

Appendix J  
Collection System Hydraulic  
Modeling Summary

Pierce County Public Works and Utilities – Sewer Utility  
Unified Sewer Plan Update



## Appendix J – Collection System Hydraulic Modeling Summary

Appendix J documents the hydraulic modeling program and setup used to project sewer flow for Pierce County's sanitary sewer system.

### H2OMAP Sewer Model Background

H2OMAP Sewer is a Windows based hydraulic modeling software program developed by MWH Soft. Pierce County selected H2OMAP Sewer for its ability to model non-pressure and pressure systems along with the program being updated and errors corrected in a timely manner. The modeling was done with the most recent version available at the time, Version 8 SP 1 update 3.

### Model Setup

The model contains the entire collection system (all interceptors, trunks and collector lines) tributary to Pierce County's Chambers Creek Regional Wastewater Treatment Plant and Pierce County's collection system tributary to the City of Tacoma's Central Wastewater Treatment Plant. Both parts of Pierce County's system reside in the same model file so that analysis takes place at the same time.

Using Pierce County's GIS system's data, the model imported sewer lines with as-built inverts and rim elevations. This imported data included all manholes, gravity sewer, siphons, force mains, pump stations and bifurcation structures. This imported system has a total length of approximately 4,397,000 feet (832.77 miles) of which approximately 904,000 feet (171.21 miles) are privately owned and operated collector lines.

Sub-basin boundaries were imported into the model from the County's GIS system. These sub-basin boundaries represent sanitary sewer planning areas for existing and future interceptor, trunk, and collector lines.

### Model Scenario

In the evaluation of Pierce County's future capacity needs only one modeling scenario was created. This one scenario was based on future build-out of the entire sewer service area. Build-out does not represent a specific point in time but a time when the current sewer service area has been developed to its greatest extent based on assumptions of current zoning and what parcels will redevelop.

### Flow Allocations

To try and make the model as accurate as possible the flow allocation was split into three wastewater flow groups: existing, future, and Inflow/Infiltration. Existing and future flows were done on via GIS data while Inflow/Infiltration was done via gross land acreage.

H2OMAP Sewer uses "load" data to determine flow in each sewer line. The flow volume is introduced at manholes and flows through each line till it reaches the treatment plant. To create this flow value the model makes a Thiessen polygon around each manhole but not over Sub-basin lines. This Thiessen polygon layer is coupled with a GIS point shape file so that when a point in the shape file is inside a Thiessen it gets allocated to the respective manhole.

Existing flows were determined by how many Residential Equivalents (REs) each parcel is billed. Pierce County assumes a RE is equal to 220 gallons per day (gpd) of wastewater production. Each Single Family Resident (SFR) is billed 1 RE, multifamily 0.83 REs per unit, and commercial/industrial is based on water usage.

Using the County's billing data a GIS point shape file was created and imported into the model and then allocated in the previously stated fashion. Because a RE is assumed to be 220 gpd isn't accurate for all areas the model is then calibrated so that flows closely resemble what is monitored by flow meters throughout the sewer system. Point flows from the City of Tacoma, the City of Fife, the Town of Steilacoom, and the Lakehaven Utility District were added, to the full contractual flow amounts, to the existing flows at their respective points of connection into Pierce County's sanitary sewer system.

Future flows were also determined on a parcel bases. GIS was used to take existing base per acre zoning densities (typical density achieved when developing in the zoning type) times 80% of the gross parcel area (20% is assumed to be used for open space, roads, wetlands, etc) minus any existing billed volumes. Parcels smaller than 0.5 acres were assumed to not be re-developable and were left at current billed REs or set at 1 RE.

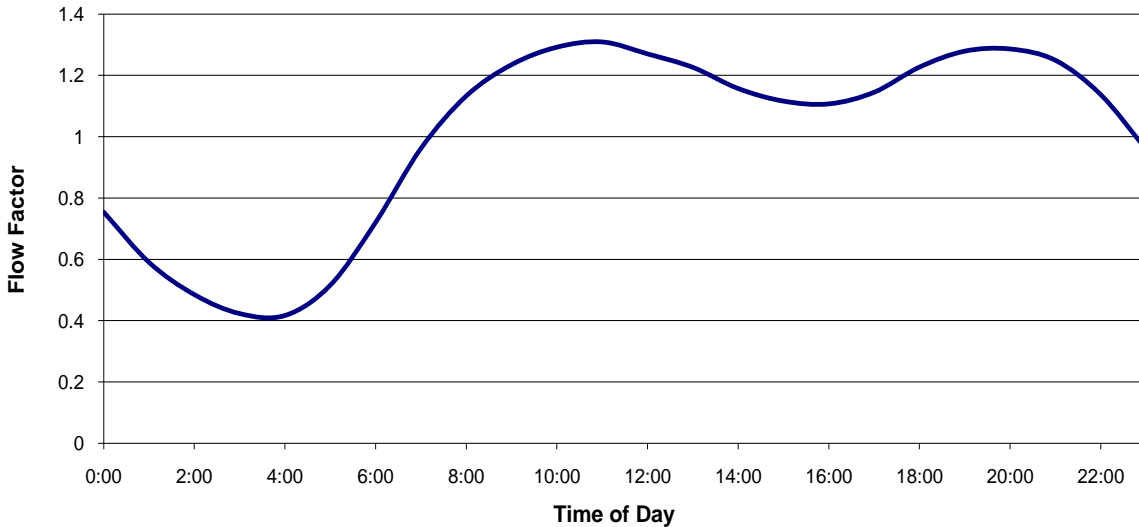
Inflow/Infiltration (I&I) flows was not determined on a parcel bases instead it was done based on acreage. Pierce County uses an assumed 1000 gallons per acre per day (gpad) for designing its sanitary sewer system. At present the County’s system does not see this kind of I&I, however the County’s system is fairly new so using current I&I rates will not be accurate as the system ages. So, for modeling purposes the assumed design rate of 1000 gpad was used. This was allocated by using the area of each Thiessen polygon instead of parcel acreage because parcel acreage would not include I&I rates from rights-of-way.

**Diurnal Curve**

The model uses a diurnal curve to reflect the pattern of use in Pierce County’s system. At present there is no specific diurnal curve for different land uses instead the County used a unified diurnal curve to estimate patterns of use.

The following diurnal curve was created to reflect the pattern of wastewater flow seen at flow meters through out our collections system.

**Figure 1: Model Diurnal Curve**



While the curve shown in the above figure does not exactly match flow factors seen in each basin it creates a fairly accurate representation of monitored wastewater flow throughout Pierce County’s sanitary sewer system.

This diurnal curve was used to modify the existing and future RE flow values during the Extended Period Simulation (EPS) done by the model. The I&I flow rate was not modified using this curve so it stayed constant throughout the simulation.

### **Modeling Results**

Once modeling has been performed, H2OMAP Sewer provides detailed estimates on how much wastewater travels through each pipe at any given time during the simulation. However, the model assumes zero wastewater flow at the start of the simulation. This assumption results in the first 24-hours worth of data being erroneous and only the data from the second 24-hours can be used to estimate wastewater flows.

The model showed significant surcharging of Pierce County's interceptor backbone and major interceptors/trunks serving the DuPont, East, Frederickson, Lakewood, Parkland, Rainer Terrace, and Spanaway Basins. All but one of these undersized lines has been addressed in the Future System Improvements. The Pierce County Sewer Utility has made a decision not to replace the 54-inch line under Interstate 5 at 112<sup>th</sup> Street and instead surcharge it during high flows. During the estimated highest flows the surcharge would be between 2 and 3 feet which does not pose an overflow risk. The expected velocity during peak flows is approximated to be around 9 feet per second (fps) which is not a concern. For proposed modifications to Pierce County's system please refer to the Future Expansion and Improvements section for a detailed breakdown of projects in each sub-basin.

In the interceptor system, velocities of less than 2 fps take place only in the Brookdale II Interceptor. Pierce County is currently monitoring and doing routine maintenance to insure that build-ups and blockages are not causing level-of-service issues.