Mendenhall Wastewater Treatment Plant

City and Borough of Juneau

West Mendenhall Valley Sewer Conceptual Design and Technical Report

January, 2006

Carson Dorn, Inc.

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CHAPTER 1
INTRODUCTION

BACKGROUND

Enhancing the City and Borough of Juneau's (CBJ's) wastewater collection and treatment systems has consistently been one of the community's highest priorities. Since the early 1980's extensive work has been done to provide sewer service to many residents of Juneau. New wastewater collection systems were added in the Mendenhall Valley, Lemon Creek, Douglas Island and Back Loop Road areas. Additionally, significant progress has been made in separating combined sewers in downtown Juneau; the capacity of the Auke Bay Treatment Plant has been increased with construction of a new clarifier; a new wastewater treatment plant was constructed to serve the Mendenhall Valley; chlorine disinfection systems have been replaced with UV disinfection systems; and many other important improvements have been made to Juneau's sewage collection, treatment and disposal systems.

Despite extensive capital improvements there is continuing demand for sewer service in new areas. To accommodate new demands for service it is essential for Juneau to develop a logical and feasible plan for improving the municipal wastewater collection systems.

OBJECTIVE

The objective of the Conceptual Design and Technical Report for the West Mendenhall Sewer is to provide guidance for future growth and expansion of Juneau's wastewater collection system into the West Mendenhall Valley area. This involves identifying ultimate sewer service area boundaries that would be connected to this sewage collection system and describing conceptually the facilities needed to accommodate sewer from the new service areas.

Developing the Conceptual Design and Technical Report involves:

- Identifying existing and future service areas that might be served by the West Mendenhall Valley sewer systems;
- Projecting future service area populations;
- Estimating per capita wastewater flows; and
- Establishing minimum design criteria for sizing sewer facilities.

EXISTING AND FUTURE SERVICE AREAS

In order to plan for possible future sewer system development in the West Mendenhall Valley area and to adequately size sewer mains for future use it is necessary to consider all areas that might contribute flow to the sewer mains. The planning area shown in Figure 1 was reviewed with CBJ's Public Works and Engineering Departments to verify it includes all areas that might contribute flow to the West Mendenhall Valley Sewer System.

To define future sewer system needs for CBJ's West Mendenhall Valley Sewer System it is important to establish CBJ's long term plans for the large tracts of undeveloped property held by CBJ (USS 3406, 3873, 3817 and 3816) in the West Mendenhall Valley Area. In addition recent discussions with CBJ's Public Works Department indicate there is still significant interest in eventually decommissioning the Auke Bay Wastewater Treatment and converting it to a pump station to pump sewage from the Auke Bay area to the Mendenhall Plant for treatment and disposal.

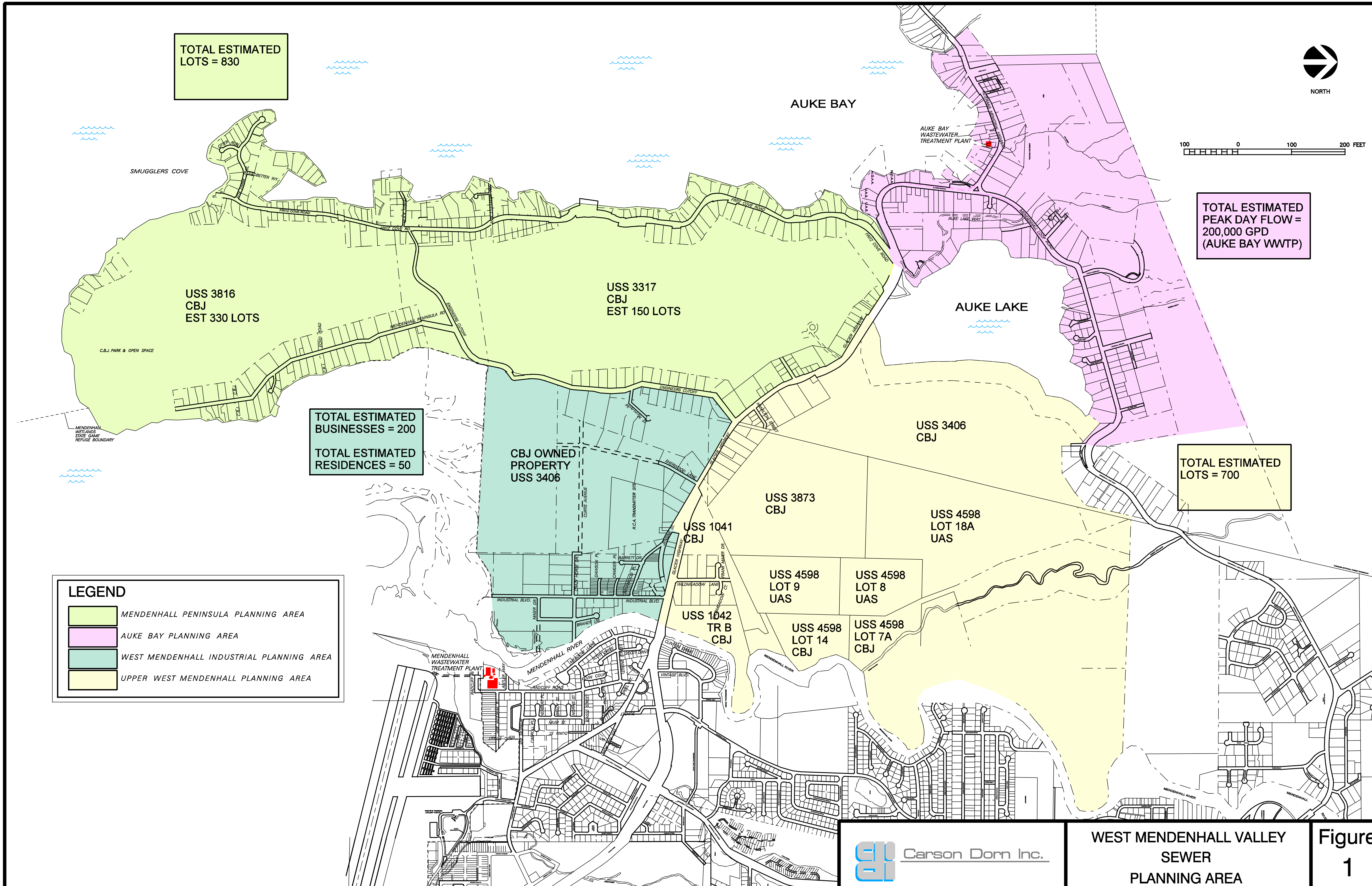
After the West Mendenhall Sewer Service Area boundaries had been defined with CBJ's Engineering and Public Works Department staff they were then reviewed with CBJ's Community Development and Lands and Resources personnel to verify if they are consistent with such things as CBJ's zoning, proposed land disposals and land use plans. In addition to the review of the service area boundaries and development potential, the CBJ Lands and Resources personnel have been developing estimates of the number of lots that might be developed on CBJ's property in the service area. After carefully reviewing the service area defined on Figure 1 with CBJ Lands and Resources personnel, estimates of the number of potential lots for each area were made. These estimates are reflected in the total estimated number of lots for each of the planning areas shown on Figure 1.

POPULATION PROJECTIONS

The CBJ Community Development Department has prepared population projections for Juneau based on socioeconomic analyses done as part of mine permit reviews, and other economic factors including projected declines in oil revenue and corresponding declines in government spending. Baseline populations for Juneau have generally been predicted to remain static or decline slightly over the next few years in response to decreases in state oil revenues.

While current population projections for Juneau do not indicate significant population increases will be realized in the foreseeable future, it is still valuable to consider the capacity of Juneau's major wastewater collection facilities from a much longer perspective. A longer term review of the collection system capacity may serve to help Juneau define where future residential development should occur.

Future Service Area Population Projections


TOTAL ESTIMATED LOTS = 830
AUKE BAY
SMUGGLERS COVE
AUKE BAY WASTEWATER TREATMENT PLANT
NORTH
100 0 100 200 FEET
TOTAL ESTIMATED PEAK DAY FLOW = 200,000 GPD (AUKE BAY WWTP)
USS 3816 CBJ EST 330 LOTS
USS 3317 CBJ EST 150 LOTS
AUKE LAKE
C.B.J. PARK & OPEN SPACE
MENDENHALL WETLANDS STATE GAME REFUGE BOUNDARY
TOTAL ESTIMATED BUSINESSES = 200
TOTAL ESTIMATED RESIDENCES = 50
CBJ OWNED PROPERTY USS 3406
USS 3406 CBJ
TOTAL ESTIMATED LOTS = 700
USS 3873 CBJ
USS 4598 LOT 18A UAS
USS 1041 CBJ
USS 4598 LOT 9 UAS
USS 4598 LOT 8 UAS
USS 1042 TR B CBJ
USS 4598 LOT 14 CBJ
USS 4598 LOT 7A CBJ
MENDENHALL WASTEWATER TREATMENT PLANT
MENDENHALL RIVER
LEGEND
MENDENHALL PENINSULA PLANNING AREA
AUKE BAY PLANNING AREA
WEST MENDENHALL INDUSTRIAL PLANNING AREA
UPPER WEST MENDENHALL PLANNING AREA
Carson Dorn Inc.
WEST MENDENHALL VALLEY SEWER PLANNING AREA
Figure 1
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Correctly sizing pipe and other facilities for wastewater collection systems is based on estimates of wastewater flow that may be expected from areas to be served. Since the expected life of sewage collection system piping is about 50 years the usual design practice is to size pipes for either the estimated population in 50 years or for the saturation population of the area served. Using saturation populations minimizes the likelihood of facilities being unexpectedly undersized but it can also result in system capacity being installed that is never used.

Saturation Population Procedures

The saturation population of future service areas is based on the amount of usable land available for residential development and assumed population densities for each area. The amount of usable land is based on the number of lots on existing subdivided land and estimates of the number of lots that might be developed on currently unsubdivided land. Once the total number of existing and future undeveloped lots has been determined the saturation population for an area is determined by multiplying Juneau's average number of residents per lot (or residence) by the total number of developable lots.

Some areas are not typically considered for future development for the following reasons:

Public Use Reserves - Properties identified in the long range land use plan by the City and Borough of Juneau Property Resources Manager as being reserved for public use, open space and properties within the U. S. Forest Service boundaries of the Tongass National Forest.

Wetlands - Properties identified in the Juneau Wetlands Management Plan as high value wetlands (classifications A and B). There are properties classified as wetlands C and D that may be eliminated from development in the future when more data are obtained and a determination is made by the U. S. Army Corps of Engineers..

Water Courses - Rivers, lakes, and creeks.

Slope - Property considered to be too steep (20% slope or greater).

The CBJ Community Development Department has done studies of the number of persons per household in different areas of the CBJ. The Community Development Department uses 2.64 persons per household as the average for all housing types (single family residences, apartments, condominiums and mobile homes) and an average of 2.79 persons per household for just single family residences. For the purpose of sewer planning an average of 2.8 persons per residence is frequently used to ensure that the saturation population is not underestimated.

SEWER SYSTEM DESIGN CRITERIA

Wastewater Flows

In previous sewer system planning for the Back Loop Road Sewer project (*Back Loop Road/West Mendenhall Valley Sewer System Plan*, James M. Montgomery Consulting Engineers, 1992) projections were made of per capita sewage flows. The projections were based on a review of sewage flows at the Mendenhall Valley Wastewater Treatment Plant and estimates of the existing service area population. The average daily per capita flow and factors for determining peak daily and hourly flows from the average daily flow were determined. The average daily sewage flow was 130 gallons per capita per day, the peak daily flow was determined to be about 2.0 times the average daily flow and the peak hourly flow was 2.5 times the average daily flow. Table 1 summarizes these per capita wastewater flows.

TABLE 1
PER CAPITA WASTEWATER FLOW PROJECTIONS

Average Daily Per Capita Sewage Flow	130 gallons/day
	5.42 gallons/hr
	0.09 gallons/min.
Peak Daily Per Capita Sewage Flows	265 gallons/day
(2.04 times average daily flows)	11.05 gallons/hr
	0.18 gallons/min.
Peak Hourly Per Capita Sewage Flow	13.5 gallons/hr
(2.5 times average hourly flows)	0.225 gallons/min.

The per capita wastewater flow projections in Table 1 were reviewed with CBJ Public Works staff and compared to current per capita wastewater flows. These current flows will be used for sizing sewer facilities in this study. It is the peak hourly flow that is used for sizing sewage collection facilities to reduce the risk of sewer manholes surcharging under high flow conditions.

For industrial and business the wastewater flows are usually estimated at 20 gallons per employee per day. For the purposes of this evaluation we have estimated an average of 10 employees for each business.

Flow data from the Auke Bay Wastewater Treatment Plant were collected from the last 3 years of operation and were reviewed to develop an estimate of the average daily flow and the peak hourly flow at the plant. A summary of these records is included in Appendix A. The records indicate the average monthly flow during the evaluation period was 73,086 gallons per day and the peak daily flow that occurred during the last 3 years was 146,000 gallons per day. Flows at the Auke Bay Wastewater Treatment Plant were discussed with the CBJ Wastewater Utilities Division and it was concluded there is some potential for increase in the peak hourly flow rates due to the possibility of additional student housing at the University of Alaska Southeast and expansion of the sewer system beyond it current terminus at Waydelich Creek. It is estimated there is the potential for about a 30% increase in flows as a result of future developments. Consequently the

TABLE 2
WASTEWATER FLOW PROJECTIONS

Mendenhall Peninsula Planning Area

Existing Lots	350
Estimated Additional Lots	480
Total Estimated Lots	830
Population Projection @ 2.8 Residents/Residence	2,324
Avg Daily Flow (gpd) @ 130 gpd/resident	302,120
Peak Daily Flow (gpd) @ 2.00 x Avg Daily Flow	604,240
Avg. Daily Flow Rate (gpm)	209
Peak Daily Flow Rate (gpm)	418
Peak Hourly Flow Rate @ 2.5 x Avg Daily Flow Rate	**523**
Projected Peak Hourly Flow (GPM)	**523**

Upper West Mendenhall Valley Planning Area

Existing Lots	40
Estimated Additional Lots	660
Total Estimated Lots	700
Population Projection @ 2.8 Residents/Residence	1,960
Avg Daily Flow (gpd) @ 130 gpd/resident	254,800
Peak Daily Flow (gpd) @ 2.0 x Avg Daily Flow	509,600
Avg. Daily Flow Rate (gpm)	176
Peak Daily Flow Rate (gpm)	353
Peak Hourly Flow Rate @ 2.5 x Avg Daily Flow Rate	**441**
Projected Peak Hourly Flow (GPM)	**441**

West Mendenhall Industrial Planning Area

Estimated Residential Lots	40
Population Projection @ 2.8 Residents/Residence	110
Avg Daily Residential Flow (gpd) @ 130 gpd/resident	14,300
Peak Daily Residential Flow (gpd) @ 2.0 x Avg Daily Flow	28,600
Avg. Daily Residential Flow Rate (gpm)	10
Peak Daily Residential Flow Rate (gpm)	20
Peak Hourly Residential Flow Rate @ 2.5 x Avg Daily Flow Rate	25
Estimated Number of Potential Businesses	200
Avg. Daily Flow (gpd) @ 10 employees/business x 20 gal/empl./day	40,000
Avg. Daily Business Flow Rate (gpm)	28
Peak Daily Business Flow Rate @ Twice Avg. Daily Rate (gpm)	56
Peak Hourly Business Flow Rate @ 2.5 times Avg. Daily Rate (gpm)	70
Peak Hourly Business and Residential Flow Rate (gpm)	**95**
Projected Peak Hourly Flow (GPM)	**95**

SUBTOTAL PEAK HOURLY FLOW RATE (GPM) **1,059**

Auke Bay Planning Area

Current Peak Day (gpd)	150,000
Projected Peak Day (gpd)	200,000
Projected Peak Hourly Flow Rate (gpm)	175
Projected Peak Hourly Flow (gpm)	**175**

TOTAL PROJECTED PEAK HOURLY FLOW RATE INCLUDING AUKE BAY PLANNING AREA (GPM) **1,234**

estimated peak daily flow from the Auke Bay Wastewater Treatment Plant used in this study is assumed to be about 200,000 gallons per day and the resulting projected peak hourly flow rate from the Auke Bay area is estimated at 175 gallons per minute.

Table 2 on the following page illustrates the Wastewater Flow Projection for each of the planning areas included in this evaluation. The estimated number of lots in each area, the projected population and the projected wastewater flows based on the design criteria are shown.

The projected peak hourly flow from the planning area is estimated to be 1,059 gallons per minute at full development with it increasing to 1,234 gallons per minute if the flows from the Auke Bay Wastewater Treatment Plant are included.

SEWER SYSTEM DESIGN

Gravity Sewer Capacities

Gravity sewers are typically laid at slopes such that when flowing full the mean velocity of sewage in the line is at least 2.0 feet per second. This practice is based on maintaining sufficient flow velocity to prevent solids accumulation in gravity sewers.

Gravity sewers are normally sized to carry the peak design flow at a flow depth of one-half the pipe diameter for smaller pipes (16-inch and smaller) and a depth of 3/4 the pipe diameter for larger pipes (greater than 16-inch). The minimum size allowed for gravity sewer is 8-inch. The flows and flow velocities are based on the Manning Formula for flow in open channels.

Based on the above criteria the capacities of gravity sewers are as shown in Table 3.

TABLE 3
SEWER DESIGN CAPACITY

PIPE SIZE	MINIMUM SLOPE (FT/100 FT)	CAPACITY FULL DEPTH	DESIGN CAPACITY (1/2 FULL)	DESIGN CAPACITY (3/4 FULL)
8-inch	0.40 ft	340 gpm	136 gpm	
10-inch	0.28 ft	517 gpm	207 gpm	
12-inch	0.22 ft	745 gpm	298 gpm	
14-inch	0.17 ft	988 gpm	395 gpm	
16-inch	0.14 ft	1280 gpm	512 gpm	
18-inch	0.12 ft	1623 gpm		1298 gpm
20-inch	0.11 ft	2058 gpm		1646 gpm
24-inch	0.08 ft	2854 gpm		2284 gpm
30-inch	0.058 ft	4407 gpm		3525 gpm

Force Main Capacity

Force mains are normally sized for flow velocities of 3 to 4 ft/sec to ensure that any solids which settle when the pumps are not operating will be re-suspended when pumping resumes. Velocities in excess of 4 ft/sec are generally not desired because excessive head losses from friction result in unnecessarily high pumping costs. Based on this criterion the capacities of force mains are as shown in Table 4.

TABLE 4
FORCE MAIN DESIGN CAPACITY

PIPE SIZE	CAPACITY (3 FT/SEC)	CAPACITY (4 FT/SEC)
4-inch	118 gpm	157 gpm
6-inch	289 gpm	386 gpm
8-inch	517 gpm	689 gpm
10-inch	794 gpm	1059 gpm
12-inch	1140 gpm	1520 gpm
14-inch	1535 gpm	2047 gpm
16-inch	2006 gpm	2675 gpm

Required Pipe Sizes

With the projected peak hourly flows from the planning area estimated at 1,234 gallons per minute as indicated in Table 2, a review of Table 3 shows the main gravity sewer line serving the planning area needs to be an 18” line in order to handle the projected flows and the force main needs to be a 12” line.

CHAPTER 2
EVALUATION OF ALTERNATIVES

ALTERNATIVES

Meetings were held with the CBJ Engineering Department and the CBJ Wastewater Utilities Division staff to determine the alternatives to be considered for providing sewer service to the West Mendenhall Industrial area. The alternatives for the West Mendenhall sewer improvements needed to meet the following criteria:

- **Reasonably low in capital cost**
- **Use technologies Wastewater Collection System personnel are familiar with**
- **Acceptable to the greater community of Juneau**
- **Acceptable to residents and businesses in the West Mendenhall Valley area**
- **Acceptable to CBJ Engineering staff**

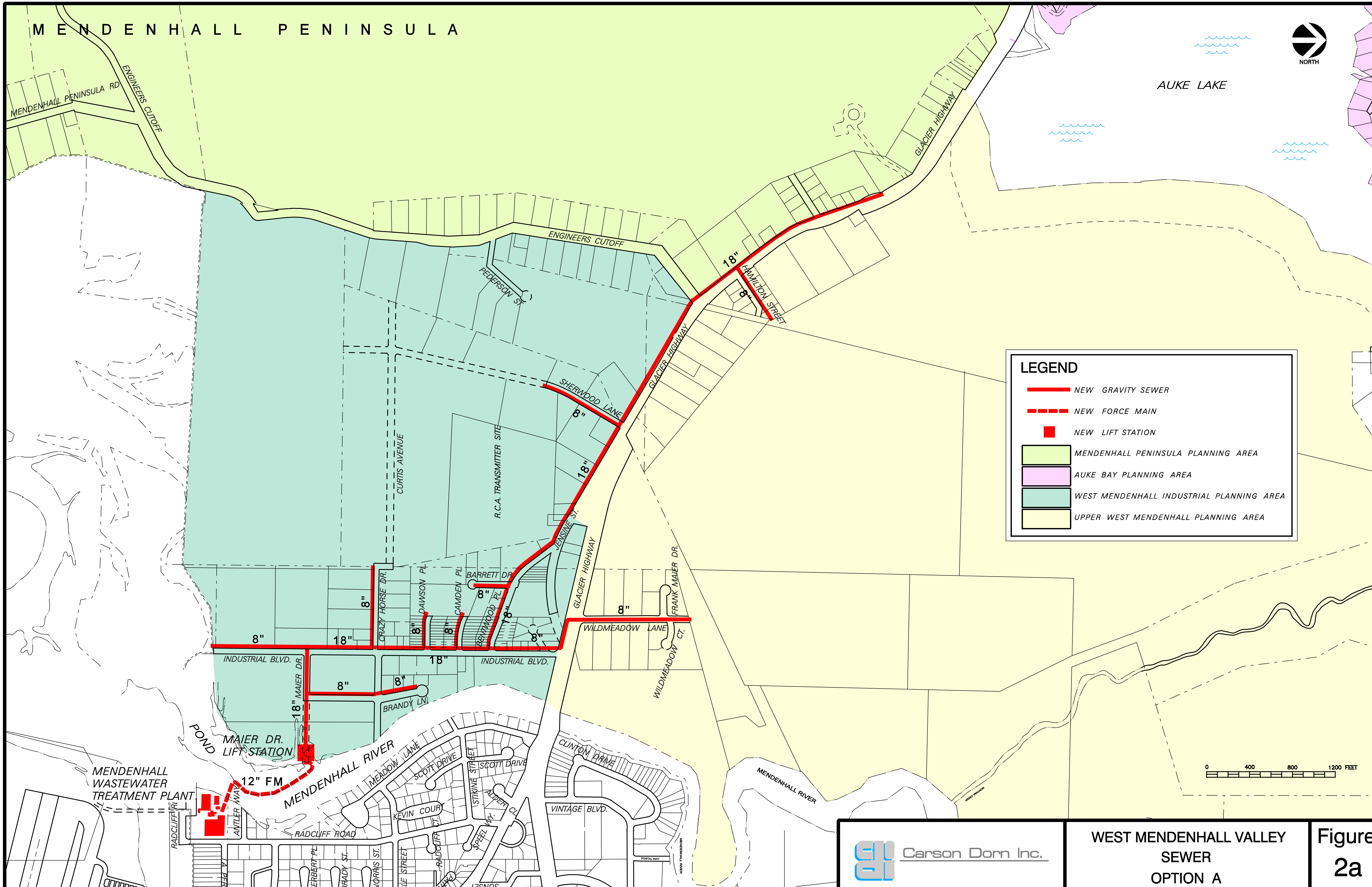
Three options to provide sewer service to the West Mendenhall Valley area were identified for further evaluation and cost estimating. These three options are:

Option A – Gravity sewers serving the West Mendenhall Valley area with the Peterson Hill area of Glacier Highway served via a gravity sewer main routed along Bentwood Ave. A sewage lift station would be used to pump sewage across the Mendenhall River at the end of the existing easement that extends Maier Drive. Option A is shown on Figure 2a.

Option B – Primarily gravity sewers serving the West Mendenhall Valley area with the Peterson Hill area of Glacier Highway served via a gravity sewer main routed along a new gravel road connecting Crazy Horse Drive to Sherwood Avenue A sewage lift station would be used to pump sewage across the Mendenhall River at the end of the existing easement that extends Maier Drive. Option B is shown on Figure 2b.

Option C – Primarily gravity sewers serving the West Mendenhall Valley area with the Peterson Hill area of Glacier Highway served via a gravity sewer routed along Bentwood Ave. An inverted siphon sewer would be used to transport sewage across the Mendenhall River at the end of a new easement crossing property currently owned by the Smith Family. Option C is shown on Figure 3.

Based on the potential residential development discussed in Chapter 1 of this report and the projected wastewater flows, the main sewer trunk system connecting Peterson Hill to the Mendenhall Wastewater Treatment Plant is projected to carry wastewater flows of up to 1,234 gallons per minute at full development. In order to handle these flows the main



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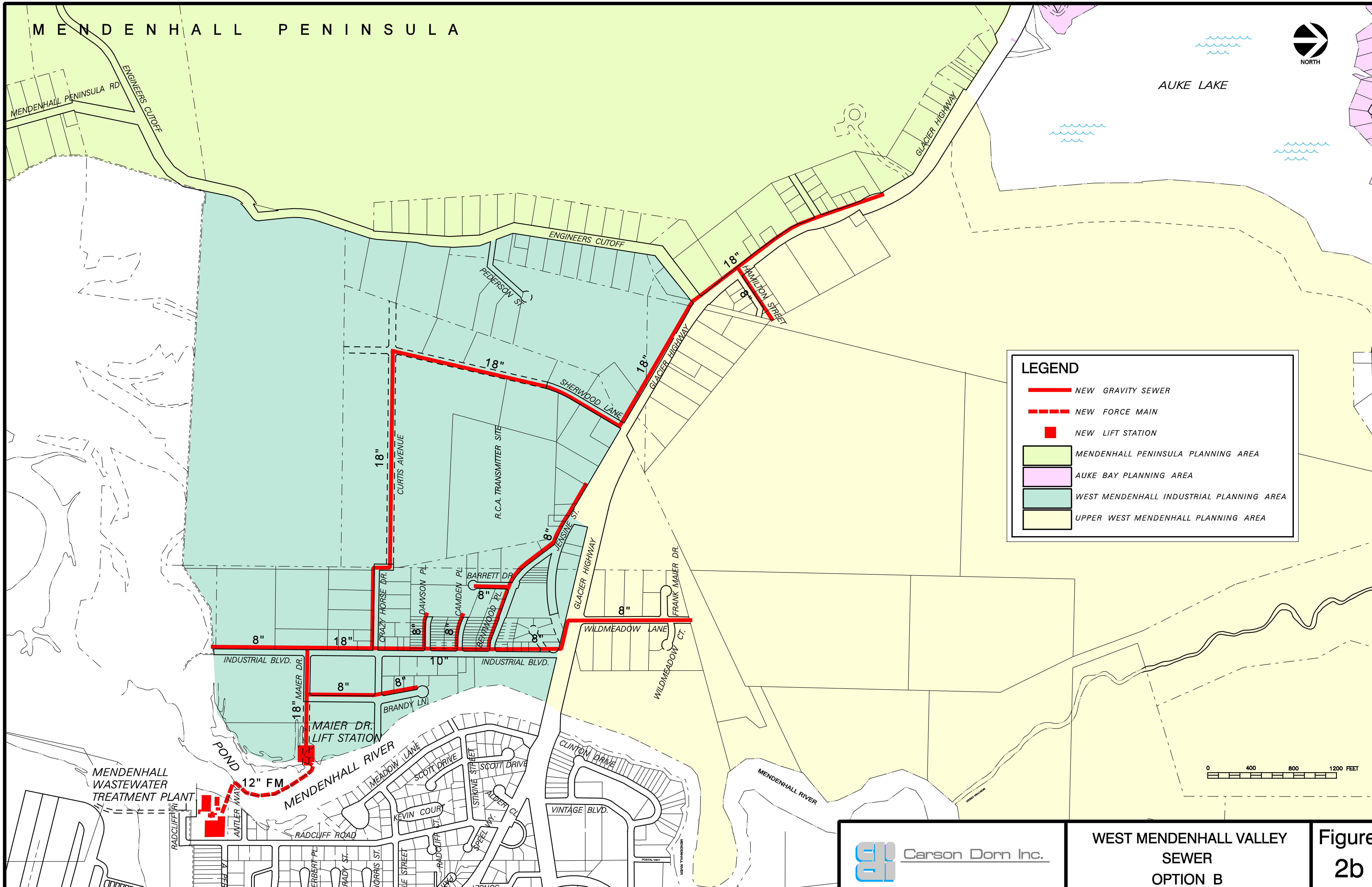
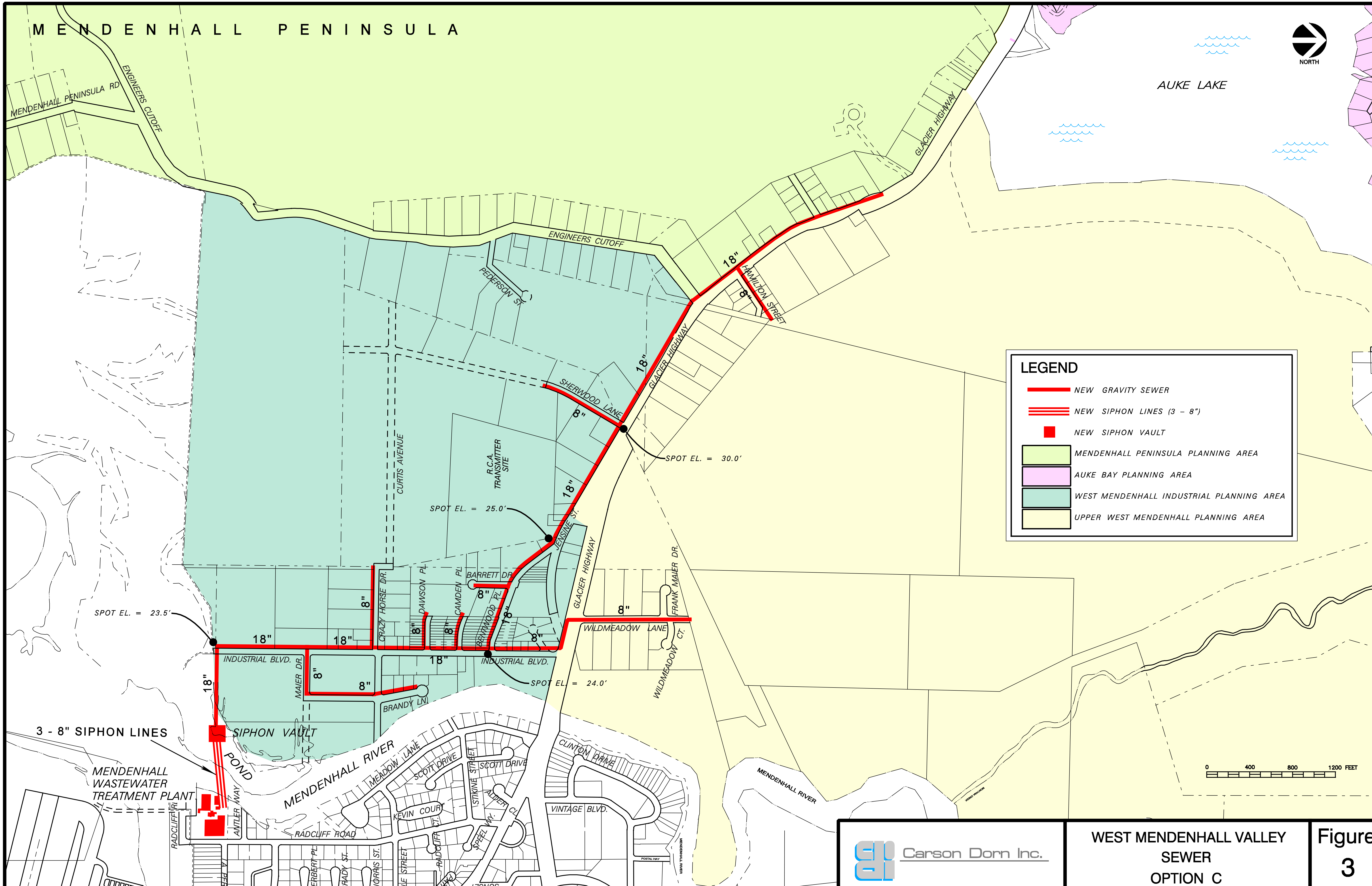


WEST MENDENHALL VALLEY SEWER OPTION B

Figure 2b



WEST MENDENHALL VALLEY SEWER OPTION C

Figure 3

Path/File Name: D:\2cad\CBJ\MSTRPLAN\2005\FIG_3.V8 Date Plotted: 10/30/2005 Time Plotted: 6:36:31 PM sewer trunk serving the West Mendenhall area will need to be an 18” diameter sewer line.

Additionally any sewer force main that would carry sewage pumped across the Mendenhall River would also need to be able to handle flows of up to 1,234 gallons per minute. As discussed in Chapter 1, the sewer force main would need to be a 12” diameter pipe.

The main difference between Option A and Option B is that Option A follows existing roads to Peterson Hill and Option B involves construction a new road between Crazy Horse Drive and Sherwood Lane. This new road would cross the meadows in the area and would require US Army Corps of Engineers permits as most of the area is classified as wetland.

Option A and Option B are similar in that both require a pump station and force main across the Mendenhall River to reach the Mendenhall Wastewater Treatment Plant. Much of the West Mendenhall area is very flat. The ground elevation was determined for a number of locations in the West Mendenhall Valley area and this data is shown on Figure 5 in Appendix A. In general, most of the industrial area is at about elevation 25’. With flat topography, sewer lines need to get progressively deeper as they maintain the minimum grades. For an 18” sewer line the minimum grade is 0.0012’ per foot. The Mendenhall River can be crossed by using a sewage pump station and force main regardless of how deep the line needs to be to maintain sewer grades. For this reason, Option A and Option B are less sensitive to the slope of the sewers and their elevation.

Option C which proposes using an inverted siphon sewer is sensitive to sewer elevations since it is the available head in the sewer line that will allow sewage to flow through the inverted siphon. Since Option C is sensitive to elevations an more thorough analysis of the siphon option is required to determine if this option is technically feasible.

OPTION C SIPHON EVALUATION

Most gravity sewers are carefully installed to ensure there is a constant downward slope to the line. It is important to make sure there are no high points or low points in the sewers that might cause sewage to pool-up and deposition of solids to occur. On some occasions when an obstruction is reached that does not allow a sewer to be kept at a constant slope such as a stream or waterway, an inverted sewer will be used to pass under the obstruction and the grade resumed on the opposite side of the obstruction. Inverted sewers are usually designed to ensure flow velocities in the inverted (or belly portion) of the sewer are in excess of 3 feet per second. This velocity is typically assumed to be fast enough to resuspend any solids that might settle in a sewer line.

For the inverted siphon option to serve the West Mendenhall Valley area it is important to check and verify that there is sufficient available head across the siphon to achieve flow velocities of at least 3 feet per second.

A review of Figure 5 in Appendix A indicates that beyond the intersection of Bentwood Avenue with Glacier Highway that the ground elevations start to increase. Consequently, the intersection of Bentwood Avenue with Glacier Highway is one the most remote service locations that is located at about elevation 25.2’.

Figure 3 shows the plan view of Option C and Figure 4 shows the profile of Option C as it departs Industrial Boulevard and heads towards the Mendenhall Wastewater Treatment Plant. These two figures are an important part of this evaluation.

The minimum depth of bury for a sewer lines is generally about 4.0’. So at the Bentwood intersection the invert or bottom of the sewer line would be at about elevation 19.7’ (25.2’ – 4.0’ – 18” = 19.7’).

There is about 4,120’ of pipe between the location where the sewer heads towards the Mendenhall Plant at the Bentwood intersection. At a minimum slope of 0.0012’ per foot the sewer line will be about 4.94’ lower (4,120’ x 0.0012’/ft = 4.94’) when it reaches the Industrial Boulevard departure point.

In addition it is estimated that there will be about 16 manholes in this section of line (one about every 250’). The elevation drop across a manhole, according to CBJ standard details for manholes, is supposed to be 0.1’. Consequently the sewer line will be an additional 1.6’ deeper when it reaches the Industrial Boulevard departure point as a result of the elevation drop across manholes.

Therefore the sewer invert elevation at the departure point will be 13.16’ based on a starting elevation of 19.7’ and a drop of 5.04’ due to the sewer gradient and an additional drop of 1.6’ due to the elevation drop across manholes.

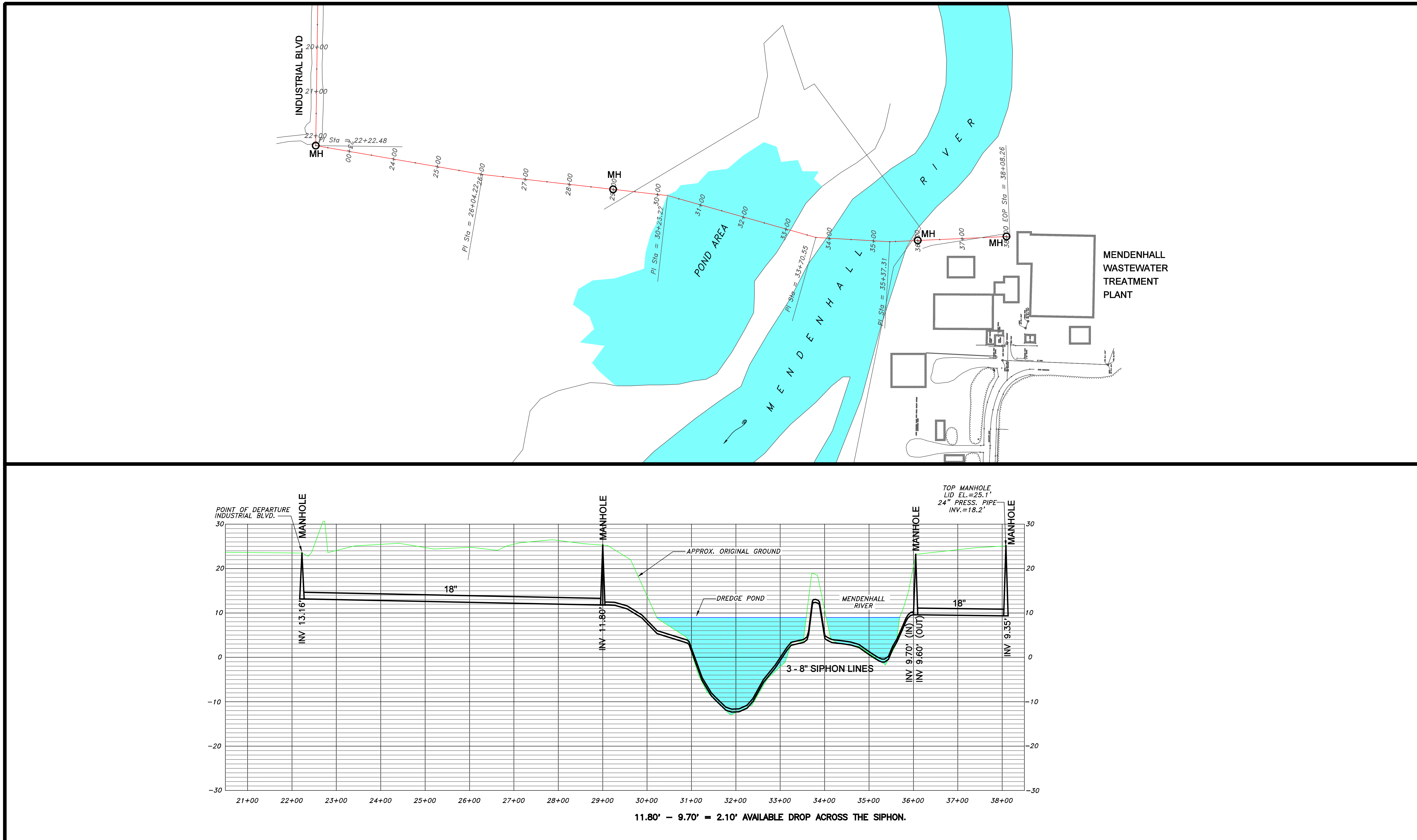
There is an additional elevation loss of about 0.84’ due the gradient of the sewer line across the Smith Property and about an addition head loss of 0.5’ in the siphon vault. As a result the invert of the siphon lines as the begin to head into the dredge pond and across the Mendenhall River is at about elevation 11.8’.

The inlet manhole for the Mendenhall Plant is at about elevation 9.35’ and about 200’ of gravity sewer is required to reach from the River to the plant. This results in an invert elevation for the siphon line on the Mendenhall Treatment Plant side of the Mendenhall River of about 9.7’ as shown on Figure 4.

Consequently the “available drop across the siphon” is 2.1’ (11.8’-9.7’=2.1’).

The siphon length between the siphon manhole and the manhole on the Mendenhall Wastewater Treatment Plant side of the Mendenhall River is about 700’.

The following table is a summary of the head that is necessary to achieve flow rates of 4 feet per second and 3 feet per second for a siphon sewer. In general none of the line sizes can achieve the desired flow rates with the head available across the siphon.



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MENDENHALL RIVER CROSSING
SIPHON - OPTION C
PLAN & PROFILE

Figure
4

Table 4
Siphon Head Loss

HEAD LOSS CALCULATIONS 4 FPS SMITH PROPERTY					
Nominal Pipe Size	Discharge (gpm)	Pipe ID (inches)	Siphon Length (feet)	Hazen Williams "C"	Head
6" SDR 11	306	5.59	700	130	7.99
8" SDR 11	527	7.34	700	130	5.81
10" SDR 11	793	9	700	130	4.58
12" SDR 11	1121	10.7	700	130	3.75
HEAD LOSS CALCULATIONS 3 FPS SMITH PROPERTY					
Nominal Pipe Size	Discharge (gpm)	Pipe ID (inches)	Siphon Length (feet)	Hazen Williams "C"	Head
6" SDR 11	230	5.59	700	130	4.71
8" SDR 11	396	7.34	700	130	3.42
10" SDR 11	595	9	700	130	2.69
12" SDR 11	841	10.7	700	130	2.20

Consequently while an inverted siphon sewer can eliminate the need for a sewage pump station and force main, it does not appear that this is a feasible location for a sewer siphon. As a result no additional consideration is given to Option C.

COST ESTIMATES

Estimates of the construction cost and total project cost were developed for Option A and for Option B. Unit bid prices were collected from other similar CBJ projects, primarily the North Douglas Sewer Project Phase I and adjusted for inflation that has occurred since the bids were submitted. Estimates of quantities were developed for major items of work in to construct the West Mendenhall Valley Sewer such as sewer line, asphalt resurfacing, highway casings, road construction and pump stations.

Table 5 shows the Estimated Construction Costs and the Estimated Project Costs for Option A, while Table 6 shows the same information for Option B.

Estimated Project Costs were determined by adding 50% to the Estimated Construction Cost for each item. The 50% mark-up is to account financially for project design, project inspection, CBJ administration and contingency.

TABLE 5

OPTION A - MAIER DRIVE PUMP STATION TO PETERSON HILL via BENTWOOD PLACE
PROJECT COST ESTIMATE

Location	Size	Length (feet)	Unit Price Sewer Line[1]	Sewer Line	Remove and Replace Asphalt[2]	Remove and Replace RAP[3]	Remove and Replace Chip Seal[4]	Highway Pipe Casing	Pump Station	Estimated Construction Costs	Estimated Project Costs[5]
Maier Drive	18"	1,080	$150	$162,000	$15,000					$177,000	$265,500
Maier Drive Lift Station and Generator Building									$500,000	$500,000	$750,000
Mendenhall River Force Main	12"	1,260	$150	$189,000						$189,000	$283,500
Maier Drive to Bentwood Pl. along Industrial Blvd.	18"	1,690	$150	$253,500	$50,700					$304,200	$456,300
Industrial Blvd. to Glacier Highway along Bentwood Pl.	18"	1,610	$150	$241,500	$12,000	$24,000		$25,000		$302,500	$453,750
Bentwood Pl. to Sherwood Lane along Glacier Highway	18"	850	$150	$127,500	$25,500					$153,000	$229,500
Sherwood Lane to Engineers Cutoff along Glacier Highway	18"	1,350	$150	$202,500	$40,500					$243,000	$364,500
Engineers Cutoff to Peterson Hill along Glacier Highway	18"	2,050	$150	$307,500	$61,500			$25,000		$394,000	$591,000
Brandy Lane	8"	1,030	$100	$103,000	$30,900					$133,900	$200,850
Maier Dr. to south end of Industrial Blvd.	8"	880	$100	$88,000						$88,000	$132,000
Crazy Horse Drive	8"	750	$100	$75,000	$22,500					$97,500	$146,250
Dawson Pl.	8"	330	$100	$33,000		$6,600				$39,600	$59,400
Camden Pl.	8"	330	$100	$33,000						$33,000	$49,500
Wildmeadow Lane to Bentwood Pl.	8"	2,090	$100	$209,000	$30,000		$15,000	$25,000		$279,000	$418,500
Barrett Dr.	8"	300	$100	$30,000		$6,000				$36,000	$54,000
Sherwood Lane	8"	790	$100	$79,000	$23,700					$102,700	$154,050
Wilma Avenue	2" Pres.	400	$100	$40,000					$80,000	$120,000	$180,000
Hamilton Street	8"	580	$100	$58,000	$17,400			$25,000		$100,400	$150,600
									ESTIMATED TOTALS	**$3,292,800**	**$4,939,200**

Note 1: Unit price includes pipe, manholes, services, excavation, imported backfill, construction surveying, mobilization, D-1 base course resurfacing

Note 2: Includes removing 14' wide strip of asphalt @ $6/sy and replacing with 2 1/4" AC pavement @ $100/ton. ($30/linear foot of sewer)

Note 3: Estimate includes resurfacing 28' wide road with 3" of RAP @ $40/ton. ($20/linear foot of sewer)

Note 4: Estimate includes resurfacing 28' wide road with chip seal @ $15/linear foot of sewer

Note 5: Estimated Total Project Cost is the Estimated Construction Cost plus 50% of the estimated construction cost to account for CBJ Administration, Design, Inspection and Contingency.

TABLE 6
OPTION B - MAIER DRIVE PUMP STATION TO PETERSON HILL via SHERWOOD LANE
PROJECT COST ESTIMATE

Location	Size	Length (feet)	Unit Price Sewer Line[1]	Sewer Line	Remove and Replace Asphalt[2]	Remove and Replace RAP[3]	Remove and Replace Chip Seal[4]	Highway Pipe Casing	Pump Station	Road Construction[5]	Estimated Constuction Costs	Estimated Project Costs[6]
Maier Drive	18"	1,080	$150	$162,000	$15,000						$177,150	$265,725
Maier Drive Lift Station and Generator Building									$500,000		$500,000	$750,000
Mendenhall River Force Main	12"	1,260	$150	$189,000							$189,150	$283,725
Maier Drive to Crazy Horse Dr. along Industrial Blvd.	18"	610	$150	$91,500	$18,300						$109,950	$164,925
Crazy Horse Dr. and Curtis Dr. to Sherwood Lane	18"	2,930	$150	$439,500	$48,300					$343,200	$831,150	$1,246,725
Sherwood Lane to Glacier Highway	18"	2,250	$150	$337,500	$23,700					$237,600	$598,950	$898,425
Sherwood Lane to Engineers Cutoff along Glacier Highway	18"	1,350	$150	$202,500	$40,500			$25,000			$268,150	$402,225
Engineers Cutoff to Peterson Hill along Glacier Highway	18"	2,050	$150	$307,500							$307,650	$461,475
Brandy Lane	8"	1,030	$100	$103,000	$30,900						$134,000	$201,000
Maier Dr. to south end of Industrial Blvd.	8"	880	$100	$88,000							$88,100	$132,150
Bentwood Avenue	8"	1,610	$100	$161,000	$12,000	$24,000		$25,000			$222,100	$333,150
Dawson Pl.	8"	330	$100	$33,000		$6,600					$39,700	$59,550
Camden Pl.	8"	330	$100	$33,000							$33,100	$49,650
Wildmeadow Lane to Bentwood Pl.	8"	2,090	$100	$209,000	$30,000		$15,000	$25,000			$279,100	$418,650
Barrett Dr.	8"	300	$100	$30,000		$6,000					$36,100	$54,150
Wilma Avenue	2" Pres.	400	$100	$40,000					$80,000		$120,100	$180,150
Hamilton Street	8"	580	$100	$58,000	$17,400			$25,000			$100,500	$150,750
										ESTIMATED CONSTRUCTION TOTAL	**$4,034,950**	**$6,052,425**

Note 1: Unit price includes pipe, manholes, services, excavation, imported backfill, construction surveying, mobilization, D-1 base course resurfacing

Note 2: Includes removing 14' wide strip of asphalt @ $6/sy and replacing with 2 1/4" AC pavement @ $100/ton. ($30/linear foot of sewer)

Note 3: Estimate includes resurfacing 28' wide road with 3" of RAP @ $40/ton. ($20/linear foot of sewer)

Note 4: Estimate includes resurfacing 28' wide road with chip seal @ $15/linear foot of sewer

Note 5: Estimate includes imported fill 5' deep by 36' wide @ $20/cy and 28' wide road surface of 6" D-1 @ $25/ton. Road cost estimated @ $160/ft.
Note 5: Estimated Total Project Cost is the Estimated Construction Cost plus 50% of the estimated construction cost to account for CBJ Administration, Design, Inspection and Contingency.

CHAPTER 3
MENDENHALL WASTEWATER TREATMENT PLANT
CAPACITY EVALUATION

BACKGROUND

The Mendenhall WWTP is a Sequencing Batch Reactor type wastewater treatment plant. It was designed in 1985 and construction was completed in 1990 under the Innovative/Alternative treatment program administered by the U.S. Environmental Protection Agency. This program provided higher levels of grant funding for treatment technologies that were not yet considered proven technologies to encourage innovation in wastewater treatment.

In 1999 CBJ undertook an aggressive program to improve operation of the Mendenhall Plant. Nearly $615,000 was spent to replace the old decanters with new solids excluding decanters manufactured by U.S. Filter, thereby eliminating the need for flushing the decanters. The last of the new decanters was installed in April 2000 and significantly reduced the amount of recycled wastewater flow in the plant thereby increasing the plant throughput.

Also in 1999, CBJ issued a $225,000 contract to replace the computer control system at the Mendenhall Plant with a flow proportional system that constantly adjusts reactor basin cycle times in response to changing influent flow. This new system can also measure dissolved oxygen levels in the SBR basins and terminate the aeration cycle once the treatment process is complete. With shortening reactor cycles in response to increasing flow and terminating aeration in response to dissolved oxygen levels.

Average monthly flows and the peak daily flow that occurred each month were collected for the past 3 years and are summarized in Table 7. The average monthly flow during this period was 2.18 million gallons per day. The peak day occurred November, 2005 during the record rainfall and was 4.77 million gallons per day. The next highest daily flow was over a million gallons less at 3.69 million gallons per day during December, 2004.

The treatment plant was originally designed for an average day capacity at design of about 4.9 million gallons per day (MGD). The peak design flow was 7.81 MGD.

Plant batch volumes and cycle times were reviewed to determine the hydraulic throughput of the facility while maintaining treatment. At an average day design flow of 4.9 MGD, the influent flow rate is about 3,400 gpm. During peak day flows of 7.8 MGD, the influent flow rate is about 5,420 gpm. Cycle times were discussed with plant operators, and in general it was concluded the cycle time for a typical SBR basin during average flow conditions should be between 4 to 6 hours. Use of eight basins for a plant of this size is unique. Plants of the Mendenhall WWTP's size typically have between 2 and 4 larger basins. Since the Mendenhall SBR basins are so small it does not take very

Table 7
MENDENHALL WASTEWATER TREATMENT PLANT
FLOW RECORDS

MONTH	AVG. MONTHLY FLOW (MGD)	MONTHLY PEAK DAY FLOW (MGD)
Jan-03	2.18	2.73
Feb-03	1.92	2.15
Mar-03	1.90	2.13
Apr-03	1.80	2.00
May-03	1.77	1.91
Jun-03	1.82	2.10
Jul-03	1.85	2.16
Aug-03	1.89	2.05
Sep-03	2.35	3.48
Oct-03	2.09	2.81
Nov-03	2.07	2.59
Dec-03	2.18	2.84
Jan-04	2.33	2.94
Feb-04	2.35	2.69
Mar-04	2.19	2.92
Apr-04	2.21	2.65
May-04	2.09	2.40
Jun-04	2.10	2.49
Jul-04	2.12	2.28
Aug-04	1.93	2.17
Sep-04	2.10	2.53
Oct-04	2.26	2.86
Nov-04	2.50	3.34
Dec-04	2.76	3.69
Jan-05	2.29	2.68
Feb-05	2.68	3.21
Mar-05	2.78	3.29
Apr-05	2.27	2.81
May-05	2.03	2.23
Jun-05	2.05	2.35
Jul-05	1.75	2.05
Aug-05	1.96	2.39
Sep-05	2.59	3.31
Oct-05	2.58	3.16
Nov-05	2.68	4.77

Monthly Average **2.18**

Highest Recorded Peak Day Flow **4.77**

long to fill and decant the basin. Consequently it was decided the cycle time should be about 4 hours during average flow conditions. Operating parameter for average flows of 4.9 MGD are assumed as follows:

AVERAGE FLOW EVALUATION
4.9 MGD
SETPOINT CONDITIONS

Bottom Water Level	17’
Top Water Level	25’
Fill Rate	3,400 gpm
Batch Volume	104,000 gallons
Batches per Day	47.11
Batches per Basin/Day (8 basins)	5.88
Minutes per batch	244.9
React Time	90 minutes
Settle Time	80 minutes
Decant Rate	6,000 gpm
Minimum Idle Time	15 minutes

With these conditions a cycle time for each reactor basin is as follows

Fill (at 3,400 gpm)	30.6 minutes
React	90 minutes
Settle	80 minutes
Decant (at 6,000 gpm)	17.3 minutes
Idle	27 minutes
Total Cycle Time	244.9 minutes

This proposed cycle time works for a flow of 4.9 MGD and meets the criteria established for average daily flow setpoints.

Under peak flow conditions of 7.8 MGD, the operating parameters are assumed as follows:

PEAK FLOW EVALUATION
7.8 MGD
SETPOINT CONDITIONS

Bottom Water Level	17’
Top Water Level	25’
Fill Rate	5,420 gpm
Batch Volume	104,000 gallons
Batches per Day	75.0
Batches per Basin/Day (8 basins)	9.38
Minutes per batch	153.5
Minimum React/Aerated Fill Time	50 minutes
Settle Time	80 minutes
Decant Rate	6,000 gpm
Minimum Idle Time	0 minutes

With these conditions a cycle time for each reactor basin is as follows

Aerated Fill (at 5,420 gpm)	19.2 minutes
React	30.8 minutes
Settle	80 minutes
Decant (at 6,000 gpm)	17.3 minutes
Idle	0 minutes
Total Cycle Time	153.5 minutes

Based on the cycle times described above, the Mendenhall WWTP average day treatment capacity is 4.9 MGD and the peak flow is up to 7.8 MGD.

If the development in the planning area for the West Mendenhall Sewer System is fully realized and the saturation population is reached, the projected average daily sewage flow from the area and the peak daily flows (including the Auke Bay Wastewater Treatment Plant) are expected to be about as follows:

	Average Daily Flow (gallons/day)	Peak Daily Flow (gallons/day)
Mendenhall Peninsula Planning Area	302,120	604,240
Upper West Mendenhall Valley Planning Area	254,800	509,600
West Mendenhall Industrial Planning Area	54,300	108,600
Auke Bay Planning Area	100,000	200,000
TOTAL	**711,220**	**1,422,440**

With these additional flows and the current flow at the plant, the average daily flow is projected to increase from 2.19 MGD to 2.90 MGD and the peak daily flow is projected to increase from 4.77 MGD to 6.19 MGD. Neither the projected average daily flow nor the projected peak daily flow exceed the plant design.

If one or two of the basins are off-line for maintenance and the plant consequently loses 25% of its capacity due to having 25% of its basins off-line, the plant would still be able to handle the projected average daily flow and the projected peak daily flow except for a period of record rainfall as was recently experienced. During such a time, the plant would need to have at least 7 of its basins on-line.

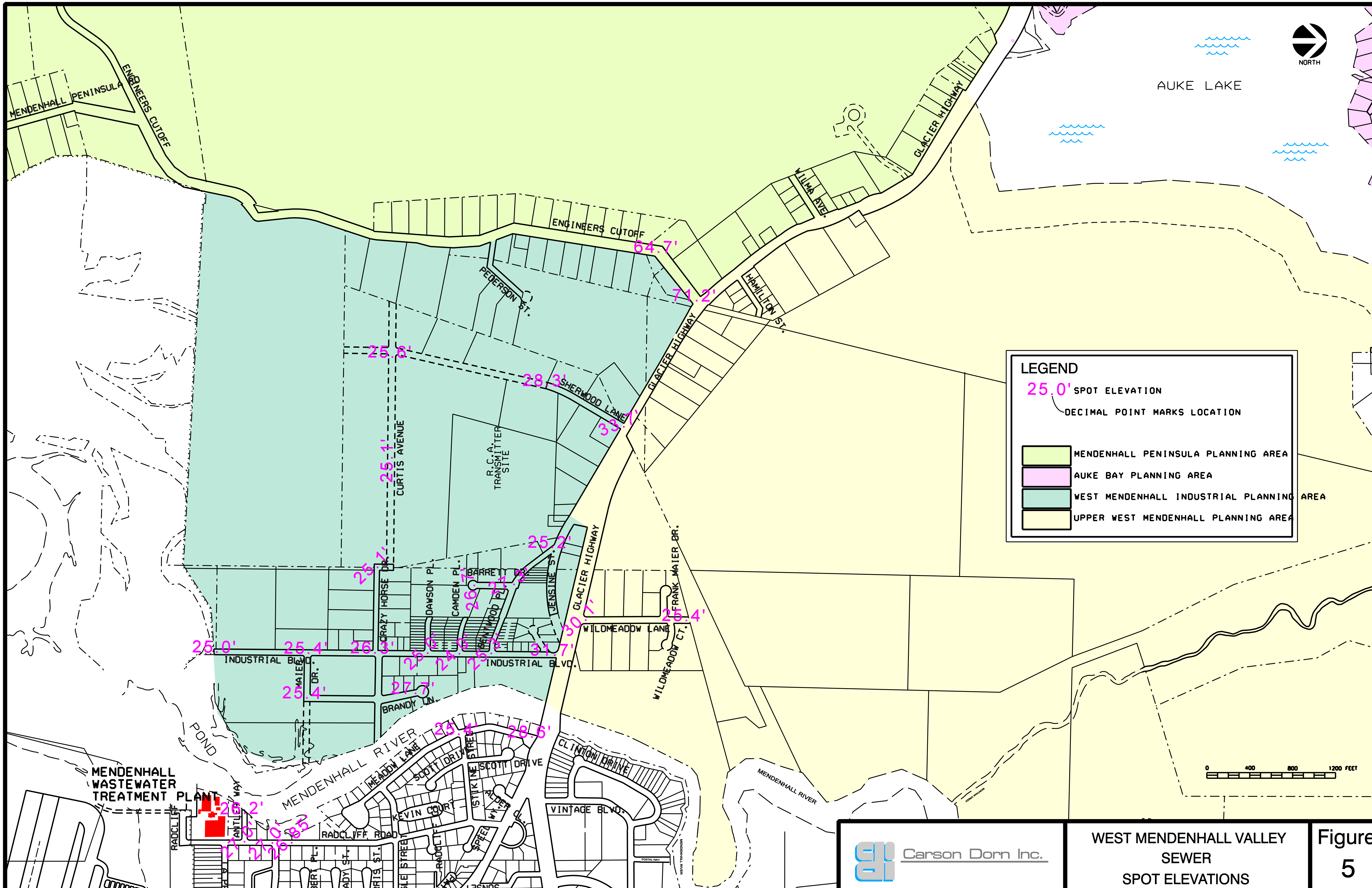
Consequently it appears the Mendenhall Wastewater Treatment Plant has the capacity to handle the projected increase of wastewater flow from the West Mendenhall Sewer Planning Area.

APPENDIX A

AUKE BAY WASTEWATER TREATMENT PLANT
FLOW RECORDS

MONTH	AVG. MONTHLY FLOW (gpd)	MONTHLY PEAK DAY FLOW (gpd)
Jan-03	72,070	96,940
Feb-03	75,250	101,450
Mar-03	73,440	107,700
Apr-03	74,800	98,970
May-03	71,000	102,500
Jun-03	76,070	115,790
Jul-03	76,640	103,100
Aug-03	97,460	105,000
Sep-03	103,500	146,000
Oct-03	82,100	120,800
Nov-03	82,560	116,410
Dec-03	74,570	117,310
Jan-04	74,330	142,000
Feb-04	70,100	87,480
Mar-04	67,430	106,000
Apr-04	67,410	82,090
May-04	60,500	74,600
Jun-04	65,650	90,670
Jul-04	70,890	86,870
Aug-04	63,930	79,640
Sep-04	77,160	115,430
Oct-04	77,350	97,820
Nov-04	74,910	118,000
Dec-04	66,930	92,380
Jan-05	55,100	82,630
Feb-05	69,010	93,570
Mar-05	67,210	101,840
Apr-05	63,130	99,900
May-05	53,260	71,170
Jun-05	62,480	90,770
Jul-05	73,570	95,020
Aug-05	72,700	102,740
Sep-05	86,140	132,030
Oct-05	76,140	94,660
Nov-05	83,220	127,370

Average **73,086**
Highest Recorded Peak Day Flow **146,000**



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