Max. Pipe Flow Velocity	13 ft/sec	DCM Section 2.7 B, P.2-25
Max. Manhole Spacing	300 ft.	DCM Section 2.7 D, P.2-27
Drop Across Manhole	0.05 feet	DCM Section 2.7 D, P.2-27
Max. Cleanout Spacing	150 ft.	DCM Section 2.7 F, P.2-28
Cleanout Diameter	12 Inches	DCM Section 2.7 F, P.2-28
Min. Cover Over Storm Drain	4 feet	DCM Section 2.7 J, P.2-22
Max. Inlet Spacing	1,100 ft	DCM Section 2.8 D, P.2-35
Min. Culvert Diameter	18 inches	DCM Section 2.7 CJ, P.2-27

F.5 *ILLUDAS Model*

The Illinois Urban Drainage Area Simulator (ILLUDAS) program was used to evaluate the existing storm drain system and to size proposed upgrades to the piped drainage system. Data analysis and coding was performed in accordance with the input parameters as outlined in the DCM. The following assumptions and area characteristics were input into the model:

- 1) The area was modeled for full development;
- 2) At full development, all roads will be paved;
- 3) Where as-built information is unavailable, pipe and ditch slopes were assumed to be the same as the centerline road slopes;
- 4) Future development and upgrades outside the drainage boundaries will not increase existing drainage boundaries; and
- 5) The design mode was used to determine the minimum pipe diameters.

*Basin Characteristics*

The basin characteristics for the residential subdivision surrounding the project are as follows:

**Table F2: Percentage of Impervious Area**

<b>Zone</b>	<b>Directly Connected<sup>1</sup></b>	<b>Indirectly Connected<sup>1</sup></b>
Residential 3 to 6 units per acre	17%	13%
Public Lands and Institutions	35%	10%
Commercial	70%	20%

<sup>1</sup> Percentage of Impervious Area Based on DCM Section 2.5 C, Table 2-2 unless otherwise noted.

*Design Storm*

A 10-year, 3-hour storm was used as the design event to determine pipe sizes. A 2-year, 6-hour storm was used for water quality considerations. Per the DCM, a rainfall intensity adjustment factor of 1.15 was applied to the Anchorage International Airport (AIA) hyetograph.

*Drainage Characteristics*

Evaluating as-built data, topographic mapping, existing drainage studies, and site inspections determined existing drainage patterns. Manning’s coefficient of roughness (“n” value) for all ditches, swales, and pipes were determined. An “n” value of 0.024 was used for the corrugated metal pipe and a value of 0.012 was used for smooth-walled metal pipe.

*Sub-Basin Identification*

Figures F2 and F3 depict the various branches, reaches, and sub-basins of the ILLUDAS model. Drainage Basin 1 was subdivided into sub-basins for the purpose of determining the area contributing to each branch of the storm drain network. As with the major delineation, sub-basin

development was primarily based on field investigation and review of topographical contour mapping.

Drainage Basin No. 2 was also subdivided into sub-basins for modeling. This division was based on the layout of the piping, and the impervious pavement percentages based on land use. Branch-Reach 1-1 was modeled with a higher percentage of impervious areas to account for the commercial nature of the land. Branch-Reach 1-0 was modeled with the impervious area for residential lots.

*Model Results*

The following table summarizes the results of the ILLUDAS model for each basin:

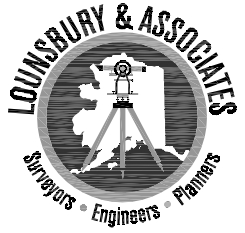
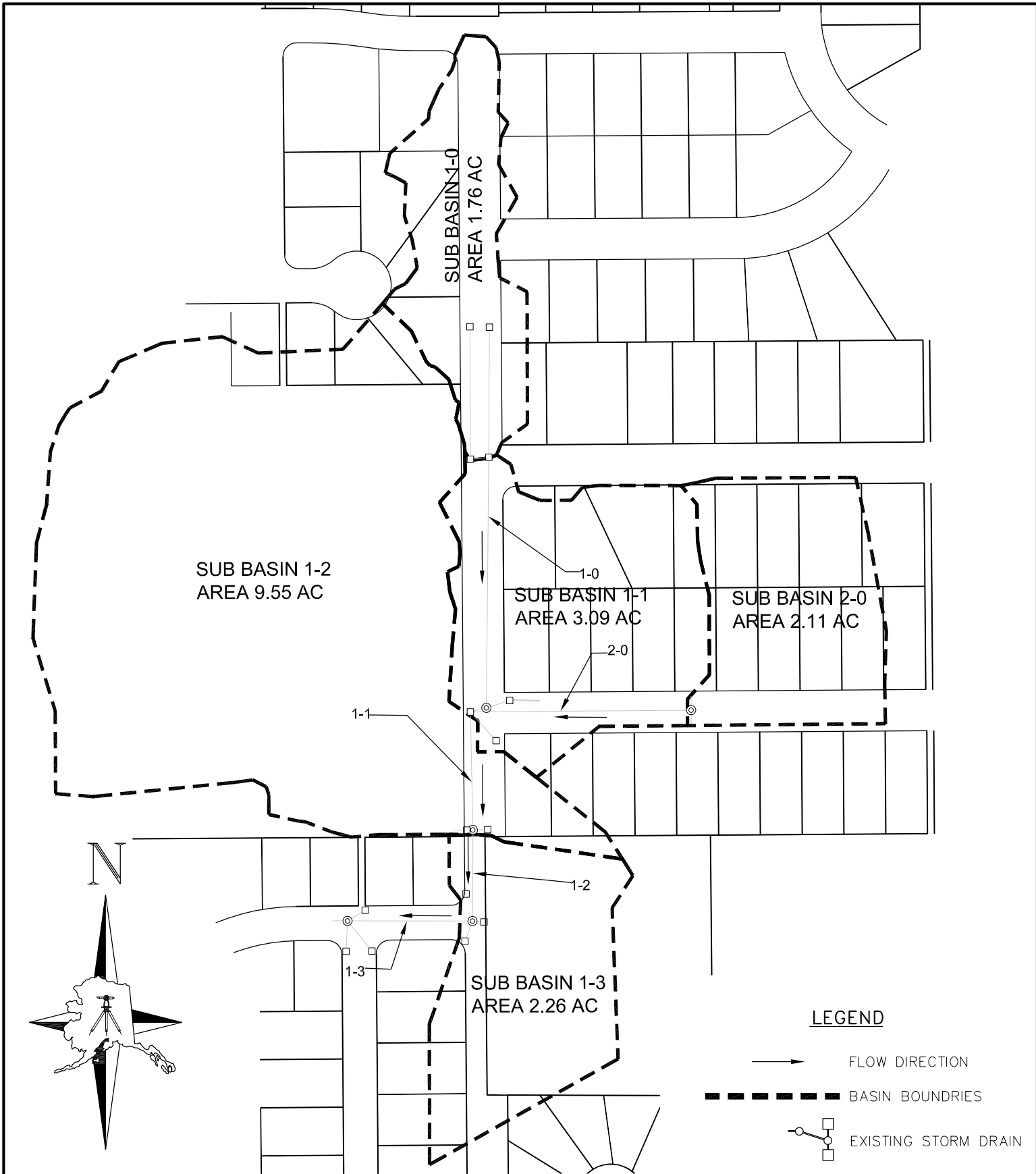
**Table F3: Model Runs**

Basin	Branch-Reach	Design Flow	Existing Pipe	Required Pipe Size*	
				High Flow (n=0.012)	CMP (n=0.024)
<b>Basin No. 1</b>	1-0	0.405 cfs	6" plastic	12-inch	12-inch
	2-0	0.485 cfs	15" CMP	12-inch	12-inch
	1-1	1.199 cfs	15" CMP	12-inch	15-inch
	1-2	5.434 cfs	15" CMP	18-inch	24-inch
	1-3	5.300 cfs	15" CMP	18-inch	24-inch
<b>Basin No. 2</b>	1-0	0.781 cfs	12" CMP	12-inch	12-inch
	1.1	3.897 cfs	12" CMP	15-inch	18-inch

\* Pipe size based on maintaining existing pipe slopes

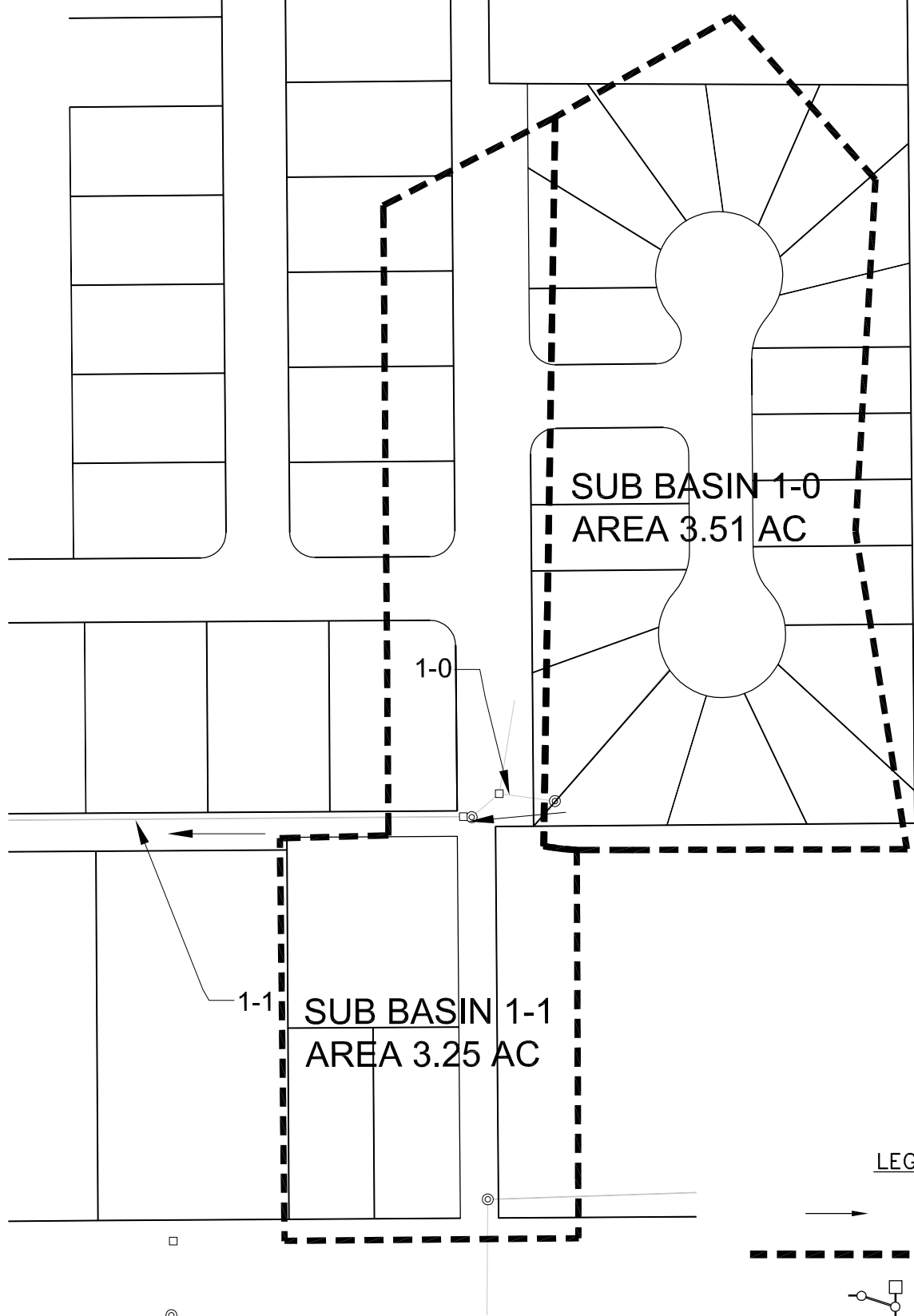
F.6 Alternatives Considered

The storm drain mains along Edward Street are substandard in two respects. The first is the size of the pipes. The 6-inch diameter pipes at the north end of Basin 1 do not meet the minimum requirement of the DCM. Secondly, the 15-inch pipes at the south end of Basin No. 1 are undersized according to the ILLUDAS modeling. For Basin 2, the pipes are slightly undersized and should be replaced. With proposed changes to the profile of the road and the improvements to the side street intersections, it is recommended that the storm drain system in Edward Street be replaced. These improvements should be extended to the first manhole in Winding Way for Basin No. 1 and the first manhole in the alley south of 12<sup>th</sup> Avenue for Basin No. 2.



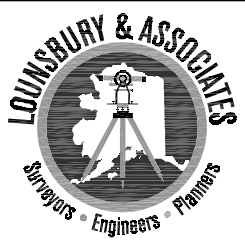
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FIGURE F2  
 EDWARD STREET UPGRADE  
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 ILLUDAS MODEL SCHEMATIC  
 BASIN 1



**LEGEND**

- FLOW DIRECTION
- BASIN BOUNDARIES
- ○ EXISTING STORM DRAIN



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**FIGURE F3**  
**EDWARD STREET UPGRADE**  
**PM&E PROJECT 00-026**  
**ILLUDAS MODEL SCHEMATIC**  
**BASIN 2**

#### F.7 Runoff Water Quality Considerations

Currently, the runoff along Edward Street receives little to no pretreatment prior to entering the storm drain system. It is recommended that as the storm drain system is reconstructed, a storm water quality treatment system be installed. With the limited ROW and full development of the adjoining lots, treatment options are extremely limited. Development of bioswales or other similar treatments is not practical within the project limits. To improve water quality within the project limits, an inline treatment system is recommended. A Stormceptor STC 2400 for Basin 1 and Basin 2 or equivalent as manufactured by CDS is recommended.