



City of Yakima
Wastewater Division
Annual Infiltration and Inflow Report
2007

2007 Annual Inflow and Infiltration Evaluation

Reduction of inflow and infiltration (I/I) is a major priority for the City of Yakima Wastewater Division. In 2007, the City continued its effort to reduce I/I to the domestic wastewater collection system.

Municipal Wastewater Facilities must demonstrate that wastewater collection systems are not and will not contribute to excessive infiltration or inflow. EPA's Infiltration/Inflow I/I Analysis and Project Certification brochure (Ecology Publication No. 97-03) is being used to determine if there is excessive I/I to the City's wastewater system. The submittal of this report by January 31, 2008 to the Department of Ecology satisfies the requirement of Section S4. D., of the City of Yakima's National Pollution Discharge Elimination System (NPDES) permit WA-002402-03, Infiltration and Inflow Evaluation.

EPA's guidance uses a national average to determine dry weather flow (DWF) and wet weather flow (WWF). For DWF, 120 gallons per capita per day (gpcd) is used and for WWF, 275 gpcd is used to determine non-excessive flows. Flows exceeding these values are considered to be excessive. For 2007, the highest average flow recorded over a 7-14 day period during high seasonal ground water was used to calculate the DWF. The highest single day flow was used as the WWF. The total flow, calculated from the plant loadings, consists of a combination of residential, commercial, and industrial flows as well as infiltration and inflow. These flows were determined by using the 2007 total sewer billed flows. The residential, commercial and industrial flows are used to calculate the I/I by being subtracted from the total flow. With the Urban Service area for both Terrace Heights and Union Gap subtracted and recent annexations added, a Service Area population of 87,557 (Table 3-1a, Sec. 3 Draft 2004 Wastewater facility Plan) is used to calculate the per capita flow rate for the City of Yakima. Terrace Heights and Union Gap flows were classified as industrial.

The City reads retail customer's water meters every two months and bills accordingly. For example: September billing is based upon meter readings for July and August. The City will incorporate the bi-monthly billing into the I/I report as oppose to monthly, to illustrate a more representative depiction of events based on recorded influent flows at the plant and when customers were actually billed.

In 2007, the DWF for the Yakima Treatment Plant was determined using the highest 14-day period during the billing period with the highest flow (September). The highest 14-day average was during the month of August. The following Table illustrates this and in Figure 1 (2007 Infiltration/Inflow Data) shows the gpcd for the entire year of 2007.

September Billing Period 2007 DWF
(July/August)

Date	Ave. Daily Flow Rate (mgd)	Ave. Daily Industrial Flow rate for July 2007 (mgd)	Residential + Commercial + I/I (mgd)	Ave. Daily Flow Rate (gpcd)
Aug. 17 - 30	12.99	1.31	11.68	133.4

This table indicates that the DWF for this 14 day average during the September billing period for 2007 Average Daily Flow Rate was 133.4 gpcd and does exceed the EPA national average of 120 gpcd in determining excessive I/I. It should be noted however, that the reported value for 2006 was 144.1 gpcd; resulting in a 7.43% decrease from last year.

The attached spreadsheet (2007 Infiltration/Inflow Data) shows that the plant's high flows occur in late summer to early fall rather than in the winter and spring. This is typically the case because the Yakima area is heavily irrigated with many canals running through the city limits.

2007 Infiltration/Inflow Data

Bi-Monthly Billing Period	Plant Flow & Meter Read	# Days	Total Plant Flow per Billing Mg	BI-MONTHLY BILLED FLOWS			DAILY AVERAGE FLOWS					Res+Com+ I/I Mgd	Flow/Capita Gpcd
				Res flow Mg/billing	Com flow Mg/billing	Ind Flow Mg/billing	Total Mgd	Res Mgd	Com Mgd	Ind Mgd	I/I Mgd		
January	Nov/Dec '06	61	572.57	306.76	152.57	77.09	9.39	5.03	2.50	1.26	0.59	8.12	93
March	Jan/Feb	59	560.48	251.51	114.65	71.29	9.50	4.26	1.94	1.21	2.09	8.29	95
May	Mar/Apr	61	597.42	245.90	107.05	68.50	9.79	4.03	1.75	1.12	2.88	8.67	99
July	May/June	61	662.71	329.20	155.96	85.71	10.86	5.40	2.56	1.41	1.51	9.46	108
September	Jul/Aug	62	761.79	381.28	195.07	89.68	12.29	6.15	3.15	1.45	1.54	10.84	124
November	Sep/Oct	61	739.32	375.65	175.96	101.38	12.12	6.16	2.88	1.66	1.42	10.46	119
Yearly Total			3894.29	1890.3	901.26	493.65							
Yearly Daily Averages							10.66	5.17	2.46	1.35	1.67	9.31	106
total flow %								49	23	13	15		
billed flow %								58	27	15			

(Union Gap & Terrace Heights classified as industry)

(Population of Union Gap & Terrace Heights omitted)

To formulate a more realistic picture of I/I, one could utilize a simplified version of EPA's Infiltration/Inflow by taking the difference between the Total Flow and Billed Flow to represent the I/I Flow.

2007

Total Flow: 3,894.29 mg
 Total Billed: -3,285.21 mg
 I/I Flow: 609.08 mg`

609.08 mg/365 days = 1.67 mgd

1.67 mgd x 100/8.7557 = **19.1 gpcd**

2006

Total Flow: 3,876.77 mg
 Total Billed: -3,294.86 mg
 I/I Flow: 581.91 mg

581.91 mg/365 days = 1.59 mgd

1.59 mgd x 100/8.7557 = **18.2 gpcd***

*Correction - 2006 report used the value of 21.2 gpcd. It should have been 18.2 gpcd

Using this simplified format, the Yearly Daily Average for I/I calculates to 19.1 gpcd for 2007 and only 18.2 gpcd in 2006; compared to 106 gpcd for both years as officially reported by using EPA's formula. The City is concerned that by utilizing the summation of the residential, commercial, and I/I flows to determine the Flow/Capita, this appears misleading and actually inflates the I/I report since industrial is not part of the equation.

The total flows from 2006 to 2007 decreased by 0.92% with the total yearly flows decreasing by 9.43% since 2000. Billed flows decreased 0.29% since 2006.

Total Yearly Flows

Month	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic
	2000	2001	2002	2003	2004	2005	2006	2007
January	219.94	298.21	269.37	275.26	269.74	259.62	264.32	289.19
February	244.57	255.62	236.33	242.45	252.59	231.57	229.00	271.29
March	274.19	283.17	262.45	260.33	286.40	261.60	250.69	275.94
April	330.75	313.36	303.48	321.34	349.61	310.03	300.47	321.48
May	370.69	381.00	349.50	337.52	364.56	348.36	345.57	328.34
June	391.48	395.40	353.62	369.70	364.16	313.85	376.52	334.37
July	463.96	436.24	394.40	429.87	395.88	347.31	420.62	366.61
August	519.15	476.89	416.94	419.10	433.67	375.78	418.08	395.87
September	484.75	443.34	427.06	416.47	409.58	382.44	402.94	384.19
October	395.02	347.18	354.52	361.89	365.09	295.40	353.91	355.13
November	309.30	269.19	264.39	267.63	270.33	252.04	283.87	286.04
December	300.46	269.61	270.08	270.88	265.37	260.63	288.70	289.90
Total	4,304.26	4,169.21	3,902.14	3,972.44	4026.98	3638.63	3934.69	3898.35
% Change Yearly		-3.14%	-6.41%	1.8%	1.37%	-9.64%	8.14%	-0.92%
% Change Compared to 2000		-3.14%	-9.34%	-7.71%	-6.44%	-15.46	-8.59	-9.43

Leakage from irrigation pipes and canals, during the irrigation season, significantly raises the shallow ground water table that runs under the City of Yakima and along the Yakima River. When the irrigation is shut down in the fall, the City's Wastewater Treatment Plant flows are reduced significantly. When turned on in the spring, the plants flows begin to increase and top out in the late summer and early fall. Winter flows are generally well below 100 gpcd and thus not even close to the excessive WWF flow rate of 275 gpcd. Even the highest single day flow of 13.33 mgd (August 20th) is well below this threshold. One can deduce from this data that inflow is not a significant problem because the flows during the wetter weather seasons (winter and spring) are well below this threshold. On the other hand it is obvious that during the irrigation season, the dry weather season, infiltration is a problem and much of the Wastewater Division's focus is on reducing the impacts from this infiltration.

The City of Yakima will continue to pressurize and rehabilitate a major portion of its' irrigation system over the next several years to reduce leaking of irrigation water into the water table. The increase in the water table level has been documented as a major source of I/I for the Wastewater Treatment Plant. Phase 3 of the City's irrigation pipe replacement program for the 308 System was initiated in the fall of 2007, with 57,500 feet of pipe scheduled for replacement through 2010. In 2007 alone, the City's Irrigation Department replaced approximately 14,000 feet of leaking irrigation

main lines. It is highly anticipated that when this project is completed, the water table level will be greatly reduced eliminating as much as 2 to 3 million gallons a day of irrigation water from entering into the wastewater system during the irrigation season.

Our commitment to reducing I/I continues. A flow-monitoring project was implemented in August 2004 with the purchase and installation of 20 TELEDYNE ISCO flow monitors in 12 manholes to isolate basins for further monitoring and prioritization of I/I rehabilitation work. Flow-monitoring sites were selected based on analysis of connectivity and system experience and have remained the same since 2004.

Flow Monitoring Sites

Basin ID	Manhole	Size	Location	No. of Flow Monitors
A	E-21 MH11	22"	N. 2 nd Ave and West Yakima	1
B,C	E-21 MH17	15" and 10"	S. 7 th Ave and West Yakima	2
D	E-2 MH5	24"	S. 2 nd Ave. and Division	1
E	E-6 MH2	18"	W. Nob Hill and 15 th Ave.	1
F,G,H	E-30 MH13	24", 20", and 12"	W. Nob Hill and Ledwich Ave	3
J,I	E-44 MH25	27" and 18"	S. 7 th St and Beech	2
L,K	E-43 MH28	24" and 30"	W. Nob Hill and 8 th St.	2
M,N	E-32 MH92	18" and 27"	W. Mead Ave in front of GS Long	2
O,P	W-32 MH80	18" and 18"	W. Washington and 36 th Ave	2
Q,R	E-40 MH40	21" and 21"	Under Valley Mall Blvd Overpass	2
S	E-63 MH20	30"	Rudkin Rd by Freightliner	1
T	E-45 MH34	18"	Union St.	1

Four rainfall-monitoring locations were selected to provide spatial distribution of rainfall and ease of service and gauge security. The rainfall gauges represent a gauge density of 1 gauge per 9 square miles. The four locations have remained the same since 2004. Comparing 2007 to 2006, the rain gauges indicated a 68.5% decrease in precipitation levels.

Rainfall Gauges

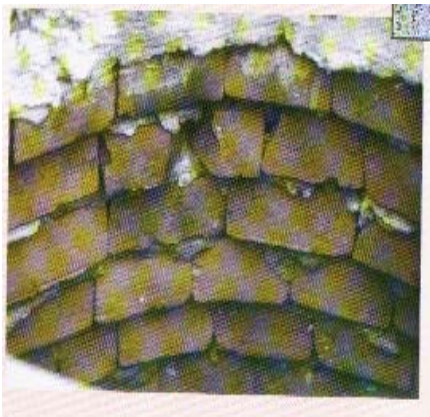
Rainfall Gauge Location	Address
Fire Station #94 (Airport)	2404 W. Washington Ave.
Fire Station #92	7707 Tieton Dr.
Yakima City Shops	2301 Fruitvale Blvd.
Wastewater Treatment Plant	2220 E. Viola

In 2004, the City's engineer, Black & Veatch, developed a flow-monitoring plan that will establish a model to simulate the collection system accurately and efficiently to analyze the system. The developed model will allow simulation of infiltration and inflow from high ground water, during the irrigation season, and rainfall events. Results from the flow monitoring, in concert with further flow, infiltration and inflow analysis, will be an important building block for the wastewater collection system model.

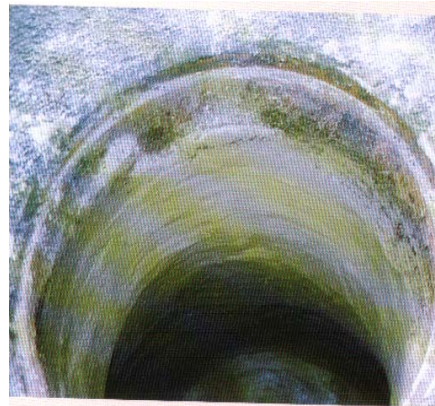
Wastewater Collection crews performed a significant amount of TV inspections of pipe during 2007 to help identify leaking systems to maximize future grouting and repair projects. Their production increased by 87.1% by inspecting a total of 96,419 feet of pipe, compared to only 51,539 feet in 2006. As a result, (33) leaking joints, twenty-six (26) cracks, sixteen (16) broken pipes, six (6) broken sidelines, and three (3) sideline infiltrations were identified and documented for repair.

The City of Yakima has approximately 7,000 manholes, of which 50% are block or brick and mortar. As these manholes have aged over the years, much of the mortar has deteriorated and created voids in which infiltration can enter. Repairing or replacing these manholes is a top priority in reducing groundwater infiltration into the wastewater system. The City has put together an aggressive manhole rehabilitation program to address this very issue. Beginning in 2005, a manhole rehab trailer was purchased allowing City crews the ability to reline 50 – 100 manholes per year on a seasonal basis, thus eliminating the need to contract out this type of work. In 2007, City crews rehabilitated 47 manholes, including major channel repairs or modifications on 53 manholes. In addition, 66 manholes were raised to grade with the rings sealed, thus furthering the reduction of possible inflow. Since 2005, a total of 172 manholes have been rehabilitated. The manholes have been relined with fiber-impregnated cementatous grout, effectively eliminating the previous infiltration. See photos below.

Before



After



Also in 2005, the City purchased a bladder and repair kit in order to perform “cured in place pipe (CIPP) repair.” Once again, allowing the City to complete the needed work, without contracting it out. The CIPP process is useful for the permanent repair of cracks or voids in sewer pipes, effectively eliminating infiltration, all without having to excavate the pipe. Since 2005, a total of 13 CIPP projects have been completed, 7 being completed in 2007 alone.

In summary, flow volumes discharged by the commercial and industrial sectors are more accurately depicted within the report due to the record keeping of the City’s Pretreatment Program. In addition, the City continues to gain insight to I/I target areas through the use of the City engineer’s flow-monitoring plan. Through smoke-testing and dye-testing, extensive time and effort is also being exerted by the City’s Collection crew in identifying flows from wastewater dischargers connected to the WWTP, with no previous account history and billing information. The City continues to identify and prioritize projects in its efforts to further reduce infiltration to its wastewater system.

The City exceeded the threshold for excessive I/I during the September billing period with a value of 124 gpcd in accordance with the EPA flow guideline for DWF. However, much credit must be given to the efforts of the City's Collection crews for continuing to reduce the amount of infiltration into the wastewater system over the past few years.

Report Submitted By:

Scott Schafer
Assistant Manager
Wastewater Division
January 23, 2008