

# Terminal Sanitary Utility Study

For

## General Mitchell International Airport

Prepared for:

Milwaukee County Department of Transportation  
And Public Works

Milwaukee Wisconsin

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## Executive Summary

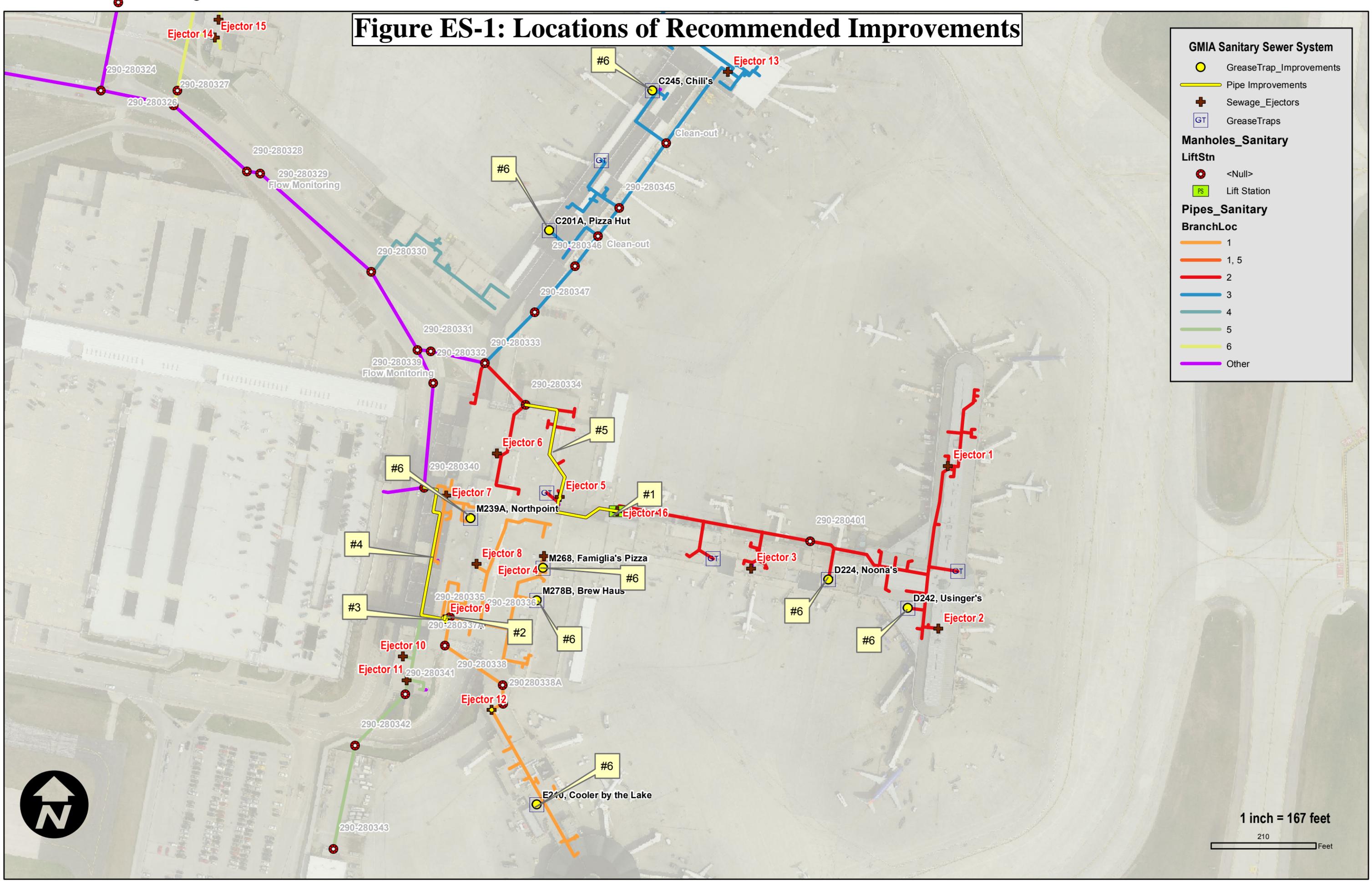
The General Mitchell International Airport (GMIA) Sanitary Sewer Evaluation Study of the sanitary sewer collection system, as detailed in the RFP dated April 22, 2010, has been completed. The purpose of the study was to analyze the GMIA sanitary sewer collection system and recommend solutions for resolving the deficiencies that currently plague the system. The following recommended improvements are presented below:

**Table ES-1 – Recommended Improvements**

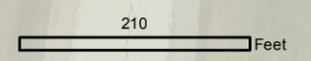
<b>Recommended Improvement</b>	<b>Cost</b>
1. Replace sewage ejector (Ejector #16) with new grinder pump system west end of Concourse D.	\$64,231
2. Replace the under-sized 6-inch piping between Manhole 290-280335 and Ejector #9 with 20 feet of 8-inch pipe.	\$3,794
3. Replace pneumatic pump (Ejector #9) with new pneumatic pump system (Two (2) 250 GPM pumps) serving south end of baggage claim.	\$144,723
4. Replace the under-sized 6-inch piping between Service Entry (Map ID 9) and the pneumatic pump (Ejector #9) with 330 feet of 10-inch pipe	\$58,097
5. Replace the under-sized 6-inch line between Ejector #16 and manhole 290-280334 with 20 feet of 8-inch pipe.	\$37,017
6. Replace 7 Grease Interceptors	\$77,500
<b>Total Estimated Project Cost</b>	<b>\$385,362</b>

Figure ES-1 shows the locations of these recommended improvements.

# Figure ES-1: Locations of Recommended Improvements



1 inch = 167 feet



## 1.0 Background

Over the past several years the existing sanitary sewer collection system in the GMIA has experienced overloading and grease related issues causing portions of the system to be shut down for emergency maintenance. As the number of restaurants within the terminal has grown, demands have been placed on the system that it was not designed to meet. As a result, the system suffers from recurrent pipe clogging and overflows. Maintenance personnel indicate that several of the sewage ejectors have reduced capacities due to the buildup of grease in the pump chambers.

In September of 2010 the Airport commissioned Kapur and Associates Inc.; in association with PSJ Engineering, Inc., to review, identify deficiencies, and provide recommendations to improve the overall performance of the sanitary sewer system. Site system investigations were performed to verify record drawings and plans provided by the Airport Engineering Staff. This report summarizes the findings of this investigation and recommends improvements. This study included the preparation of a Geographic Information System (GIS) of the sanitary sewer system based upon GMIA record drawings, field investigations, and existing GIS data.

## 2.0 Work Performed

The following narrative identifies tasks performed during this investigation as specified in the original scope of services.

### 1. Reviewed Record Drawings:

Digital files and paper copies of the sanitary collection system were provided by the GMIA Engineering Department. These documents were reviewed to obtain an initial overview of the present system configuration. The complete list of reviewed documents during this investigation is provided in Appendix A. The reviewed data included:

- a. Forty-nine (49) digital engineering files were reviewed covering the following areas:
  - Concourse C Stem and Hammerhead
  - Concourse D Security Checkpoint and Stem
  - Main Terminal
- b. One-hundred-seven (107) paper engineering drawings were reviewed covering the following areas:
  - FAA Weather Office in the Administration Building
  - Main Terminal
  - Midwest Airlines Concourse D Remodel, Apron Office and Plumbing Upgrades
  - Various drawings covering the main terminal and each concourse

### 2. Met with Airport Staff:

A kick-off meeting and several follow up sessions were conducted to exchange information, align expectations and provide a venue for project feedback.

- a. Kick-Off Meeting, 1/20/2011

Attendees:

Ed Baisch – GMIA Engineering; Bob Wagner – PSJ Engineering; Dave Misun – Kapur; Terry Blue – GMIA Deputy Director, O&M; Christopher Lucas – GMIA Maintenance Manager; John Moore – GMIA Landside Operations Manager; Jerry Peterson – GMIA HVAC Maintenance Supervisor

Items Discussed:

- Need for a restaurant fixture count
- Implement best practice solutions to resolve deficiencies
- Pneumatic sewage ejector in basement of Main Terminal – Severe grease issues

- D-Stem Lift Station – Signs of grease build-up
  - Recently increased E Concourse Lift Station capacity
  - Some floor drains eliminated in ground floor bag rooms
  - Demand spikes: Arriving flights – toilets, departing flights – restaurants
  - Increase in aircraft waste being discharged into collection system
  - Evidence of clear flows in some segments
- b. Meeting with GMIA Plumbing Staff, 3/23/2011
- Attendees:  
Jim G. – GMIA Staff Plumber; Bob Wagner – PSJ Engineering, Dave Misun - Kapur
- Items Discussed:
- Sewage Ejectors  
D-Stem (North) and Hammerhead  
E-Concourse @ N End of Line  
Lower Level Baggage Claim
- c. GIS Meetings Conclusions
- Attendees:  
Timothy Pearson – GMIA GIS Specialist; Ed Baisch – GMIA Engineering;  
Tom Wagner & Dave Misun – Kapur
- Items Discussed:
- CAD drawings of entire sanitary collection system available, will incorporate into the GIS
  - Floor plans available in database format compatible with proposed GIS

### 3. Update sewer plans:

Relevant engineering drawings were updated based upon information obtained from field visits and interviews with GMIA Plumbing Department staff.

- a. Updated sewer system plan provided by GMIA to reflect field observations. The digital file is in an AutoCAD DWG format and will be **included on the CD** containing the GIS data.

### 4. Setup GIS system for sanitary sewer system:

A GIS of the sanitary collection structures was created from the data supplied by the GMIA Engineering Department and updated with information collected during field visits. The geodatabase includes:

- a. Environmental Systems Research Incorporated (ESRI) Geodatabase Format
- b. ESRI is compatible with existing GMIA GIS
- c. The GIS data produced for this project is viewable with various versions of ESRI software, including a free application called ArcReader. GMIA already has a GIS in place and this new data will be available using any of the methods currently employed by the airport staff. The data will be delivered in an ESRI shapefile format incorporated on a CD.

## **5. Identify and inventory wastewater fixtures:**

Grease traps and sewage pumps were field located and the make, model number, and capacity were recorded where available. Sanitary manholes were inspected on an as-needed basis. Wastewater fixtures such as toilets, sinks, showers, pumps, etc., were identified on the engineering drawings and field verified.

- a. Kapur & PSJ staff conducted field visits to GMIA on the following dates:
  - 3/15/2011 & 3/16/2011
  - 3/23/2011
  - 4/2011
  - Additional visits by PSJ Staff
- b. Sinks and toilets comprise the dominant class by number of fixtures in the airport terminal complex. These fixtures were identified on the engineering drawings and field-verified. Showers, mop basins, and grease traps were counted in the field. The make, model number, and other sewage ejector information/relevant data were collected where available.

### 3.0 Sanitary Sewer System Fixture Inventory

The sanitary sewer system in the terminal area of GMIA consists of six different branches, numbered 1 through 6 for the purpose of this study. Table 1 presented below lists the total number of fixtures identified on the engineering drawings and/or during the field review. The complete fixture inventory by room number is listed in Appendices B. See Figure 1 for branch locations.

**Table 1 – Sanitary Sewer Fixture Summary By Branch**

Branch	Location	Toilets	Sinks	Urinals	Showers	Mop Basins	Dishwashers	Grease Traps
1	Concourse E/S End of Main Terminal	70	94	22	5	3	5	4
2	Concourse D/N End of Main Terminal	89	110	28	3	2	3	4
3	Concourse C Stem/ Hammerhead	54	68	17	2	1	1	3
4	Administration Building	16	13	6	4	--	--	--
5	Corporate Aviation Facilities	5	6	3	--	--	--	--
6	International Arrivals Building	10	9	5	1	--	--	--
<b>TOTAL</b>		<b>244</b>	<b>300</b>	<b>81</b>	<b>15</b>	<b>6</b>	<b>9</b>	<b>11</b>

# Figure 1: Fixture Inventory

**GMIA Sanitary Sewer System**

- Bathrooms
- Sinks\_Basins\_Fountains
- Inlets

**Manholes\_Sanitary**

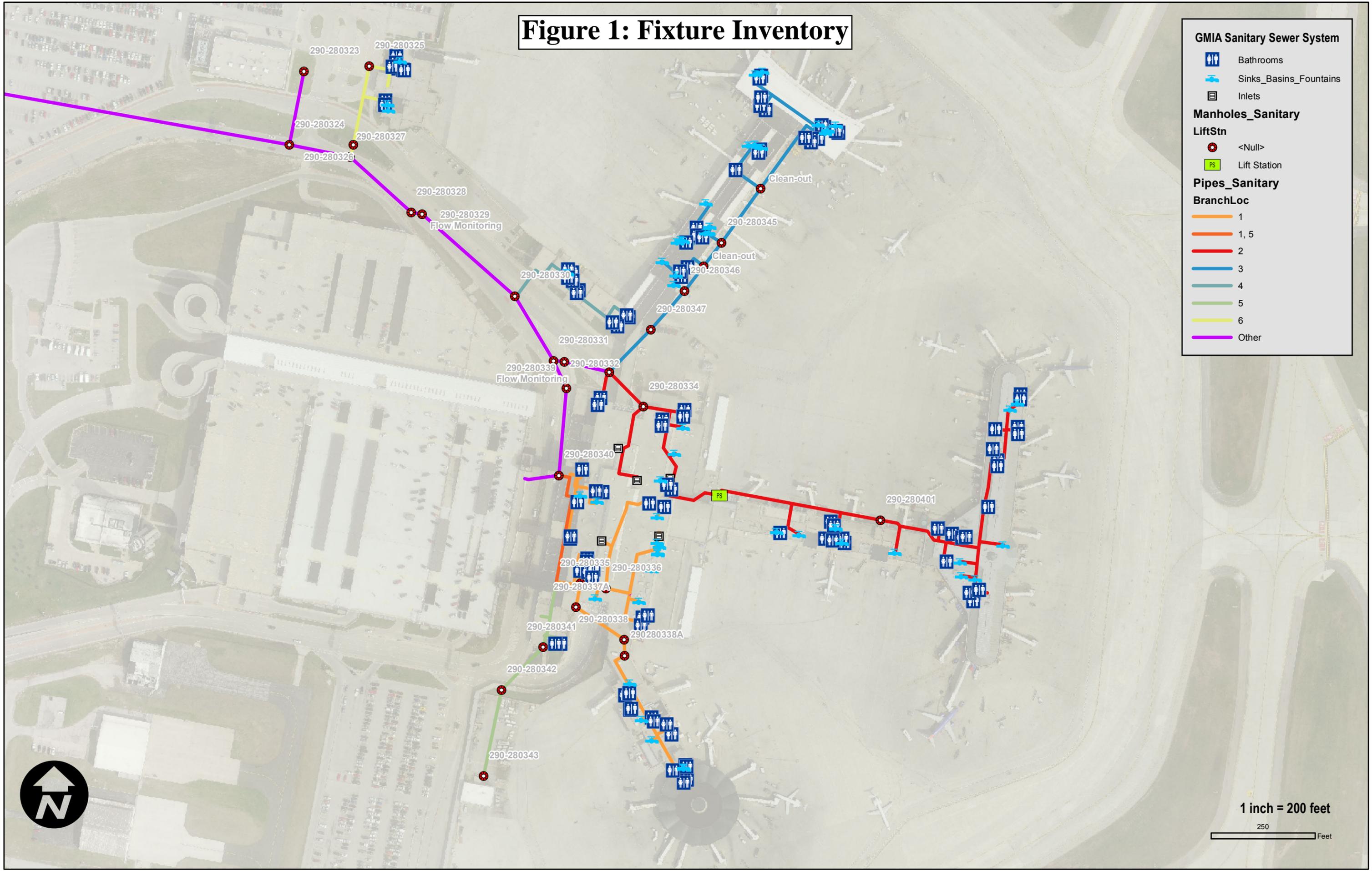
**LiftStn**

- <Null>
- Lift Station

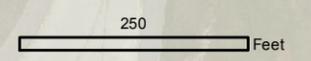
**Pipes\_Sanitary**

**BranchLoc**

- 1
- 1, 5
- 2
- 3
- 4
- 5
- 6
- Other



1 inch = 200 feet



## 4.0 Sanitary Sewage Ejectors and Sumps

Figure 2 shows the location of the existing terminal ejectors. Table 2 summarizes the location, size, make/model, etc. for each ejector. Appendix C provides more specific details for each ejector such as serial number, room number, horse power, etc.

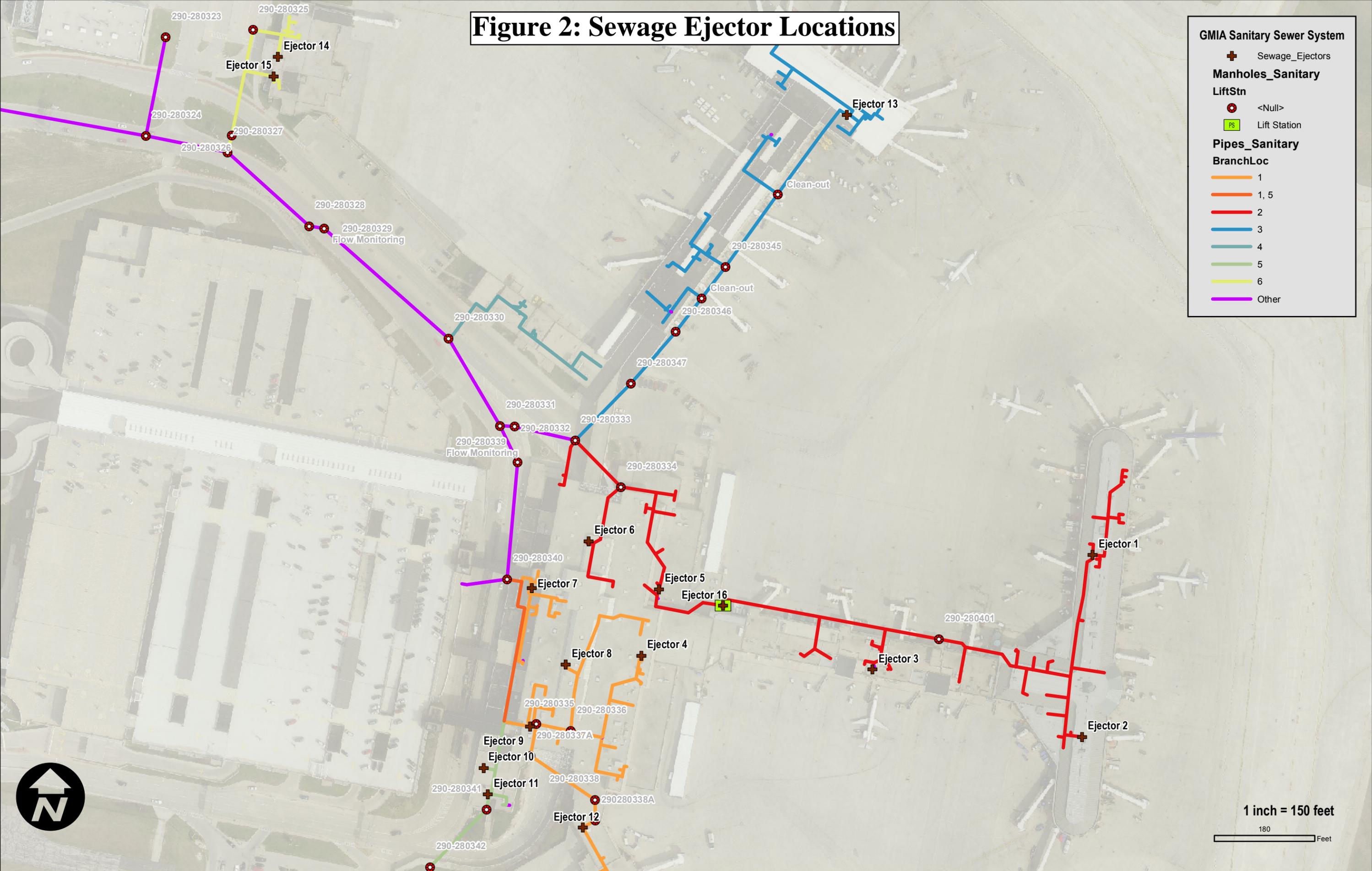
**Table 2 – Sewage Ejector Summary**

Ejector ID	Location	Branch Location	Description
1	D174A, D Concourse	2	3-inch Weil, Private Owner, 1 HP
2	D122B, D Concourse	2	3-inch ABS Sanitary Sump, Private Owner
3	D106, D Concourse	2	2-inch Weil (Noona's), 2-inch to 4-inch run
4	Room 38	1	4-inch Weil, Kitchen Sewage Ejector
5	NE end of tug tunnel	2	4-inch Weil Vertical Sewage, 2.5-Inch Solids, Model 2224
6	NW end of tug tunnel	2	4-inch Weil Vertical Sewage, 2.5-Inch Solids, Model 2224
7	Adjacent to Room 56A	1	4-inch Weil Vertical Sewage, 2.5-Inch Solids, Model 2224
8	SW end of tug tunnel	1	4-inch Weil Vertical Sewage, 2.5-Inch Solids, Model 2224
9	Baggage Claim Building Lower Level, Adjacent to Room 84B	1	Pneumatic Ejector - Dual
10	Room 73 (N End)	5	4-inch Weil Submersible Sump, 2 HP
11	Room 73 (S End)	5	4-inch Weil Submersible Sump, 2 HP
12	Under walkway @ N end of E Concourse	1	4-inch Weil Submersible Sump, 2 HP
13	C151A, C Concourse	3	Dual 3-inch Weil w/ grinder vanes
14, 15	IAB Basement	6	2-inch Sanitary, 1.5-inch Storm; Weil
16	D-Stem Lift Station	2	Dual 4-inch BJM Pumps, 5 HP

# Figure 2: Sewage Ejector Locations

**GMIA Sanitary Sewer System**

- Sewage\_Ejectors
- Manholes\_Sanitary**
- LiftStn**
  - <Null>
  - Lift Station
- Pipes\_Sanitary**
- BranchLoc**
  - 1
  - 1, 5
  - 2
  - 3
  - 4
  - 5
  - 6
  - Other



## 5.0 Inspection of Manhole, Grease Traps, Pump Stations, and Restaurant Spaces

The food service locations in the Main Terminal and each concourse were visited to observe fixture layout and note any issues that might result in the discharge of grease or unsuitable material into the collection system. Results are listed in Appendix-D.

The accumulation of grease in sewage ejector #16 and pneumatic pump system (ejector #9) is a major operational and maintenance issue, especially with the system serving the D Concourse. Even though all the restaurants/food serving areas have grease interceptors installed near dishwashing equipment and sinks, food-related grease is still entering the sanitary collection system. In April 2011, the 6-inch sanitary sewer line that serves the south area of the Main Terminal (concourse level) experienced an overflow event and upon inspection, was found to be packed with grease along its entire length. Several restaurants are located in the space served by the line; the overflow negatively impacted the ticketing area on the ground floor level.

The location and maintenance of the grease traps in some of the leased areas that offer food service appears to be sub-optimal. The in-floor grease trap at The Brew Haus, located in the Main Terminal, appears to not have been serviced/maintained on a regular basis. The cover is bolted down and covered with debris that appears to have been in place for quite some time. The trap at Famiglia's Pizza, also in the Main Terminal, is decrepit, contains no identifying marks or tags, and does not appear to have been replaced when the leased space was remodeled for the new tenant.

The set of pneumatic ejectors located in the lower level of the Baggage Claim Building (Ejector #9) and the lift station located at the north side of the Concourse D-Stem adjacent to the Main Terminal (Ejector #16), handle the majority of the solids loads. The entire D Concourse discharges through this Lift Station and the pneumatic pump receives waste from the entire E Concourse and the south half of the Main Terminal. Signs of grease build-up are present in the lift station chambers, as well as in the chambers of each pump at the pneumatic ejector. The level sensors in this pneumatic sewage ejector have been modified in an attempt to maintain capacity. According the Plumbing Staff, the discharge line from the ejector shows no sign of build-up, thus upstream from the inlet is where mitigation strategies should be implemented.

Concourse D also contains two privately owned sewage ejectors located on the north and south ends of the Concourse D extensions referred to by airport staff as the Hammerhead. The north one serves Frontier Airlines (Ejector #1) and is where the aircraft holding tank contents are discharged into the sanitary collection system. The other ejector serves Southwest Airlines (Ejector #2) and performs the same function at the north location. These locations do not appear to have grease related issues in normal operation, but work procedures must be monitored to ensure that unsuitable objects are not discharged into the collection system. Sanitary ejector locations are referenced on Figure 2.

## 6.0 Water Usage and Waste Water Discharge Based on Fixture Counts

Once the fixture inventory was completed, each fixture's contribution to the overall system load was calculated. For this sewer system analysis, the use of the Department of Commerce's standard Drainage Fixture Unit (DFU) was utilized. A curve of pipe capacity based upon pipe diameter and slope is provided in Appendix E. Table 3 summarizes the estimated sanitary flow and pipe capacities for each pipe (ID) location. Figure 3 references the locations of each ID. A detailed description and report of water usage and waste water discharge is provided in Appendix E.

**Table 3 – Sanitary Sewer Load vs. Capacity**

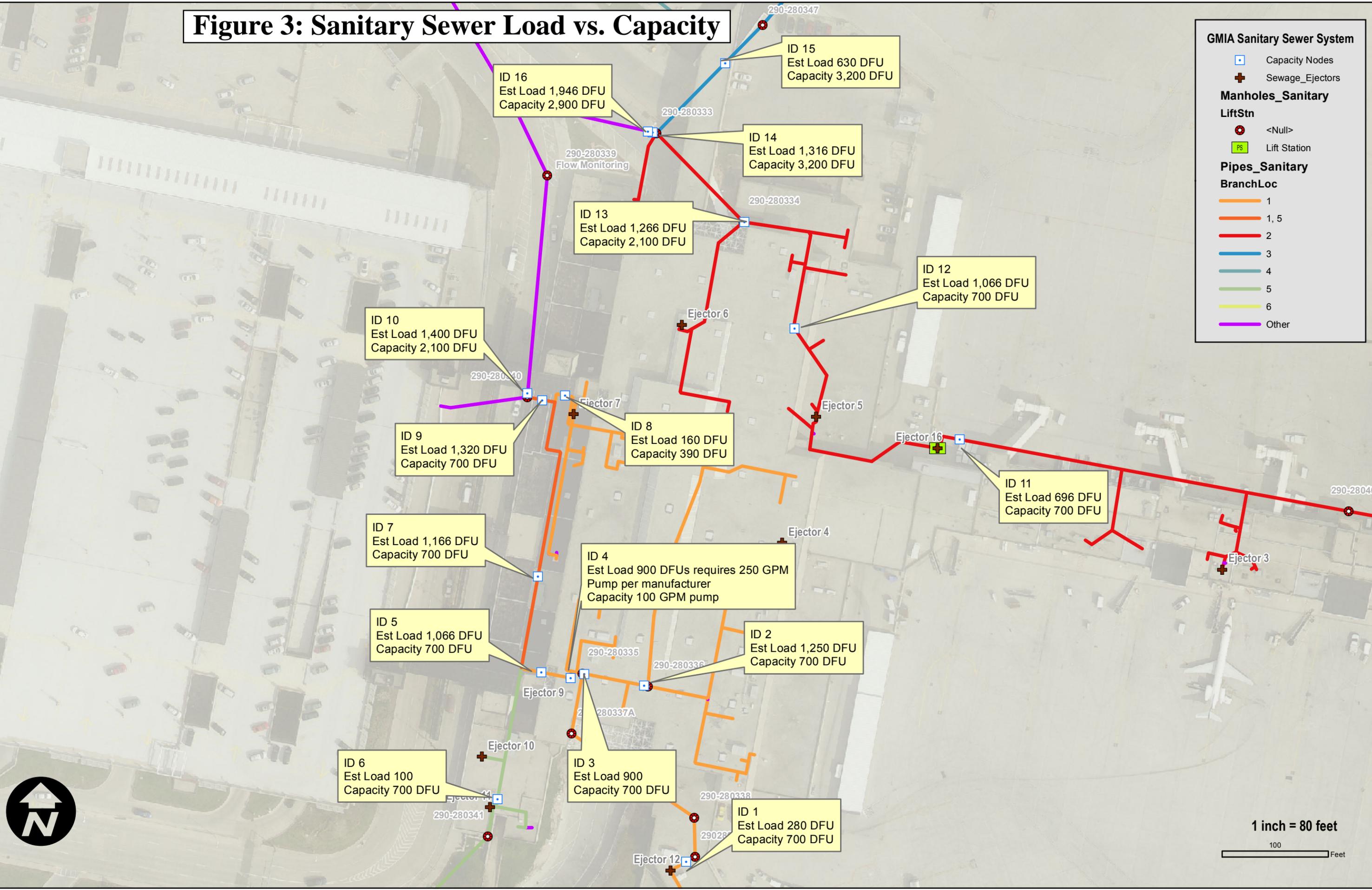
MAP ID	ESTIMATED LOAD (DFU)	EXISTING PIPE SIZE	CAPACITY OF PIPE (DFU)
1	280	6	700
2	1,250	6	700
3	900	6	700
4	900 DFUs Requires 250 GPM pump, per manufacturer	Pneumatic Pumps	100 GPM
5	1,066	6	700
6	100	6	700
7	1,166	6	700
8	160	5	390
9*	1,320	6	700
10	1,400	10	2,100
11	696	6	700
12	1,066	6	700
13	1,266	8	2,100
14	1,316	10	3,200
15	630	10	3,200
16	1,946	10	3,200

\* Pipe is being replaced as part of a separate GMIA project.

# Figure 3: Sanitary Sewer Load vs. Capacity

**GMIA Sanitary Sewer System**

- Capacity Nodes:
- Sewage\_Ejectors:
- Manholes\_Sanitary**
- LiftStn**
  - <Null>:
  - Lift Station:
- Pipes\_Sanitary**
- BranchLoc**
  - 1:
  - 1, 5:
  - 2:
  - 3:
  - 4:
  - 5:
  - 6:
  - Other:



1 inch = 80 feet  
100 Feet

## 7.0 Identify Bottlenecks in Sanitary Sewer System

Areas where the collection system load exceeds capacity were identified. Capacity upgrades for these areas were developed and discussed in section 9.0. Table 4 summarizes the bottlenecks (locations where pipe capacities are exceed). Figure 4 identifies the locations of the bottlenecks.

**Table 4 - Sanitary Collection System Bottlenecks**

MAP ID	ESTIMATED LOAD (DFU)	EXISTING PIPE SIZE	CAPACITY OF PIPE (DFU)
2	1,250	6	700
3	900	6	700
4	900 DFUs Requires 250 GPM pump, per manufacturer	Pneumatic Pumps	100
5	1,066	6	700
7	1,166	6	700
9*	1,320	6	700
12	1,066	6	700

\* Pipe is being replaced as part of a separate GMIA project.

# Figure 4: System Bottlenecks

**GMIA Sanitary Sewer System**

- ✕ System\_Bottlenecks
- ⊕ Sewage\_Ejectors
- GT GreaseTraps

**Manholes\_Sanitary**

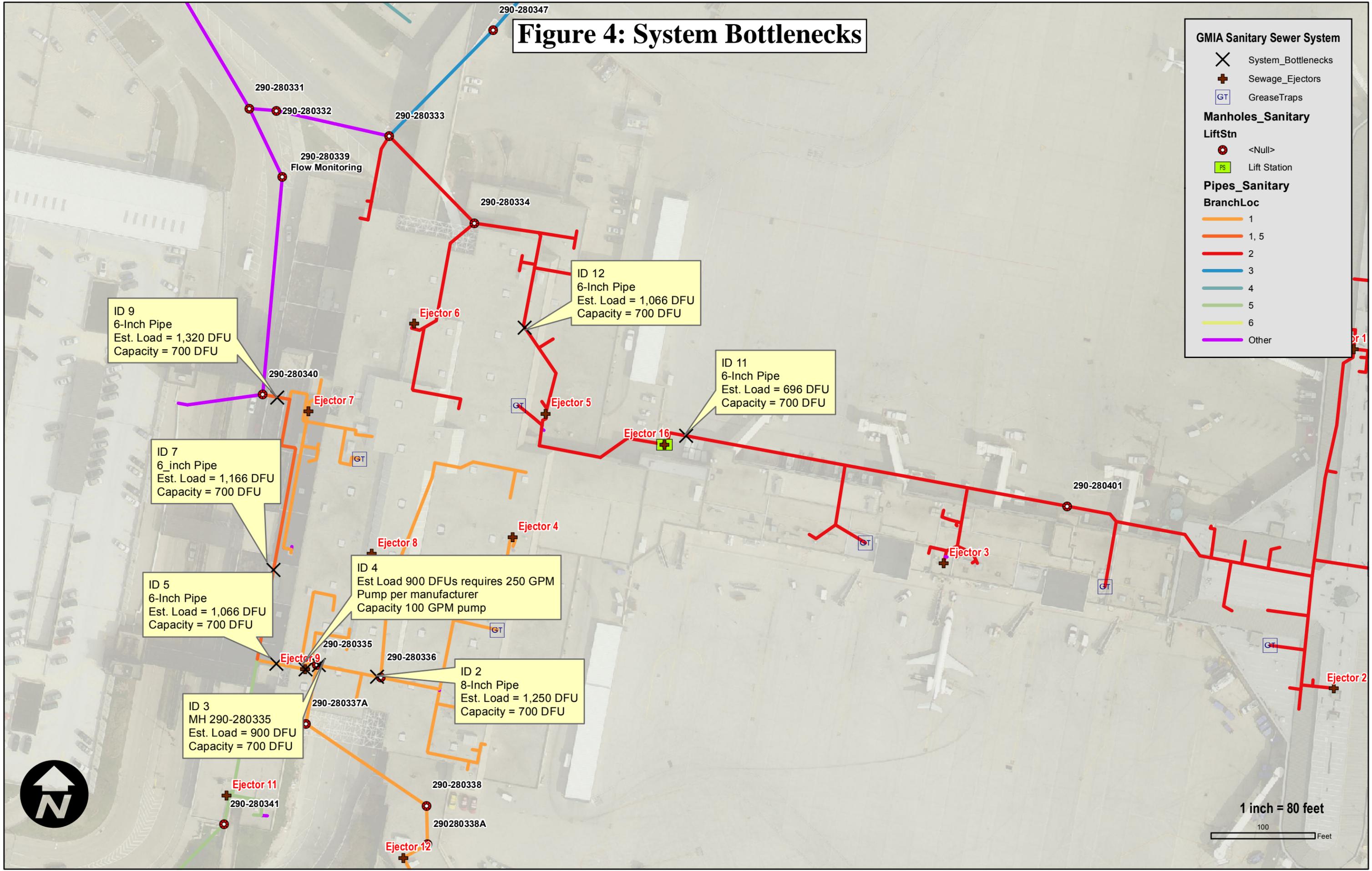
**LiftStn**

- ⊕ <Null>
- PS Lift Station

**Pipes\_Sanitary**

**BranchLoc**

- 1
- 1, 5
- 2
- 3
- 4
- 5
- 6
- Other



## **8.0 Qualitative Spot Check of Sanitary Flows at Select Manholes**

Flow measurements were checked at select manholes to verify the loading values calculated from the fixture counts. Sanitary flow monitoring identified the maximum depth of sanitary flow to be less than half of the pipe diameter. The exterior sanitary sewer, namely the 15” line, is not the cause of backups based upon field verification (spot checking sanitary flows). Spot check Flow Monitoring data is summarized in Appendix F.

## **9.0 Recommended Sanitary Sewer System Improvements**

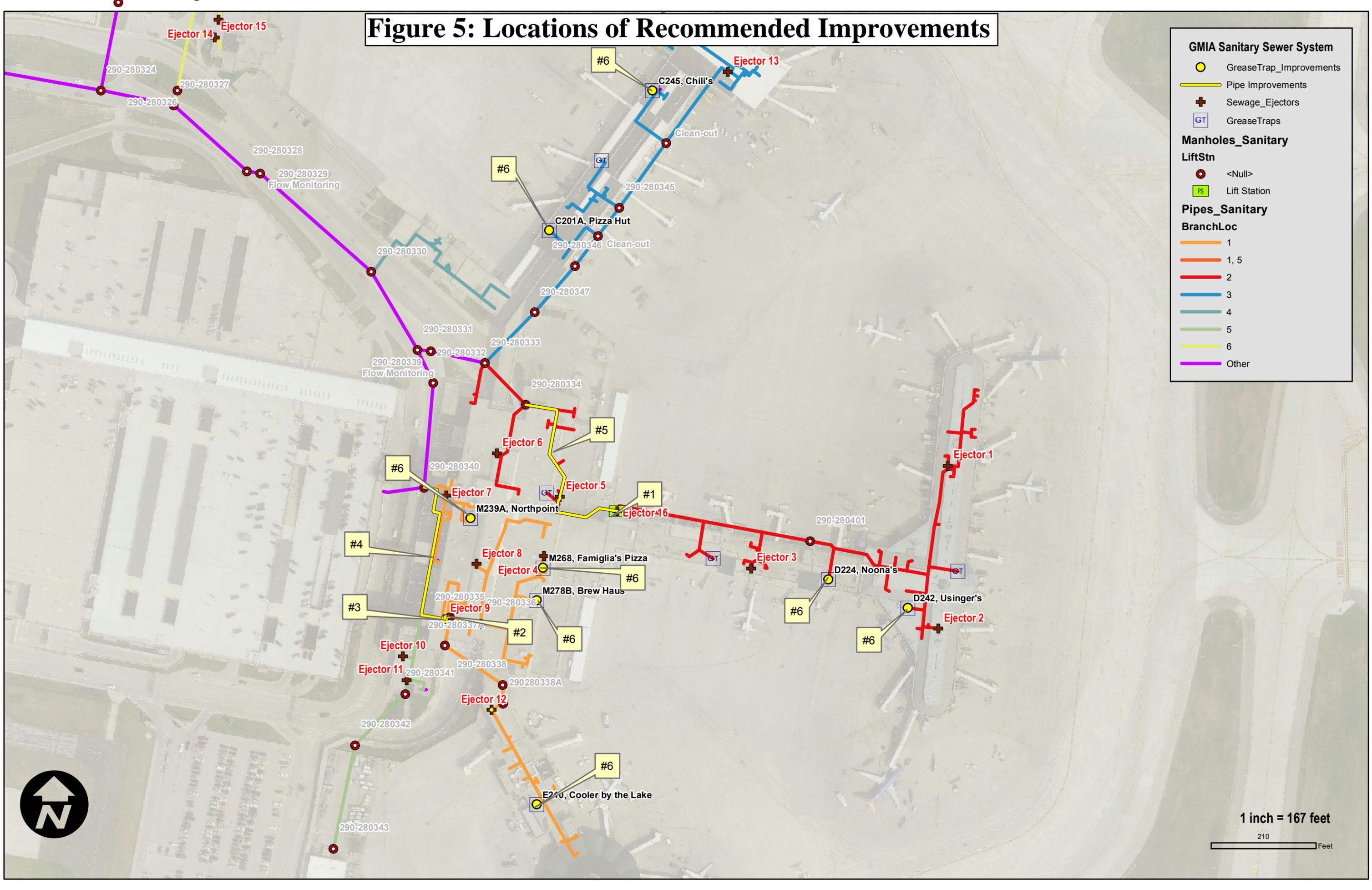
Recommended system improvements and cost estimates were identified to guide the allocation of capital resources for improvements to the collection system moving forward. Detailed cost estimates are provided in Appendix G.

The sanitary sewer lines that are recommended for upgrade are proposed to be replaced in place; conflict with other utilities or structures should be minimal. Table 5 details recommended improvements, including cost. Figure 5 identifies the locations of recommended improvements.

**Table 5 – Recommended Sanitary Sewer Improvements**

Map ID	Description	Estimated Length (LF)	Comments	Cost
1	Replace sewage ejector (Ejector #16) with new grinder pump system west end of Concourse D.	N/A	Requires wet well to be deepened and new maintenance friendly duplex grinder pump system with interlock to other parallel pumping systems. Temporary pumping to be provided during installation.	\$64,231
2	Replace the under-sized 6-inch piping between Manhole 290-280335 and Ejector #9 with 20 feet of 8-inch pipe.	20	Requires open cut through roadway and curb in tug tunnel.	\$3,794
3	Replace pneumatic pump (Ejector #9) with new pneumatic pump system (Two (2) 250 GPM pumps) serving south end of baggage claim.	NA	Requires temporary pumping during installation.	\$144,723
4	Replace the under-sized 6-inch piping between Service Entry (Map ID 9) and the pneumatic pump (Ejector #9) with 330 feet of 10-inch pipe.	330	Accessible and has already bridged the luggage conveyor. Check valve located between two pumps to prevent cross-flow and the upgraded pipe capacity (6-inch to 10-inch) should be sufficient to handle any discharge even if both are operating simultaneously. Can electrically lock out non-pumping station when other station is pumping, then let non-pumping station pump down	\$36,300
5	Replace the under-sized 6-inch line between Ejector #16 and manhole 290-280334 with 20 feet of 8-inch pipe.	20	Runs mostly through office areas. Section to Lift Station will require open cut through tug tunnel roadway and curb.	\$2,200
6	Replace 7 Grease Interceptors	NA		\$77,500
<b>TOTAL ESTIMATED PROJECT COST</b>				<b>\$385,362</b>

# Figure 5: Locations of Recommended Improvements



**GMIA Sanitary Sewer System**

- GreaseTrap\_Improvements
- Pipe Improvements
- + Sewage\_Ejectors
- GT GreaseTraps

**Manholes\_Sanitary**

**LiftStn**

- <Null>
- PS Lift Station

**Pipes\_Sanitary**

**BranchLoc**

- 1
- 1, 5
- 2
- 3
- 4
- 5
- 6
- Other



1 inch = 167 feet

210 Feet

## Grease Traps and Interceptors

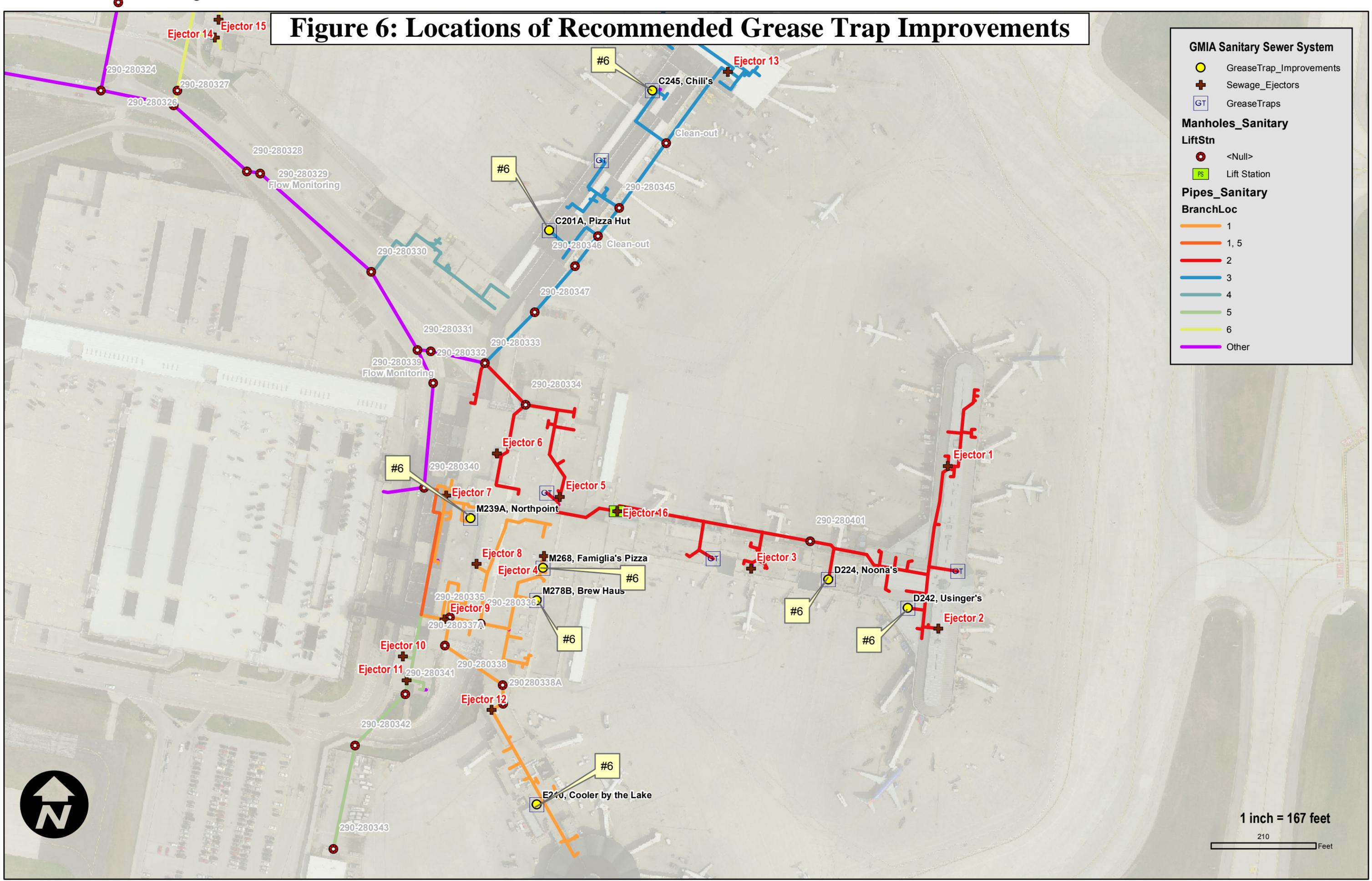
The installation of larger grease interceptor units is recommended, sized for the entire kitchen load, at the end of the restaurant waste line and upstream of its connection to the sanitary waste line. At this point in the waste stream no restroom fixtures would be involved. All of the grease traps inspected for this project were connected too close to the fixtures being served and did not have sufficient line length to allow the grease to cool before discharging into the grease trap. This results in grease pushing past or washing through the interceptors and coagulating farther down the sanitary collection system, causing the problems being observed with the system. In addition, the suggested configuration has the advantage of collecting any grease inadvertently dumped into the floor drains.

Table 6 lists the facilities and Figure 6 depicts the locations of the proposed grease trap interceptors. It is suggested that the replacements be made a priority maintenance project and installed as soon as budgetary limits allow.

**Table 6- Recommended Grease Trap Improvements**

<b>Facility</b>	<b>Location</b>	<b>Suggested Grease Trap Location</b>	<b>Cost</b>
Cooler By The Lake	E Concourse	Apron Level Mechanical Room	\$9,500
Northpoint	Main Terminal	TBD	\$15,000
Famiglia's Pizza & Brew Haus	Main Terminal	In Baggage Makeup as piping drops through the space	\$15,000
Noona's	D Concourse	Apron Level Mechanical Room	\$9,500
Johnny Rockets & Usinger's	D Concourse	TBD	\$9,500
Chili's	C Concourse	Apron Level Mechanical Room	\$9,500
Pizza Hut	C Concourse	Apron Level Mechanical Room	\$9,500
		<b>Estimated Total Cost</b>	<b>\$77,500</b>

# Figure 6: Locations of Recommended Grease Trap Improvements



1 inch = 167 feet  
210 Feet

## **APPENDIX-A: REVIEWED DRAWING LIST**

<b>Digital Drawings</b>	
<b>A006 Conc C Expansion &amp; Hammerhead</b>	
.\c-16.1.dwg	Site Plan
.\c-4.dwg	Utility Plan & Profiles
.\conc c hammerhead - c4.dwg	Utility Plan & Profiles
<b>A048 D Security Checkpoint</b>	
.\03004001.dwg	Site Plan
.\03004002.dwg	Site Plan
.\p100.dwg	Demolition - Plumbing
.\p200.dwg	Foundation Plan - Plumbing
<b>A048 D Stem Improvements</b>	
.\c001.dwg	Site Plan
.\c002.dwg	N/A
.\c005.dwg	Site Utilities Plan
.\p000-rec.dwg	Cover Sheet - Plumbing
.\p100-rec.dwg	Demolition - Plumbing
.\p101-rec.dwg	Demolition - Plumbing
.\p102-rec.dwg	Demolition - Plumbing
.\p103-rec.dwg	Demolition - Plumbing
.\p104-rec.dwg	Demolition - Plumbing
.\p105-rec.dwg	Demolition - Plumbing
.\p106-rec.dwg	Demolition - Plumbing
.\p107-rec.dwg	Demolition - Plumbing
.\p108-rec.dwg	Demolition - Plumbing
.\p200-rec.dwg	Foundation Plan - Plumbing
.\p201-rec.dwg	Foundation Plan - Plumbing
.\p202-rec.dwg	Plumbing
.\p203-rec.dwg	Plumbing
.\p204-rec.dwg	Plumbing
.\p205-rec.dwg	Plumbing
.\p206-rec.dwg	Plumbing
.\p207-rec.dwg	Plumbing
.\p208-rec.dwg	Plumbing
.\p209-rec.dwg	Plumbing
.\p300-rec.dwg	Details - Plumbing
.\p400-rec.dwg	Isometric - Plumbing
.\p401-rec.dwg	Isometric - Plumbing
.\p500-rec.dwg	Isometric - Water
<b>A325 - New Parking Facilities</b>	
.\c001.dwg	Demolition
.\c002.dwg	Grading
.\he-cp301.dwg	Construction Staging

.\he-rm201.dwg	Utility Abandonment
.\he-san101.dwg	Sanitary Modifications
.\he-san102.dwg	Sanitary Modifications
.\nw-c001.dwg	Paving & Utility Plan
.\p100.dwg	Foundation Plan
.\p101.dwg	First Floor Plan
.\p102.dwg	Mezzanine Floor Plan
.\p103.dwg	Plumbing Schedule & Details
.\p104.dwg	Plumbing Isometrics
.\sp-rm101.dwg	Utility Abandonment
<b>Paper Drawings</b>	
<b>A326 - GMIA Airway Interior Remodeling</b>	
MYSCAN_20101007_0001.PDF	Demolition
MYSCAN_20101007_0002.PDF	Base Bid Plumbing & Riser Diagrams
MYSCAN_20101007_0003.PDF	Under Floor Piping
MYSCAN_20101007_0004.PDF	First Floor
<b>FAA Weather Bureau - Westend of admin bldg</b>	
MYSCAN_20100930_0021.PDF	Basement Plumbing
MYSCAN_20100930_0022.PDF	First Floor Plumbing
MYSCAN_20100930_0023.PDF	Second Floor Plumbing
MYSCAN_20100930_0024.PDF	Plumbing Details
<b>GMF Terminal Exp 02-9982</b>	
a201.pdf	Site Plan
p300.pdf	Lower Level Demolition
p301.pdf	Grade Level Demolition
p302.pdf	Second Level Demolition
p400 with notes.PDF	Lower Level Overall
p400.pdf	Lower Level Overall
p401.pdf	Grade Level Overall
p402.pdf	Second Level Overall
p403.pdf	Lower Level First Quadrant
p404.pdf	Lower Level Second Quadrant
p405.pdf	Lower Level Second Quadrant (South End)
p406.pdf	Lower Level Third Quadrant
p407.pdf	Lower Level Fourth Quadrant
p408.pdf	Grade Level First Quadrant
p409.pdf	Grade Level Second Quadrant
p410.pdf	Grade Level Second & Third Quadrant
p411.pdf	Grade Level Third Quadrant
p412.pdf	Grade Level Fourth Quadrant
p413.pdf	Second Level First Quadrant
p414.pdf	Second Level Second Quadrant



p415.pdf	Second Level Third Quadrant
p416.pdf	Second Level Fourth Quadrant
p417.pdf	Ops Mezzanine & Mech Deck
p418.pdf	Connection to Concourse A
p419.pdf	Grade Level North Concourse
p420.pdf	Second Level North Concourse
p421.pdf	Existing Tower
p422.pdf	Sub-drainage
p423.pdf	Sanitary, Vent & Water Piping Diagrams
p424.pdf	Sanitary, Vent & Water Piping Diagrams
p425.pdf	Sanitary, Vent & Water Piping Diagrams
p426.pdf	New Boiler House
<b>Midwest Airlines conc d remodel 87228</b>	
myscan_20101005_0001.pdf	Demo, Remodeling & Vent Piping
<b>Midwest apron office h-s-s 7-28-95</b>	
myscan_20100930_0037.pdf	Apron Level Plumbing & Risers
<b>Midwest Express Illingworth 9-24-98</b>	
myscan_20100930_0033.pdf	Under floor Plumbing
myscan_20100930_0034.pdf	Tarmac Level Plumbing
myscan_20100930_0035.pdf	D-W-V and Water Isometrics
myscan_20100930_0036.pdf	Detail Sheet
<b>various other</b>	
02-3057-p-1.pdf	Apron Level Plan (West)
02-3057-p-2.pdf	Apron Level Plan (Central)
02-3057-p-3.pdf	Apron Level Plan (East)
02-3057-p-7.pdf	Riser Diagrams
02-430-p-12.pdf	Riser Diagrams
02-4448-a-2.pdf	Unit A First Floor Plan
02-6430-a.1.1.1.pdf	Concourse D Phase III Site Plan
02-6430-a.1.4.1.pdf	Storm Sewer Relocation
02-6430-p-1.pdf	Existing Terminal & Site Plan
02-6430-p-10.pdf	Partial Concourse (West)
02-6430-p-11.pdf	Partial Concourse (South)
02-6430-p-1-2.pdf	Grade/Concourse/Roof Level Plans
02-6430-p-13.pdf	Section & Details
02-6430-p-1a.pdf	As-Built Partial Site Plan
02-6430-p-2.1.pdf	Apron Level Plumbing (North)
02-6430-p-2.2.pdf	Apron Level Plumbing (North Central)
02-6430-p-2.3.pdf	Plumbing & Fire Protection
02-6430-p-2.pdf	Partial Apron Level (North)
02-6430-p-3.pdf	Partial Apron Level (North Central)



02-6430-p-4.2.pdf	Waste & Vent Piping - North & North Central
02-6430-p-4.pdf	Partial Apron Level (Rotunda)
02-6430-p-5.pdf	Partial Apron Level (West)
02-6430-p-6.pdf	Partial Apron Level (South)
02-6430-p-7.pdf	Partial Concourse Level (North)
02-6430-p-8.pdf	Partial Concourse Level (North Central)
02-6430-p-9.pdf	Partial Concourse Level (Rotunda)
02-6430-sd-52.pdf	Mech Tunnel (West End)
02-6430-sd-53.pdf	Mech Tunnel (Central)
02-6430-sd-54.pdf	Mech Tunnel (East End)
02-6430-sd-72.pdf	Apron Level Under floor Plumbing (North)
02-6430-sd-73.pdf	Apron Level Under floor Plumbing (North Central)
02-6430-sd88.pdf	As-Built
02-8616-p-1.pdf	Plumbing Site Plan
02-8616-p-2.pdf	Plumbing Foundation Plan
02-8616-p-3.pdf	Plumbing First Floor & Isometrics
02-8735-a-1.pdf	Admin Site Plan (Alternate)
02-8735-pa-1.pdf	Admin Foundation Plan & Isometrics
02-8735-pa-2.pdf	Admin First & Second Floor Plumbing
02-8735-pb-1.pdf	Admin Basement & Storm Sewer
02-8735-pb-2.pdf	Admin Ground Level Plumbing & Isometrics
02-8735-pc-1.pdf	Unit C Plumbing Revisions
02-8735-pd-1.pdf	Admin Demo & Remodeling Plan
02-8987-a-2.pdf	Admin Site Plan
02-8987-a-2a.pdf	North Concourse Site Plan
02-8987-p-1.pdf	Admin Plumbing Site Plan
02-8987-p-2.pdf	North Concourse Foundation Plumbing & Partial Basement
02-8987-p-3.pdf	North Concourse Foundation Plumbing
02-8987-p-4.pdf	North Concourse First Floor Plumbing
02-8987-p-5.pdf	North Concourse First Floor Plumbing
02-8987-p-6.pdf	North Concourse Second Floor Plumbing
02-8987-p-7.pdf	North Concourse Second Floor Plumbing
02-8987-p-8.pdf	Isometrics
67-573-p-1.pdf	Isometrics & Details
67-573-p-2.pdf	Unit A First Floor Plumbing
67-573-p-3.pdf	Unit B First Floor Plumbing
67-573-p-4.pdf	Unit B Second Floor Plumbing
67-573-p-5.pdf	Tunnel Plan & Details
766-p-1.pdf	East Pier Addition Floor Plans
766-p-2.pdf	East Pier Addition Plot Plan & Risers

**APPENDIX-B: COMPLETE FIXTURE INVENTORY BY ROOM  
NUMBER**

<b>BRANCH 1</b>						
<b>Room No</b>	<b>Type</b>	<b>Toilets</b>	<b>Sinks</b>	<b>Urinals</b>	<b>Showers</b>	<b>Branch</b>
27	Men's	2	2	1	--	1
28	Women's	4	2	--	--	1
56	Men's	2	2	1	1	1
57	Women's	3	2	--	1	1
63	Men's	1	1	--	1	1
64	--	1	1	--	--	1
--	Women's	1	1	--	--	1
--	Men's	1	1	1	--	1
E105	Men's	1	1	1	--	1
E106	Women's	1	1	--	--	1
E116	Men's	1	1	--	--	1
E118	Women's	1	1	--	--	1
E145	--	2	1	--	2	1
E146	Women's	2	2	--	--	1
E148	Men's	2	2	2	--	1
E211	Women's	6	4	--	--	1
E215	Men's	3	4	5	--	1
E230	Women's	3	2	--	--	1
E231	Men's	1	2	--	--	1
M223	Men's	3	4	4	--	1
M227	Women's	6	4	--	--	1
M271B	--	1	1	--	--	1
M271C	--	1	1	--	--	1
M275	Family	1	2	--	--	1
M279	Family	1	2	--	--	1
M283	Women's	8	5	--	--	1
M287	Men's	3	5	5	--	1
M312	--	1	1	--	--	1
T194	Men's	2	3	2	--	1
T198	Women's	5	4	--	--	1
	<b>Total</b>	<b>70</b>	<b>65</b>	<b>22</b>	<b>5</b>	

<b>BRANCH 2</b>						
<b>Room No</b>	<b>Type</b>	<b>Toilets</b>	<b>Sinks</b>	<b>Urinals</b>	<b>Showers</b>	<b>Branch</b>
33	Men's	1	2	2	--	2
34	Women's	2	2	--	--	2
B100	Men's	2	3	3	--	2
B104	Women's	3	3	--	--	2
D104	Men's	3	3	3	--	2
D108A	Family	1	1	--	--	2
D112	Women's	4	4	--	--	2
D132	Women's	2	2	--	--	2
D134	Men's	1	2	1	--	2
D163	Men's	3	2	--	1	2
D171	Men's	1	1	1	--	2
D172	Women's	2	1	--	--	2
D178A	Men's	2	2	1	1	2
D181A	Women's	2	2	--	1	2
D196B	Women's	3	2	--	--	2
D196C	Men's	2	2	1	--	2
D206A	Family	2	2	--	--	2
D211	Women's	4	3	--	--	2
D213	Family	1	1	--	--	2
D216	Men's	3	3	3	--	2
D228	Women's	5	4	--	--	2
D231	--	1	1	--	--	2
D233	Men's	3	4	2	--	2
D241B	Men's	2	3	2	--	2
D241C	Women's	2	1	--	--	2
D250	--	--	--	--	--	2
D252	--	--	--	--	--	2
D273	Women's	12	6	--	--	2
D275	Men's	5	5	4	--	2
D301A	--	1	1	--	--	2
M200	Men's	2	2	2	--	2
M204	Women's	6	3	--	--	2
T104	Men's	2	3	3	--	2
T106	Women's	4	3	--	--	2
	<b>Total</b>	<b>89</b>	<b>79</b>	<b>28</b>	<b>3</b>	

<b>BRANCH 3</b>						
<b>Room No</b>	<b>Type</b>	<b>Toilets</b>	<b>Sinks</b>	<b>Urinals</b>	<b>Showers</b>	<b>Branch</b>
--	Family	1	1	--	--	3
C113	Women's	2	2	--	--	3
C116	Women's	2	2	--	1	3
C117	Men's	1	2	1	--	3
C118	Men's	1	2	1	1	3
C135F	--	1	1	--	--	3
C139G	Women's	1	1	--	--	3
C139H	Men's	1	1	--	--	3
C163A	Women's	1	1	--	--	3
C163B	Men's	1	1	--	--	3
C187	Men's	1	1	--	--	3
C188	Women's	1	1	--	--	3
C196	--	1	1	--	--	3
C197	--	1	1	--	--	3
C206	Men's	4	7	7	--	3
C208	Family	1	1	--	--	3
C210	Women's	11	7	--	--	3
C261	Women's	7	5	--	--	3
C263	Men's	3	5	4	--	3
C263A	Family	1	1	--	--	3
C271	Men's	3	5	4	--	3
C273	Women's	7	5	--	--	3
C273A	Family	1	1	--	--	3
	<b>Total</b>	<b>54</b>	<b>55</b>	<b>17</b>	<b>2</b>	

<b>BRANCH 4</b>						
<b>Room No</b>	<b>Type</b>	<b>Toilets</b>	<b>Sinks</b>	<b>Urinals</b>	<b>Showers</b>	<b>Branch</b>
A107B	Women's	1	1	--	1	4
A111B	Men's	1	1	1	1	4
A141A	Men's	1	1	1	--	4
A141B	Women's	1	1	--	--	4
A152	Women's	2	1	--	1	4
A155	Men's	1	1	1	1	4
A220	Men's	2	2	2	--	4
A222	Women's	3	2	--	--	4
A241	Men's	2	2	1	--	4
A245	Women's	2	1	--	--	4
	<b>Total</b>	<b>16</b>	<b>13</b>	<b>6</b>	<b>4</b>	

<b>BRANCH 5</b>						
<b>Room No</b>	<b>Type</b>	<b>Toilets</b>	<b>Sinks</b>	<b>Urinals</b>	<b>Showers</b>	<b>Branch</b>
B192	Men's	2	3	3	--	5
B196	Women's	3	3	--	--	5
	<b>Total</b>	<b>5</b>	<b>6</b>	<b>3</b>	<b>0</b>	

<b>BRANCH 6</b>						
<b>Room No</b>	<b>Type</b>	<b>Toilets</b>	<b>Sinks</b>	<b>Urinals</b>	<b>Showers</b>	<b>Branch</b>
IAB	Men's	2	2	2	--	6
IAB	Women's	3	2	--	--	6
IAB	Women's	2	1	--	--	6
IAB	Men's	1	1	2	--	6
IAB	Women's	1	1	--	--	6
IAB	Men's	1	1	1	--	6
IAB	--	--	1	--	1	6
	<b>Total</b>	<b>10</b>	<b>9</b>	<b>5</b>	<b>1</b>	

<b>MOP BASINS</b>	
M239A, Northpoint	1 Mop Basin
M278B, Brew Haus	1 Mop Basin
D242, Usinger's	1 Mop Basin
Legend Bar	1 Mop Basin
C12A, Alterra	1 Mop Basin
E202	1 Mop Basin

<b>SUMMARY OF FIXTURES</b>								
<b>Branch</b>	<b>Location</b>	<b>Toilets</b>	<b>Sinks</b>	<b>Urinals</b>	<b>Showers</b>	<b>Mop Basins</b>	<b>Dishwashers</b>	<b>Grease Traps</b>
1	Concourse E/S End of Main Terminal	70	94	22	5	3	5	4
2	Concourse D/N End of Main Terminal	89	110	28	3	2	3	4
3	Concourse C Stem/ Hammerhead	54	68	17	2	1	1	3
4	Administration Building	16	13	6	4			
5	Corporate Aviation Facilities	5	6	3	0			
6	International Arrivals Building	10	9	5	1			
	<b>Total</b>	<b>244</b>	<b>300</b>	<b>81</b>	<b>15</b>	<b>6</b>	<b>9</b>	<b>11</b>

## **APPENDIX-C: DETAILED SUMMARY OF SEWAGE EJECTORS**

<b>ID</b>	<b>Sewage Ejectors</b>
1	3-inch Weil
	Private Owner
	1 HP
	Room D174A
2	3-inch ABS Sanitary Sump
	Private Owner
	Room D122B
3	2-inch Weil for Noona's
	2-inch to 4-inch run
	D106
4	4-inch Weil
	Kitchen Sewage Ejector, W-2224-13, Powerframe 201.392.101
	725 Iron L84 Impeller
	320.015.319 Motor
	Serial # 458-465
	Room 38
5	4-inch Weil Vertical Sewage, 2.5-Inch Solids
	Model 2224, 4-inch Single-Seal
	C.I. Impeller
	208-230/460 V
	1750 RPM
	NE end of tug tunnel
6	4-inch Weil Vertical Sewage, 2.5_Inch Solids
	Model 2224, 4-inch Single-Seal
	C.I. Impeller
	208-230/460 V
	1750 RPM
	NW end of tug tunnel

<b>ID</b>	<b>Sewage Ejectors</b>
7	4-inch Weil Vertical Sewage, 2.5-Inch Solids
	Model 2224, 4-inch Single-Seal
	C.I. Impeller
	208-230/460 V
	1750 RPM
	Adjacent to Room 56A
8	4-inch Weil Vertical Sewage 2.5-Inch Solids
	Model 2224, 4-inch Single-Seal
	C.I. Impeller
	208-230/460 V
	1750 RPM
	SW end of tug tunnel
9	Pneumatic Ejector - Dual
	Outlet clean, Adjusted sensors to allow greater tank fill
	Adjacent to Room 84B
10	4-inch Weil Submersible Sump
	Room 73 (N End)
11	4-inch Weil Submersible Sump
	IMP700 Iron Impeller
	W9709-6T 20G15 Motor
	460 V
	4.7 A
	2 HP
	1150 RPM
	Room 73 (S End)

<b>ID</b>	<b>Sewage Ejectors</b>
12	4-inch Weil Submersible Sump
	W-2519 F-11
	IMP700 Iron Impeller
	W9709-6T 20G15 Motor
	460 V
	4.7 A
	2 HP
	1150 RPM
	Serial # 474-127
	Under walkway @ N end of E Concourse
13	Room C151A: Two 3-inch Weil w/ grinder blades
14, 15	IAB basement: 2-inch Sanitary, 1.5-inch Storm; Weil
16	Dual 4-inch BJM Pumps
	5 HP
	460V, 7A
	Model SK-37C
	Serial # 70662
	D-Stem Lift Station

## **APPENDIX-D: RESTAURANT FIXTURES**

<b>Dishwashers</b>	
M278B, Brew Haus	1 Ecolab APEX TSC-Double
M268, Famiglia's Pizza	1 Ecolab APEX-TSC Double
Alterra	1 Hobart LX1SA
D242, Usinger's	1 Ecolab APFQTSC-V
D224, Noona's	1 Dishwasher
D212	1 Dishwasher
C245, Chili's	1 Dishwasher
E202	1 Dishwasher
E210, Cooler by the Lake	1 Ecolab APEX-TSC
<b>Grease Traps</b>	
M218A, Starbucks	1 Schier PATG18-LO
M239A, Northpoint	1 Zern GT2101-20-3NH
M278B, Brew Haus	1 In-Floor Grease Trap; Doesn't appear to be maintained
M268, Famiglia's Pizza	1 Old, Unidentifiable Grease Trap; Poor condition
D242, Usinger's	1 Schier PATG 35-LO, 1 Schier PATG 20-LO
Alterra	1 Schier PATG1818
D224, Noona's	1 Schier PATG 30-LO
D212	1 Schier PATG 30-LO
C201A, Pizza Hut	1 Rockford 3512-600PT
C12A, Alterra	1 Schier PATG 18-15
C245, Chili's	2 Schier PATG 20-LO, 1 Schier PATG 15-20 (For Oven & Hood)
E210, Cooler by the Lake	1 Rockford G-36-LO, 1 Rockford G-23-60-M

Sinks	
M218A, Starbucks	2 Hand, 1 Regular, 1 3-Compartment
M239A, Northpoint	1 Hand, 1 Regular, 1 3-Compartment
M278B, Brew Haus	2 Hand, 1 4-Compartment Bar, 2 Bar, 2 Regular, 2 Prep, 1 2-Compartment, 1 Disposal
M268, Famiglia's Pizza	3 Hand, 1 4-Compartment, 2 Prep
Alterra	2 Regular
D242, Usinger's	6 Hand, 1 4-Compartment Bar, 2 Prep, 1 4-Compartment
D244A, Johnny Rocket's	1 Hand
Alterra	1 4-Compartment (2 to Grease Trap), 1 Regular
D224, Noona's	2 Hand, 4 Regular, 1 3-Compartment, 1 Glass Washer
Legend Bar	2 Hand, 1 Regular, 1 4-Compartment
D212	1 Hand, 1 2-Compartment Prep
C201A, Pizza Hut	2 Hand, 1 3-Compartment
C12A, Alterra	1 Regular, 1 4-Compartment
C245, Chili's	3 Hand, 3 Prep (1 w/ Disposal), 1 4-Compartment, 1 4-Compartment Bar
E202	2 Regular
E210, Cooler by the Lake	1 Hand, 1 Regular, 1 4-Compartment Bar, 1 3-Compartment, 1 Prep

## **APPENDIX-E: WATER AND WASTEWATER USAGE**

## Concourse E

This first portion of the system entails the line that serves Concourse E, the south half of the Main Terminal, the south half of Ticketing, the Northwest (Delta) Airlines Maintenance Facility and the proposed Trituration Building.

(Nodes 1 to 2) Serves Concourse E and has approximately 280 DFUs on a 6" line which can handle 700 DFUs. The pipe size is adequate for this load.

This line is of adequate size from the ejector to the manhole 290-280337A at the south east end of the Baggage Claim (Node 3 to 4).

(Nodes 4 to 8) Manhole 290-280337A to manhole 290-280335 with the load being 280 DFUs on a 6" pipe.

(Nodes 5 to 6) The next portion of this branch is from the South half of the Terminal and Ticketing which has approximately 176 DFUs. This branch also has one sump (SP-1) collection drainage in the Tug Tunnel (200 DFUs), which puts this line at approximately 376 DFUs.

(Nodes 7 to 6) Another portion of this branch is also from the South half of the Terminal and Ticketing which has approximately 50 DFUs. This branch also has one sump (SP-2) collection drainage in the Tug Tunnel (200 DFUS) with the load being approximately 250 DFUs.

(Node 6 to 8) From manhole 290-280336 to manhole 290-280335 the load is 626 DFUs on a 6" pipe

(Node 8) Manhole (290-280335) collects the discharge from Nodes 4 and 6 for a load of approximately 900 DFUs. (Also, there is an 8" PVC pipe near the top of the manhole that runs to the north; the origin and destination of this line is not known).

(Node 8 to 9) The 900 DFUs load for this line feeds into the Pneumatic Sumps with a 6" pipe, which is only supposed to have 700 DFUs.

(Node 9) The existing duplex pneumatic pumps are sized at 100 GPM. Per the pump manufacturer, a load of 900 DFUs equals 250 GPM and requires a pump system consisting of two (2) 250 GPM pumps.

Out of the Pneumatic Sumps another branch line connects to this with an approximate load of 166 DFUs (Node 10) for a load of 1,066 DFUs on a 6" pipe, which has a capacity of 700 DFUs. This line runs to the west where it connects to the line from the South end of the building (Node 9 to 11).

The line from the South end of the building has the loads from the South end of Baggage Claim, NWMF and the proposed Trituration Building.

(Nodes 12 to 13) The waste from the NWMF and proposed Trituration Building enter the system into a sewage ejector (SE-2). This load is approximately 30 DFUs on a 6" pipe, which is of adequate capacity.

(Node 14) Handles the load from the south end of Baggage Claim with a load 66 DFUs and connects the line from Node 13.

(Nodes 14 to 11) This 6" line runs exposed through the Basement level of the Baggage Claim building along the West wall, where it connects with the line from the Pneumatic Sumps. This 6" line has adequate capacity.

(Nodes 11 to 15) This line runs north to the point where it exits the building, with a load of approximately 1,166 DFUs; the maximum load for a 6" is 700 DFUs.

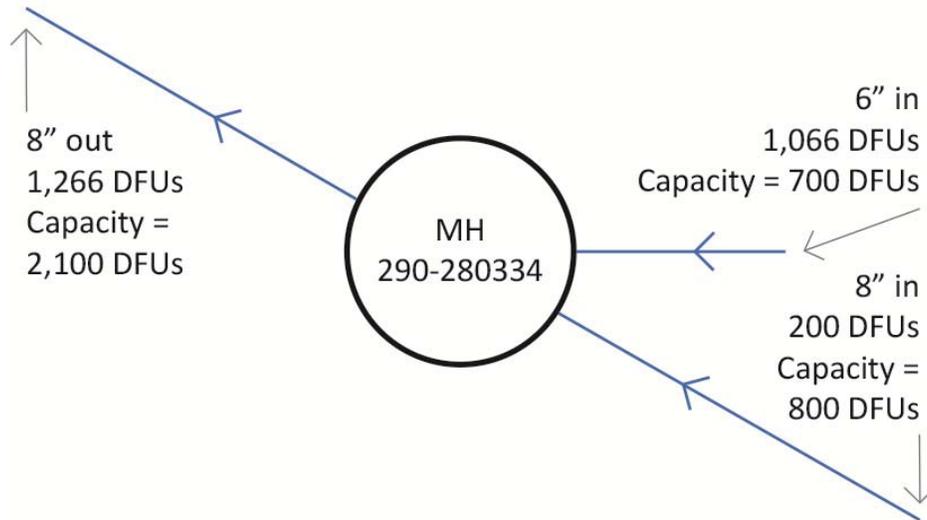
(Node 16) Is a branch that feeds into this line which serves the basement restrooms and restrooms from the Main Terminal with approximately 160 DFUs on a 5" pipe. This line has adequate capacity.

(Node 15 to 17) An approximate load of 1,320 DFUs on a 6" pipe leaves the building and into manhole 290-280340 (Node 17). The maximum load for a 6" is 700 DFUs.

(Node 17) manhole 290-280340 collects the load of approximately 80 DFUs from the car rental facilities and leaves the manhole through a 10" pipe carrying 1,400 DFUs. A 10" pipe with a slope 0.27% slope has a capacity of 2,100 DFUs (Per Commerce Table 82,30-3, see graph included in Appendix E).

<b>MH 290-280340</b>			
Diameter-Flow-Direction	Slope	Flow/Load (DFUs)	Pipe Capacity (DFUs)
6" IN-E*	--	1,320	700
6" IN-W	--	80	700
10" OUT-NW	0.27%	1,400	2,100

\* Pipe is being replaced as part of a separate GMIA project.



### Concourse D

(Node 19 to 20) This system in Concourse D has approximately 696 DFUs on a 6" pipe into the sewage ejector/lift station at the northwest end of the concourse (Node 20). (Node 20 to 21) This line pumps into the Terminal on the North end of the Tug Tunnel.

(Node 21 to 22) connects with a 200 DFU sump load (SP-3) and connection loads of 170 DFUs for a load of 1,066 DFUs on a 6" pipe that has a design capacity of 700 DFUs.

(Node 22) Manhole 290-280334 in the building, it picks up another sump of 200 DFUs (Node 23) for a load of 1,266 DFUs out to manhole 290-280333 (Node 24) north of the building. An 8" pipe with a slope of 3.4% has a capacity of 2,100 DFUs.

MH 290-280334			
Diameter-Flow-Direction	Slope	Flow/Load (DFUs)	Pipe Capacity (DFUs)
6" IN-E	--	1,066	700
8" IN-SW	--	200	800
8" OUT-NW	3.4%	1,266	2,100

## Concourse C

Concourse C (Node 25) which has approximately 580 DFUs, 50 DFUs is from the trituration sump for a load of 630 DFUs on 10" pipe. This line ties into manhole 290-280333 (Node 24)

(Node 24) Manhole 290-280333 also collects a load of 50 DFUs from Node 26 for a combined total of approximately 1,946 DFUs on a 10" pipe. A 10" pipe with a slope of 1.7% has a capacity of 3,200 DFUs.

MH 290-280333			
Diameter-Flow-Direction	Slope	Flow/Load (DFUs)	Pipe Capacity (DFUs)
6" IN-SW		50	700
8" IN-SE	3.4%	1,266	2,100
10" IN-NE	0.5%	630	2,500
10" OUT-W	1.7%	1,946	3,200

The total load leaving the airport via a 15" pipe is 3,626 DFUs. This estimated flow is below the design capacity of the 15" pipe. Field spot measurements at manholes 290-280339 and 290-280329 verified that the 15" pipe has adequate capacity. A summary of the spot field flow monitoring is provided in Appendix F.

This analysis of the GMIA sanitary sewer system identified several internal plumbing deficiencies as the cause of clogging and backups. The exterior sanitary sewer, namely the 15" line, is not the cause of backups based upon total DFU calculation and field verification. It is the recommendation of Kapur & Associates to proceed with the internal recommendations. Should backups continue after these upgrades, periodically check flows in the outside sewers for possible surcharging on peak usage days.

TAG/NODE		ESTIMATED LOAD (DFUs)	EXISTING PIPE SIZE	CAPACITY OF PIPE
1 to 2		280	6	700
3	SE 13			
3 to 4		280	6	700
5	SP-1	200		
5 to 6		375	6	700
6				
7	SP-2	200		
7 to 6		250	6	700
6 to 8		625		700
8		900	6	700
8 to 9		900	6	700
9	900 DFUs Requires 250 GPM pump, per manufacturer	Pneumatic Pumps	100 GPM	900 DFUs Requires 250 GPM pump, per manufacturer
10 to 9		165	6	700
9 to 11		1,065	6	700
12 to 13		30	6	700
13	SE 2	30	6	700
14		65	6	700
14 to 11		100	6	700
11 to 15		1,166	6	700
16 to 15		160	5	390
15 to 17*		1,320	6	700
18 to 17		80	6	700
17		1,400	10	2,100
19 to 20		695	6	700
20	PS			
20 to 21		695	6	700
21	SP-3	200		
21 to 22		1,066	6	700
23 to 22	SP-4	200	6	700
22		1,266	8	2,100
22 to 24		1,266	8	2,100
26 to 24		50	6	700
25 to 24		630	10	2,500
24		1,946	10	3,200
24 to 27		1,946	10	3,200

\* Pipe is being replaced as part of a separate GMIA project.

**GMIA Sanitary Sewer System**

**AppendixE\_Nodes**

- AppendixE\_Nodes
- ⊕ Sewage\_Ejectors
- GT GreaseTraps

**Manholes\_Sanitary**

**LiftStn**

- ⊕ <Null>
- PS Lift Station

**Pipes\_Sanitary**

**BranchLoc**

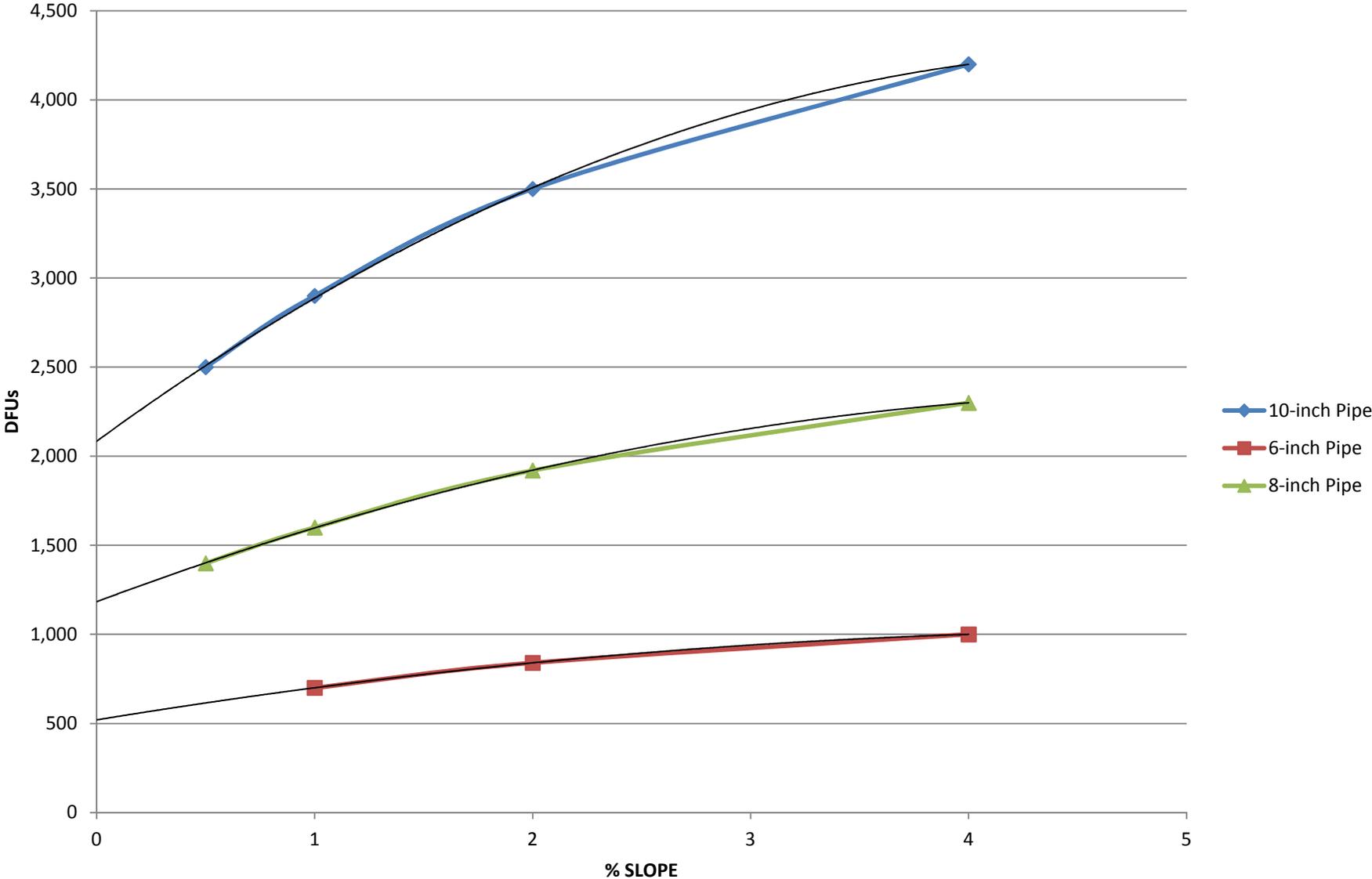
- 1
- 1, 5
- 2
- 3
- 4
- 5
- 6
- Other



1 inch = 167 feet  
210 Feet

# DFUs vs. Pipe Slope

From Department of Commerce Table 82.30-3



## **APPENDIX-F: SPOT CHECK FLOW MONITORING**

GMIA Flow Measurement, 5/4/12	MH 290-280339 15-inch OUT (IE = 7.70)				MH 290-280329 15-inch OUT (IE = 11.85)			
	Top of Flow	Depth (ft)	Slope	Flow (cfs)	Top of Flow	Depth (ft)	Slope	Flow (cfs)
7:30a	7.60	0.10	0.10	0.28	11.35	0.50	0.0018	0.92
9:30a	7.65	0.05	0.10	0.06	11.35	0.50	0.0018	0.92
11:30a	7.65	0.05	0.10	0.06	11.38	0.47	0.0018	0.82
1:30p	7.60	0.10	0.10	0.28	11.35	0.50	0.0018	0.92
3:30p	7.63	0.07	0.10	0.28	11.43	0.42	0.0018	0.67



## **APPENDIX-G: COST ESTIMATES**

1. Replacement of Sewage Ejector Number 16

## SUMMARY SHEET

Page	System	Material	Material Total	Labor Total		
	UG DRAIN	CISP	\$ -	0		
	UG DRAIN	PVC SCH. 40 DWV	\$ -	0		
	UG ACID WASTE	POLY PRO	\$ -	0		
	WASTE & VENT	NO HUB	\$ -	0		
	FUEL GAS	BLK. STEEL & MI	\$ -	0		
	WATER VALVES	BRONZE / IRON	\$ -	0		
	GAS VALVES	BRONZE	\$ -	0		
	RO VALVES	PVDF	\$ -	0		
	DRAINS		\$ -	0		
	FIXTURES		\$ -	0		
		SUBTOTAL	\$ -			
	MISCELLANEOUS		\$ 47,500.00	120		
	<b>SUBTOTALS</b>		<b>\$ 47,500.00</b>	<b>120</b>		
	<b>Escalation (# of years)</b>		<b>1</b>			
	<b>Escalation (% per year)</b>		<b>5%</b>			
	<b>Material SUBTOTAL (Including Escalation)</b>		<b>\$ 47,500.00</b>			
	<b>Tax</b>	5.5%	\$ 2,612.50			
	<b>Material TOTAL</b>		<b>\$ 50,112.50</b>			
	<b>LABOR SUBTOTAL</b>		<b>120.00</b>	hours		
	LABOR RATE		\$ 65.00			
	<b>LABOR TOTAL</b>		<b>\$ 7,800.00</b>			
	<b>MATERIAL &amp; LABOR SUBTOTAL</b>		<b>\$ 55,300.00</b>			
	Markup (O and P)	15%	\$ 8,295.00			
	<b>SUBTOTAL</b>		<b>\$ 63,595.00</b>			
	<b>SUBCONTRACTORS</b>					
	INSULATION		\$ -			
	<b>SUBTOTAL</b>		<b>\$ -</b>			
	MARK UP	23.5%	\$ -			
	<b>SUBCONTRACTOR TOTAL</b>		<b>\$ -</b>			
	Bond	1.0%	\$ 635.95			
	<b>TOTAL</b>			<b>\$ 64,230.95</b>	#DIV/0!	per sq. ft.
	Building Square Footage		-			
	Construction Cost %		100%	\$ 64,230.95	#DIV/0!	per sq. ft.
	<b>Total for Plumbing</b>			<b>\$ 64,230.95</b>		



2. Replacement of 6" sanitary line between Manhole 290-280335 and Ejector #9

## SUMMARY SHEET

Page	System	Material	Material Total	Labor Total		
	UG DRAIN	CISP	\$ -	0		
	UG DRAIN	PVC SCH. 40 DWV	\$ -	0		
	UG ACID WASTE	POLY PRO	\$ -	0		
	WASTE & VENT	NO HUB	\$ 1,586.00	18.01		
	WASTE & VENT	PVC SCH. 40 DWV	\$ -	0		
	ACID WASTE	POLY PRO	\$ -	0		
	WATER	L COPPER	\$ -	0		
	RO WATER	PVDF	\$ -	0		
	FUEL GAS	BLK. STEEL & MI	\$ -	0		
	WATER VALVES	BRONZE / IRON	\$ -	0		
	GAS VALVES	BRONZE	\$ -	0		
	RO VALVES	PVDF	\$ -	0		
	DRAINS		\$ -	0		
	FIXTURES		\$ -	0		
		<b>SUBTOTAL</b>	\$ 1,586.00			
	MISCELLANEOUS		\$ -	5.34		
	<b>SUBTOTALS</b>		\$ 1,586.00	23.35		
	<b>Escalation (# of years)</b>			2		
	<b>Escalation (% per year)</b>			5%		
	<b>Material SUBTOTAL (Including Escalation)</b>		\$ 1,748.57			
	<b>Tax</b>	5.5%	\$ 96.17			
	<b>Material TOTAL</b>		\$ 1,844.74			
	<b>LABOR SUBTOTAL</b>			23.35	hours	
	LABOR RATE		\$ 65.00			
	<b>LABOR TOTAL</b>		\$ 1,517.75			
	<b>MATERIAL &amp; LABOR SUBTOTAL</b>		\$ 3,266.32			
	Markup (O and P)	15%	\$ 489.95			
	<b>SUBTOTAL</b>		\$ 3,756.26			
	<b>SUBCONTRACTORS</b>					
	INSULATION		\$ -			
	<b>SUBTOTAL</b>		\$ -			
	MARK UP	23.5%	\$ -			
	<b>SUBCONTRACTOR TOTAL</b>		\$ -			
	Bond	1.0%	\$ 37.56			
	<b>TOTAL</b>			\$ 3,793.82	#DIV/0!	per sq. ft.
	Building Square Footage		-			
	Construction Cost %		100%	\$ 3,793.82	#DIV/0!	per sq. ft.
				\$ -		
	<b>Total for Plumbing</b>			\$ 3,793.82		

# SUMMARY SHEET

NO HUB WASTE & VENT						
Qty.	Description	Mat't Unit	Mat'l Total	Labor Unit	Labor Total	COMMENTS
	10" NO HUB PIPE / LF	70	0	0.53	0	Includes Hgr. & Cplg.
20	8" NO HUB PIPE / LF	46	920	0.46	9.28	Includes Hgr. & Cplg.
	6" NO HUB PIPE / LF	26.5	0	0.3	0	Includes Hgr. & Cplg.
	4" NO HUB PIPE / LF	9.45	0	0.28	0	Includes Hgr. & Cplg.
	3" NO HUB PIPE / LF	7.6	0	0.25	0	Includes Hgr. & Cplg.
	2" M COPPER PIPE / LF	6.75	0	0.18	0	Includes Hgr. & Cplg.
	1 1/2" M COPPER PIPE / LF	4.26	0	0.15	0	Includes Hgr. & Cplg.
3	8" NO HUB Y	222	666	2.91	8.73	Includes Cplg.
	6" NO HUB Y	109	0	1.8	0	Includes Cplg.
	4" NO HUB Y	42	0	1.46	0	Includes Cplg.
	3" NO HUB Y	32.1	0	1.26	0	Includes Cplg.
	2" COPPER DWV WYE	12.5	0	1.14	0	
	1 1/2" COPPER DWV WYE	10.8	0	1	0	
	10" NO HUB R Y	375	0	3.43	0	Includes Cplg.
	8" NO HUB R Y	164	0	2.54	0	Includes Cplg.
	6" NO HUB R Y	86.6	0	1.69	0	Includes Cplg.
	4" NO HUB R Y	38.7	0	1.39	0	Includes Cplg.
	3" NO HUB R Y	30	0	1.26	0	Includes Cplg.
	10" NO HUB BEND	380	0	3.2	0	Includes Cplg.
	8" NO HUB BEND	154	0	1.94	0	Includes Cplg.
	6" NO HUB BEND	71.2	0	1.2	0	Includes Cplg.
	4" NO HUB BEND	31	0	0.97	0	Includes Cplg.
	3" NO HUB BEND	18	0	0.84	0	Includes Cplg.
	2" COPPER DWV 1/4 BEND	8.55	0	0.8	0	
	1 1/2" COPPER DWV 1/4	5.85	0	0.67	0	
	6" NO HUB P TRAP	74.5	0	1.41	0	Includes Cplg.
	4" NO HUB P TRAP	31	0	1.23	0	Includes Cplg.
	3" NO HUB P TRAP	18	0	1.14	0	Includes Cplg.
	2" COPPER DWV P TRAP	42	0	0.53	0	
	10" NO HUB PLUGS	65.5	0		0	Excludes cplgs.
	8" NO HUB PLUGS	44.5	0		0	Excludes cplgs.
	6" NO HUB PLUGS	16.7	0		0	Excludes cplgs.
	4" NO HUB PLUGS	8.55	0		0	Excludes cplgs.
	3" NO HUB PLUGS	5.55	0		0	Excludes cplgs.
	NO HUB SUBTOTAL		1586		18.01	

# SUMMARY SHEET

<b>MISCELLANEOUS</b>					
Qty.	Description	Mat't Unit	Mat'l Total	Labor Unit	Labor Total
	1" RPBP	248	0	0.571	0
	1-1/2" RPBP	465	0	0.8	0
	EEWS	287	0	4	0
	TMV (1/2")	415	0	0.421	0
	3" Water Meter	1950	0	5.333	0
	ET-1	1950	0	1.333	0
	CP-1	410	0	2.667	0
	HWX-1	25000	0	8	0
	HWX-2	25000	0	8	0
	ST-1	1925	0	1.333	0
	Exterior Grease Interceptor	12500	0	24	0
	4" Draintile	0.99	0	0.153	0
	Elevator Sump Pump (1/2 HP)	200	0	2	0
	Duplex Clearwater Sump (1 HP)	3050	0	29	0
	Duplex Effluent Sump (3/4 HP)	2800	0	25	0
	TMV (1-1/2")	1025	0	0.8	0
	EEW	205	0	4	0
	TMV (EEW)	595	0	0.5	0
	3/4" RPBP	163	0	0.5	0
	2" RPBP	525	0	1.143	0
	Hot & Cold Hose Bibb	100	0	0.5	0
	Wall Hydrant	297	0	0.571	0
	Floor Sink	916.5	0	1.6	0
	Natural Gas Connection	27.5	0	0.724	0
	1-1/2" Pumped Discharge	4.76	0	0.15	0
	2" Pumped Discharge	7.25	0	0.19	0
	3" Pumped Discharge	14.7	0	0.29	0
	3" Natural Gas PRV	955	0	1.231	0
	2" Natural Gas PRV	490	0	0.727	0
	Sump Excavation (cu. ft.)	0.86	0	0.019	0
	Elevator Sump	250	0	1	0
	Valve Tags	2.3	0	0.2	0
	Underground Tape (per 100 ft)	2	0	0.053	0
	4" Ductile Iron - Mechanical Jt.	14.15	0	0.2	0
	4" PVC - Mechanical Jt.	2.7	0	0.084	0
	Pipe Demolition (3")	0	0	0.053	0
	Pipe Demolition (4"-6")	0	0	0.16	0
20	Pipe Demolition (8"-14")	0	0	0.267	5.34
	Fixture Demolition	0	0	1.5	0
	Sawcut		0		0
	Pipe Identification	4	0	0.133	0
	VTR	30	0	1	0
	GWH-1 (125,000 btu, 60 gal)	6050	0	8	0
	Flowmeter	105	0	0.5	0
	8" Core Drill	16.7	0	1.231	0
	6" Core Drill	12.2	0	1.143	0
	14" Core Drill	74	0	2.2	0
			0		0
<b>TOTAL</b>			0		5.34

### 3. Replacement of Pneumatic Pump with New Pneumatic Pump System

## SUMMARY SHEET

Page	System	Material	Material Total	Labor Total		
	UG DRAIN	CISP	\$ -	0		
	UG DRAIN	PVC SCH. 40 DWV	\$ -	0		
	UG ACID WASTE	POLY PRO	\$ -	0		
	WASTE & VENT	NO HUB	\$ -	0		
	FUEL GAS	BLK. STEEL & MI	\$ -	0		
	WATER VALVES	BRONZE / IRON	\$ -	0		
	GAS VALVES	BRONZE	\$ -	0		
	RO VALVES	PVDF	\$ -	0		
	DRAINS		\$ -	0		
	FIXTURES		\$ -	0		
		SUBTOTAL	\$ -			
	MISCELLANEOUS		\$ 122,000.00	40		
	<b>SUBTOTALS</b>		<b>\$ 122,000.00</b>	<b>40</b>		
	<b>Escalation (# of years)</b>		<b>1</b>			
	<b>Escalation (% per year)</b>		<b>5%</b>			
	<b>Material SUBTOTAL (Including Escalation)</b>		<b>\$ 122,000.00</b>			
	<b>Tax</b>	5.5%	<b>\$ 6,710.00</b>			
	<b>Material TOTAL</b>		<b>\$ 128,710.00</b>			
	<b>LABOR SUBTOTAL</b>		<b>40.00</b>	hours		
	LABOR RATE		\$ 65.00			
	<b>LABOR TOTAL</b>		<b>\$ 2,600.00</b>			
	<b>MATERIAL &amp; LABOR SUBTOTAL</b>		<b>\$ 124,600.00</b>			
	Markup (O and P)	15%	\$ 18,690.00			
	<b>SUBTOTAL</b>		<b>\$ 143,290.00</b>			
	<b>SUBCONTRACTORS</b>					
	INSULATION		\$ -			
	<b>SUBTOTAL</b>		<b>\$ -</b>			
	MARK UP	23.5%	\$ -			
	<b>SUBCONTRACTOR TOTAL</b>		<b>\$ -</b>			
	Bond	1.0%	\$ 1,432.90			
	<b>TOTAL</b>			<b>\$ 144,722.90</b>	#DIV/0!	per sq. ft.
	Building Square Footage		-			
	Construction Cost %		100%	\$ 144,722.90	#DIV/0!	per sq. ft.
	Total for Plumbing			\$ 144,722.90		



4. Replacement of 6" sanitary drain piping with 10" pipe running from pneumatic pump (Ejector #9) to manhole 290-280340

## SUMMARY SHEET

Page	System	Material	Material Total	Labor Total		
	UG DRAIN	CISP	\$ -	0		
	UG DRAIN	PVC SCH. 40 DWV	\$ -	0		
	UG ACID WASTE	POLY PRO	\$ -	0		
	WASTE & VENT	NO HUB	\$ 27,640.00	212.578		
	WASTE & VENT	PVC SCH. 40 DWV	\$ -	0		
	ACID WASTE	POLY PRO	\$ -	0		
	WATER	L COPPER	\$ -	0		
	RO WATER	PVDF	\$ -	0		
	FUEL GAS	BLK. STEEL & MI	\$ -	0		
	WATER VALVES	BRONZE / IRON	\$ -	0		
	GAS VALVES	BRONZE	\$ -	0		
	RO VALVES	PVDF	\$ -	0		
	DRAINS		\$ -	0		
	FIXTURES		\$ -	0		
		<b>SUBTOTAL</b>	\$ 27,640.00			
	MISCELLANEOUS		\$ 1.00	88.11		
	<b>SUBTOTALS</b>		\$ 27,641.00	300.688		
	<b>Escalation (# of years)</b>			2		
	<b>Escalation (% per year)</b>			5%		
	<b>Material SUBTOTAL (Including Escalation)</b>		\$ 30,474.10			
	<b>Tax</b>	5.5%	\$ 1,676.08			
	<b>Material TOTAL</b>		\$ 32,150.18			
	<b>LABOR SUBTOTAL</b>			300.69	hours	
	LABOR RATE		\$ 65.00			
	<b>LABOR TOTAL</b>		\$ 19,544.72			
	<b>MATERIAL &amp; LABOR SUBTOTAL</b>		\$ 50,018.82			
	Markup (O and P)	15%	\$ 7,502.82			
	<b>SUBTOTAL</b>		\$ 57,521.64			
	<b>SUBCONTRACTORS</b>					
	INSULATION		\$ -			
	<b>SUBTOTAL</b>		\$ -			
	MARK UP	23.5%	\$ -			
	<b>SUBCONTRACTOR TOTAL</b>		\$ -			
	Bond	1.0%	\$ 575.22			
	<b>TOTAL</b>			\$ 58,096.86	#DIV/0!	per sq. ft.
	Building Square Footage		-			
	Construction Cost %		100%	\$ 58,096.86	#DIV/0!	per sq. ft.
	<b>Total for Plumbing</b>			\$ 58,096.86		



# SUMMARY SHEET

<b>MISCELLANEOUS</b>					
Qty.	Description	Mat't Unit	Mat'l Total	Labor Unit	Labor Total
	1" RPBP	248	0	0.571	0
	1-1/2" RPBP	465	0	0.8	0
	EEWS	287	0	4	0
	TMV (1/2")	415	0	0.421	0
	3" Water Meter	1950	0	5.333	0
	HWX-1	25000	0	8	0
	HWX-2	25000	0	8	0
	ST-1	1925	0	1.333	0
	Exterior Grease Interceptor	12500	0	24	0
	4" Draintile	0.99	0	0.153	0
	Elevator Sump Pump (1/2 HP)	200	0	2	0
	Duplex Clearwater Sump (1 HP)	3050	0	29	0
	Duplex Effluent Sump (3/4 HP)	2800	0	25	0
	TMV (1-1/2")	1025	0	0.8	0
	EEW	205	0	4	0
	TMV (EEW)	595	0	0.5	0
	3/4" RPBP	163	0	0.5	0
	2" RPBP	525	0	1.143	0
	Garbage Disposal	159	0	1.6	0
	Shower and Enclosure	206	0	2.222	0
	Hot & Cold Hose Bibb	100	0	0.5	0
	Wall Hydrant	297	0	0.571	0
	Floor Sink	916.5	0	1.6	0
	Natural Gas Connection	27.5	0	0.724	0
	1-1/2" Pumped Discharge	4.76	0	0.15	0
	2" Pumped Discharge	7.25	0	0.19	0
	3" Pumped Discharge	14.7	0	0.29	0
	3" Natural Gas PRV	955	0	1.231	0
	2" Natural Gas PRV	490	0	0.727	0
	Sump Excavation (cu. ft.)	0.86	0	0.019	0
	Elevator Sump	250	0	1	0
	Valve Tags	2.3	0	0.2	0
	Underground Tape (per 100 ft)	2	0	0.053	0
	4" Ductile Iron - Mechanical Jt.	14.15	0	0.2	0
	4" PVC - Mechanical Jt.	2.7	0	0.084	0
	Pipe Demolition (3")	0	0	0.053	0
	Pipe Demolition (4"-6")	0	0	0.16	0
330	Pipe Demolition (8"-14")	0	100%	0.267	88.11
	Fixture Demolition	0	0	1.5	0
	Sawcut		0		0
	Pipe Identification	4	0	0.133	0
	VTR	30	0	1	0
	GWH-1 (125,000 btu, 60 gal)	6050	0	8	0
	Flowmeter	105	0	0.5	0
	8" Core Drill	16.7	0	1.231	0
	6" Core Drill	12.2	0	1.143	0
	14" Core Drill	74	0	2.2	0
			0		0
<b>TOTAL</b>			1		88.11

## SUMMARY SHEET

Page	System	Material	Material Total	Labor Total		
	UG DRAIN	CISP	\$ -	0		
	UG DRAIN	PVC SCH. 40 DWV	\$ -	0		
	UG ACID WASTE	POLY PRO	\$ -	0		
	WASTE & VENT	NO HUB	\$ 14,051.40	149.06		
	WASTE & VENT	PVC SCH. 40 DWV	\$ -	0		
	ACID WASTE	POLY PRO	\$ -	0		
	WATER	L COPPER	\$ -	0		
	RO WATER	PVDF	\$ -	0		
	FUEL GAS	BLK. STEEL & MI	\$ -	0		
	WATER VALVES	BRONZE / IRON	\$ -	0		
	GAS VALVES	BRONZE	\$ -	0		
	RO VALVES	PVDF	\$ -	0		
	DRAINS		\$ -	0		
	FIXTURES		\$ -	0		
		<b>SUBTOTAL</b>	\$ 14,051.40			
	MISCELLANEOUS		\$ -	102.915		
	<b>SUBTOTALS</b>		\$ 14,051.40	251.975		
	<b>Escalation (# of years)</b>			2		
	<b>Escalation (% per year)</b>			5%		
	<b>Material SUBTOTAL (Including Escalation)</b>		\$ 15,491.67			
	<b>Tax</b>	5.5%	\$ 852.04			
	<b>Material TOTAL</b>		\$ 16,343.71			
	<b>LABOR SUBTOTAL</b>			251.98	hours	
	LABOR RATE		\$ 65.00			
	<b>LABOR TOTAL</b>		\$ 16,378.38			
	<b>MATERIAL &amp; LABOR SUBTOTAL</b>		\$ 31,870.04			
	Markup (O and P)	15%	\$ 4,780.51			
	<b>SUBTOTAL</b>		\$ 36,650.55			
	<b>SUBCONTRACTORS</b>					
	INSULATION		\$ -			
	<b>SUBTOTAL</b>		\$ -			
	MARK UP	23.5%	\$ -			
	<b>SUBCONTRACTOR TOTAL</b>		\$ -			
	Bond	1.0%	\$ 366.51			
	<b>TOTAL</b>			\$ 37,017.06	#DIV/0!	per sq. ft.
	Building Square Footage		-			
	Construction Cost %		100%	\$ 37,017.06	#DIV/0!	per sq. ft.
				\$ -		
	Total for Plumbing			\$ 37,017.06		

# SUMMARY SHEET

NO HUB WASTE & VENT						
Qty.	Description	Mat't Unit	Mat'l Total	Labor Unit	Labor Total	COMMENTS
	10" NO HUB PIPE / LF	70	0	0.53	0	Includes Hgr. & Cplg.
245	8" NO HUB PIPE / LF	46	11270	0.46	113.68	Includes Hgr. & Cplg.
	6" NO HUB PIPE / LF	26.5	0	0.3	0	Includes Hgr. & Cplg.
	4" NO HUB PIPE / LF	9.45	0	0.28	0	Includes Hgr. & Cplg.
	3" NO HUB PIPE / LF	7.6	0	0.25	0	Includes Hgr. & Cplg.
	2" M COPPER PIPE / LF	6.75	0	0.18	0	Includes Hgr. & Cplg.
	1 1/2" M COPPER PIPE / LF	4.26	0	0.15	0	Includes Hgr. & Cplg.
6	8" NO HUB Y	222	1332	2.91	17.46	Includes Cplg.
	6" NO HUB Y	109	0	1.8	0	Includes Cplg.
	4" NO HUB Y	42	0	1.46	0	Includes Cplg.
	3" NO HUB Y	32.1	0	1.26	0	Includes Cplg.
	2" COPPER DWV WYE	12.5	0	1.14	0	
	1 1/2" COPPER DWV WYE	10.8	0	1	0	
	10" NO HUB R Y	375	0	3.43	0	Includes Cplg.
4	8" NO HUB R Y	164	655.4	2.54	10.16	Includes Cplg.
	6" NO HUB R Y	86.6	0	1.69	0	Includes Cplg.
	4" NO HUB R Y	38.7	0	1.39	0	Includes Cplg.
	3" NO HUB R Y	30	0	1.26	0	Includes Cplg.
	10" NO HUB BEND	380	0	3.2	0	Includes Cplg.
4	8" NO HUB BEND	154	616	1.94	7.76	Includes Cplg.
	6" NO HUB BEND	71.2	0	1.2	0	Includes Cplg.
	4" NO HUB BEND	31	0	0.97	0	Includes Cplg.
	3" NO HUB BEND	18	0	0.84	0	Includes Cplg.
	2" COPPER DWV 1/4 BEND	8.55	0	0.8	0	
	1 1/2" COPPER DWV 1/4	5.85	0	0.67	0	
	6" NO HUB P TRAP	74.5	0	1.41	0	Includes Cplg.
	4" NO HUB P TRAP	31	0	1.23	0	Includes Cplg.
	3" NO HUB P TRAP	18	0	1.14	0	Includes Cplg.
	2" COPPER DWV P TRAP	42	0	0.53	0	
	10" NO HUB PLUGS	65.5	0		0	Excludes cplgs.
4	8" NO HUB PLUGS	44.5	178		0	Excludes cplgs.
	6" NO HUB PLUGS	16.7	0		0	Excludes cplgs.
	4" NO HUB PLUGS	8.55	0		0	Excludes cplgs.
	3" NO HUB PLUGS	5.55	0		0	Excludes cplgs.
	NO HUB SUBTOTAL		14051.4		149.06	

# SUMMARY SHEET

<b>MISCELLANEOUS</b>					
Qty.	Description	Mat't Unit	Mat'l Total	Labor Unit	Labor Total
	1" RPBP	248	0	0.571	0
	1-1/2" RPBP	465	0	0.8	0
	EEWS	287	0	4	0
	TMV (1/2")	415	0	0.421	0
	3" Water Meter	1950	0	5.333	0
	ET-1	1950	0	1.333	0
	CP-1	410	0	2.667	0
	HWX-1	25000	0	8	0
	HWX-2	25000	0	8	0
	ST-1	1925	0	1.333	0
	Exterior Grease Interceptor	12500	0	24	0
	4" Draintile	0.99	0	0.153	0
	Elevator Sump Pump (1/2 HP)	200	0	2	0
	Duplex Clearwater Sump (1 HP)	3050	0	29	0
	Duplex Effluent Sump (3/4 HP)	2800	0	25	0
	TMV (1-1/2")	1025	0	0.8	0
	EEW	205	0	4	0
	TMV (EEW)	595	0	0.5	0
	3/4" RPBP	163	0	0.5	0
	2" RPBP	525	0	1.143	0
	Hot & Cold Hose Bibb	100	0	0.5	0
	Wall Hydrant	297	0	0.571	0
	Floor Sink	916.5	0	1.6	0
	Natural Gas Connection	27.5	0	0.724	0
	1-1/2" Pumped Discharge	4.76	0	0.15	0
	2" Pumped Discharge	7.25	0	0.19	0
	3" Pumped Discharge	14.7	0	0.29	0
	3" Natural Gas PRV	955	0	1.231	0
	2" Natural Gas PRV	490	0	0.727	0
	Sump Excavation (cu. ft.)	0.86	0	0.019	0
	Elevator Sump	250	0	1	0
	Valve Tags	2.3	0	0.2	0
	Underground Tape (per 100 ft)	2	0	0.053	0
	4" Ductile Iron - Mechanical Jt.	14.15	0	0.2	0
	4" PVC - Mechanical Jt.	2.7	0	0.084	0
	Pipe Demolition (3")	0	0	0.053	0
	Pipe Demolition (4"-6")	0	0	0.16	0
245	Pipe Demolition (8"-14")	0	0	0.267	65.415
	Fixture Demolition	0	0	1.5	0
125	Sawcut		0	0.3	37.5
	Pipe Identification	4	0	0.133	0
	VTR	30	0	1	0
	GWH-1 (125,000 btu, 60 gal)	6050	0	8	0
	Flowmeter	105	0	0.5	0
	8" Core Drill	16.7	0	1.231	0
	6" Core Drill	12.2	0	1.143	0
	14" Core Drill	74	0	2.2	0
			0		0
<b>TOTAL</b>			0		102.915

### Grease Interceptors

<b>Facility</b>	<b>Location</b>	<b>Suggested Grease Trap Location</b>	<b>Cost</b>
Cooler By The Lake	E Concourse	Apron Level Mechanical Room	\$9,500
Northpoint	Main Terminal	TBD	\$15,000
Famiglia's Pizza & Brew Haus	Main Terminal	In Baggage Makeup as piping drops through the space	\$15,000
Noona's	D Concourse	Apron Level Mechanical Room	\$9,500
Johnny Rockets & Usinger's	D Concourse	TBD	\$9,500
Chili's	C Concourse	Apron Level Mechanical Room	\$9,500
Pizza Hut	C Concourse	Apron Level Mechanical Room	\$9,500
		<b>Estimated Total Cost</b>	<b>\$77,500</b>