Thurston County
Grand Mound Service Area

WASTEWATER COMPREHENSIVE PLAN

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PREPARED BY

Barrett Consulting Group
10800 N.E. 8th Street, Seventh Floor
Bellevue, WA 98004

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CHAPTER 1 - GENERAL INFORMATION

1.1 PURPOSE OF REPORT

Thurston County, in accordance with the provisions of RCW Chapter 36.94, is empowered to own, operate, and maintain wastewater facilities in unincorporated portions of Thurston County. These facilities can include collection systems, interceptors, pump stations and forcemains, wastewater treatment plants, outfalls, and effluent and sludge disposal.

The community and residents of the Grand Mound area, through a locally formed Citizen's Advisory Committee, have initiated contact with Thurston County and expressed their interest in developing a water supply and wastewater disposal system.

The Grand Mound service area, which is currently served by septic tank and drainfield systems, is situated over permeable soils that do not provide adequate protection of the groundwater, which is the primary source of drinking water. In an effort to protect against further degradation of this aquifer, Thurston County has issued a building restriction, which prevents building lots less than one acre. This moratorium was the result of substantial information that suggested this area is fragile and environmentally sensitive to increased human activities. To satisfy the demand for residential, commercial, and industrial growth in this area, an alternative means of sewage disposal, other than septic tank systems, must be developed.

This report investigates alternative methods of wastewater collection and disposal for the treated effluent, resulting sludge, and reuse of the effluent.

1.2 SCOPE OF COMPREHENSIVE SEWER PLAN

This report is prepared to satisfy requirements for a Comprehensive Sewer Plan, as outlined in WAC Section 173-240-050.

1.3 OBJECTIVES

The major objective of this report is to develop a comprehensive plan which will serve as a guideline for developing an adequate sanitary sewer system for the Grand Mound area through the year 2020 This objective is consistent with the WAC requirements, which are listed below. As an aid to the reviewer, these requirements are summarized in Table 1.1 and identifies the corresponding chapter and section in which the requirement is addressed.

- The purpose and need for the proposed plan.
- A discussion of who will own, operate, and maintain the system(s).
- The existing and proposed service boundaries.

Table 1-1
Comprehensive Sewer Plan Requirements

Reference Paragraph in WAC173-240-050 Requirement	Description of Requirement	Found in Section/ Figure
3a	Purpose and need for the proposed plan	1.1
3b	Discussion of who will own, operate, and maintain the system	1.1
3c	Existing and proposed service boundaries	4.1
3d	Layout map showing boundaries; existing sewer facilities; proposed sewers; topography and elevations; streams, lakes, and other water bodies; water systems	Fig. 1.1
3e	Population trends	5.2
3f	Existing domestic and/or industrial wastewater facilities within 20 miles	
3g	Infiltration and inflow problems	4.2D
3h	Treatment systems and adequacy of such treatment	7.1 & 7.2
3i	Identify industrial wastewater sources	4.2E
3j	Identify public and private wells	3.5
3k	Discussion of collection alternatives	6.2 & 6.3
3k	Discussion of treatment alternatives	Chapter 7
3k	Discussion of disposal alternatives	Chapter 9
3l	Define cost per service, debt service, O&M costs	Chapter 10
3m	Compliance with water quality management plan	1.4
3n	SEPA compliance	EIS

- Layout map including the following:
  - *Boundaries.* The boundary lines of the area to be sewered, including a vicinity map.
  - *Existing Sewers.* The location, size, slope, capacity, direction of flow of all existing trunk sewers, and the boundaries of the areas served by each.
  - *Proposed Sewers.* The location, size, slope, capacity, direction of flow of all proposed trunk sewers, and the boundaries of the areas served by each.
  - *Existing and Proposed Pump Stations and Force Mains.* The location of all existing and proposed pumping stations and force mains, designated to distinguish between those existing and proposed.
  - *Topography and Elevations.* Topography showing pertinent ground elevations and surface drainage shall be shown, as well as proposed and existing streets.
  - *Streams, Lakes, and Other Bodies of Water.* The location and direction of flow of major streams, the high and low elevations of water surfaces at sewer outlets. All existing and potential discharge locations should be noted.
  - *Water Systems.* The location of wells or other sources of water supply, water storage reservoirs and treatment plants, and water transmission facilities.
- The *population trend,* as indicated by available records, and the estimated future population for the stated design period. Briefly describe the method used to determine future population trends and the concurrence of any applicable local or regional planning agencies.
- Any existing domestic and/or industrial *wastewater facilities* within 20 miles of the general plan area and within the same topographical drainage basin containing the general plan area.
- A discussion of any *infiltration and inflow problems.* Also, a discussion of action that will alleviate these problems in the future.
- A statement regarding provisions for treatment and discussion of the *adequacy of such treatment.*
- List of all establishments producing *industrial wastewater*, the quantity of wastewater and periods of production, and the character of such industrial

wastewater insofar as it may affect the sewer system or treatment plant. Consideration shall be given to future industrial expansion.

- Discussion of the location of all existing private and public wells, or other sources of *water supply*, and distribution structures as they relate to both existing and proposed domestic wastewater treatment facilities.

- Discussion of the various *alternatives evaluated*, and a determination of the alternative chosen, if applicable.

- A discussion, including a table, which shows the *cost per service* in terms of both debt service and operation and maintenance costs, of all facilities (existing and proposed) during the planning period.

- A statement regarding *compliance with any adopted water quality management plan* pursuant to the Federal Water Pollution Control Act as amended.

- A statement regarding compliance with the State Environment Policy Act of 1971 (*SEPA*).

1.4 PREVIOUS DOCUMENTS

The following technical documents preceded the development of this Comprehensive Plan and are summarized below in chronological order as a background for the development of this Plan:

- "Grand Mound Sewerage Plan" was prepared by Skillings & Chamberlain, Inc., in May 1987. This early study encompassed a larger service area than is now proposed.

- Final EIS for the Grand Mound Sewerage System

- "Chehalis River Low Flow Water Quality Analysis," prepared by Thurston County Environmental Health, Resource Protection Section, in November 1989. This study was initiated specifically because of the pending Grand Mound sewer system and outfall into the Chehalis River. The report identifed a maximum release to the river as 0.75 mgd based on a 100:1 dilution ratio. No mixing or dilution modeling was done under this study.

- "Grand Mound Sewerage Systems Feasibility Study - Phase I" was prepared by Barrett Consulting Group, dated February 25, 1991. This feasibility study developed some preliminary costs and assessments per equivalent residential unit (ERU).

- "Grand Mound Wastewater Engineering Report," prepared in March 1992 by Barrett Consulting Group. This study recommended a wastewater treatment flow equalization, disinfection, and sludge storage and disposal.

- "Grand Mound Water System Plan," prepared in March 1992 by Barrett Consulting Group. This study recommended a system of wells, reservoirs, and transmission and distribution piping.

1.5 PROJECT DESCRIPTION

The location of the Grand Mound area and the surrounding communities is shown on Figure 1.1. These service area boundaries have been established by Thurston County through the GMA planning process.

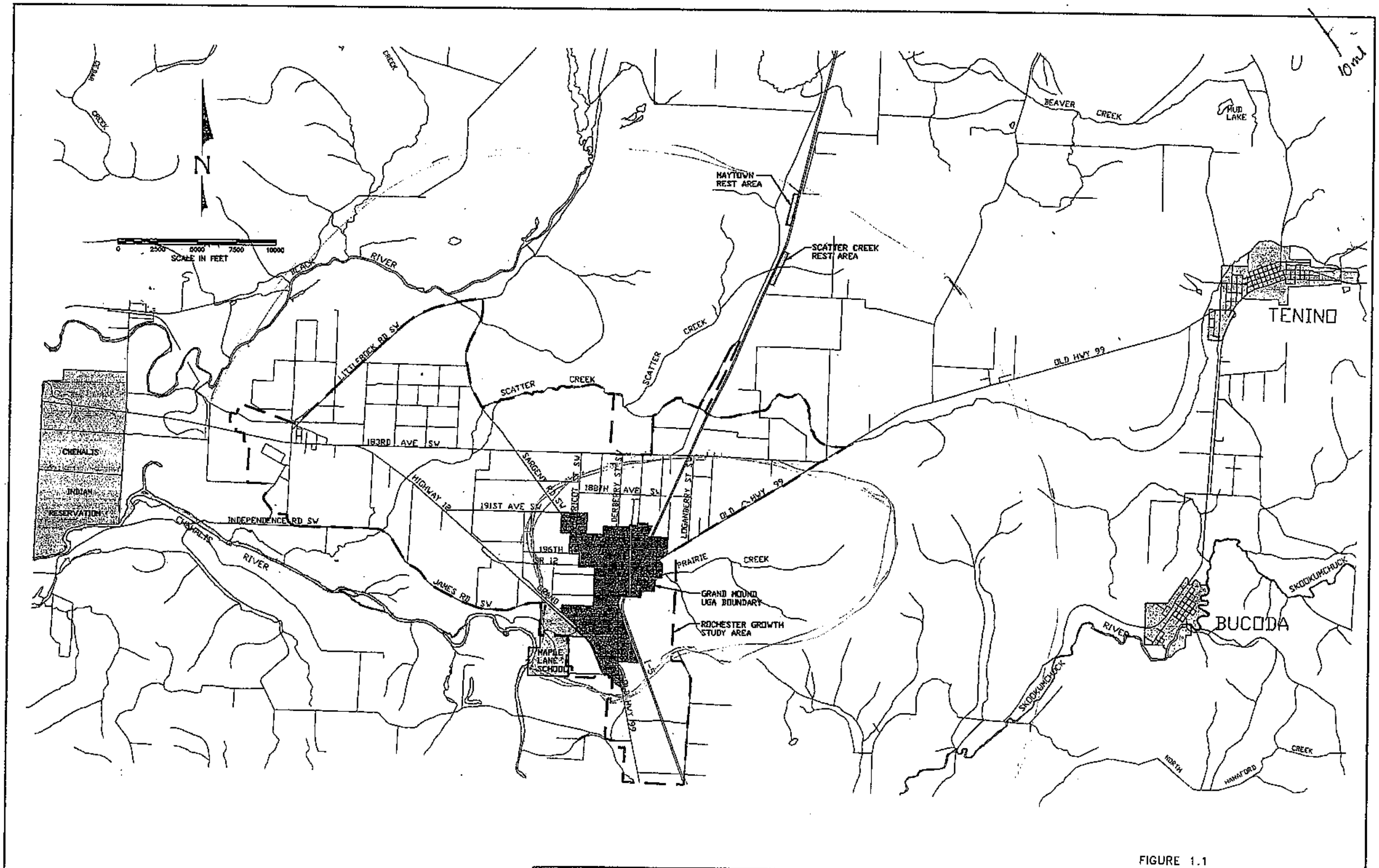
The service area boundaries, as shown on Figure 1.1, are significantly larger than those which were previously proposed in the 1992 Engineering Report. This increased area was delineated as part of the UGA boundary process and endorsed by the local Citizen's Advisory Committee.

The study area encompasses a gross area of 847 acres (original area of 957 acres less 110 acres of removed area). Though the nominal gross area of the study area is 847 acres, there are pending considerations to add certain areas and modify the allowable zoning in still other areas. To account for these uncertainties, the maximum and minimum expected scenario has been evaluated throughout this Comprehensive Report. Final determination of the actual service area is expected to fall within this envelope. The current service area is approximately bordered on the north by 193rd Avenue S.W., by Prairie Creek on the east side of I-5, by Old Highway 99 on the east (west side of I-5), by the south line of Section 13, T15N, R3W on the south, and on the west by the east line of Section 14, T15N, R3W to its intersection with Sargent Road, to its intersection with SR12 westerly along SR12, then northerly along the east line of the west half of Section 11, T15N, R3W to 193rd Avenue S.W. A precise legal description of the study area boundary is included in Appendix A.

The Grand Mound area currently and exclusively is served with individual septic tanks and drainfields. There is neither collection, transmission, or treatment facilities. Septic tank and drainfield maintenance is entirely the responsibility of the property owner. Disposal of the septage is coordinated by the septic tank hauler, who most likely transports and disposes of the septage at the Centralia or LOTT WWTP.

In addition to the service area boundary shown in Figure 1.1, there are two potential contract customers. The WSDOT rest areas are located approximately two miles north of the northern study area limits. The possibility of serving the two rest areas has been pursued with WSDOT officials, although a firm commitment to the Grand Mound system has not yet been made.

The second potential contractual user is the Maple Lane School. Currently, this DSHS facility is using a 15,000- to 20,000-gallon septic tank which discharges to a five-acre, non-aerated lagoon. The school has expressed interest in connecting to the new system and abandoning their lagoon operation. Discussions have also been held with the school's administrator for the purchase or lease of several acres of their property for the siting of the wastewater treatment plant.



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THURSTON COUNTY

FIGURE 1.1

GRAND MOUND SERVICE AREA BOUNDARY AND VICINITY MAP

CHAPTER 2 - SUMMARY

2.1 CONCLUSIONS

A. Growth and Flow Projections

The anticipated growth in the Grand Mound area was analyzed in three phases.

Phase I is defined as the growth and development adequate to generate 350,000 gpd maximum week flow. This intermediate (halfway) step to the maximum allowable discharge of 700,000 gpd (see Phase II) is expected to occur north of 203rd Avenue. Doubling the capacity from 350,000 gpd to 700,000 gpd can be easily accomplished by modular expansion of the Phase I treatment plant layout. The layout of Phase I and the subsequent expansions to Phases II and III are shown on Figure 7.3.

Phase II included population up to the level that would generate a maximum weekly flow of 700,000 gpd. This limitation was determined by the Department of Ecology in 1990, and was based on the assumption that conventional secondary effluent would be discharged to the Chehalis River. As described in Chapter 3, Phase II growth projections and modifications to the Urban Growth Boundary (UGB) zoning and boundaries result in a range of dates from year 2006 to 2010, when this maximum week flow will be reached. However, by projecting the medium growth scenarios, the most likely date appears to be 2008.

Phase III analyzed development within the UGB at the year 2020, as shown on Figure 3.1 and as described in Appendix A. Maximum week (month) flow projects at the year 2020 range from 946,831 gpd (872,089 gpd) to 1,432,884 gpd (1,319,019 gpd). These values bracket the extreme minimum and maximum flows that are reflective of either low growth and minimum land use or high growth and maximum land use. The most likely flow projections are those that are presented in the medium growth scenario, which is 1,110,703 gpd (1,023,175 gpd).

Table 2-1 on the following page summarizes the three phases.

Table 2-1
Summary of Phases I, II, and III

	PHASE I	PHASE II			PHASE III		
		Low	Medium	High	Low	Medium	High
Approximate Year	—	2010	2008	2006	2020	2020	2020
Residential Population	—	624	652	705	693	833	1,050
Area, Acres[1]	—	352	359	407	374	441	524
FLOW							
Average Daily Flow (gpd)							
Residential ≈ 14%	40,000		49,300		51,997	62,474	78,749
Commercial	11,800		46,300		70,000	79,200	82,000
Industrial	25,800		147,100		204,500	267,250	386,750
Maple Lane	44,300		95,600		150,000	150,000	150,000
WSDOT Rest Areas	13,900		19,300		24,600	24,600	24,600
I/I	154,200		222,400		224,336	264,594	314,431
TOTAL AVERAGE DAILY FLOW (gpd)	290,000		580,000		725,433	848,118	1,036,530
Adjustment to Service Area	—		—		(2,825)	0	54,760
ADJUSTED AVERAGE DAILY FLOW (gpd)	290,000		580,000		722,608	848,118	1,091,290
ADJUSTED MAXIMUM MONTH FLOW (gpd)	330,000		660,000		872,089	1,023,175	1,319,019
ADJUSTED MAXIMUM WEEK FLOW (gpd)	350,000		700,000		946,831	1,110,703	1,432,884
ADJUSTED MAXIMUM DAILY FLOW (gpd)	550,000		1,100,000		1,719,152	2,015,165	2,609,488
ADJUSTED PEAK HOUR FLOW (gpd)	745,000		1,490,000		2,467,809	2,890,450	3,738,026
LOADINGS							
BOD – Annual Average (#/day)	420		1,050			1,670	
TSS – Annual Average (#/day)	380		890			1,410	
BOD – Maximum Month (#/day)	520		1,260			2,130	
TSS – Maximum Month (#/day)	470		1,070			1,790	

[1]Includes area only from Grand Mound Urban Growth Area (UGA)

B. Plant Siting and Sizing

Two sites were evaluated for the location of the WWTP. As part of the site investigation, soil exploration pits were dug at both locations. The findings of this investigation are contained in Appendix B. One site is located in the northwest corner of the Maple Lane School property, and the other is located across Old Highway No. 9 in an abandoned mine. The mine property offered some advantages in that it was closer to the collection system, offered good soil and foundation conditions, and is partially excavated, which will result in reduced earthworking and excavation costs.

The treatment plant is size based on the medium growth and flow projections, and is proposed to be constructed in three phases. A summary of the number and sizes of the treatment units is presented in Table 2-2.

C. Collection System

Chapter 6 of this document addresses the collection and conveyance of the wastewater to the proposed wastewater treatment site. Consideration was given to gravity interceptors and a vacuum sewer system.

Because of the general flat terrain in the service area, the gravity sewer system resulted in deep excavation in order to serve the entire service area. This deep construction was not only more expensive, but was also very disruptive to the Grand Mound community.

The vacuum sewer system involves shallow construction and, consequently, was shown to be considerably less expensive. The County's staff and consultant have investigated vacuum sewer systems throughout western Washington and at facilities throughout the midwest and eastern coastal areas. The consensus is that vacuum sewers are well-suited in areas of flat terrain, similar to what is present in the Grand Mound service area. Despite the favorable advantages of the vacuum system, it was felt that due to the uncertainty of industrial development and the resulting wastewater, it would be advisable to construct a gravity "spine" that ran centrally along 203rd Avenue and northerly along Old Highway 99 to the intersection of SR-12 and I-5. This spine would allow greater flexibility to convey flows greater than those which have been anticipated in this report. The collection system at the northern and southern ends of the study area are collected using vacuum sewers, which then move the wastewater to the gravity spine and finally to the WWTP. This combination of gravity and vacuum sewers provides for future increases in the flows while minimizing the costs of collection.

Table 2.2
Oxidation Ditch Design Criteria

Grand Mound WWTP- Oxidation Ditch Process Sizing			
	Phase I	Phase II	Phase III
Flow, mgd			
Annual Average	290,000	580,000	848,000
Maximum Month	330,000	660,000	1,023,000
Maximum Week	350,000	700,000	1,111,000
Maximum Day	550,000	1,100,000	2,015,000
Peak Hour	745,000	1,490,000	2,890,000
BOD, lb/day			
Annual Average	420	1,050	1,670
Maximum Month	520	1,310	2,250
Maximum Week	650	1,600	2,600
TSS, lb/day			
Annual Average	380	890	1,410
Maximum Month	470	1,110	1,910
Headworks			
Mechanical Screen			
No. of Units	1	1	2
Channel Width, ft.	1.5		1.5
Manual Bar Screen			
No. of Units	1	1	1
Channel Width, ft.	1.5		1.5
Grit Removal Chambers			
No. of Units	1	1	2
Chamber Diameter, ft.	7		7
Chamber Depth, fe	4		4
Grit Hopper Diameter, ft.	3		3
Grit Hopper Depth, ft.	5		5
Parshall Flume			
Throat Width, in.	6		6
Capacity, mgd	2.8		2.8
Oxidation Ditches			
No. of Ditches	1	2	3
Dimension Each, ft.			
Total Ditch Width	32	32	32
Total Ditch Length	124	124	124
Side Water Depth	12	12	12
Total Ditch Volume, gal.	336,000	672,000	1,008,000
Hydraulic D.T. at Max. Mo. Flow, hr.	24	24	24
Organic Loading, lb/1000 cf./day (1)	14.47	17.81	19.29
MLSS, mg/l	3,500	3,500	3,500
F/M Ratio, lb BOD/lb MLSS/day	0.053	0.067	0.076
No. of Aerators, Each Ditch	2	2	2
Aerator Horsepower, Each	40	40	40
Total Anoxic Tank Volume, gal.	6,000	12,000	18,000
Anoxic Tank D.T., min.	26	26	25

Table 2.2
Oxidation Ditch Design Criteria

Secondary Clarifier			
No. of Units	2	2	3
Diameter, ft.	34	34	34
Side Water Depth, ft	13	13	13
Each Clarifier Surface Area, sf.	908	908	908
Total Clarifier Area, sf.	1,816	1,816	2,724
Overflow Rate, gpd/sf.			
Maximum Month	363	363	376
Peak Hourly	821	821	1,061
Solids Loading, lb/sf/day			
Maximum Month (3)	21	21	33
Peak Design (4)	31	31	40
Ultraviolet Light Disinfection			
No. of Channels	1	1	2
Bank of lamps	2	3	6
No. of Lamps, Total	40	60	120
UV Transmission, %	60	60	60
Fecal Coliform Limit	<200	<200	<200
Waste Sludge Quantities			
Dry Solids, lb/day			
Annual Average	280	710	1,130
Maximum Month	350	890	1,530
Volume at 1.2% Solids, gpd			
Annual Average	2,800	7,100	11,300
Maximum Month	3,500	8,900	15,300
Volume at 4.0 % Solids, gpd			
Annual Average	840	2,100	3,400
Maximum Month	1,050	2,700	4,600
Sludge Storage Tanks			
No. of Tanks	2	2	2
Tank Dimension, ft			
Length	15	15	15
Width	15	15	15
Side Water Depth	12	12	12
Tank Volume, Each, gal.	20,000	20,000	20,000
Total Volume, gal.	40,000	40,000	40,000
Sludge Thickening Device			
No. of Units	1	2	2
Unit Capacity, Each, gpm	40	40	40
Total Thickening Capacity, gpm	80	80	80

(1) Based on peak week loading
(2) Based on one clarifier operation
(3) Based on 100 percent RAS flow and 3500 mg/l MLSS
(4) Based on 50 percent RAS flow and 3000 mg/l MLSS

CHAPTER 3 - SERVICE AREA CHARACTERISTICS

3.1 SERVICE AREA

Figure 3.1 identifies the sewer service area boundary for the Grand Mound Urban Growth Area. The growth projections presented in this report looked at three growth scenarios.

The Grand Mound area is uniquely situated at the intersection of I-5 and SR12, two major roadway systems. The area has the following significant advantages that will undoubtedly attract growth:

- Intersection of major north-south (I-5) and east-west (SR12) highway system
- Existing interchange to accommodate easy access from both I-5 and SR12
- Substantial amount of available undeveloped property
- Abundant source of available water
- Close proximity to Olympia and Centralia/Chehalis
- Relatively flat topography
- Relatively low land costs
- Rail service
- County has identified and designated this area as a growth center in the Thurston County Comprehensive Plan.

The delineation of the service area boundary has evolved over the last several years. The initial service area was identified in 1985 in the Grand Mound Sewerage System plan. Through the public involvement process, citizens were able to voice their support or their opposition to the proposed project. As a result, the service area boundaries were modified to include those properties that favored sewer service and excluded those area that were against sewers. This revised service area was reflected in a feasibility study dated February 25, 1991. This service area has remained more or less constant (except for a minor revision which was presented in the March 1992 Engineering Report) and has been the basis for financial feasibility analysis that has been done during the past few years. The current service area boundary is a revision of the previous study area boundaries and encompasses approximately 847 acres. The proposed service area boundary is presented in Figure 3.1.

3.2 LAND USE AND ZONING

The preliminary zoning for this area has been developed by Thurston County Advanced Planning, dated August 1995, and is presented in Figure 3.2. Although other zoning alternatives are being investigated, the preliminary zoning shown on Figure 3.2 is the preferred alternative and the basis for population and flow projections. The densities indicated are for gross developable land. Consequently, an allowance for street and other amenities has been subtracted to account for this adjustment. Sensitive areas such as steep slopes and wetlands are excluded from development.

The zoning which is presented on Figure 3.2 identifies five different zoning classifications. These classifications are described below:

- *R 3 - 6.* Residential with 3 to 6 units per acre.

- *R 4 - 8.* Residential with 4 to 8 units per acre.

- *AC.* Arterial Commercial zoning allows commercial uses that are oriented to vehicular traffic and that serve as a trade center for the surrounding community. Permitted uses include, in part: restaurants, grocery store, book, video, hardware stores, bakery, cafe, gas station, service uses, laundry and dry cleaning, beauty and hair care, churches, professional services (law, medical, dental, chiropractic, and veterinary), automotive service and sales, wholesale and retail sales, storage yards, motel and motor hotels, public facilities (except schools), multi-family residences.

- *PI.* Planned Industry zoning provides for industrial development under regulation to protect the nearby land uses and to encourage planning of an entire industrial site within a park like environment. This zoning includes, but is not necessarily limited to: service and retail uses that primarily serve industrial uses such as delivery services, truck and heavy equipment services, banks, restaurants, cafes, bards, gas stations, research and commercial testing labs, product assembly or manufacturing, process and storage warehouses, bottle plants, brewery, welding shops and public facilities.

- *LI.* Light Industrial zoning provides areas where a broad range of processing, fabrication and storage of products may be located as well as commercial uses that are included under the PI designation as well as salvage and recycling, masonry and veterinary clinics.

3.3 PHYSICAL AND NATURAL FEATURES

Topographic and geological characteristics of the service area are important because they affect the location and capacity of the sewer mains, interceptor trunks, and sewage pump stations.

The UGB consists principally of Spanaway gravelly sandy loam on nearly level to rolling soils. This material is very well drained and provides a direct intertie to the underlaying aquifer. Some association with the Spanaway-Nisqually series is also evident in the I-5/SR12 interchange area. There are also approximately seven active or previously abandoned gravel pit operations that are in or adjacent to UGB.

The elevation of the Grand Mound UGB ranges from 150 to 185 and generally slopes to the southwest toward the Chehalis River.

The native vegetation of this area is predominately Douglas Fir/Oregon White Oak; however, there are some areas of Douglas Fir/Red Alder.

Thurston County has also delineated the extent of wetlands throughout the service area. Generally, the wetlands that have been identified are located at the extreme edges of the UGB. The identified wetlands are shown on Figure 3.3. In addition, a specific wetland reconnaissance was conducted by The Coot Company, which determined that none of the proposed Wastewater Treatment Plant sites had any wetlands associated with them. This evaluation is included as Attachment C.

A. Water

Surface water: A small seasonal water course, Prairie Creek, crosses the Grand Mound area. It drains across the area from northeast to southwest to the Chehalis River. A second and much smaller, unnamed, seasonal creek crosses the southern portion of the service area.

Drainage: The Grand Mound area is relatively flat and slopes from northeast to southwest towards the Chehalis River.

Subsurface water: There is an underlying aquifer generally under the entire Grand Mound area. Well logs show that the water layer is quite close to the surface, approximately 20 feet deep. The water in the aquifer moves in the same northeast to southwest direction as the surface water. This aquifer is the source of all domestic water for the residents of Grand Mound.

Quality of water: Within the Grand Mound area there are no sources of pollution to the waters except the individual septic systems that are in use on many parcels. Upstream of Grand Mound there are agricultural sources of potential pollution into the surface or subsurface waters. Some higher levels of nitrates have been found in domestic wells just to the northeast of the Grand Mound area. These are generally believed to be from dairy farming sources.

B. Air

The air quality in the Grand Mound area appears to be normal. There are no known sources of air contamination with the exception of the exhaust from heavy traffic on Interstate Highway 5.

C. Land

The Grand Mound service area is generally flat prairie land which slopes gently toward the Chehalis River. The elevation varies from approximately 150 feet to 185 feet above sea level.

Figure 3.3 Wetland Inventory

The soil is generally Spanaway, Nisqually, and Everett type gravelly sandy soil which is very porous and which drains rapidly. It is covered in typical prairie vegetation in areas that are not developed.

Average rainfall is approximately 48 to 52 inches per year.

D. Sensitive Areas

1. *Floodplains:* There are no significant floodplains within the Grand Mound service area. There are floodplains along the Chehalis River. There is a small floodplain along the banks of Prairie Creek next to one of the potential sewer plant locations. Refer to Figure 3.4 for the delineation of the 100-year floodplain boundaries.

2. *Wild and Scenic Rivers:* There are no wild and scenic rivers within the Grand Mound service area.

3. *Historic and Archaeological Sites:* There are two historical sites within the Grand Mound service area. One is the Grand Mound Sunshine Club, built in 1858 as a school and community church. The second is the Oregon Trail Marker which was erected in 1916 as part of the efforts of the Daughters and Sons of the American Revolution to mark the Oregon Trail.

   There are no known archaeological sites in the service area.

4. *Threatened Species:* There are no known threatened species of birds or animals within the service area.

5. *Prime and Unique Farm Lands:* Little or none of the service area is being used for agricultural purposes. None of the land is prime or unique farm land.

6. *Fisheries, Shellfish, Etc.:* No fishery or shellfish activity takes place within the service area. Prairie Creek is generally dry in the summer months.

   The Chehalis River possesses significant runs of spring and fall Chinook, Coho, and Chum Salmon, as well as steelhead and sea-run cutthroat trout. These fish contribute to the various ocean, bay, and river commercial and sport fisheries.

Figure 3.4 Floodway Delineation

E. **Public Health**

The current use of septic systems for disposing of human wastes within the service area has a potential for contaminating the underlying water aquifer. This is primarily due to the very porous nature of the soil in the area which does not allow sufficient time for biological treatment as the sewage effluent passes through the underlying strata towards the groundwater.

3.4 PRESENT POPULATION

The area which is slated for service from the Grand Mound facilities includes contribution from the Grand Mound UGA, the DSHS Maple Lane School, and the two WSDOT I-5 rest areas (Scatter Creek and Maytown).

The current population of the Grand Mound UGA boundary is estimated to be approximately 240 households (190 north of 203rd Avenue S.W. and 50 south of 203rd Avenue S.W.). On a national average, the typical household size decreased during the 1980s from 2.6 to 2.4 people per household. It is assumed that the same trend and value are typical of the Grand Mound area. Consequently, the number of people is approximately 575 All of the existing population are sewered with individual septic tanks. No community sewer collection nor treatment system currently exists.

The current population of the DSHS Maple Lane School is 230 residents. This population base is fairly constant, but is anticipated to grow to 300 residents, with an anticipated expansion in the near future (Gray and Osbourne, January 1995).

The wastewater contribution from each of these three categories obviously differs. A detailed discussion of the wastewater generated from each of these users is presented in Chapter 4.

3.5 WATER FACILITIES

There is no public water supply system that serves the Grand Mound Area. All potable water is provided from individual private wells. Hundreds of these smaller wells have been drilled in this area to serve the residents and small businesses. These wells are exempted from a requirement to obtain water rights from DOE; however, all drilling logs, regardless of size, are recorded with DOE. Those wells appearing in DOE records are shown on Figure 3.5.

The County has adopted and enforces the Uniform Building Code which includes water conservation measures. In addition, the County has taken, or anticipates taking, the following water conservation steps:

- Enclosing water conservation tips periodically within billings mailed to water customers
- Progressive pricing of water rates

Figure 3.5 Wells in Grand Mound Vicinity

- Periodic review of water sold in comparison to water delivered so that losses can be identified and corrected

- Encourage the installation of low water use fixtures

CHAPTER 4 - EXISTING SEWERAGE SYSTEM

4.1 EXISTING SYSTEM

All areas within the Grand Mound UGA, and those areas outside the UGA but potentially served at some time in the future, are all sewered on private sewer systems. These systems generally consist of individual septic tanks and drain fields. Consequently, within the boundary of service (with the exception of the Maple Lane facility) there are no collection lines, interceptors, pump stations, or treatment plants. No significant industrial contributions exist within the service area. The two potential contract customers are the WSDOT I-5 rest stops and the DSHS Maple Lane School, which have the following systems:

- *WSDOT I-5 Rest Areas*

  The south bound rest area pumps the wastewater southerly to an area (west of I-5) which is better suited for percolation. The northbound rest area utilizes on-site septic tanks and drainfields.

- *DSHS Maple Lane School*

  The Maple Lane School uses a 15,000- to 20,000-gallon septic tank, which discharges into a 5-acre, non-aerated, non-discharging lagoon. Effluent from this system percolates through the lagoon bottom, which presumably enters the groundwater and the Chehalis River.

There are no known heavy industrial users currently within the study area boundaries. There are, however, light industrial users such as a diesel repair/welding shop and a paint shop. The County is currently finalizing a utility ordinance that includes a section on industrial pretreatment. This ordinance would be applicable to industrial users that may be attracted to this service area, a copy of which is available for review at the Thurston County Department of Public Works.

4.2 EXISTING WASTEWATER FLOW

A. Grand Mound UGA

The existing population consists of 240 SFU (190 north of 203rd Avenue and 50 south of 203rd Avenue). It is impossible to document the wastewater generated from these individual septic tanks. However, based on typical flow data from other similar areas, the wastewater flow generated from this area is estimated to be:

240 households × 2.4 people/household × 75 gal/person = 43,200 gals/day

B. WSDOT I-5 Rest Areas

Thurston County has provided their estimate of the wastewater which is generated from each of the two rest areas as follows:

Scatter Creek Rest Area	9,250 gpd
Maytown Rest Area	5,750 gpd
TOTAL ANNUAL AVERAGE	15,000 gpd

The WSDOT rest areas are subject to seasonal fluctuations in their wastewater flows. Typically, however, the greatest flows correspond to summer vacation time and the associated highway usage. The maximum monthly and weekly flows from the rest areas will not likely coincide with the maximum wintertime flows from the remaining study area. Nonetheless, factors of 30 and 45 percent for maximum month and week, respectively, have been applied to determine the peak flow conditions.

C. DSHS Maple Lane School

Currently, the school operates a non-aerated lagoon, with an outfall to the Chehalis River. This lagoon has been the focus of attention from DOE and other entities concerned about water quality in the Chehalis River. Existing wastewater flow from the school is estimated to be:

43 200
15 000
34 000
92,200

Annual Average: 230 students = 34,000 gpd*

These numbers are identified in the Gray and Osbourne report, dated January 1995.

The Maple Lane School is a year-round boarding school that is located near the proposed WWTP sites. The school is viewed to have a constant loading with little fluctuations in their operation and discharge.

D. Inflow and Infiltration

Under typical conditions, an important element to consider is the contribution from inflow/infiltration (I/I). However, since there is no existing piping system, the I/I contribution is assumed to be negligible. It should be noted that the flow values for the Maple Lane School include an I/I component. Allowances for I/I will be included in the future wastewater flow estimates.

E. Existing Total Flow Summary

Table 4-1
Existing Flows

Users in UGA	Estimated Wastewater Flow (gpd)
NORTH OF 203rd AVENUE S.W.	
Commercial/Industrial:	
Interstate Mobile Home Service	300
Jet Ster Inc.	600
Atlas Concrete Products	300
Milman Engineering, Inc.	300
Columbia Fiberglass, Inc.	600
Quality Steel Products	300
Rochester Lumber Co.	600
Aztec Technology Corp.	300
Housing Mart, Inc.	600
Short Stop Food Mart	2,900
Grand Mound Tire, Inc.	300
Fred's Discount Tires	300
Grand Mound AM-PM	2,900
Grand Mound Shell	2,900
Little Red Barn	4,500
Burgermaster	6,000
Dairy Queen	1,500
Los Haciendas Mexican	7,400
D&T Espresso	0
Cricket's Floral & Gifts	300
Grand Mound Liquor Store	300
Key Bank	600
Jim Thomas Agency	300
Farmers Insurance	300
Campbell Home & Property	300
The Hair Loft	1,200
Frank's R.V. Repair	300
Grand Mound Auto Repair	300
Grand Mound Video	300
SUBTOTAL	36,800
Residential Units:	
Permanent and Mobile 190 @ 180 gpd	34,200
TOTAL FLOW - North of 203rd Avenue S.W.	**71,000**

Users in UGA	Estimated Wastewater Flow (gpd)
SOUTH OF 203rd AVENUE S.W.	
Commercial/Industrial:	
VJ Bargain Center	300
Tavern	2,900
Fire Station	600
SUBTOTAL	
Residential Units:	
Permanent and Mobile 50 @ 200 gpd	
TOTAL FLOW - South of 203rd Avenue S.W.	
C. CONTRACT CONNECTIONS	
DSHS Maple Lane School	34,000
WSDOT Rest Areas	15,000
SUBTOTAL	49,000
TOTAL EXISTING FLOW	**132,800**

CHAPTER 5 - FUTURE GROWTH AND FLOW PROJECTIONS

5.1 INTRODUCTION AND PHASING

The growth projections are a combination of the three growth scenarios, as presented in the Chase Report, dated November 24, 1995 (see Appendix D), and the pending/potential additions and/or zoning changes that are modifications to the Grand Mound UGA. To properly evaluate the full range of growth alternatives, both the growth and UGA changes are folded together to define the outer limits of growth potential.

Phase I is a halfway intermediate step to the 700,000-gpd limitation imposed by DOE. Phase I is defined as growth and development adequate to generate a 350,000-gpd maximum week flow. Phase I facilities are expected to serve only an initial portion of the service area. It is expected that this initial area would consist of that property around the SR-12/I-5 interchange and the contractual connections of Maple Lane and WSDOT.

Phase II service boundary includes that land which, when developed, will produce a maximum weekly flow of 700,000 gpd. This limitation was established by DOE as the maximum allowable discharge of conventional secondary effluent to the Chehalis River. Since Phase II is defined by an exact flow quantity, the various growth projections, as presented in Tables 5.1, 5.2, and 5.3, anticipate that Phase II flows would be reached as early as 2006 (as anticipated under the high growth projection, with maximum addition areas and maximum zoning upgrades), or as late as 2010 (as anticipated under the low growth projection and minimum zoning upgrades).

Phase III assumes full development of the UGA based on the proposed zoning as presented on Figure 3.2. The resulting population and industry of this area will generate wastewater flows greater than the 700,000 gpd limit which DOE has established. In discussions with DOE personnel, it has become clear that their intention was to limit the BOD and Suspended Solids loading to the river. DOE has revised their limitation to allow a larger discharge to the river provided the total poundage of BOD and suspended solids is not increased. This means that the effluent quality must be improved to ensure that the total pounds of BOD and suspended solids are not exceeded. This planning boundary has been identified in the County's Comprehensive Plan, which is currently being updated to reflect this boundary delineation.

5.2 GROWTH AND FLOW PROJECTIONS

The Chase Report forecasted growth projections as falling into either low, medium, or high growth scenarios. These three scenarios are reflected in Tables 5-1 (low), 5-2 (medium), and 5.3 (high) for the 847-acre Grand Mound UGA and the Maple Lane School and WSDOT Rest Areas. (See Appendix E for a detailed presentation and documentation.)

Though these tables in Appendix E may be self-explanatory, some clarifying comments may be beneficial.

Table 5.1
Grand Mound Summary of Flows
Phasing - low

	1995	2000	2005	2010	2015	2020
Annual Average						
Industrial	27,875	43,400	93,300	128,525	168,175	204,500
Commercial	12,700	20,320	35,640	45,360	59,500	70,000
Residential	43,139	43,194	44,296	47,012	49,850	51,997
Maple Lane	34,000	60,000	80,000	100,000	150,000	150,000
WSDOT Rest Areas	15,000	16,600	18,300	20,200	22,300	24,600
I/I	166,576	167,471	205,764	211,654	220,644	224,336
Total	299,290	350,985	477,300	552,751	670,468	725,433
Maximum Month	339,104	406,039	558,761	655,080	805,416	875,762
Maximum Week	359,011	433,566	599,491	706,244	872,889	950,927
Peak Day	564,719	718,013	1,020,371	1,234,944	1,570,117	1,727,627
Peak Hour	763,790	993,284	1,427,675	1,746,589	2,244,854	2,479,272

Table 5.2
Grand Mound Summary of Flows
Phasing - medium

	1995	2000	2005	2010	2015	2020
Annual Average						
Industrial	27,875	44,300	101,413	153,900	210,675	267,250
Commercial	12,700	21,120	35,640	48,440	62,560	79,200
Residential	43,139	43,194	45,968	51,605	57,992	62,474
Maple Lane	34,000	60,000	80,000	100,000	150,000	150,000
WSDOT Rest Areas	15,000	16,600	18,300	20,200	22,300	24,600
I/I	166,576	169,271	211,555	232,633	252,409	264,594
Total	299,290	354,485	492,875	606,778	755,936	848,118
Maximum Month	339,104	410,049	577,271	719,021	906,994	1,023,175
Maximum Week	359,011	437,831	619,469	775,143	982,523	1,110,703
Peak Day	564,719	724,913	1,055,516	1,355,067	1,762,989	2,015,165
Peak Hourly	763,790	1,002,734	1,477,496	1,916,284	2,518,278	2,890,450

Table 5.3
Grand Mound Summary of Flows
Phasing - high

	1995	2000	2005	2010	2015	2020
Annual Average						
Industrial	27,875	45,200	115,025	208,850	295,250	386,750
Commercial	12,700	21,120	35,640	51,520	66,300	82,000
Residential	43,139	43,194	51,279	60,102	70,406	78,749
Maple Lane	34,000	60,000	80,000	100,000	150,000	150,000
WSDOT Rest Areas	15,000	16,600	18,300	20,300	22,300	24,600
I/I	166,576	169,871	218,453	268,002	295,262	314,431
Total	299,290	355,985	518,697	708,774	899,518	1,036,530
Maximum Month	339,104	411,819	608,770	841,006	1,080,795	1,253,159
Maximum Week	359,011	439,736	653,807	907,122	1,171,433	1,361,474
Peak Day	564,719	728,213	1,119,185	1,590,318	2,108,030	2,480,728
Peak Hour	763,790	1,007,384	1,569,551	2,251,476	3,014,413	3,563,876

Each growth projection scenario is done in five-year intervals, starting in 1995 and continuing through 2020. The anticipated growth is divided between Industrial, Commercial, and Residential. The gross acreage has been adjusted to account for the right-of-way. The absorption factor reflects the percentage of the available property that is actually expected to be developed by the year indicated. That is not to suggest that the industrial and commercial property is maximized to the fullest extent (that is accounted for under the column "% Max Develop"), but simply is an indication of the percentage of the acreage which is being used for the intended zoning. The flow-per-acre values are typical numbers that are commonly used for planning purposes. The unit I/I values are intentionally low to reflect the expected I/I for a new vacuum collection system, which is slated for use through the UGA. Peaking factors of 30 and 45 percent have been applied to the average annual flows to determine the maximum month and maximum week flows, respectively. Similarly, factors of 3.0 and 4.5 have been applied to the sanitary portion of the flow to determine the peak day and hour flows.

These flow quantities are reflective of the growth scenarios in the Ground Mound UGA only. Adjustments to these flows are found in Paragraph 5.3 to account for the additional area that may be added to the UGA and to account for a potential revision to the zoning.

5.3 UGA BOUNDARY AND ZONING MODIFICATIONS

Using the base flows presented in Section 5.2, it is necessary to modify these flows to account for two areas that are being considered for inclusion in the UGA. These areas are referred to as "Area A" and "Area C" on Figure 3.2, and consist of approximately 20 acres each. The planned zoning for these two areas is expected to be Planned Industrial. The other pending modification to the UGA deals with a zoning change from Planned Industrial to Arterial Commercial. This area is referred to as "Area B" on Figure 3.2. To bracket the widest range of flows, the addition of Areas A and C have been added to the high growth scenario to reflect the upper limit of expected flows, and the change of zoning (which is a net reduction in the flows) has been subtracted from the low flow scenario to define the lower limit of expected flows. The adjustments to the base flows are presented in Appendix E, and a composite of all adjusted flows is shown in Table 5-4.

Table 5.4
Grand Mound Flow Summary
Anticipated Growth

Year	Growth	Average Annual Flow 1)																Maximum Month Flow 1)			Maximum Week Flow 1)			Peak Daily Flow 1)		
		Grand Mound UGB						Maple Lane			WSDOT Rest Areas			Total Flow	Area/ Zone Adjust Increas	Area/ Zone Adjust Decrease	Total Adjust Flow	Total Flow	Area/ Zone Adjust 1)	Total Adjusted Flow	Total Flow	Area/ Zone Adjust 1)	Total Adjusted Flow	Total Flow	Area/ Zone Adjust 1)	Total Adjusted Flow
		Resident	Comm	Indust	Total Sanitary	I/I	Total Flow	Total Sanitary	I/I	Total Flow	Total Sanitary	I/I	Total Flow													
		gpd	gpd	gpd	gpd	gpd	gpd	gpd	gpd	gpd	gpd	gpd	gpd	gpd	gpd	gpd	gpd	gpd	gpd	gpd	gpd	gpd	gpd	gpd	gpd	gpd
1995	Low	43139	12700	27875	83714	156376	240090	34000	9000	43000	15000	1200	16200	299290	-	2825	296465	339104	-3673	335431	359011	-4096	354915	564719	-8475	556244
	Med	43139	12700	27875	83714	156376	240090	34000	9000	43000	15000	1200	16200	299290			299290	339104		339104	359011		359011	564719		564719
	High	43139	12700	27875	83714	156376	240090	34000	9000	43000	15000	1200	16200	299290	0	-	299290	339104	0	339104	359011	0	359011	564719	0	564719
2000	Low	43194	20320	43400	106914	157271	264185	60000	9000	69000	16600	1200	17800	350985	-	2825	348160	406039	-3673	402366	433566	-4096	429470	718013	-8475	709538
	Med	43194	21120	44300	108614	159071	267685	60000	9000	69000	16600	1200	17800	354485			354485	410049		410049	437831		437831	724913		724913
	High	43194	21120	45200	109514	159671	269185	60000	9000	69000	16600	1200	17800	355985	18500	-	374485	411819	22250	434069	439736	24125	463861	728213	43500	771713
2005	Low	44296	35640	93300	173236	195564	368800	80000	9000	89000	18300	1200	19500	477300	-	2825	474475	558761	-3673	555088	599491	-4096	595395	1020371	-8475	1011896
	Med	45968	35640	101413	183021	201355	384376	80000	9000	89000	18300	1200	19500	492876			492876	577271		577271	619469		619469	1055516		1055516
	High	51279	35640	115025	201944	208253	410197	80000	9000	89000	18300	1200	19500	518697	36260	-	554957	608770	43610	652380	653807	47285	701092	1119185	85260	1204445
2010	Low	47012	45360	128525	220897	201454	422351	100000	9000	109000	20200	1200	21400	552751	-	2825	549926	655080	-3673	651407	706244	-4096	702148	1234944	-8475	1226469
	Med	51605	48440	153800	253945	222433	476378	100000	9000	109000	20200	1200	21400	606778			606778	719021		719021	775143		775143	1355067		1355067
	High	60102	51520	208850	320472	257802	578274	100000	9000	109000	20200	1200	21400	708674	36260	-	744934	841006	43610	884616	907122	47285	954407	1590318	85260	1675578
2015	Low	49850	59500	168175	277525	210444	487969	150000	9000	159000	22300	1200	23500	670469	-	2825	667644	805416	-3673	801743	872889	-4096	868793	1570117	-8475	1561642
	Med	57892	62560	210875	331227	242209	573436	150000	9000	159000	22300	1200	23500	755936			755936	906994		906994	982523		982523	1762989		1762989
	High	70406	66300	295250	431956	285062	717018	150000	9000	159000	22300	1200	23500	899518	54760	-	954278	1080795	65860	1146655	1171433	71410	1242843	2108030	128760	2236790
2020	Low	51997	70000	204500	326497	214136	540633	150000	9000	159000	24600	1200	25800	725433	-	2825	722608	875762	-3673	872089	950927	-4096	946831	1727627	-8475	1719152
	Med	62474	79200	267250	408924	254394	663318	150000	9000	159000	24600	1200	25800	848118			848118	1023175		1023175	1110703		1110703	2015165		2015165
	High	78749	82000	386750	547499	304231	851730	150000	9000	159000	24600	1200	25800	1036530	54760	-	1091290	1253159	65860	1319019	1361474	71410	1432884	2480728	128760	2609488

1) Refer to Appendix E for a breakdown of these flows and for an explanation of the flow adjustments.

Based on this projected flow, it is evident that the Phase II flow limits would be reached between years 2006 and 2010. For purposes of further analysis in this report, we have selected the medium growth scenario, and adjusted flows in sizing the collection, treatment, and discharge facilities.

Since Phases I and II are tied to defined maximum week flow values of 350,000 and 700,000 gpd, respectively, the only affect which the various growth projections have is how quickly that level of flow is reached, and does not affect the sizing of these two phases. Phase III, however, is affected by the growth projections. A summary of the flows for all phases is presented in Table 5-5:

Table 5-5
Summary of Flows for All Phases

Flow	Phase I	Phase II	Phase III
Average Annual Flow	290,000	580,000	848,118
Maximum Month Flow	330,000	660,000	1,023,175
Maximum Week Flow	350,000	700,000	1,110,703
Maximum Daily Flow	550,000	1,100,000	2,015,165
Peak Hourly Flow	745,000	1,490,000	2,890,452

5.4 LOADINGS

The determination of the annual and maximum month BOD and TSS loadings is presented in Tables 5-6 and 5-7, respectively. These loadings are, with the exception of the loadings of Maple Lane School, typical values that are frequently used throughout the industry. The values used for the Maple Lane School were derived from the Gray and Osbourne Report, dated January 1995. That report identified BOD and TSS values of 150 lbs/day. It is assumed that these were intended to be the loading for the design flow, which DOE defines as the maximum month flow conditions. Consequently, the loadings for the annual average have been proportionately reduced. A summary of the loadings is presented in Table 5-8.

Table 5.6
Grand Mound
Flow and Loading Summary
Average Annual

Source	Phase I					Phase II					Phase III				
	Flow	BOD		TSS		Flow	BOD		TSS		Flow	BOD		TSS	
	gpd	mg/l	lbs	mg/l	lbs	gpd	mg/l	lbs	mg/l	lbs	gpd	mg/l	lbs	mg/l	lbs
Residential	40,000	300	100	250	83	49,300	300	123	250	103	62,474	300	156	250	130
Commercial	11,800	400	39	325	32	46,300	400	154	325	125	79,200	400	264	325	215
Industrial	25,800	300	65	250	54	147,100	300	368	250	307	267,250	300	669	250	557
Maple Lane*	44,300		100		100	95,600	300	239	250	199	150,000	300	375	250	313
WSDOT	13,900	450	52	350	41	19,300	450	72	350	56	24,600	450	92	350	72
I/I	154,200	50	64	55	71	222,400	50	93	55	102	264,594	50	110	55	121
Total Annual Average	290,000		420		380	580,000		1050		893	848,118		1667		1408
Total - Use			420		380			1050		890			1670		1410

* Phase I flow values based on Gray and Osbourne Report, January 1995. The loading values presented in that report were assumed to be for Maximum month

Table 5.7
Grand Mound
Flow and Loading Summary
Maximum Month

Source	Phase I					Phase II					Phase III				
	Flow	BOD		TSS		Flow	BOD		TSS		Flow	BOD		TSS	
	gpd	mg/l	lbs	mg/l	lbs	gpd	mg/l	lbs	mg/l	lbs	gpd	mg/l	lbs	mg/l	lbs
Residential	47,800	300	120	250	100	60,300	310	156	260	131	81,216	320	217	270	183
Commercial	14,000	400	47	325	38	56,700	420	199	335	158	102,960	420	361	335	288
Industrial	30,900	300	77	250	64	180,000	310	465	260	390	347,425	320	927	270	782
Maple Lane*	66,500		150		150	117,000	310	302	260	254	195,000	320	520	270	439
WSDOT	16,600	450	62	350	48	23,600	450	89	350	69	31,980	450	120	350	93
I/I	154,200	50	64	55	71	222,400	50	93	55	103	264,594	50	109	55	121
Total Maximum Month	330,000		520		471	660,000		1304		1105	1,023,175		2254		1907
Total - Use			520		470			1310		1110			2250		1910

* Phase I values based on Gray and Osbourne Report, January 1995

Table 5-8
Summary of Loadings

Loading	Phase I	Phase II	Phase III
BOD - Average Annual (#/day)	420	1,050	1,670
TSS - Average Annual (#/day)	380	890	1,410
BOD - Maximum Month (#/day)	520	1,310	2,250
TSS - Maximum Month (#/day)	470	1,110	1,910

CHAPTER 6 - WASTEWATER COLLECTION SYSTEM EVALUATION

6.1 INTRODUCTION

Two types of collection systems were selected for evaluation: gravity and vacuum. Gravity sewer systems are used in virtually all collection systems and, due to their conveyance by gravity flow, do not exhibit significant operation and maintenance costs. The piping must be laid to a specific design slope with manholes used to provide slope and horizontal direction changes. As a pipeline continues at the design slope it becomes deeper and eventually a pump station is required to "lift" the wastewater to a higher elevation. The depth of gravity sewers and the use of pump stations is related to the cost of deep pipeline construction versus costs of pump stations. Usually gravity sewers should be constructed no deeper than 14 to 16 feet. At these depths and deeper, the construction costs can be quite high as compared to shallower installations.

Vacuum sewers have been used in Europe for over 100 years and in the United States for the last 25 years. Over 100 vacuum collection systems are in use in the United States, primarily on the East Coast; however, there are two installations in Western Washington. Their increased use in recent years has been prompted by their reliability and typically lower construction cost than for gravity sewers.

Vacuum sewer pipelines are typically buried at depths similar to a water main and therefore construction costs are low compared to gravity sewers. Tending to offset the low pipeline costs are significant costs for the vacuum pump stations. Since the system includes electrical/mechanical equipment the operation/maintenance costs are higher than for gravity sewers.

Vacuum sewers are not yet considered a direct substitution for gravity sewers. Each situation should be evaluated on a life-cycle cost basis to ensure cost-effective selection.

Vacuum sewerage is a mechanized system of wastewater transport. Unlike gravity flow, it uses differential air pressure to move the wastewater. It requires a central source of power to run vacuum pumps which maintain a vacuum on the collection system. The system requires a normally closed vacuum/gravity interface valve at each entry point to seal the lines so that the vacuum is maintained. These valves, located in a pit, open when a predetermined amount of wastewater accumulates in the collecting sump. The resulting differential pressure between atmosphere and vacuum becomes the driving force that propels the wastewater towards the vacuum station.

6.2 VACUUM SEWER SYSTEM COMPONENTS

Gravity sewers are so common that a description of the system components is not included herein. However, vacuum sewer technology is relatively unknown; therefore, the major components are discussed in the following paragraphs.

A vacuum sewer system consists of three major components; the house/building service, the collection mains, and the vacuum station:

A. Services

The services in a vacuum system consist of the following components:

- Vacuum valve
- Valve pit/sump
- Auxiliary vents

The vacuum valve provides the interface between the vacuum in the collection piping and the atmospheric air in the building sewer. System vacuum in the collection piping is maintained when the valve is closed. With the valve opened, system vacuum causes evacuation of the sump. The valve is entirely pneumatic by design, and has a 3-inch opening.

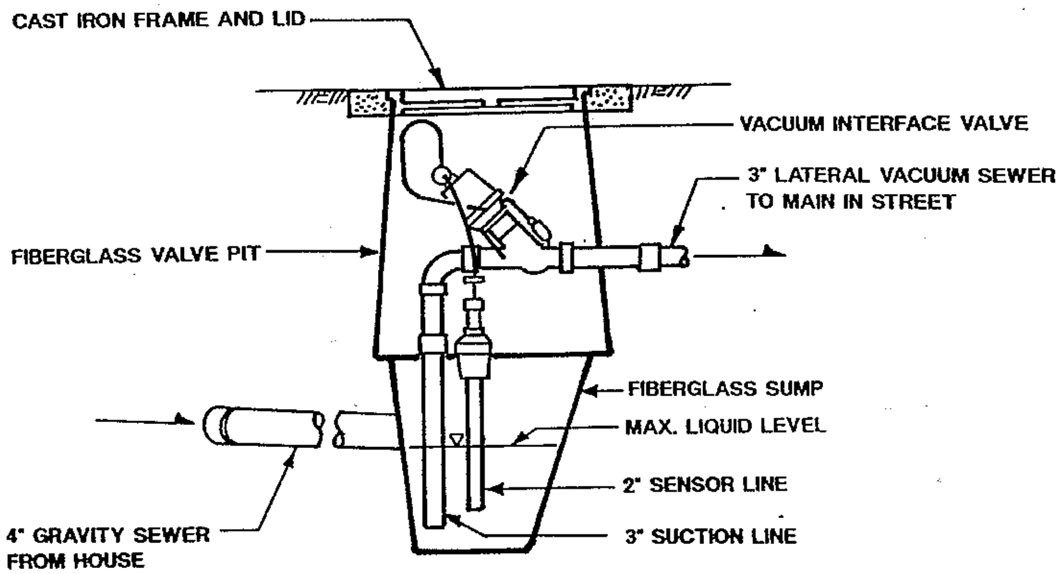
Valve pits and sumps are needed to accept the wastes from the house (See Figure 6.1). These may consist of one unit with two separate chambers. In these cases, the upper chamber houses the vacuum valve and the bottom chamber is the sump into which the building sewer is connected. These two chambers are sealed from each other. The combination valve pit/sump is made of fiberglass, and is able to withstand traffic loads. For deeper settings or larger customers, the fiberglass pit/sump arrangement may be replaced by a concrete manhole section in which the vacuum valve(s) is mounted. In this arrangement, only one chamber exists.

A 4-inch auxiliary vent is installed on the homeowner's service lateral, downstream of all of the house traps. This vent is necessary to provide the volume of air that will follow the wastewater into the main during each vacuum interface valve operation. Some operating entities require the vent to be located near a permanent structure for aesthetic and protection reasons. The installation of this 4-inch auxiliary vent will be the property owner's financial and coordinative responsibility. Installation must be completed prior to connection of the side sewer to the vacuum sump.

B. Collection Mains

The collection piping network consists of the following components:

- Pipe
- Fittings
- Lifts
- Division valves



Barrett Consulting Group
10800 N.E. 8th St., Seventh Floor
Bellevue, WA 98004
(206) 455-9494

FIGURE 6.1

TYPICAL VACUUM VALVE PIT/SUMP

The piping network is connected to the individual valve pits and the collection tank in the vacuum pump station. Typical piping in the street and service to a home is shown in Figure 6.2. Schedule 40, SDR 21 and SDR 26 PVC pipe have been used, with SDR 21 being the most appropriate and most common. Both solvent-welded and gasketed have been used. Experience has shown that there are fewer problems with the gasketed type pipe. Where gasketed pipe is used, the gaskets must be certified for use under vacuum condition.

Lifts or vertical profile changes are required for proper operation. These lifts are generally made in a sawtooth fashion and utilized approximately every 500 feet. A single lift consists of two 45-degree fittings connected with a short length of pipe so that the vertical distance between the horizontal pipes is one to two feet.

Valves are located to isolate portions of the system to aid in locating a pipe break and/or leak.

C. Vacuum Station

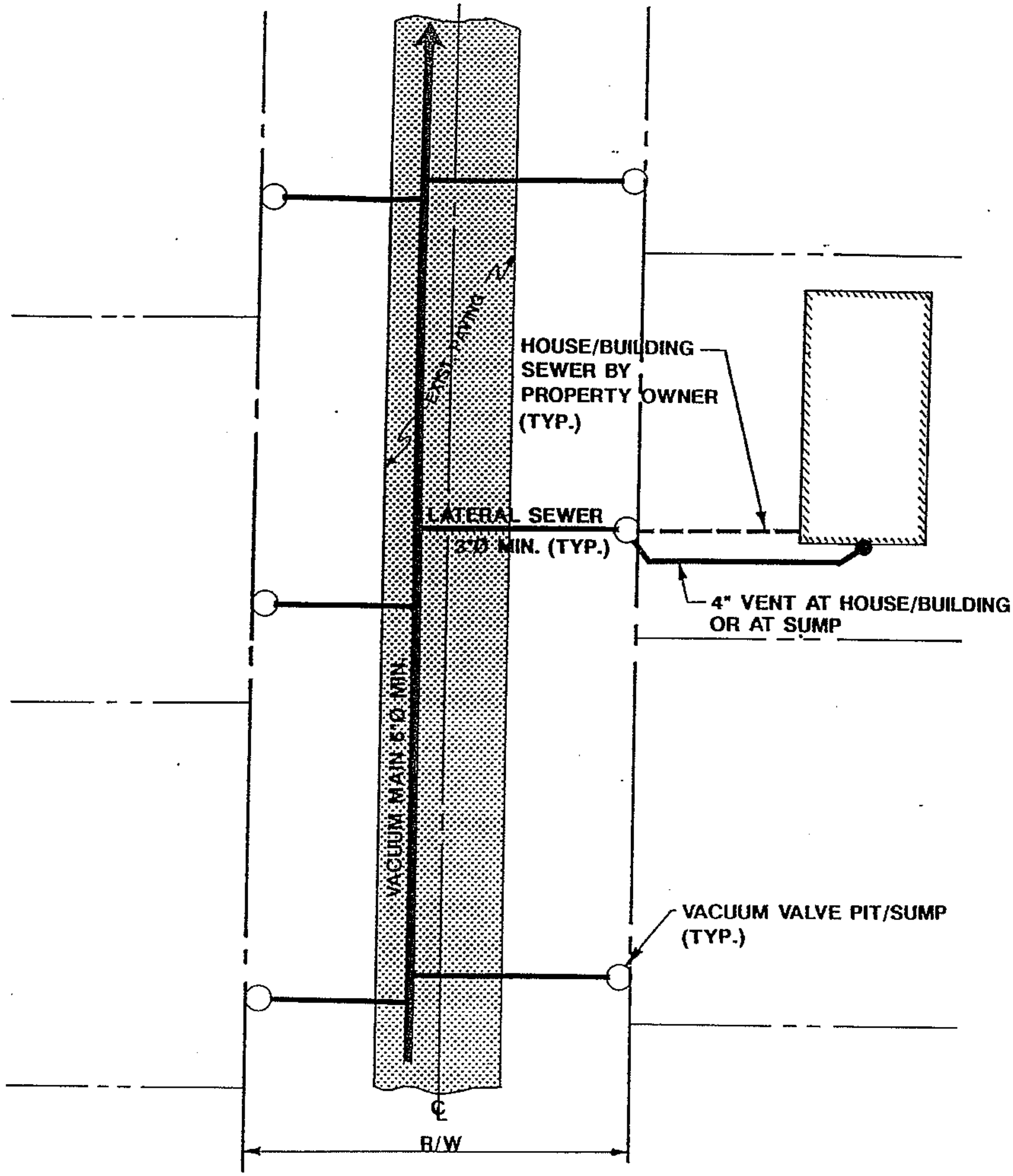
Vacuum stations function as transfer facilities between a central collection point for all vacuum sewer lines and a force main leading directly or indirectly to a treatment facility. The following components are included in the vacuum station (see Figure 6.3).

- Vacuum pumps
- Wastewater pumps
- Generator
- Wastewater collection tank
- Vacuum reservoir tank
- Electrical controls and alarm system

Vacuum pumps are needed to produce the vacuum necessary for liquid transport. The operational history of vacuum sewers indicates that the optimum operating range is 16- to 20-inch Hg. The pumps, however, should have the capability of providing up to 25-inch Hg as this level is sometimes needed in the troubleshooting process. Redundancy is a minimum requirement with each pump capable of providing 100 percent of the required air flow (cfm).

Wastewater pumps are required to transfer the liquid that is pulled into a collection tank by the vacuum pumps. Redundancy is provided, with each pump capable of providing 100 percent of the design capacity.

A standby generator is also required. It ensures the continuing operation of the system in the event of a power outage.



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(206) 455-9494

FIGURE 6.2

TYPICAL VACUUM SEWER SYSTEM LAYOUT

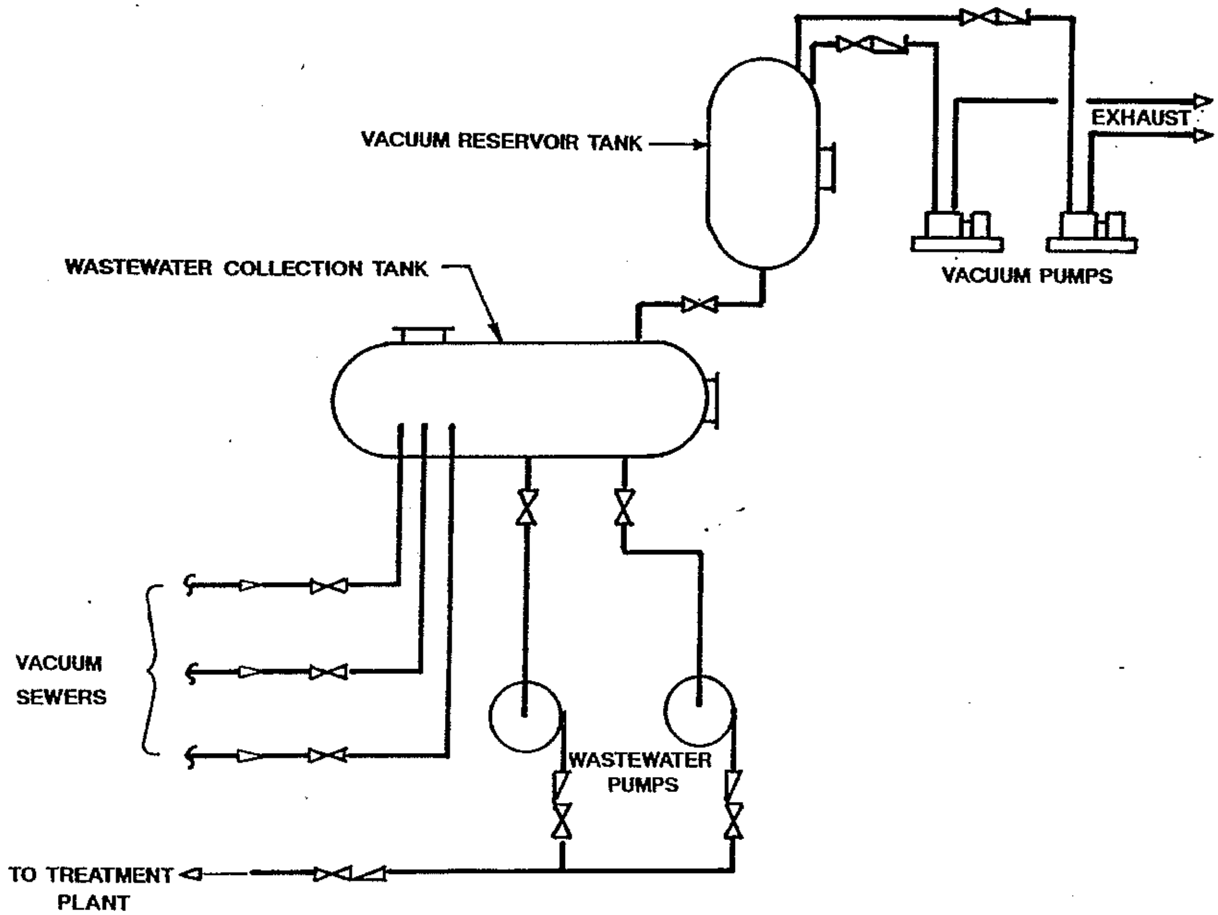

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FIGURE 6.3

TYPICAL VACUUM STATION SCHEMATIC

The wastewater is stored in the collection tank until a sufficient volume accumulates, at which point the tank is evacuated. It is a sealed, vacuum-tight vessel. Vacuum, produced by the vacuum pumps, is transferred to the collection system through the top part of this tank. The part of the tank below the invert of the incoming collection lines acts as the wet well.

A vacuum reservoir tank is located between the vacuum pumps and the collection tank. It has three functions: 1) to reduce carryover of moisture into the vacuum pumps; 2) to act as an emergency reservoir; and 3) to reduce the frequency of vacuum pump starts.

6.3 PROPOSED SYSTEM

Because gravity sewers and pump stations require deep excavation that may encroach into groundwater, it was felt that shallower construction would be beneficial from both a water quality and cost comparative perspective. The author and the County staff have investigated vacuum sewer system both in the state and at other locations throughout the midwest and eastern coastal areas. The results of this investigation was convincing that vacuum sewers would be well-suited for application in the Grand Mound service area. However, given the uncertainty of the development within the service area, and not wanting to restrict that development if it did occur, it was concluded that a gravity interceptor "spine" would be installed in a north-south direction from 203rd Avenue to the SR-12/I-5 interchange area. This interceptor would continue in a westerly direction along 203rd Avenue to the treatment plant. A vacuum collection system would be located in the north end of the service area. This vacuum system would collect the wastewater from the extreme boundaries and then lift the wastewater into the gravity spine. Inasmuch as the gravity interceptor does not have to be extended to the outer limits of the service area, the spine can be much shallower and this, in turn, results in reduced construction costs. This proposed collection system combines the advantages of both the gravity and vacuum systems. The layout of this combined system is presented on Plate 1 (in map pocket in back).

The collection system was configured to provide service to all the existing individual ownerships along the spine. If individual parcels are subdivided or developed in a manner requiring collection system extension, the owner/developer will be required to make such required extensions.

The projected wastewater flows, as presented in Chapter 5, identified the average annual, maximum month, and maximum week flows. This flow information was appropriately increased (4.5 times the annual average flow) to determine the peak hourly flows. These values were used to size the pipelines and vacuum systems. The sizing is based upon a distribution of flow consistent with the zoning system, as shown on Figure 3.2. Therefore, the system will be able to convey the peak hourly flow generated by each parcel.