

# Barton and Murray

## Combined Sewer Overflow Control Facilities Plan

### Volume 2 Appendix A



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**King County**

Department of Natural Resources and Parks  
**Wastewater Treatment Division**



**Draft**  
**Barton and Murray Combined Sewer Overflow Control Facilities Plan**

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**KING COUNTY WASTEWATER TREATMENT DIVISION**

**BARTON AND MURRAY COMBINED SEWER OVERFLOW CONTROL FACILITIES PLAN**

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**Appendix A**

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**FLOW MODELING AND CALIBRATION DOCUMENTATION**



## **MODELING AND CALIBRATION TECHNICAL REPORTS**



# **2006 CSO CONTROL PROJECT**

## **BARTON PUMP STATION SERVICE BASIN CALIBRATION**

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## **Introduction**

In the King County combined wastewater conveyance system, when a significant rainfall event occurs sewer flows exceed the system capacity and the excess flow is typically diverted into a local water body. These events are termed combined sewer overflows (CSO). The magnitude and duration of these events are different for each area serviced by the wastewater conveyance system, and the County is required to limit the number of CSO events to no more than one event per year (on average) over a five year period. The actual permit language states,

*The Permittee shall discharge no more than an average of one overflow event per year per CSO based on a long term average. Compliance will be based on a five-year average for the permit cycle. The compliance point will be based on the five-year average as provided at the time of application for permit renewal. Annual reporting of the five-year moving average is required in the Annual CSO report.*

At these CSO sites, event frequency and volume are estimated with a hydrologic water shed model. This model has been configured for the greater Seattle metropolitan area, but the County has specific interest in determining CSO frequency and volumes at the Barton Pump Station (PS) Service Basin. This report documents the calibration of the Runoff/Transport model for the Barton PS service area.

## **Methods**

### **1.1 Model**

The County's Runoff/Transport model was used for simulating CSO events at the Barton PS. This model is a modified version of the San Francisco Storm water Model (Book, 1980) and has been modified by the County subsequently. The model applies the kinematic wave formulation (Bob Swarner, per comm.). For this study, the model was configured for the Barton PS service area, Figure 1.



**Figure 1.** Barton PS service basin represented in the Runoff/Transport model. The service basin comprises five sub-basins: 414, 415, 416, 417, and 418.

## 1.2 Delineation of Impervious and Pervious Areas

For combined sewer systems, basin runoff is defined as flows from roofs and streets, open spaces, and groundwater infiltration from pervious areas; for partially separated systems, street runoff is caught and routed away from the sewer system, (Bergam, 1993). Completely separated systems are absent roof and street connection into the local sewer system but sewers are still susceptible to groundwater infiltration. The runoff and/or infiltration from these areas is routed through the watershed model into the sewer transport model. The volume of runoff depends on several parameters but we will currently address those associated with the pervious and impervious areas. For estimating these areas, methods were interpreted from Bergam (1993).

Total basin area (acres) was calculated using a planimeter and rounded to a whole number.

Percent impervious was estimated through a combination of steps, but impervious area was “eyeballed” from DCLU zoning maps (no definition supplied by Bergam) for specific types of land use. This area was specified as a percent of the total basin area, (1.1). This step roughly estimated percentages of total area for each land use type: high, medium, or low density residential areas, commercial areas, and other land use types within a basin. For relevant land use types that are potentially connected to the sewer, these areas are multiplied by the percent connected that defines what is connected to local sewer lines.

The percent connected impervious ( $A_{\text{impervconn}}$ ) represents the percentage of the impervious area that is actually connected to the sewer system.

$$\begin{aligned} A_{\text{imperv}} &= A_{\text{total}} P_{\text{imperv}} \\ A_{\text{impervconn}} &= A_{\text{imperv}} P_{\text{conn}} \\ A_{\text{impervconn}} &= A_{\text{total}} P_{\text{impervconn}} \\ P_{\text{impervconn}} &= (P_{\text{imperv}})(P_{\text{conn}}) \end{aligned} \tag{1.1}$$

Where  $A_{\text{imperv}}$  is the impervious area,  $A_{\text{total}}$  is the total sub-basin area,  $P_{\text{imperv}}$  is the percent impervious area, and  $P_{\text{conn}}$  is the percent impervious connected to the sewer lines. Unless  $P_{\text{imperv}}$  or  $P_{\text{conn}}$  is known explicitly, the form of  $P_{\text{impervconn}}$  is an ill-posed equation as  $P_{\text{imperv}}$  or  $P_{\text{conn}}$  can assume an infinite number of combinations and produce the same  $P_{\text{impervconn}}$ .

While the Barton model is configured for five sub-basins, hydrograph transport analyses suggested the five sub-basin hydrographs reach the pump station (basin terminus) simultaneously (Appendix A). And because only a single flow record existed at the terminus, delineating sub-basin contributions in the model is a record keeping exercise that can be better handled external to the model. Within the model, sub-basin contributions were equally represented; essentially, the model is configured to act as a single contributing basin.

### 1.3 Flow and Rainfall Data

#### 1.3.1 Flow Data

At the Barton and Murray PS, conveyance system flows are recorded at the pump station and stored to an offsite facility. The data comprises flow, pump speed, and wet-well water levels. This data was retrieved from the online King County Sewage Data Retrieval System. Relevant tag numbers used to extract data from the County Retrieval System are given in Table 1. For the Barton Pump Station, recorded flows are available back to 1998; however, the system did not record at a sufficient temporal resolution to assess diurnal flow variations until the year 2000, Table 2. Diurnal flow variations are important for assessing how rainfall infiltrates into the soil and ultimately into the conveyance system; therefore, only data sets that contained diurnal flow variations were retained for model calibration. From these sets, only larger storm events were selected for use in calibrating the model; CSO's only occur when flows exceed pump capacity. From the five years of data, 11 possible events were selected for calibrating the model, Table 3. Before the events were selected, the data was assessed for reasonable quality; reasonable implies most data points trended well over the observed event. When pump flow data appeared corrupt and pump speed data was available and reasonable, flow was approximated from pump speeds. Using flow and pump speed data prior to the corrupt data, we regressed pump speed against measured flows using either a linear or quadratic equation. The corrupt data was replaced by the flow-pump speed regression.

**Table 1.** Tag numbers for obtaining flow, wet-well water levels, and pump speed at the Barton PS.

FB485111VL(MGD)	Flow meter for pump 1
FB485112VL(MGD)	Flow meter for pump 2
LB485106VL(FT)	Wet-Well Water Level
SB485126VL(RPM)	Pump Speed for pump 1

**Table 2.** Summary of measured flow conditions at the Barton Pump Station. These are CATAD data sets. Missing infers diurnal flow observations were absent and No Data infers there was no data for that period.

Year	Diurnal Flow	Storm Event	Time Series Plot
6/98-9/98	Missing	Yes	NA
9/98-12/98	Data corrupted		NA
12/98-4/99	Missing	Yes	NA
4/99-7/99	No Data		NA
7/99-11/99	Missing	Yes	NA
11/99-12/99	Missing	Yes	NA
1/00-3/00	No Data		NA
6/00-9/00	Missing	Yes	NA
9/00-12/00	Yes	Yes	Figure 2
12/00-3/01	Yes	Yes	Figure 3
6/01-10/01	Yes	Yes	Figure 4
10/01-12/01	Yes	Yes	Figure 5
1/02-3/02	No Data		
3/02-10/02	Yes	Yes	Figure 6
10/02-12/02	Yes	Yes	Figure 7

Year	Diurnal Flow	Storm Event	Time Series Plot
3/03-6/03	Yes	Yes	Figure 8
6/03-9/03	Yes	Yes	Figure 9
9/03-12/03	Yes	Yes	Figure 10
12/03-3/04	Yes	Yes	Figure 11
8/04-10/04	Yes	Yes	Figure 12
1/05-3/05	Yes	Yes	Figure 13
3/05-6/05	Yes	Yes	Figure 14
10/05-12/05	Yes	Yes	Figure 15

**Table 3.** Date ranges for the 11 possible events for use in calibrating the Barton PS basin model.

Event Date	Peak Flow (MGD)	Event Number
11/12/01 - 11/18/01	16	1
11/19/01 - 11/26/01	16	2
11/28/01 - 12/1/01	20	3
11/11/02 - 11/13/02	22	4
12/13/02 - 12/17/02	17	5
10/15/03 - 10/17/03	17	6
10/20/03 - 10/25/03	24	7
11/16/03 - 11/28/03	22	8
1/6/04 - 1/11/04	16	9
1/28/04 - 2/2/04	21	10
12/23/05 - 12/27/05	20	11

### 1.3.2 Rainfall

Rainfall rates were obtained from the City of Seattle. The Barton PS service lies within rain gauge (RG) 5 Thiessen polygon, the gauge is approximately 3000 ft from the center of the basin. The RG data was QA/QC by Bruce Crawford.

### 1.3.3 Weir flow calculations

When basin flow exceeds pump capacity, excess sewer flows over a broad crested weir. Traditionally, the weir equation had been used to estimate the excess flow and added to observed pump flows; however, uncertainty in wet well levels and weir coefficients propagate potentially significant errors into calculated flows. Available County documents suggest wet well levels (bubblers) are accurate to about 0.1 ft; for typical heights over the weir, calculated flow errors are near  $\pm 40\%$  (Schock, 2006). The uncertainty in the calculated flows exceeds benefits in including excess flows for model calibration.

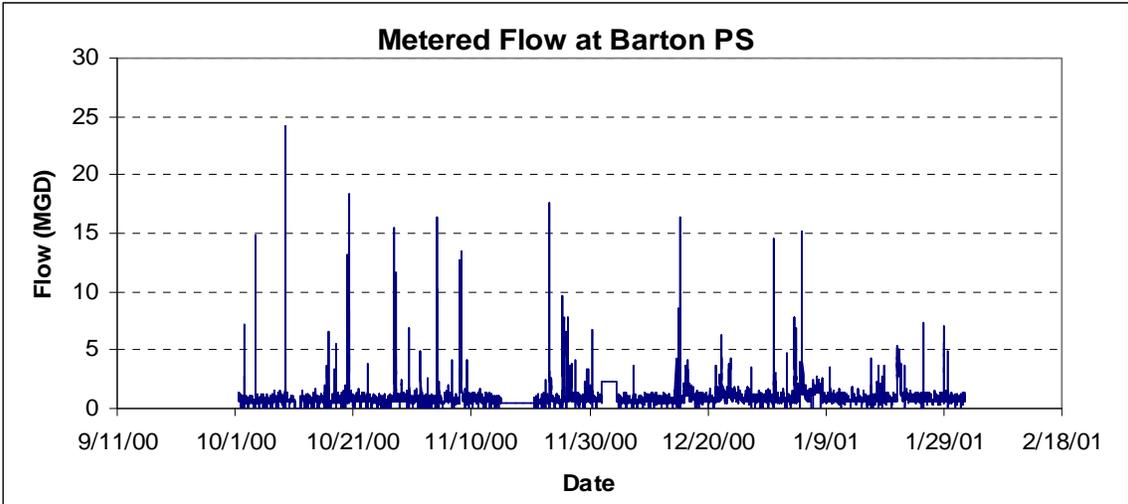


Figure 2. Metered flow at the Barton PS.

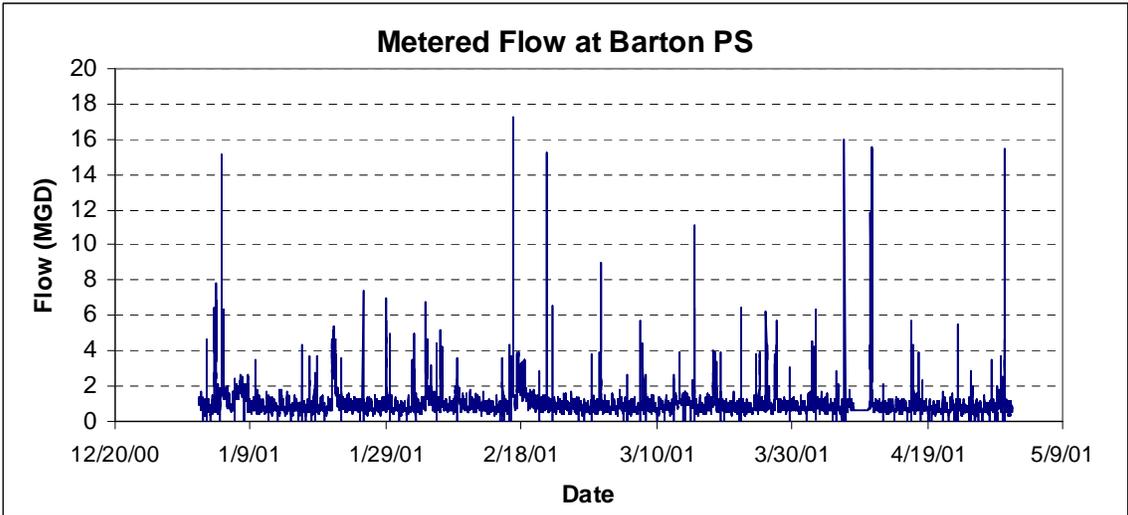
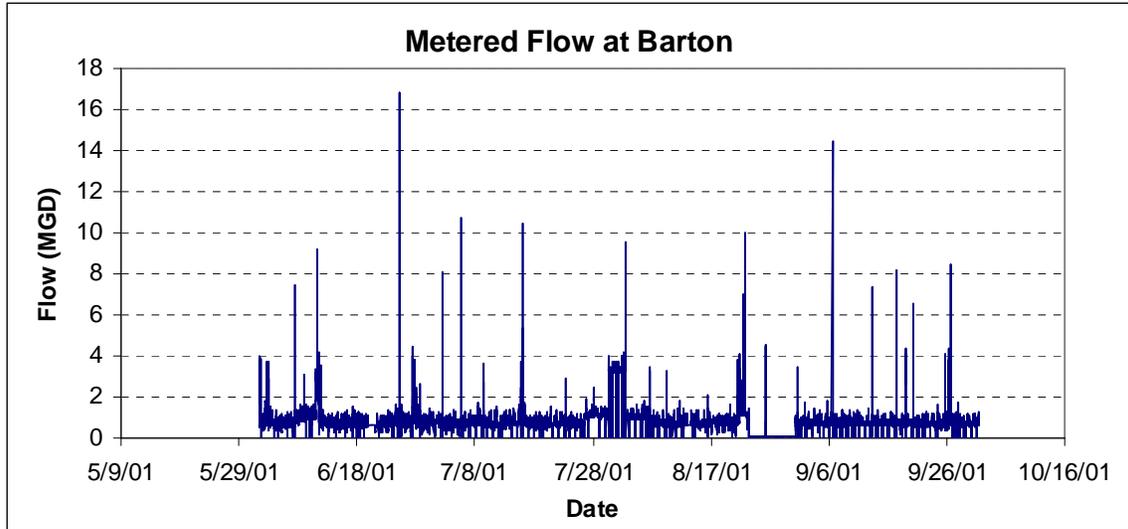
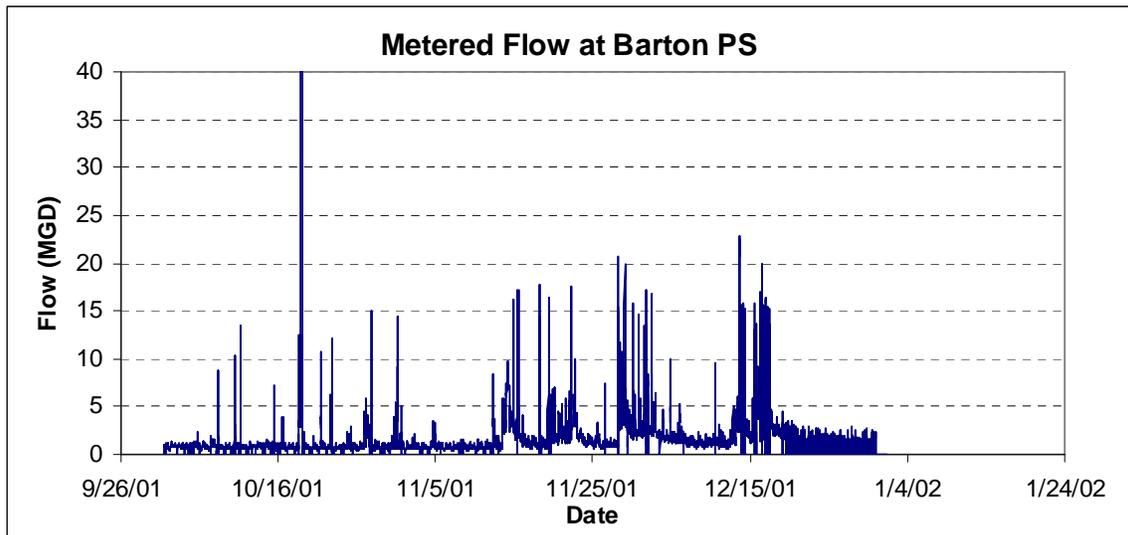


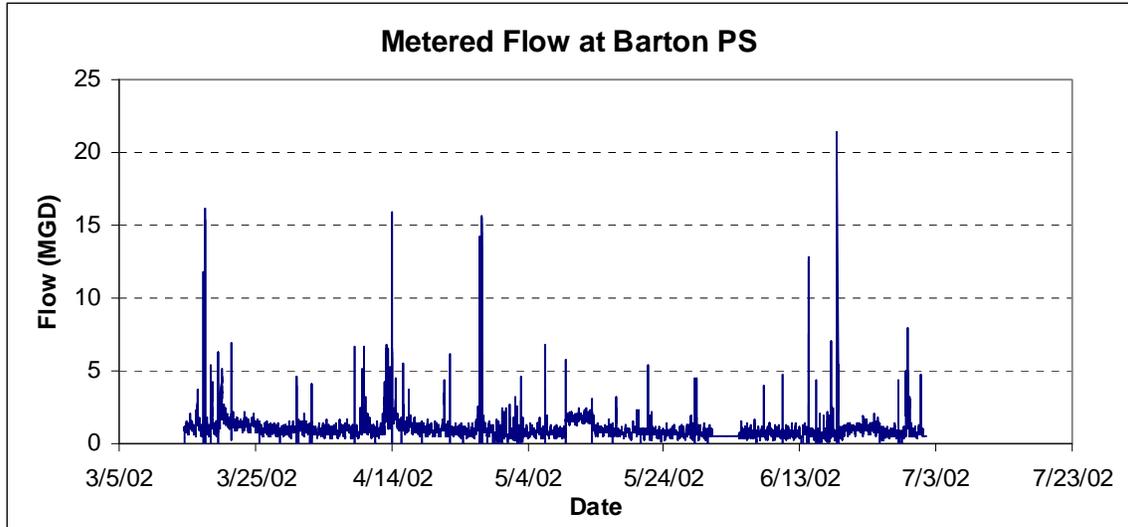
Figure 3. Metered flow at the Barton PS.



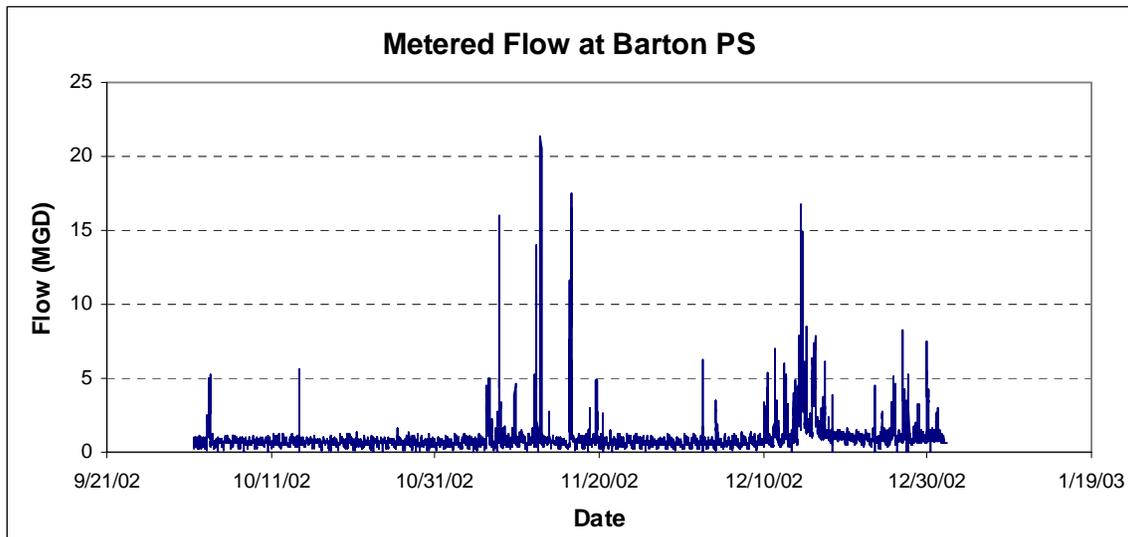
**Figure 4.** Metered flow at the Barton PS.



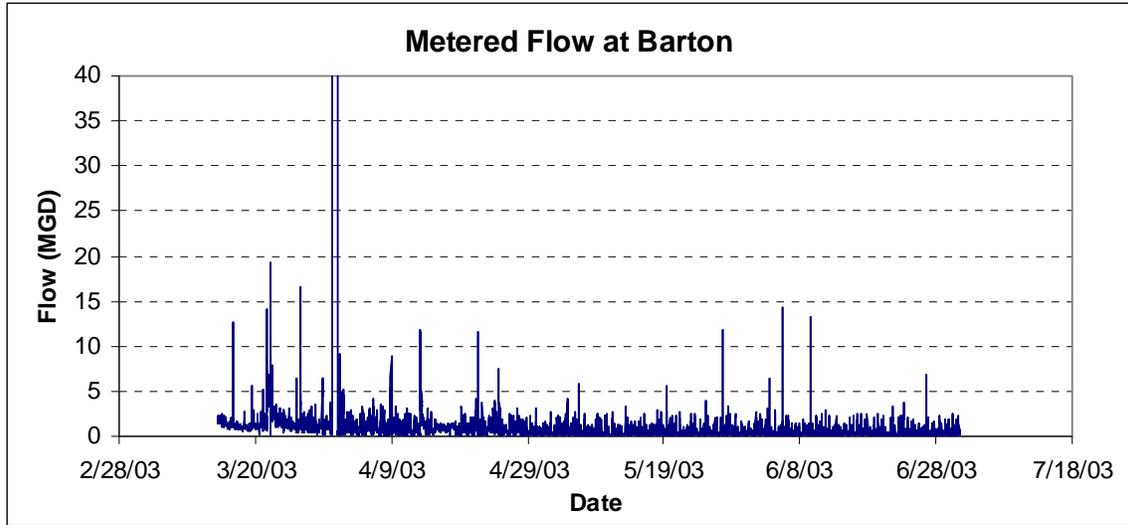
**Figure 5.** Metered flow at the Barton PS.



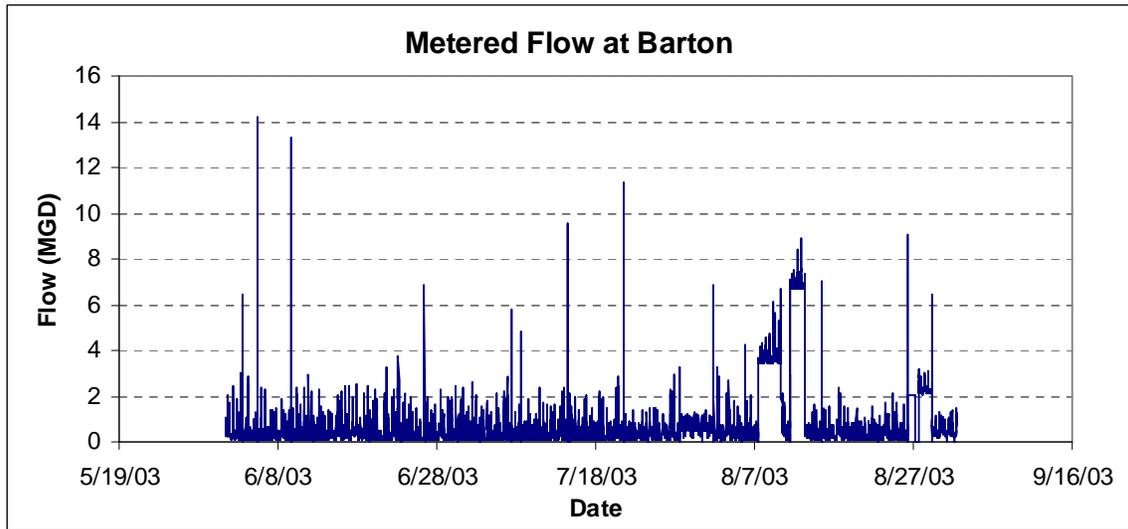
**Figure 6.** Metered flow at the Barton PS.



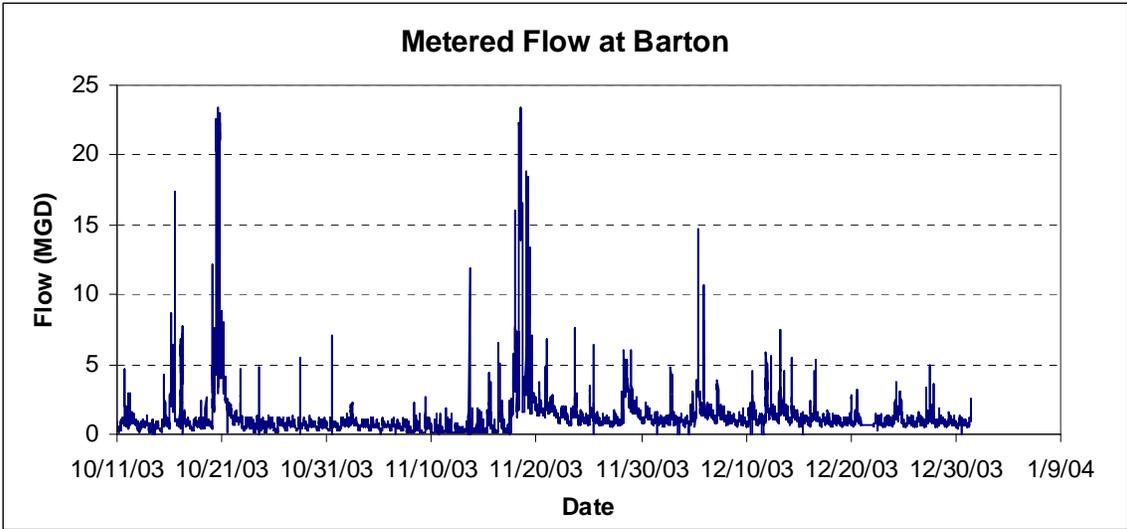
**Figure 7.** Metered flow at the Barton PS.



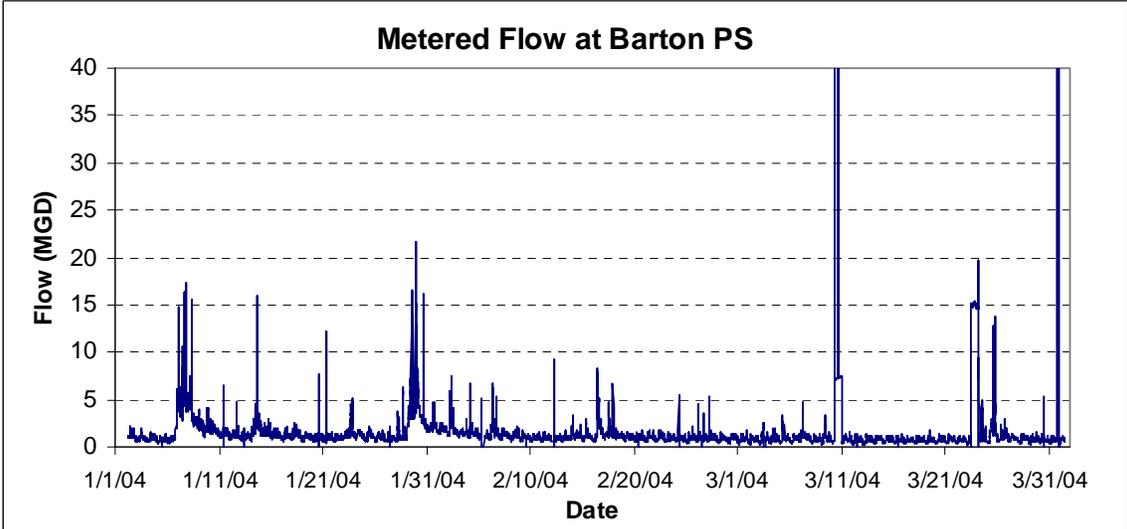
**Figure 8.** Metered flow at the Barton PS.



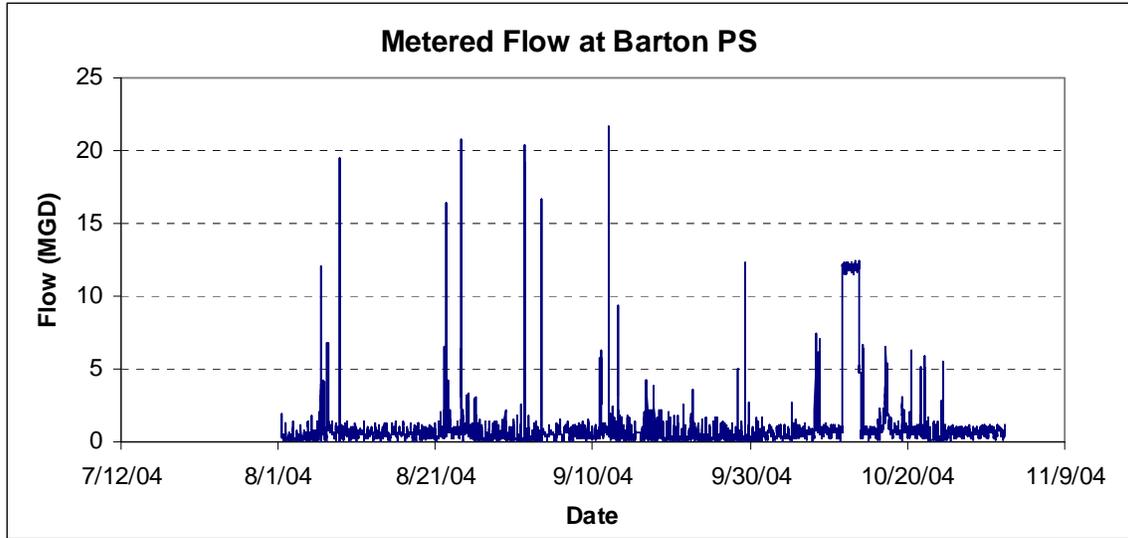
**Figure 9.** Metered flow at the Barton PS.



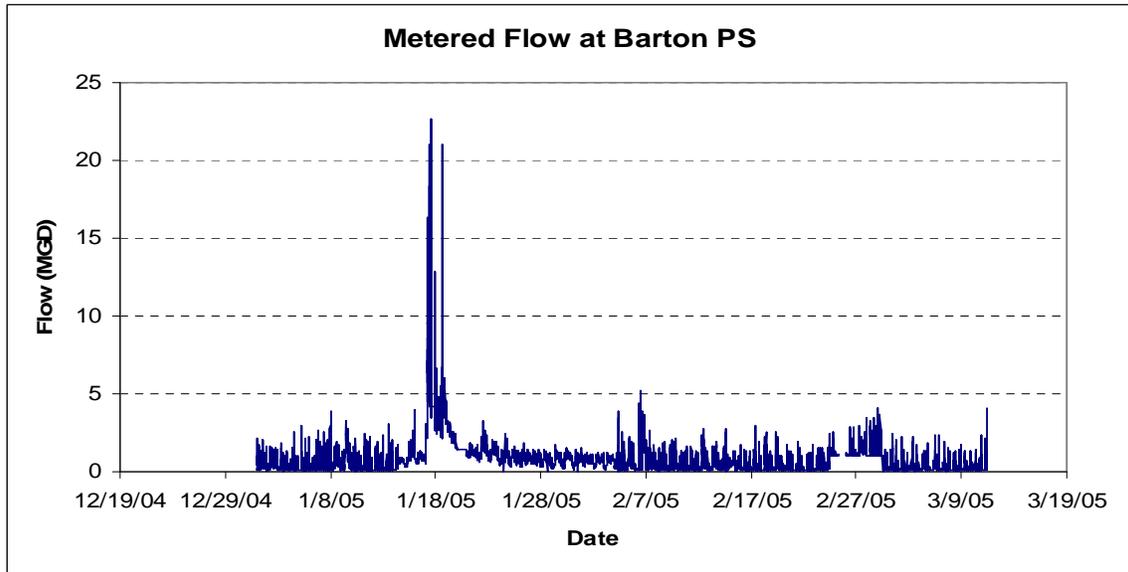
**Figure 10.** Metered flow at the Barton PS.



**Figure 11.** Metered flow at the Barton PS.



**Figure 12.** Metered flow at the Barton PS.



**Figure 13.** Metered flow at the Barton PS.

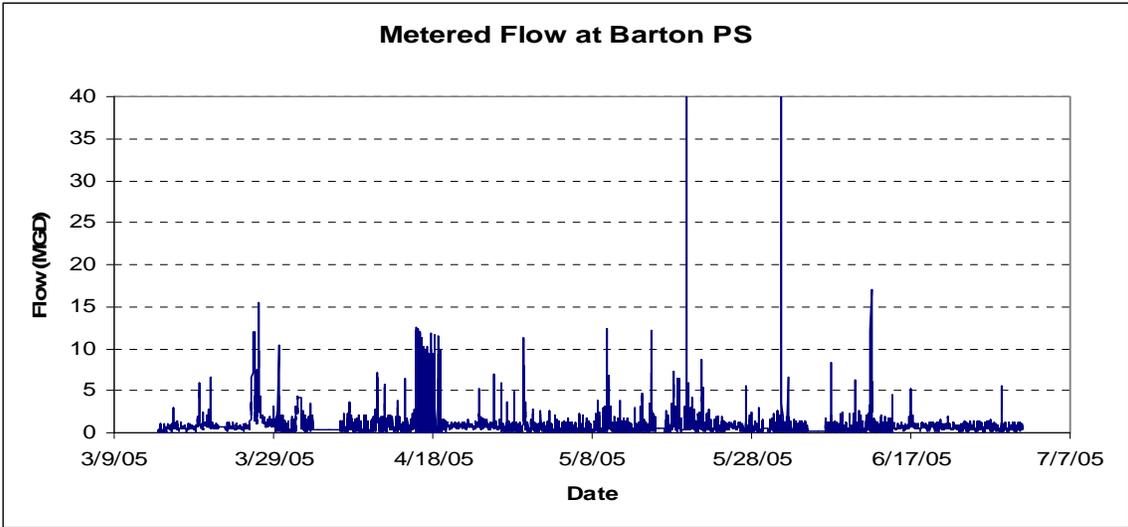


Figure 14. Metered flow at the Barton PS.

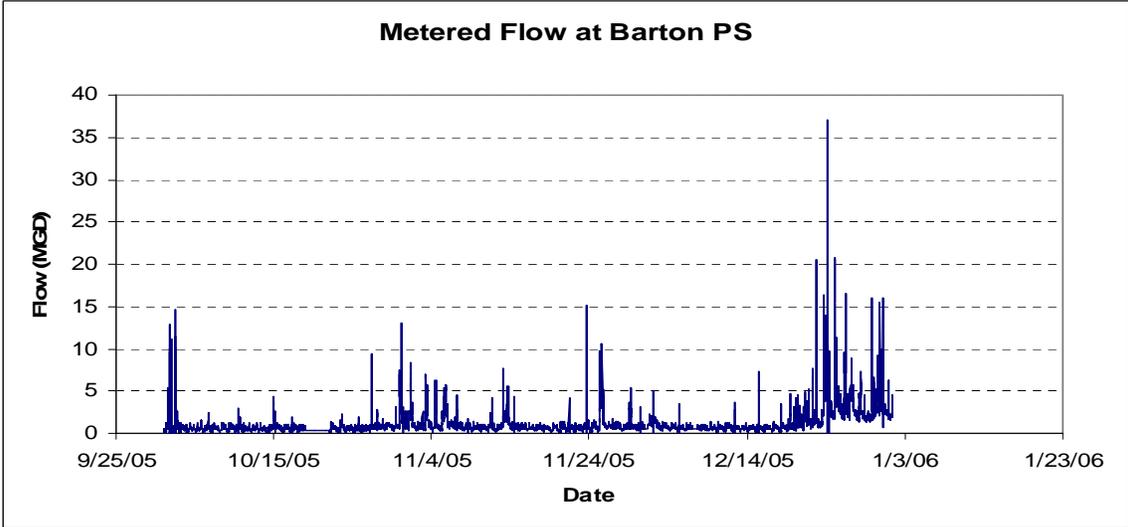
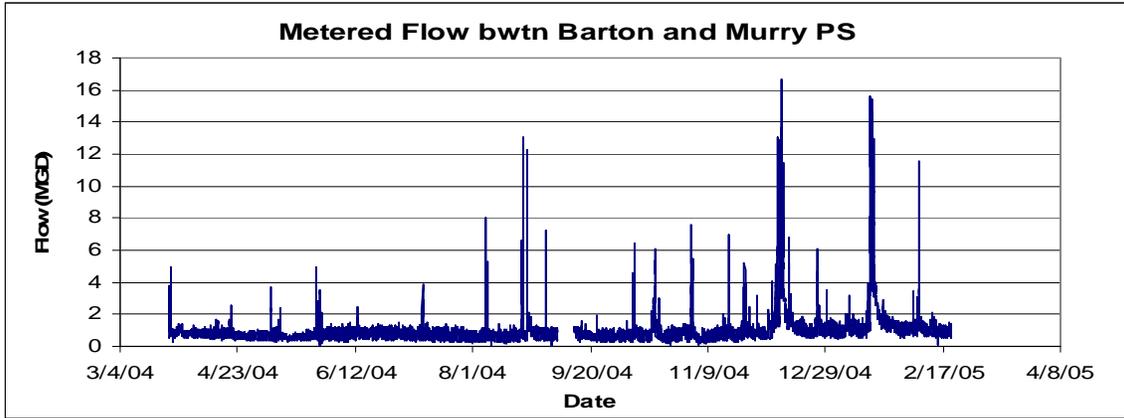
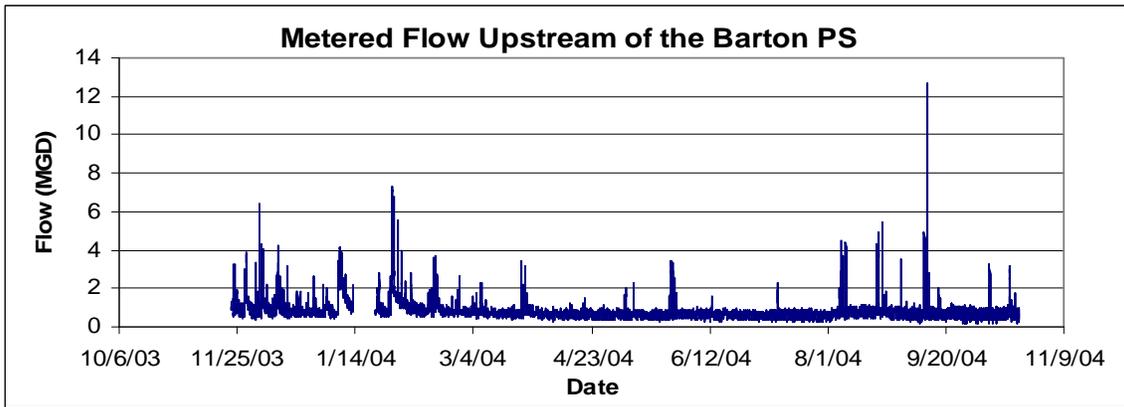


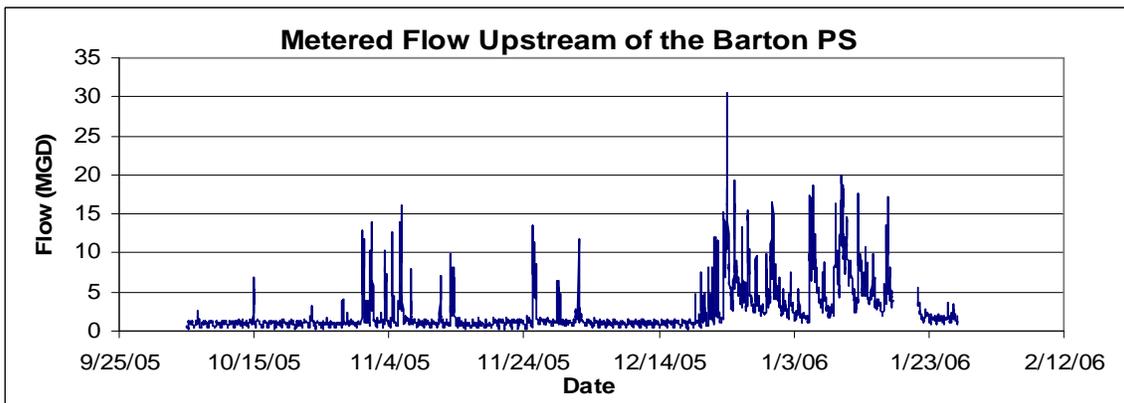
Figure 15. Metered flow at the Barton PS.



**Figure 16.** Metered flow with metered located upstream of the Murray Pump Station. Flow was measured with FloDar meters.



**Figure 17.** Metered flow with metered located upstream of the Barton Pump Station in manhole 022. Flow was measured with FloDar meters.



**Figure 18.** Metered flow with metered located upstream of the Barton Pump Station in manhole 022. Flow was measured with FloDar meters.

### 1.4 Flow Meter Errors

For the Barton PS ultra-sonic flow meters, flow errors were estimated from pump tests; the meters have a potential relative error of about  $\pm 8\%$  (Table 4). Pump testing suggested the ultra-sonic meters provided better flow estimates compared to portable flow meters. During the 2007 – 2008 Barton basin flow monitoring program, portable flow meters significantly under estimated basin flows (Table 4). Because of the observed portable meter errors and their propagation into simulated flows, data from the portable meters were not used for model calibration.

**Table 4.** Summary of findings concerning flow estimates from the portable meters used in the 2007 – 2008 Barton flow monitoring program and estimated Barton PS meter error (Schock, 2008).

Meter	Percent error of mean flow	Percent error of flow amplitude	Percent error in flow
PS Ultra-sonic	NA	NA	8%
Portable	11%	26%	NA

### 1.5 Measures of Goodness of Fit

When calibrating a model, some measure of fit must be used to assess how well a particular parameter set recreates the observed flow. For the Barton PS calibration, three statistical measures of fit were used.

$$R^2 = \sum (q_{obs} - q_{mdl})^2 \quad (1.2)$$

$$b = \frac{1}{N} \sum \left( \frac{q_{mdl} - q_{obs}}{q_{obs}} \right) \quad (1.3)$$

$$wr^2 = \begin{cases} |m| r^2 & \text{for } m \leq 1 \\ |m|^{-1} r^2 & \text{for } m > 1 \end{cases} \quad (1.4)$$

$$|b| = \frac{1}{N} \sum_i \left| \sum_{M_i} \frac{q_{mdl} - q_{obs}}{q_{obs}} \right| \quad (1.5)$$

Where  $R^2$  is the sum of the squares of the residuals,  $q_{obs}$  is the observed flow,  $q_{mdl}$  is the simulated flow;  $b$  is the normalized bias and  $N$  is the total number of observations;  $wr^2$  is the weighted coefficient of determination ( $r^2$ ) and  $m$  is line slope between  $q_{obs}$  verses  $q_{mdl}$ ; and  $|b|$  is the absolute value of the group bias for the  $i$  events and  $M_i$  is number of observations in each storm event.  $|b|$  is an important parameter for propagating model calibration errors into estimated storage requirements (§1.8).

The weighted coefficient of determination was found to be good estimator of fit, but should be used with other estimators of fit (Krause et al., 2005). The sum of the residuals is the optimization function used in linear regression and is also used by the optimization program utilized to calibrate the model (§ 1.6). Visual inspections were also part of the calibration process.

## 1.6 Calibration Procedures

Model calibration is an iterative process of finding a set of model parameters that optimize the measures of fit between observed data and modeled data. Initial model parameter sets (input files) were obtained from Bruce Crawford; these files provided the initial parameter set. The model was first calibrated using an optimization program and then a second (manual) calibration was performed to provide a better visual fit; often the visual fit produce worse statistical fits.

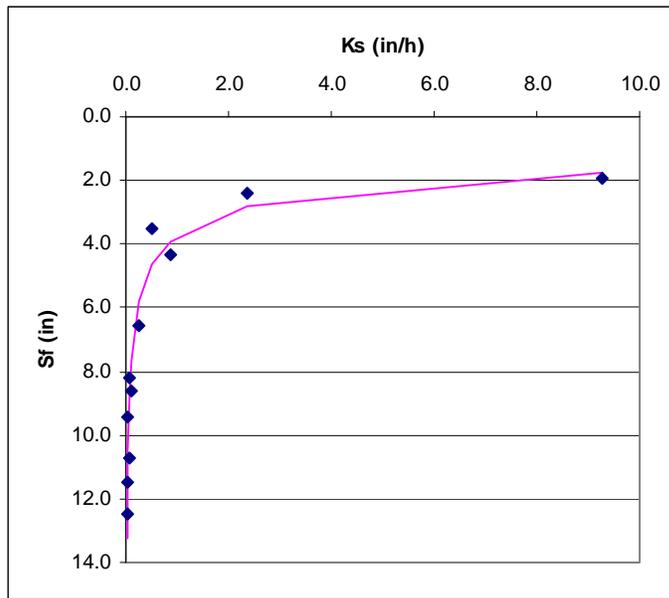
The optimization program was the Model-Independent Parameter Estimation (PEST) computer optimization code, 5<sup>th</sup> edition (Doherty, 2004). PEST is a freeware program that implements a gradient search method to find the optimum parameter set that minimizes the sum of the square of the residuals ( $R^2$ ). PEST is widely used in groundwater modeling to optimize spatial variations in hydraulic conductivity (Doherty, 2003; Keating et al, 2003; and Dubus et al, 2004). PEST has several options for constraining parameters to a given set of rules; these constraints also improve stability in the optimization routine. After several uses, the most appropriate constraining option appeared to be the estimation routine. In estimation mode, the program maintains the constraints unless a better fit can be obtained by deviating from the constraint; PEST imposes a penalty for deviating from the constraint by adding the deviated amount (sum of the constraint deviation, SCD) to  $R^2$ , PEST optimizes on the combined errors ( $SCD+R^2$ ). As long as the sum ( $SCD + R^2$ ) continues to decrease with increasing SCD, PEST will continue to deviate from the imposed constraint. This condition infers the final optimized parameter is justified because the deviation would not be imposed unless an improvement fit occurred (Doherty, 2004).

In PEST, stability refers to the ability to invert the covariance matrix. If the model is insensitive to the parameters or the parameters are highly correlated, inverting the covariance matrix will produce a singularity; in the very least, this condition is an indicator that the parameter set is non-unique (Doherty, 2004). PEST was initially run with unconstrained parameters and found the covariance matrix could not be inverted; therefore, parameter constraints were required to reduce parameter correlation. We derived three constraints: two for wet weather decay terms and one for Green-Ampt infiltration terms. Based on 103 calibrated data sets, two of the wet weather decay terms (T\_EVAP and FGAEVAP) were rarely changed and therefore maintained a relatively constant ratio (1.6). In the same data set, typical values for PARLEAK\_PERACRE were 0.01 and values for FGA\_LEAKMIN were 0.38 giving a ratio of 38, which was rounded up to 40 (1.7). Based on average Green-Ampt terms (Rawls et al, 1993), an exponential relation was derived from average values for hydraulic conductivity (PERM, permeability) and suction head (SH), (1.8) and Figure 19.

**Table 5.** Average Hydraulic soil parameters obtained from Rawls et al (1993)

Soil	Suction Head (in)	Hydraulic Conductivity (in/h)
sand	1.9	9.3
loamy sand	2.4	2.4
sandy loam	4.3	0.86
loam	3.5	0.52

Soil	Suction Head (in)	Hydraulic Conductivity (in/h)
silt loam	6.6	0.27
sandy clay loam	8.6	0.12
clay loam	8.2	0.08
silty clay loam	10.7	0.08
sandy clay	9.4	0.05
silty clay	11.5	0.04
clay	12.5	0.02



**Figure 19.** The power relation between suction head and hydraulic conductivity given by equation (1.8) (pink line).

$$T_{EVAP} = 768(FGA_{EVAP}) \quad (1.6)$$

$$FGA_{LEAKMIN} = 40(PARLEAK_{PERACRE}) \quad (1.7)$$

$$SH = 3.96(PERM)^{-0.317} \quad (1.8)$$

These relations appear to provide sufficient constraint in the optimization process. For the PEST optimization, we selected five of the eleven storms: events 2, 7, 8, 9, and 10. These five storms appeared sufficient for a good calibration and also allowed reasonable execution times.

In PEST, the gradient search method may converge to a local optimum that has a lower quality fit than the best possible fit at the global optimum (Doherty, 2004). This local convergence is dependent on the initial parameter set (Dubus et al, 2004); however, traditional calibrations methods may also converge to a local optimum unless all parameter ranges are tested.

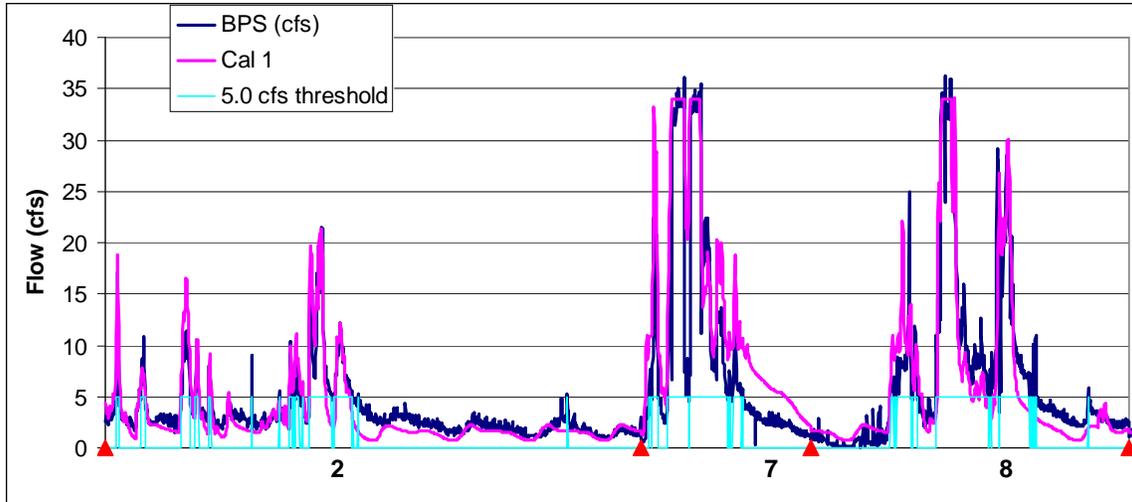
Using results from the PEST optimization, the second phase involved manually fine tuning model parameters. This second phase relied more on a visual fit between simulated and observed flows than the statistical measures of fit. After the second phase, PEST was used to assess parameter sensitivity. When PEST optimization is stable, the program estimates parameter correlation, eigenvectors and eigenvalues. These statistical measures are useful for assessing which parameters are most effective for calibrating the model. From these three steps, we found that the calibration was most affect by a sub-set of the total parameter set and this set was fairly effective in determining an optimal fit between modeled and observed flows (Table 6). Implementing a reduced parameter set is a typical calibration technique (Jacomino and Fields, 1997; Fleming and Neary, 2004; Dubus et al, 2004). Typical protocols suggest performing a parameter sensitivity analysis and select the most sensitive parameters for calibration.

## **Results**

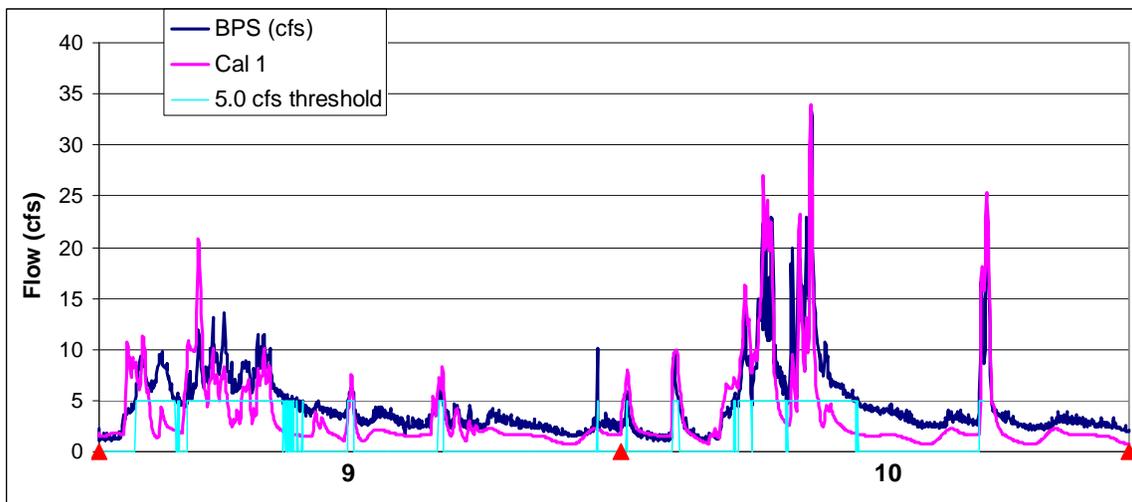
The Barton basin calibration is a little unusual because three different calibrations are presented; the three calibrations provide equally viable fits to the observed data. Different but statistically and visually similar calibrations are not unusual and are consistent with monte-carlo methods that determine a set of acceptable calibrations. These monte-carlo sets are used to develop a mean calibration and error bounds.

### **1.7 Calibration**

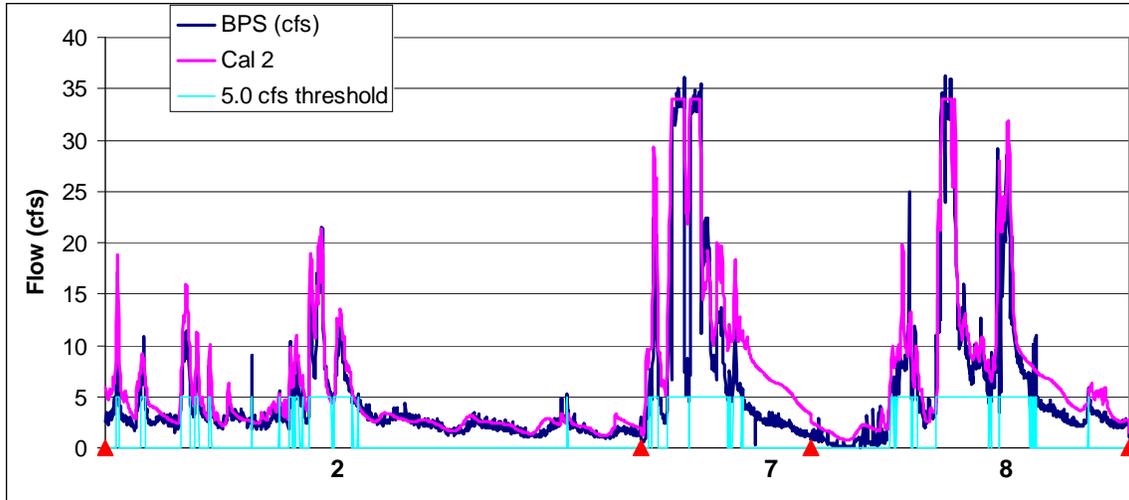
Based on PEST sensitivity results, the Barton PS service basin appeared insensitive to the trench flow component and most sensitive to wet weather flow, soil infiltration, Mannings overland flow coefficient, and connected areas (Table 6). Based on these findings, the model was calibrated with the trench flow component connected (TRFWAC>0) and disconnected (TRFWAC=0); this procedure produced three viable calibrations. More calibrations could have been developed, but time constraints did not allow more. The optimization focused on the parameter set defined in Table 6. Final calibration graphs for the five storms are presented in Figure 20 through Figure 25 and measures of fit are presented in Table 7. Measures of fit were determined for flows greater than 5 cfs, which approximately represents flow conditions above nominal sewer flows. This flow threshold is used to indicate how well the model reproduces flow during storm events rather than how well the model can reproduce nominal sewer flows and storm events.



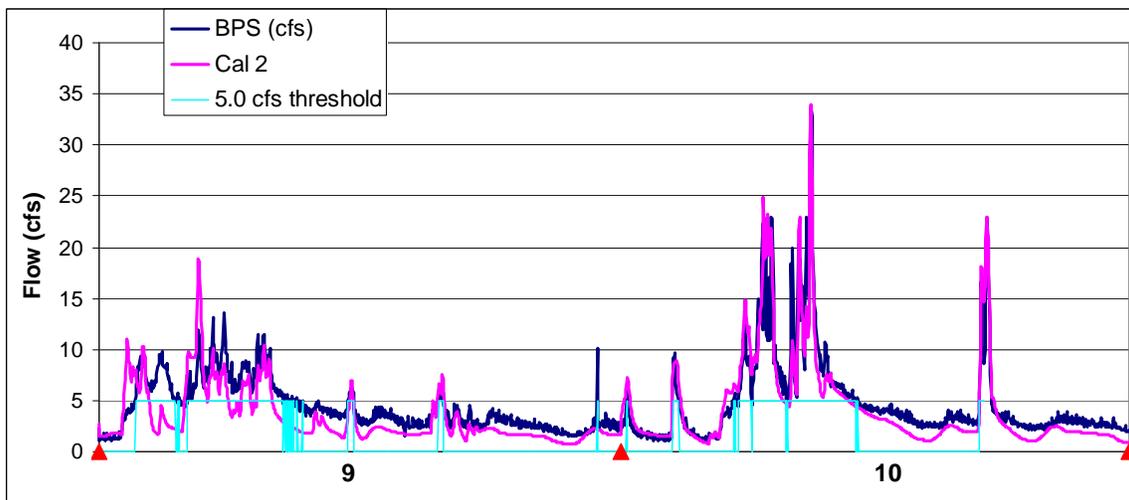
**Figure 20.** Calibration profile for parameter set Cal 1. Barton PS flows are blue and model flows are pink; red triangles demarcate storms and numbers identify storm event; cyan lines demarcate events that exceed 5 cfs.



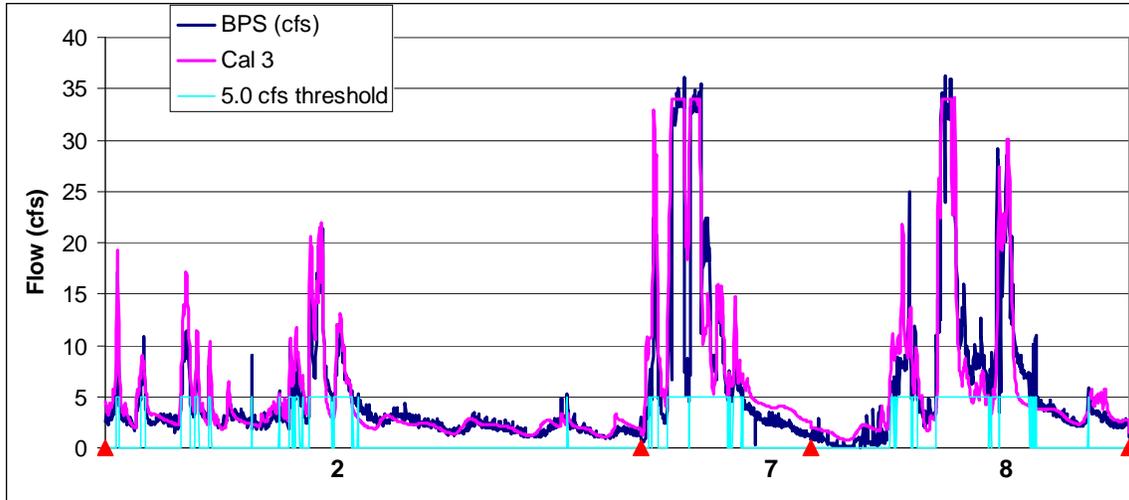
**Figure 21.** Calibration profile for parameter set Cal 1. Barton PS flows are blue and model flows are pink; red triangles demarcate storms and numbers identify storm event; cyan lines demarcate events that exceed 5 cfs.



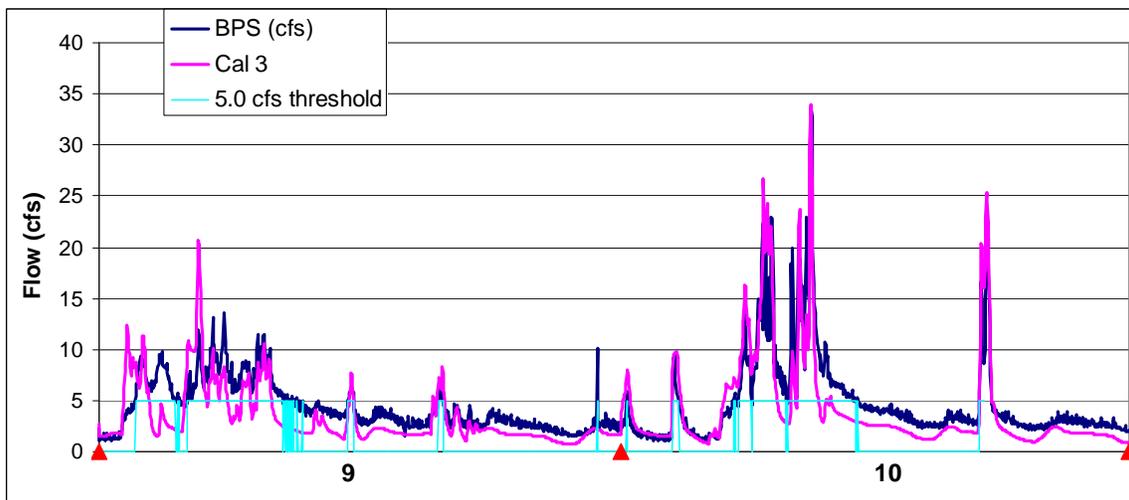
**Figure 22.** Calibration profile for parameter set Cal 2. Barton PS flows are blue and model flows are pink; red triangles demarcate storms and numbers identify storm event; cyan lines demarcate events that exceed 5 cfs.



**Figure 23.** Calibration profile for parameter set Cal 2. Barton PS flows are blue and model flows are pink; red triangles demarcate storms and numbers identify storm event; cyan lines demarcate events that exceed 5 cfs.



**Figure 24.** Calibration profile for parameter set Cal 3. Barton PS flows are blue and model flows are pink; red triangles demarcate storms and numbers identify storm event; cyan lines demarcate events that exceed 5 cfs.



**Figure 25.** Calibration profile for parameter set Cal 3. Barton PS flows are blue and model flows are pink; red triangles demarcate storms and numbers identify storm event; cyan lines demarcate events that exceed 5 cfs.

**Table 6.** The three calibration parameter sets determined for the Barton PS service basin.

Parameter name used in Fortran Code	Cal 1	Cal 2	Cal 3
FGA_LEAKMIN	0.0123	0.0123	0.0123
PARLEAK_PERACRE	0.0026	0.00056	0.0004
FGAEVAP	1.16E-05	0.0	0.0
PERM	0.551	0.551	0.551

Parameter name used in Fortran Code	Cal 1	Cal 2	Cal 3
SH (suction head)	4.79	4.79	4.79
t (factor)	37.5	190	190
T_EVAP	456	456	456
TRFLWFAC	0.0	0.0038	0.001
STORLOSSA	NA	15	15
STORLOW	NA	350	350
WCON(1)	0.025	0.025	0.025
CONIMP414	62.0	57	62
CONIMP415	62.0	57	62
CONIMP416	62.0	57	62
CONIMP417	62.0	57	62
CONIMP418	62.0	57	62
CONPER414	10	10	10
CONPER415	10	10	10
CONPER416	10	10	10
CONPER417	10	10	10
CONPER418	10	10	10

**Table 7.** Best overall statistical measures of fit for the final calibration parameters presented in Table 6. The bias (b) was computed for flows greater than 5 cfs and the group bias was computed for flows greater than 15 cfs.

Statistical Fit	Cal 1	Cal 2	Cal 3
$R^2$	26277	25511	23691
$wr^2$	0.797	0.824	0.795
b	-0.9%	11.6%	-1.0%
b	4.0%	4.7%	4.7%

### 1.8 Propagated Error into the Simulated Flows

Any measurement or model has some inherent error; flow measurement errors and model calibration errors should be propagated into a combined error. For the computer modeling of the Barton PS basin, simulated flows will contain model calibration errors and flow meter errors; model calibration errors depend on the duration of the storm events. The calibration group bias |b| is used when event durations are longer than about 30 minutes, and the sum of the residuals squared is used for event durations less than 30 minutes (Schock, 2006b). The bias calculated by (1.3) gives the overall bias for all hydrographs; however, CSO events are discrete or partially discrete events and the bias for each event is much different than the overall bias (Table 7). At the Barton PS, overflow events occur when flows exceed pump capacity; these events are the ones for which a group bias should be calculated and propagated into simulated flows.

Because CSO's occur when flows exceed pump capacity, the group bias should be estimated from the excess flow; however, accurate flows greater than the pump capacity were not available. An alternative threshold flow was selected that includes enough data but omits flow conditions that have insignificant contributions to overflow hydrographs. A reasonable threshold might be one-half the pump capacity, which for Barton is about 10 MGD (15 cfs). Model calibration errors  $|b|$  and flow meters errors are propagated into a single error term. The propagated error ( $\epsilon_T$ ) combined model calibration bias and flow meter errors is about 19% at the 95<sup>th</sup> confidence level.

$$\epsilon_T = \sqrt{(4.7)^2 + \{(2.31)(8)\}^2} \quad (1.9)$$

$$\epsilon_T = 19\%$$

In (1.9) the value 2.31 is the student t-statistic for the estimated flow error of 8% computed from 9 observations (Schock, 2006a). The propagated error is applied to the simulated hydrograph, which is used to estimate storage requires for a given pump capacity. Upper and lower storage bounds can be estimated by multiplying the simulated hydrograph by (1.10) and (1.11).

$$\epsilon_{upper} = 1 + \epsilon_T \quad (1.10)$$

$$\epsilon_{upper} = 1.19$$

Where  $\epsilon_{upper}$  is the hydrograph multiplier for assessing upper storage bounds.

$$\epsilon_{lower} = \frac{1}{1 + \epsilon_T} \quad (1.11)$$

$$\epsilon_{lower} = 0.84$$

Where  $\epsilon_{lower}$  is the hydrograph multiplier for assessing lower storage bounds.

### 1.9 Estimating Storage Requirements

For potential flows to the Barton pump station, a 30 year hydrograph was simulated from historical rainfall measurements; this hydrograph represents expected flows for existing conditions in the service basins (Table 8). A CSO overflow occurs when the basin flows exceed the pumping capacity at the pump station. For a specified pump capacity, storage volumes were determined by integrating the excess flow (hydrograph) above the specified pump capacity (1.12). This procedure produces a set of volumes, which are sorted and ranked for probabilistic analyses.

**Table 8.** Rainfall record dates used to simulate 30 years of flow in the Barton basin.

Service Basin	Rainfall Record	Existing Flow Capacity (MGD)
Barton	2/1/78 – 6/15/08	22

$$V = \int_{t_1}^{t_2} (Q - Q_T) dt \quad (1.12)$$

Where V is the storage volume for a specified pump capacity  $Q_T$ , Q is the simulated flow, and  $t_1$  and  $t_2$  are times when  $Q \geq Q_T$ .

The resultant set of volumes was sorted and ranked and statistical methods were used to determine recurrence intervals.

### 1.9.1 Estimated Storage for Three Pump Capacities

During the time of this report, the County was planning upgrades to the Barton PS and it wanted to consider how various pumping capacities would affect CSO storage needs; pump capacities could range from 26 MGD to 33 MGD. Storage for the one year recurrence interval was determined for three pumping capacities of 26, 28, and 33 MGD (9). The mean storage volume is the expected value and has error bounds about it, the coefficient of variation ranged from 13% to 20%. Some portion of this error would propagate into the total uncertainty of the storage volume.

**Table 9.** Estimated CSO storage volumes for the Barton PS for the three calibrations.

Pump Capacity (MGD)	Cal 1 (MG)	Cal 2 (MG)	Cal 3 (MG)	Mean (MG)	Std Dev (MG)
26	0.32	0.25	0.31	0.29	0.04
28	0.26	0.20	0.25	0.24	0.03
33	0.11	0.08	0.10	0.10	0.02

## Discussion

The calibration of the Barton basin provides insight to the parameterization of the Runoff model and its ability to simulate the recession limb of the hydrograph. In applying PEST, the correlation matrices and eigenvectors suggested the model contains significant parameter correlation. This condition results from the mathematical expression used to describe water flow through the watershed, the condition does not mean the equations are incorrect but it means insufficient information exists to uniquely describe all the processes represented in the model (Raat et al, 2004; Christiaens and Feyen, 2002). For example, soil infiltration parameters should be calibrated to measured infiltration tests; these parameters would be held constant during the calibration process. Because PEST results suggest significant parameter correlation, we suggest developing methods that constrain parameter variation during model calibration. These methods could be additional field studies or use of existing parameter relations whether published or derive from GIS datasets.

The Runoff model appears to have difficulty simulating conditions that affect the recession limb on the hydrograph. In developing the three calibration curves, the model could only be optimized to one of the five hydrographs. This condition is because the recession limb for each hydrograph had different decay rates and sub-surface water contributions. For parameter set in Cal 2, the model was calibrated to optimize the recession curve for hydrograph 2. For this case, the model reproduced the recession

curve fairly well but it over-estimated recession flow for hydrographs 7 and 8, and it under-estimated recession flow for hydrographs 9 and 10 (Figure 22 and Figure 23). For hydrographs 7 and 8, better recession fits worsened recession fits for the other curves (Figure 24 and Figure 25). These results can be determined without parameter manipulations and subsequent model runs; results can be determined analytically when the user has a complete understanding of the model equations and superposition principles for differential equations.

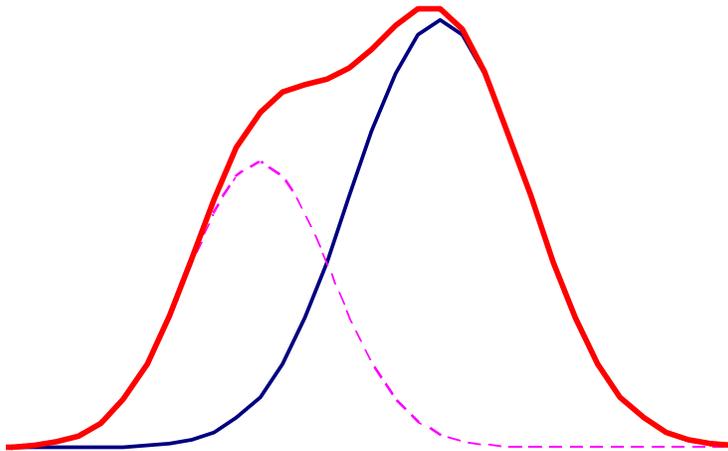
CSO volumes are affected by model and instrument errors and stochastic events like the sequencing of rainfall events. The required storages presented are based on a long-term 1-year CSO volumes from the 30-year simulation of 3 acceptable model calibrations.

## Appendix A

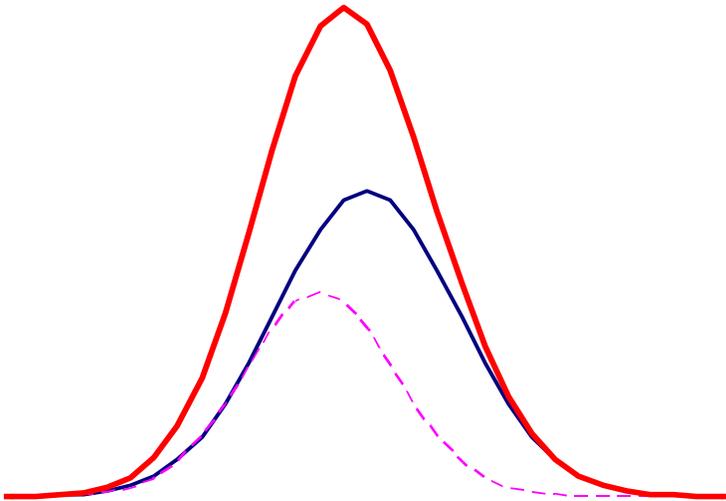
### Uniqueness of composite hydrograph

When modeling a watershed basin, the number of sub basins used should depend on the ability to uniquely identify the hydrograph from each sub basin. This identity can be determined by directly measuring each sub basin hydrograph or measuring the whole basin hydrograph (at the termination point of the whole basin); but within the whole basin hydrograph, one be able to uniquely identify each sub basin hydrograph. The whole basin hydrograph is a composite of many hydrographs transport downstream from each sub basin. If uniqueness is unattainable, then multiple sub basins do not provide additional information beyond a single basin.

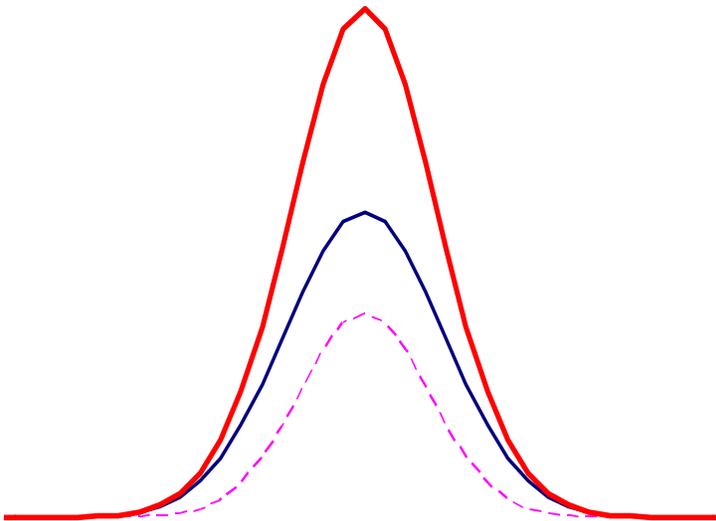
The uniqueness of the composite hydrograph depends on the transport times of each sub basin hydrograph (Figure A. 1 and Figure A. 2). If the transport times are the same, the composite hydrograph can be an infinite combination of scaled sub basin hydrographs (Figure A. 3). The transport time can depend on the channel distance between sub basins or heterogeneity of the rainfall event over the basin. If the rainfall is substantially different over the basin and the transport times are the same, sub basin uniqueness is determined by the heterogeneity of the rainfall events. If the rainfall is homogeneous over the basin, sub basin uniqueness is determined by different transport times.



**Figure A. 1.** Composite hydrograph (red) from two upstream sub basins, where the transport time of the first hydrograph (pink dash) is less than the transport time of the second hydrograph (blue). The second hydrograph is twice the first.



**Figure A. 2.** Composite hydrograph (red) from two upstream sub basins, where the transport time of the first hydrograph (pink dash) is less than the transport time of the second hydrograph (blue). The second hydrograph has a smaller transport time than depicted in Figure A. 1.



**Figure A. 3.** Composite hydrograph (red) from two upstream sub basins, where the two hydrographs have the same transport time. The composite hydrograph is three times the first (pink dash), 1-1/2 times the second (blue), or an infinite combination of the two hydrographs  $Q_T = aQ_1 + bQ_2$ .

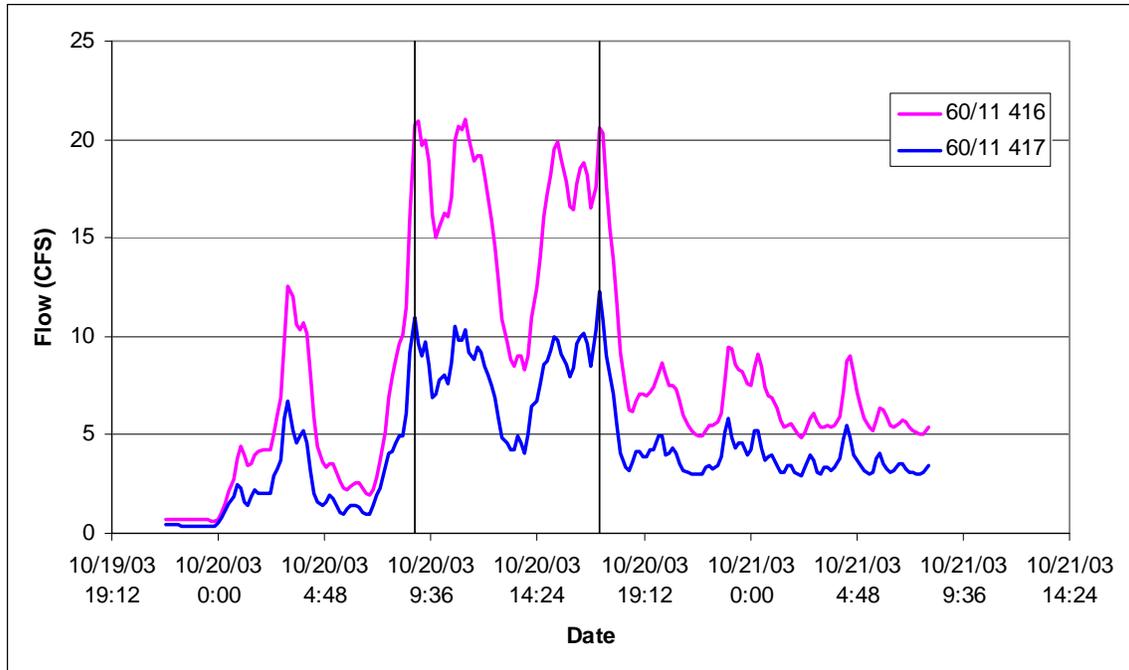
In the watershed model for the Barton basin, there are five sub basins and rainfall is uniformly distributed (homogenous) over the whole basin; therefore, uniqueness must come from different transport times, which depends on pipe length, slope, and friction

coefficient. For the Barton configuration, sub basins 415 is conveyed through a 90 foot pipe to the terminus; sub basins 416, 417, 418, and 414 are conveyed along the same pipe to the terminus (Table. A 1). Sub basin 416 is at the start of the pipe and 417 and 418 are distributed along the length of the pipe; sub basin 414 enters 250 ft upstream of the terminus. For sub basins 416, 417, and 418, hydrograph transports were assessed along their common pipe.

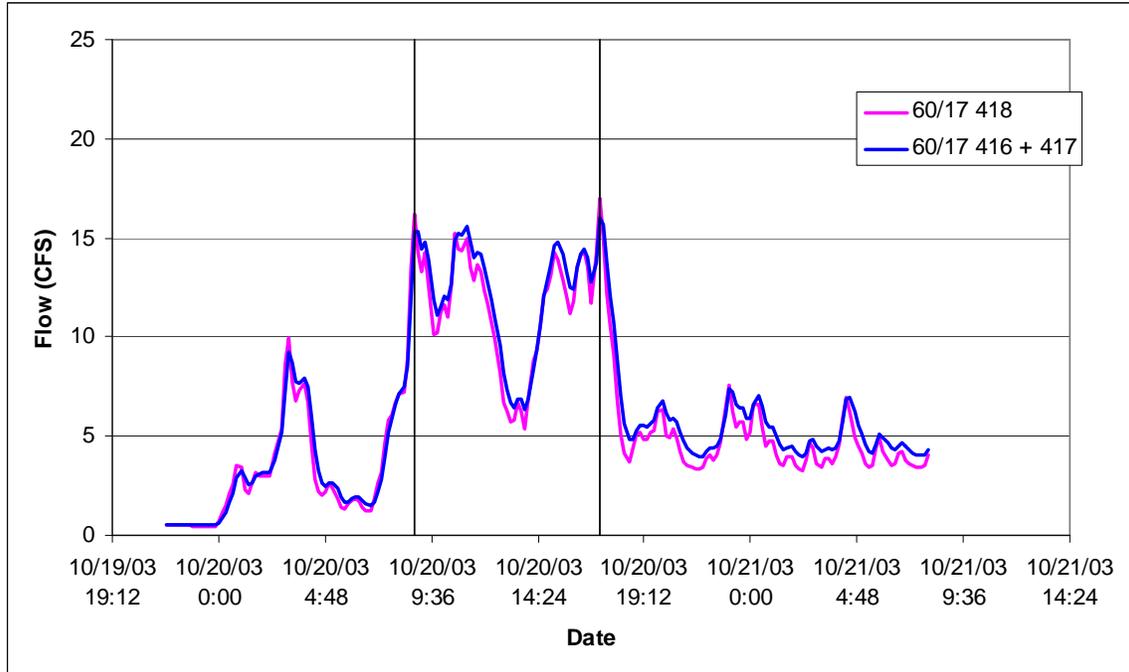
**Table. A 1.** Configuration of the Barton basin for sub basins 414, 415, 416, 417, and 418. Sub basin numbers locate their input (by percent, LAT\_FRAC) into PIPE of a given LENGTH (ft); PIPE 19 is the terminus.

BRANCH	PIPE	LENGTH	AJUNC	J_BRNCH	J_PIPE	A_INFL	INF_SRC	IN_FRACTA	LAT_FL	LAT_SRC	LAT_FRAC
60	1	330	0	0	0	1	<b>416</b>	1	0	0	0
60	2	335	0	0	0	0	0	0	1	<b>417</b>	0.4
60	3	460	0	0	0	0	0	0	0	0	0
60	4	450	0	0	0	0	0	0	0	0	0
60	5	100	0	0	0	0	0	0	0	0	0
60	6	100	0	0	0	0	0	0	0	0	0
60	7	110	0	0	0	0	0	0	1	<b>417</b>	0.1
60	8	330	0	0	0	0	0	0	0	0	0
60	9	220	0	0	0	0	0	0	1	<b>417</b>	0.1
60	10	80	0	0	0	0	0	0	0	0	0
60	11	140	0	0	0	0	0	0	1	<b>417</b>	0.4
60	12	525	0	0	0	0	0	0	1	<b>418</b>	0.2
60	13	600	0	0	0	0	0	0	0	0	0
60	14	55	0	0	0	0	0	0	0	0	0
60	15	70	0	0	0	0	0	0	1	<b>418</b>	0.2
60	16	150	0	0	0	0	0	0	1	<b>414</b>	1
60	17	100	1	60	19	0	0	0	1	<b>418</b>	0.6
60	18	90	1	60	19	1	<b>415</b>	1	0	0	0
60	19	10	0	0	0	0	0	0	0	0	0

Sub basin hydrographs 416 and 417 were transported to pipe 11 where they are combined; the two hydrographs show no discernable time lag (Figure A. 4). The separate sub basin hydrographs (416 and 417) were added at pipe 17 and compared with the hydrograph from sub basin 418; the two hydrographs showed no discernable time (Figure A. 5). These results show that simulated hydrographic transport is insufficient to uniquely identify separate hydrographs from the sub basins; this implies the multiple sub basin configuration does not provide additional information beyond use of a single basin configuration. Based on these results, the same connected impervious and pervious area percents were used for all sub basins.



**Figure A. 4Figure 26.** Based on separate simulations, hydrographs from sub basin 416 (pink) and 417 (blue) show no discernible temporal separation at branch/pipe 60/11. Vertical lines are presented to assist viewing the timing of the hydrographs.



**Figure A. 5Figure 27.** Based on separate simulations, hydrographs from sub basin 416 plus 417 (blue) and 418 (pink) show no discernible temporal separation at branch/pipe 60/17. Vertical lines are presented to assist viewing the timing of the hydrographs.

# Appendix B

## Table. B 1. Basin Sheet

ID	BASIN	SUBID	DESCRIPTION	FIRS_TAG	TRANS	NGAGE	Gauge 1	Gauge 2	Gauge 3	THEIS1	THEIS2	THEIS3	WIDTH	MNR_WID	AREA
414	Alki	1	A1	AE*BEACH.BARTON	60	1	5	0	0	1	0	0	45300	2	244.8
415	Alki	2	A2	AE*BEACH.BARTON	60	1	5	0	0	1	0	0	13575	2	73.7
416	Alki	3	B1	AE*BEACH.BARTON	60	1	5	0	0	1	0	0	48975	2	325.3
417	Alki	4	B2	AE*BEACH.BARTON	60	1	5	0	0	1	0	0	27290	2	194.6
418	Alki	5	B3	AE*BEACH.BARTON	60	1	5	0	0	1	0	0	40700	2	227.8

PCNT_IMP	SLOPE	Nimp	nPER	STOIMP	STOPER	ADWF	PERM	POR	SAT_INI	SAT_FIN	SUCT_HD	LEAK	CONIMP	CONPER	MOD
20	0.0549	0.025	0.325	0.03	0.25	546	0.551	0.5	0	1	4.79	400	50	10	90
13.3	0.0351	0.025	0.3	0.03	0.25	455	0.551	0.5	0	1	4.79	400	50	10	90
22	0.0211	0.025	0.35	0.03	0.25	552.5	0.551	0.5	0	1	4.79	400	50	10	90
17	0.0571	0.025	0.35	0.03	0.25	390	0.551	0.5	0	1	4.79	400	50	10	90
22	0.0658	0.025	0.35	0.03	0.25	526.5	0.551	0.5	0	1	4.79	400	50	10	90

## Table. B 2. BasPar Sheet

STOLOSSONA	AREAFAC	1	TRFLWFAC	0	TRFLWMAX	STORLOW_PERACRE	160	STORHI_PERACRE	4500	PARLEAK_PERACRE	HIRIAREAFAC	FGAFAC	t
33.4					0.067163					0.0026	1200	1000	37
RATEPERAREA	FGA_LEAKMAX	9.5	FGA_LEAKMIN	0.0123	FLWHIRI_SWITCH	LEAKFGA_SWITCH	1	T_EVAP	456	FGAEVAP	IFLAG_DECAY		
0.22					0					1.16e-5	1		

**Table. B 3.** Description of parameters used in the Basin Table.

Name	Description
ID	subcatchment id number ( 1 - ~500 )
BASIN	basin name (e.g. MAGNOLIA or BALLARD )
SUBID	id number for that basin ( 1 - ~30 )
DESCRIPTION	20 byte character description
FIRS_TAG	22 byte firs manhole tag at METRO pick up
TRANS	branch number for transport model
NRGAG	number of hyetographs given
Gauge1	reference number of first hyetograph
Gauge 2	reference number of second hyetograph
Gauge 3	reference number of third hyetograph
THEIS1	thiessen factor for this subcatchment HYET1
THEIS2	thiessen factor for this subcatchment HYET2
THEIS3	thiessen factor for this subcatchment HYET3
WIDTH	width of catchment (feet)
MNR_WID	gutter width (in feet)
AREA	size of area in acres
PCNT_IMP	area of streets roofs etc...
SLOPE	average slope of entire subbasin
Nimp	roughness impervious (streets)
nPER	roughness pervious (grass)
STOIMP	detention storage (puddles) impervious
STOPER	detention storage (puddles) pervious
ADWF	base flow (cfs/acre)
PERM	soil permeability
POR	soil porosity (R:0.0-1.0)
SAT_INIT	soil saturation - initial (R:0.0-1.0)
SAT_FIN	soil saturation - final (R:0.0-1.0)
SUCT_HD	soil suction head (inches)
LEAK	infiltration (gpad)
CONIMP	% connected impervious
CONPER	% connected pervious
MOD	pointer to basin parameters files (aka BASPAR)

**Table. B 4.** Description of parameters in the BasPar Table.

Name in Program	Description
STORLOSSONA	Flow out of trench storage not into pipes. This is rate at which trenches drain to ground when storage is greater than STORLOW_PERACRE (6). Lessens the rise slope and steepens decay slope for trench flow after storm. See also RATEPERAREA (12) for flow out of trench at lower levels.
AREAFAC	Adjusts amount of infiltrated water (soil moisture) added to trench storage. This is a "throttle valve" for flow into trench storage from the surrounding ground. Note that flow into trench storage is proportional to the CHANGE in soil moisture, not the soil moisture itself.
TRFLWFAC	Factor applied to trench flow into pipes. This is a trench flow scale factor.
TRFLWMAX	Maximum flow to sewer pipes from trenches. Trench flow upper limit (cap, ceiling). Set this very low when you want to adjust dry weather factors without interference.

Name in Program	Description
STORLOW_PERACRE	Trench storage volume at which inflow to sewer pipes starts. Minimum to start trench flow. This can be used to crop effects at the start and end of a storm. The difference between this and STORHI_PERACRE (7) is a good way to scale trench flow effects.
STORHI_PERACRE	Trench storage volume upper limit. Lowering this will tend to "flat line" trench flow at a maximum limit in the middle of the storm. The difference between this and STORLOW_PERACRE (6) is a good way to scale trench flow effects.
PARLEAK_PERACRE	Adjusts one part of the wet weather leakage (see 10 for other) once the net infiltrated volume exceeds the minimum (floor) set in FGA_LEAKMIN (14). The portion of wet weather leakage controlled by this factor does not increase further when soil moisture exceeds a ceiling set in FGA_LEAKMAX (13). Since there are two parts to wet weather leakage, look at (10) as well. If changes in this, (13) or (14) do not result in the effect desired, then (10) is likely dominating wet weather leakage.
HIRIAREAFAC	Intense storm scaling factor. Factor adjusts trench flow to pipes during intense rainfall events in two stages (> 0.02 inches, > 0.03 inches per timestep)
FGAFAC	Factor adjusts one part of wet weather leakage (see 8 for other). This factor and the soil moisture level are applied to the dry weather leakage set in the basin file (ZLEAK or LEAKAGE is item 26 in that file) to obtain this portion of the wet weather leakage rate. This factor is the soil moisture at which this part of wet weather leakage is equal to the dry weather leakage. Since there are two parts to the wet weather leakage, look at (8) if tweaking this is ineffectual. Note that since this factor is dependent on dry weather leakage and has no upper or lower limits, it is less preferable than using (8). To turn this factor "off", set it to 1000 or above.
t	Soil moisture GRAVITY decay rate and time after rain at which all surface storage is set dry. See also items 17, 18 and 19 below for evaporation decay effects. Lessens the rise slope and steepens the decay slope for wet weather flow. Use to decay the wet weather leakage faster. The gravity decay effects for soil moisture are at higher soil moistures than those for evaporation effects.
RATEPERAREA	Rate at which trench storage drains when level is below STORLOW_PERACRE (6). Use to clear trench storage at appropriate rate between events.
FGA_LEAKMAX	Maximum net infiltrated amount (ceiling) that impacts PARLEAK ( 8). This factor influences only the part of the wet weather leakage scaled by PARLEAK and has no influence on the part scaled by FGAFAC (10).
FGA_LEAKMIN	Minimum net infiltrated amount (floor) that impacts PARLEAK ( 8). This factor influences only the part of the wet weather leakage scaled by PARLEAK and has no influence on the part scaled by FGAFAC (10).
FLWHIRI_SWITCH	Switch that turns the high intensity storm effects on (1) and off (0). If this is off, HIRIAREAFAC (9) above has no effect on the program. Suggest this should be left off until other factors are adjusted.
LEAKFGA_SWITCH	Switch that turns the wet weather leakage effects on (1) and off (0). If this is off, item FGAFAC (10) above has no effect on the program. Suggest this should be left off until initial dry weather factors are adjusted.
T_EVAP	Soil moisture EVAPORATION decay rate and time after rain at which all surface storage is set dry. See also t (T, 11) above for gravity decay rate. Lessens the rise slope and steepens the decay slope for wet weather flow. Use to decay the wet weather leakage faster. Only works if items (17) and (18) are set correctly. This effect is at soil moistures below those where gravity effects work.
FGAEVAP	Soil moisture at which evaporation depletion effects take over from gravity depletion effects t (T, 11). The depletion rate is set proportional to this amount.
IFLAG_DECAY	Switch that turns the soil moisture evaporation effects on (1) and off (0). If this is on evaporation effects take over soil moisture depletion at the limit set in FGAEVAP (18). If this is off, T_EVAP and FGAEVAP (17 and 18) have no effect on the program and soil moisture depletion is calculated based on t (T, 11) throughout its entire range.

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# **2006 CSO CONTROL PROJECT**

## **MURRAY PUMP STATION SERVICE BASIN CALIBRATION**

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Wastewater Treatment Division  
Comprehensive Planning and Technical Resources**

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**JANUARY 14, 2009**

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## **Introduction**

In the King County combined wastewater conveyance system, when a significant rainfall event occurs sewer flows exceed the system capacity and the excess flow is typically diverted into a local water body. These events are termed combined sewer overflows (CSO). The magnitude and duration of these events are different for each area serviced by the wastewater conveyance system, and the County is required to limit the number of CSO events to no more than one event per year (on average) over a five year period. The actual permit language states,

*The Permittee shall discharge no more than an average of one overflow event per year per CSO based on a long term average. Compliance will be based on a five-year average for the permit cycle. The compliance point will be based on the five-year average as provided at the time of application for permit renewal. Annual reporting of the five-year moving average is required in the Annual CSO report.*

At these CSO sites, event frequency and volume are estimated with a hydrologic watershed model. This model has been configured for the greater Seattle metropolitan area, but the County has specific interest in determining CSO frequency and volumes at the Murray Pump Station (PS) Service Basin. This report documents the calibration of the Runoff/Transport model for the Murray PS service area.

## **Methods**

### **1.1 Model**

The County's Runoff/Transport model was used for simulating CSO events at the Murray PS. This model is a modified version of the San Francisco Storm water Model (Book, 1980) and has been modified by the County subsequently. The model applies the kinematic wave formulation of the momentum equation (Bob Swarner, per comm.). For this study, the model was configured for the Murray PS service area, Figure 1.



Figure 1. Murray PS service basin represented in the Runoff/Transport model. The service basin comprises five sub-basins: 419, 420, 421, and 423.

## 1.2 Delineation of Impervious and Pervious Areas

For combined sewer systems, basin runoff is defined as flows from roofs and streets, open spaces, and groundwater infiltration from pervious areas; for partially separated systems, street runoff is caught and routed away from the sewer system, (Bergam, 1993). Completely separated systems are absent roof and street connection into the local sewer system but sewers are still susceptible to groundwater infiltration. The runoff and/or infiltration from these areas is routed through the watershed model into the sewer transport model. The volume of runoff depends on several parameters but we will currently address those associated with the pervious and impervious areas. For estimating these areas, methods were interpreted from Bergam (1993).

Total basin area (acres) was calculated using a planimeter and rounded to a whole number.

Percent impervious was estimated through a combination of steps, but impervious area was “eyeballed” from DCLU zoning maps (no definition supplied by Bergam) for specific types of land use. This area was specified as a percent of the total basin area (1.1). This step roughly estimated percentages of total area for each land use type: high, medium, or low density residential areas, commercial areas, and other land use types within a basin. For relevant land use types that are potentially connected to the sewer, these areas are multiplied by the percent connected that defines what is connected to local sewer lines.

The percent connected impervious ( $A_{\text{impervconn}}$ ) represents the percentage of the impervious area that is actually connected to the sewer system.

$$\begin{aligned}A_{\text{imperv}} &= A_{\text{total}} P_{\text{imperv}} \\A_{\text{impervconn}} &= A_{\text{imperv}} P_{\text{conn}} \\A_{\text{impervconn}} &= A_{\text{total}} P_{\text{impervconn}} \\P_{\text{impervconn}} &= (P_{\text{imperv}})(P_{\text{conn}})\end{aligned}\tag{1.1}$$

Where  $A_{\text{imperv}}$  is the impervious area,  $A_{\text{total}}$  is the total sub-basin area,  $P_{\text{imperv}}$  is the percent impervious area, and  $P_{\text{conn}}$  is the percent impervious connected to the sewer lines. Unless  $P_{\text{imperv}}$  or  $P_{\text{conn}}$  is known explicitly, the form of  $P_{\text{impervconn}}$  is an ill-posed equation as  $P_{\text{imperv}}$  or  $P_{\text{conn}}$  can assume an infinite number of combinations and produce the same  $P_{\text{impervconn}}$ .

While the Murray model is configured for four sub-basins, hydrograph transport analyses suggested the four sub-basin hydrographs reach the pump station (basin terminus) simultaneously. And because only a single flow record existed at the terminus, delineating sub-basin contributions in the model is a record keeping exercise that can be better handled external to the model. Within the model, sub-basin contributions were equally represented; essentially, the model is configured to act as a single contributing basin.

### 1.3 Flow and Rainfall Data

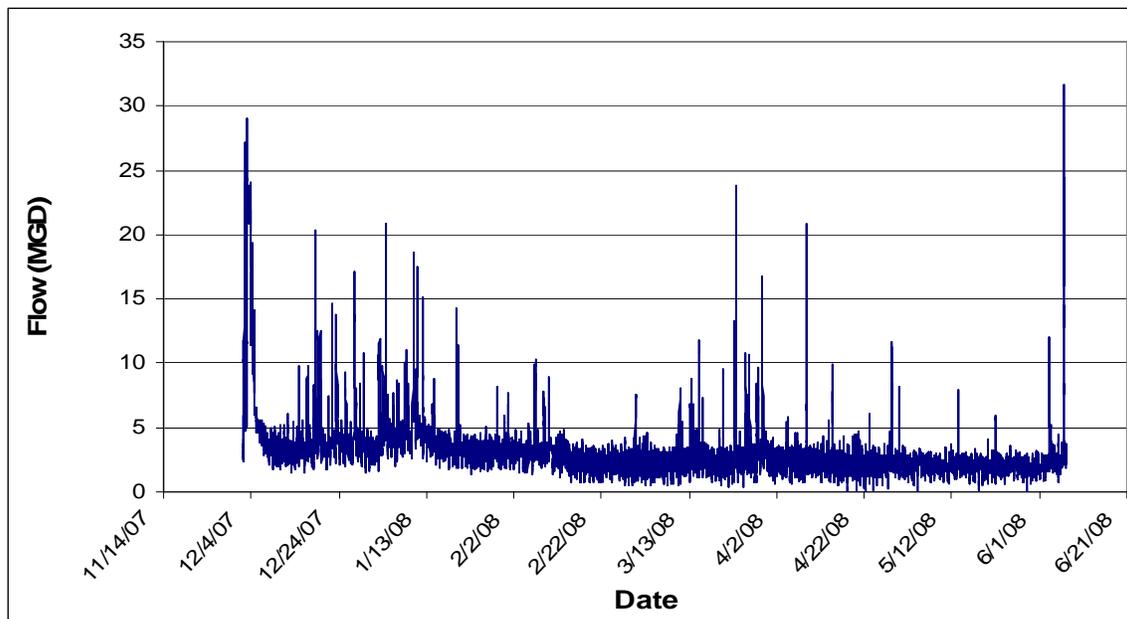
#### 1.3.1 Flow Data

At the Murray PS, conveyance system flows are recorded at the pump station and stored to an offsite facility. The data comprises flow, pump speed, and wet-well water levels. This data was retrieved from the online King County Sewage Data Retrieval System. Relevant tag numbers used to extract data from the County Retrieval System are given in Table 1. The two flow-tag numbers represent flows through the two force mains that exit the pump station; the PS has two pumps per force main. For the Murray Pump Station, recorded flows were available from 2000 forward; however, the model was calibrated to data obtained for December 2007 to June 2008 (Figure 2). In late 2007, an upgrade to the station was completed with new and more accurate magnetic meters; mag-meter flow data is superior to the data previously collected by ultra-sonic meters, which required substantial corrections (Crawford, 2003).

From the 2007 to 2008 flow observations, eight storm events were selected for calibrating the Murray basin model (Table 2). During the December 3, 2007 storm, The pumps starting ramping up to capacity and then cut back to about 23 MGD. And during the June 6, 2008, the pumps ramp to capacity and then cut back to about 23 MGD. In both cases, the pump control switches indicate the smaller pumps were shut down; the smaller pumps appeared to be operating normally before and after the events.

**Table 1.** Tag numbers for obtaining flow, wet-well water levels, and pump speed at the Barton PS.

FB484111VL (MGD)	Flow meter for force main 1
FB484112VL (MGD)	Flow meter for force main 2
LB484106VL (FT)	Wet-Well Water Level
SB484126VL (RPM)	Pump Speed for pump 1
SB484129VL (RPM)	Pump Speed for pump 4



**Figure 2.** Metered flow from the Murray Pump Station force mains.

**Table 2.** Date ranges for the 8 events used for calibrating the Murray basin.

Event Date	Peak Flow (mgd)	Event Number
12/2 -12/5/07	> 25	1
1/2/08	11	2
1/19/08	11	3
3/15/08	7	4
3/23/08	23	5
4/8/08	21	6
4/28/08	11	7
6/6/08	> 31	8

### 1.3.2 Rainfall

Rainfall rates were obtained from the City of Seattle. The Murray PS service basin lies within rain gauge (RG) 5 and 14 Thiessen polygons, with 60% coming from RG05 and 40% from RG14. RG05 is approximately 8400 ft from the center of the basin and RG14 is approximately 11,900 ft from the center of the basin. The RG data was quality checked by Bruce Crawford.

### 1.3.3 Weir flow calculations

When basin flow exceeds pump capacity, excess sewer flows over a broad crested type weir. Traditionally, the weir equation had been used to estimate the excess flow and added to observed pump flows; however, uncertainty in wet well levels and weir coefficients propagate potentially significant errors into calculated flows. Available County documents suggest wet well levels (bubblers) are accurate to about 0.1 ft; for typical heights over the weir, calculated flow errors are near  $\pm 57\%$  (Schock, 2006). The uncertainty in the calculated flows exceeds benefits of including excess flows for model calibration.

## 1.4 Instrument Errors

The installed mag-meters have a manufacturer's accuracy less than a few percent; however, these results are for conditions in a lab with long straight pipe sections before and after the meter (Rosemount Product 8700 Data Sheet). Based on pump tests at Murray, the mag-meter flows were within 6% to 11% of calculated fill-and-draw flows (Table 3, Schock, 2008); these results can be used to estimate a general uncertainty. The mean relative difference is 8.7% and probably represents uncertainty in the fill-and-draw calculations because the pump station wet well has a complicated volumetric shape. A conservative estimate might be half of the mean relative difference (4.3%), which is higher than the manufacturer's specifications but less than the observed differences. A flow uncertainty of 4.3% was used for the velocity uncertainty.

**Table 3.** Murray PS fill-and-draw test results. Mag-meter flows represent the average flow over the duration of the draw down test. Each pump was run at maximum speed.

Pump	Mag-meter (MGD)	Fill-and-Draw (MGD)	Relative difference
1	5.95	5.61	6%
2	9.72	8.70	11%
3	10.5	11.7	11%
4	5.49	5.10	7%
Total	31.6	31.1	8.7% (mean)

### 1.5 Measures of Goodness of Fit

When calibrating a model, some measure of fit must be used to assess how well a particular parameter set recreates the observed flow. For the Barton PS calibration, three statistical measures of fit were used.

$$R^2 = \sum (q_{obs} - q_{mdl})^2 \quad (1.2)$$

$$b = \frac{1}{N} \sum \left( \frac{q_{mdl} - q_{obs}}{q_{obs}} \right) \quad (1.3)$$

$$wr^2 = \begin{cases} |m| r^2 & \text{for } m \leq 1 \\ |m|^{-1} r^2 & \text{for } m > 1 \end{cases} \quad (1.4)$$

$$|b| = \frac{1}{N} \sum_i \left| \sum_{M_i} \frac{q_{mdl} - q_{obs}}{q_{obs}} \right| \quad (1.5)$$

Where  $R^2$  is the sum of the squares of the residuals,  $q_{obs}$  is the observed flow,  $q_{mdl}$  is the simulated flow;  $b$  is the normalized bias and  $N$  is the total number of observations;  $wr^2$  is the weighted coefficient of determination ( $r^2$ ) and  $m$  is line slope between  $q_{obs}$  verses  $q_{mdl}$ ; and  $|b|$  is the absolute value of the group bias for the  $i$  events and  $M_i$  is number of observations in each storm event.  $|b|$  is an important parameter for propagating model calibration errors into estimated storage requirements (§1.8).

The weighted coefficient of determination was found to be good estimator of fit, but should be used with other estimators of fit (Krause et al., 2005). The sum of the residuals is the optimization function used in linear regression and is also used by the optimization program utilized to calibrate the model (§ 1.6). Visual inspections were also part of the calibration process.

### 1.6 Calibration Procedures

Model calibration is an iterative process of finding a set of model parameters that optimize the measures of fit between observed data and modeled data. Initial model parameter sets (input files) were obtained from Bruce Crawford; these files provided the initial parameter set. The model was first calibrated using an optimization program and then a second (manual) calibration was performed to provide a better visual fit; often the visual fit produce worse statistical fits.

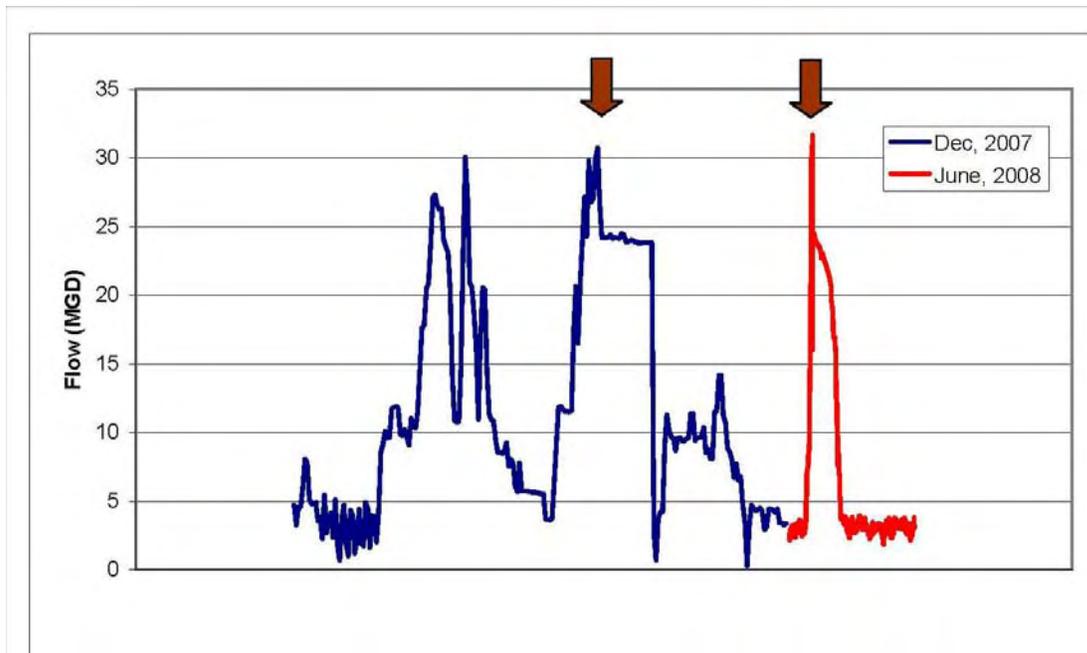
The optimization program was the Model-Independent Parameter Estimation (PEST) computer optimization code, 5<sup>th</sup> edition (Doherty, 2004). PEST is a freeware program that implements a gradient search method to find the optimum parameter set that minimizes the sum of the square of the residuals ( $R^2$ ). PEST is widely used in groundwater modeling to optimize spatial variations in hydraulic conductivity (Doherty, 2003; Keating et al, 2003; and Dubus et al, 2004). PEST has several options for

constraining parameters to a given set of rules; these constraints also improve stability in the optimization routine. After several uses, the most appropriate constraining option appeared to be the estimation routine. In estimation mode, the program maintains the constraints unless a better fit can be obtained by deviating from the constraint; PEST imposes a penalty for deviating from the constraint by adding the deviated amount (sum of the constraint deviation, SCD) to  $R^2$ , PEST optimizes on the combined errors ( $SCD+R^2$ ). As long as the sum ( $SCD + R^2$ ) continues to decrease with increasing SCD, PEST will continue to deviate from the imposed constraint. This condition infers the final optimized parameter is justified because the deviation would not be imposed unless an improvement fit occurred (Doherty, 2004).

In PEST, stability refers to the ability to invert the covariance matrix. If the model is insensitive to the parameters or the parameters are highly correlated, inverting the covariance matrix will produce a singularity; in the very least, this condition is an indicator that the parameter set is non-unique (Doherty, 2004). Based on sensitivity results for the Barton basin, the Murray calibration used the same parameter constraints (Schock, 2009).

### 1.7 Calibration

Because Barton basin flows are pumped to Murray, modeled Barton flows directly affect calibration efforts at Murray. For the Barton calibration, three calibration sets were deemed acceptable; concurrently, three calibration sets were developed for the Murray basin. For each Barton basin calibration, Barton basin parameters were held constant while Murray basin parameters were adjusted to fit simulated Barton and Murray flows to observed flows from the Murray pump station.

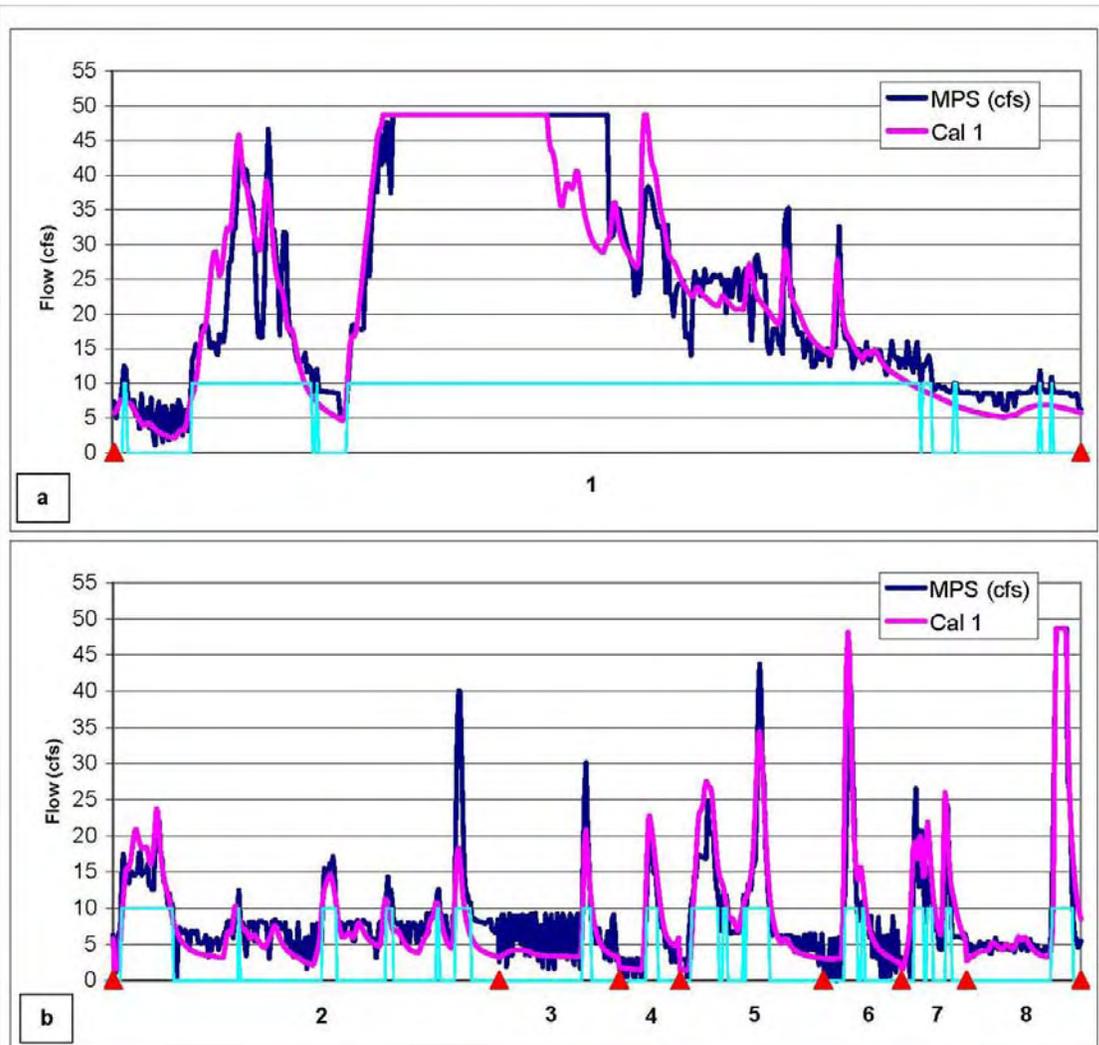


**Figure 3.** Hydrographs for the Dec, 2007 and June, 2008 storm events. Arrows show where the control system ramped pumps to about 30 MGD and then ramped them down to about 24 MGD.

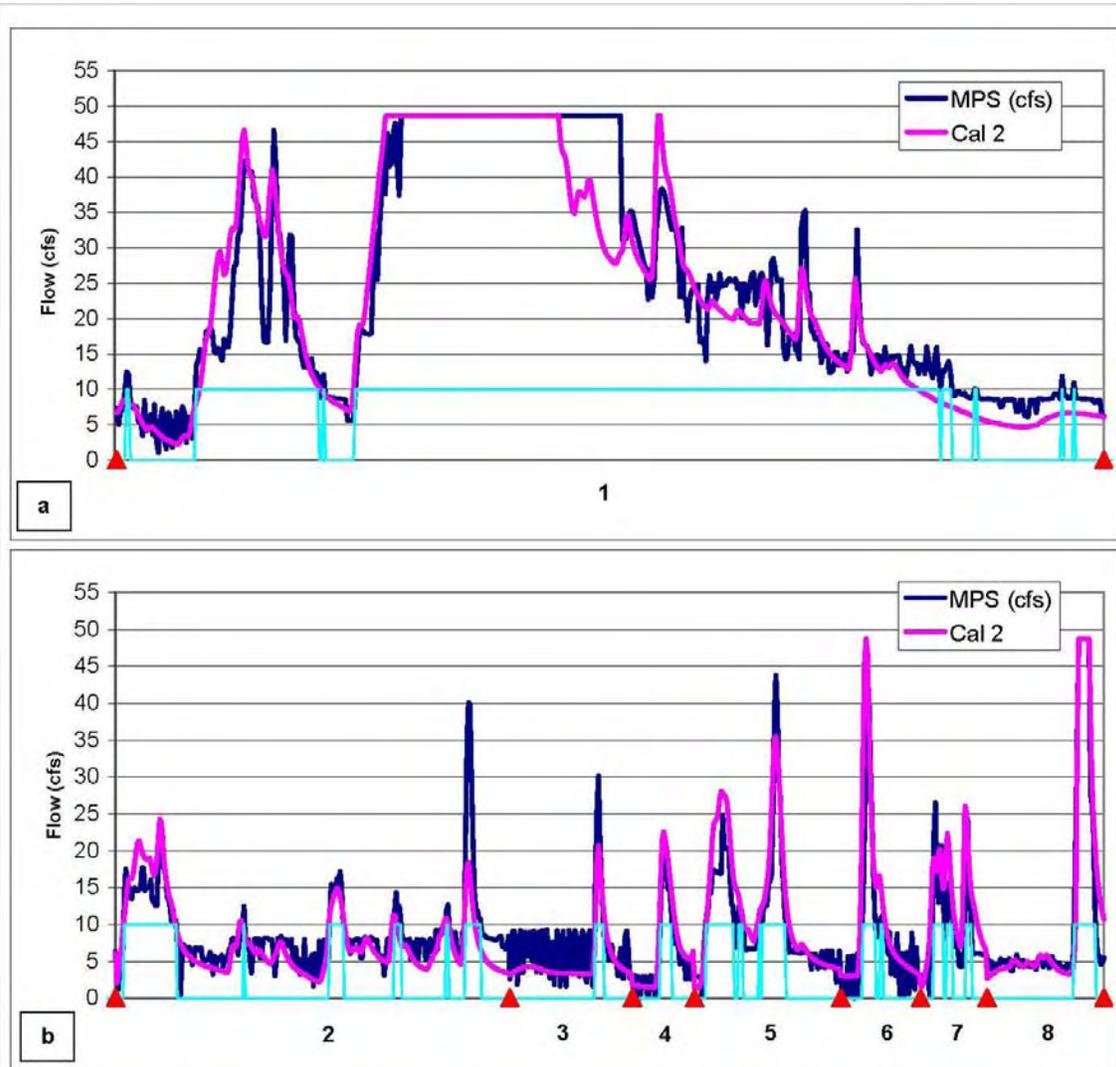
### 1.7.1 Murray PS Flows

The Murray pump station has a capacity of 31.5 MGD (Table 3); however, the control system apparently limited pump capacity to about 25 MGD during the December 3, 2007 storm and the June 6, 2008 storm. At the start of these events, pumps ramped up to about 30 MGD and then ramped down to about 24 MGD, (Figure 3). For these two events, the observed data was adjusted to 31.5 MGD to represent the maximum pump capacity specified in the model. By adjusting the observed data, the corresponding residuals are effectively zero and have negligible influence in the calibration.

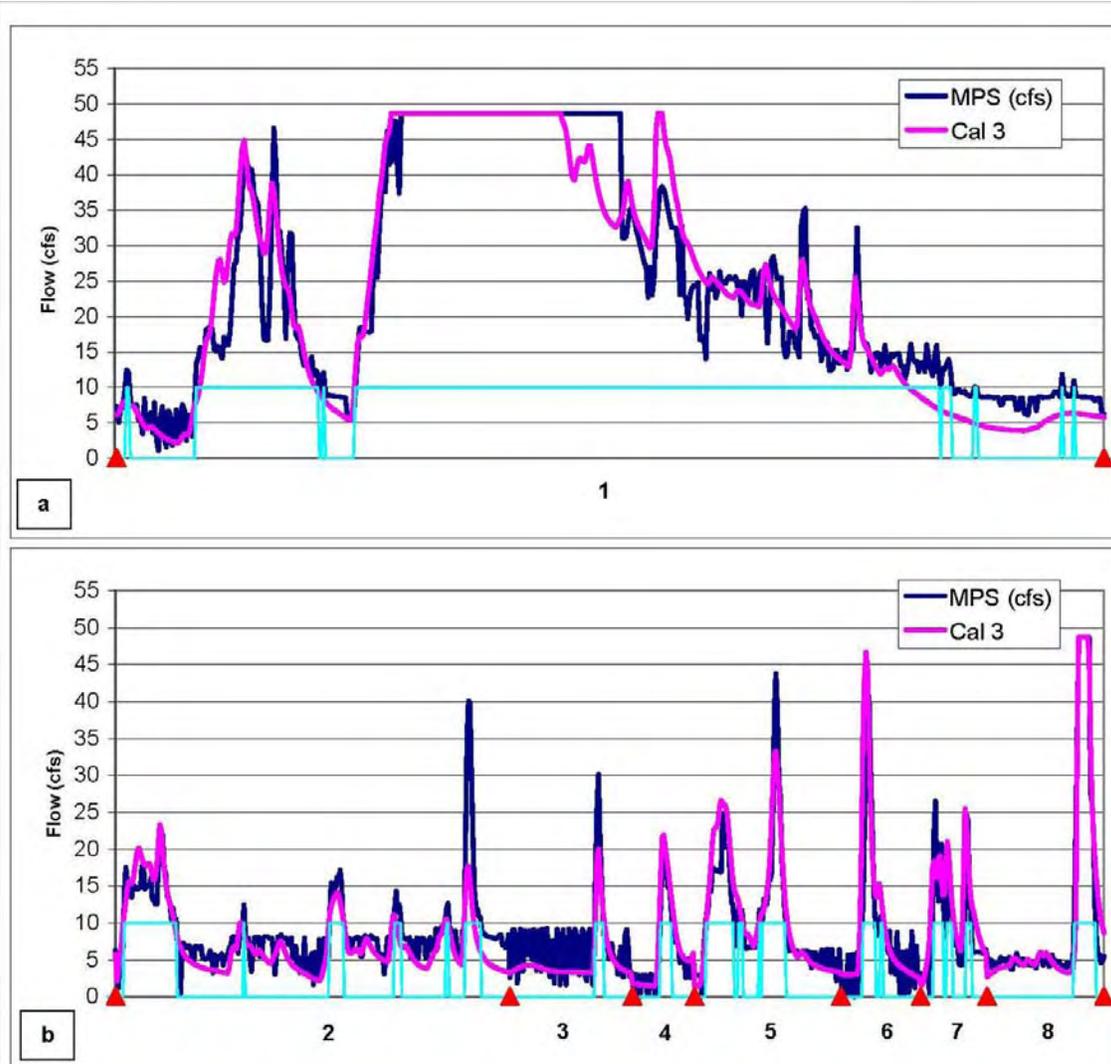
The Murray basin was calibrated to the eight storms (Table 2), for the three Murray calibrations, calibration graphs are given in Figure 4 - Figure 6, calibration parameter sets are given in Table 4, and measures of fit are presented in Table 5. Measures of fit were determined for flows greater than 10 cfs, which approximately represents flow conditions above nominal sewer flows. This flow threshold is used to indicate how well the model reproduces flow during storm events rather than how well the model can reproduce nominal sewer flows and storm events.



**Figure 4.** Murray calibration profile for Barton Cal 1 profile. Observed flows are the blue lines. Simulated flows are pink and red diamonds indicate events 1 through 8; cyan lines demarcate events that exceed 10 cfs.



**Figure 5.** Murray calibration profile for Barton Cal 2 profile. Observed flows are the blue lines. Simulated flows are pink and red diamonds indicate events 1 through 8; cyan lines demarcate events that exceed 10 cfs.



**Figure 6.** Murray calibration profile for Barton Cal 3 profile. Observed flows are the blue lines. Simulated flows are pink and red diamonds indicate events 1 through 8; cyan lines demarcate events that exceed 10 cfs.

**Table 4.** Runoff parameter set used for calibrating the Murray PS service basin.

Parameter name used in Fortran Code	Cal 1	Cal 2	Cal 3
FGA_LEAKMIN	0.0124	0.0124	0.0124
PARLEAK_PERACRE	4.70E-03	4.70E-03	8.00E-03
FGAEVAP	4.20E-06	4.20E-06	4.20E-06
NIMP	0.069	0.069	0.069
PERM	0.551	0.551	0.551
SH (suction head)	4.8	4.8	4.8
t (factor)	15	15	15
T_EVAP	100	100	100
CONIMP419	45.0	50.6	40.0
CONIMP420	45.0	50.6	40.0

Parameter name used in Fortran Code	Cal 1	Cal 2	Cal 3
CONIMP421	45.0	50.6	40.0
CONIMP423	45.0	50.6	40.0
CONPER419	10	10	10
CONPER420	10	10	10
CONPER421	10	10	10
CONPER423	10	10	10

**Table 5.** Statistical measures of fit for the three calibration parameters presented in Table 4. The

Statistical Fit	Cal 1	Cal 2	Cal 3
R <sup>2</sup>	313875	340171	263893
wr <sup>2</sup>	0.867	0.846	0.894
b	2.0%	2.6%	1.6%
b	5.4%	6.0%	3.1%

### 1.8 Propagated Error into the Simulated Flows

Any measurement or model has some inherent error; flow measurement errors and model calibration errors should be propagated into a combined error. For the computer modeling of the Murray PS basin, simulated flows will contain model calibration errors and flow meter errors; model calibration errors depend on the duration of the storm events. The calibration group bias |b| is used when event durations are longer than about 30 minutes, and the sum of the residuals squared is used for event durations less than 30 minutes (Schock, 2006b). The bias calculated by (1.3) gives the overall bias for all hydrographs; however, CSO events are discrete or partially discrete events and the bias for each event are different than the overall bias (Table 5). At the Murray PS, overflow events occur when flows exceed pump capacity; these events are the ones for which a group bias should be calculated and propagated into simulated flows.

Because CSO's occur when flows exceed pump capacity, the group bias should be estimated from the excess flow; however, accurate flows greater than the pump capacity were not available. An alternative threshold flow was selected that includes enough data but omits flow conditions that have insignificant contributions to overflow hydrographs. A reasonable threshold might be one-half the pump capacity, which for Murray is about 15 MGD (24 cfs). Model calibration errors |b| and flow meters errors are propagated into a single error term. The propagated error ( $\epsilon_T$ ) combined model calibration bias and flow meter errors is near 9% at the 95<sup>th</sup> confidence level.

$$\epsilon_T = \sqrt{(6)^2 + \{(2)(4.3)\}^2} \quad (1.6)$$

$$\epsilon_T = 10.5\%$$

In (1.6) the value 2 approximates the student t-statistic for the estimated flow error (Dieck, 1997). The propagated error is applied to the simulated hydrograph, which is

used to estimate storage requires for a given pump capacity. Upper and lower storage bounds can be estimated by multiplying the simulated hydrograph by (1.7) and (1.8).

$$\begin{aligned}\mathcal{E}_{upper} &= 1 + \mathcal{E}_T \\ \mathcal{E}_{upper} &= 1.105\end{aligned}\tag{1.7}$$

Where  $\mathcal{E}_{upper}$  is the hydrograph multiplier for assessing upper storage bounds.

$$\begin{aligned}\mathcal{E}_{lower} &= \frac{1}{1 + \mathcal{E}_T} \\ \mathcal{E}_{upper} &= 0.905\end{aligned}\tag{1.8}$$

Where  $\mathcal{E}_{lower}$  is the hydrograph multiplier for assessing lower storage bounds.

### 1.9 Estimating Storage Requirements

For potential flows to the Murray pump station, a 30 year hydrograph was simulated from historical rainfall measurements; this hydrograph represents expected flows for existing conditions in the service basins (Table 6). A CSO overflow occurs when the basin flows exceed the pumping capacity at the pump station. For a specified pump capacity, storage volumes were determined by integrating the excess flow (hydrograph) above the specified pump capacity (1.9). This procedure produces a set of volumes, which are sorted and ranked for probabilistic analyses.

**Table 6.** Rainfall record dates used to simulate 30 years of flow in the Murray basin.

Service Basin	Rainfall Record	Existing Flow Capacity (MGD)
Murray	2/1/78 – 6/15/08	31.5

$$V = \int_{t_1}^{t_2} (Q - Q_T) dt\tag{1.9}$$

Where V is the storage volume for a specified pump capacity  $Q_T$ , Q is the simulated flow, and  $t_1$  and  $t_2$  are times when  $Q \geq Q_T$ . The resultant set of volumes was sorted and ranked and statistical methods were used to determine recurrence intervals and probability of meeting regulatory discharge requirements (Schock, 2006c).

#### 1.9.1 Estimated Storage for Three Pump Capacities

During the time of this report, the County was planning upgrades to the Barton PS and it wanted to consider how various pumping capacities would affect CSO storage needs at the Murray PS. Potential Barton pump capacities could range from 26 MGD to 33 MGD; Storage for the one year recurrence interval was determined for three pumping capacities of 26, 28, and 33 MGD (Table 7). The mean storage volume is the expected value and has error bounds about it, the coefficient of variation ranged from 15% to 18%. Some portion of this error would propagate into the total uncertainty of the storage volume.

**Table 7.** Estimated CSO storage volumes for the Murray PS for the three calibrations assuming a 31.5 MGD pump capacity at Murray.

Barton Pump Capacity (MGD)	Cal 1 (MG)	Cal 2 (MG)	Cal 3 (MG)	Mean (MG)	Std Dev (MG)
26	0.69	0.86	0.61	0.72	0.13
28	0.74	0.91	0.64	0.76	0.14
33	0.83	0.99	0.73	0.85	0.13

## Discussion

Because three viable calibrations were determined for the Barton basin, three viable calibrations for the Murray basin were possible. The three calibrations provide an expected storage volume for three different pump capacities at Barton (Table 7). CSO volumes are affected by model and instrument errors and stochastic events like the sequencing of rainfall events. The storage volumes presented are the long-term average 1-year CSO volumes based on 30-year simulations of the 3 acceptable calibrated models.

# Appendix A

## Table A 1. Basin Sheet

ID	BASIN	SUBID	DESCRIPTION	FIRS_TAG	TRANS	NGAGE	Gauge 1	Gauge 2	Gauge 3	THEIS1	THEIS2	THEIS3	WIDTH	MNR_WID	AREA
419	Aiki	6	C1	AE*BEACH. MURRAY	60	2	5	14	0	0.58	0.42	0	46450	2	316.2
420	Aiki	7	C2	AE*BEACH. MURRAY-B-6	60	1	5	0	0	1	0	0	55700	2	343.7
421	Aiki	8	C3	AE*BEACH. MURRAY-B-6	60	2	5	14	0	0.63	0.37	0	42100	2	281.4
423	Aiki	10	D2	AE*BEACH .MURRAY-B-6	60	1	5	0	0	1	0	0	4950	2	18.6

PCNT_IMP	SLOPE	Nimp	nPER	STOIMP	STOPER	ADWF	PERM	POR	SAT_INI	SAT_FIN	SUCT_HD	LEAK	CONIMP	CONPER	MOD
21	0.0323	0.014	0.35	0.03	0.25	520	0.121109	0.5	0	1	3.02075	400	24	12	91
22	0.0567	0.014	0.35	0.03	0.25	546	0.01	0.5	0	1	3.02075	400	24	12	91
23	0.0422	0.014	0.35	0.03	0.25	611	0.01	0.5	0	1	3.02075	400	24	12	91
23	0.0051	0.014	0.35	0.03	0.25	539.5	0.01	0.5	0	1	3.02075	400	80	100	91

## Table A 2. BasPar Sheet

STOLOSSONA	AREAFAC	TRFLWFAC	TRFLWMAX	STORLOW_PERACRE	STORHI_PERACRE	PARLEAK_PERACRE	HIRIAREAFAC	FGAFAC	t
33.4	1	0	0.067	160	4500	0.0047	1200	1000	34.1
RATEPERAREA	FGA_LEAKMAX	FGA_LEAKMIN	FLWHIRI_SWITCH	LEAKFGA_SWITCH	T_EVAP	FGAEVAP	IFLAG_DECAY		
0.22	9.5	0.53	0	1	102	0.65	1		

**Table A 3.** Description of parameters used in the Basin Table.

Name	Description
ID	subcatchment id number ( 1 - ~500 )
BASIN	basin name (e.g. MAGNOLIA or BALLARD )
SUBID	id number for that basin ( 1 - ~30 )
DESCRIPTION	20 byte character description
FIRS_TAG	22 byte firs manhole tag at METRO pick up
TRANS	branch number for transport model
NRGAG	number of hyetographs given
Gauge1	reference number of first hyetograph
Gauge 2	reference number of second hyetograph
Gauge 3	reference number of third hyetograph
THEIS1	thiessen factor for this subcatchment HYET1
THEIS2	thiessen factor for this subcatchment HYET2
THEIS3	thiessen factor for this subcatchment HYET3
WIDTH	width of catchment (feet)
MNR_WID	gutter width (in feet)
AREA	size of area in acres
PCNT_IMP	area of streets roofs etc...
SLOPE	average slope of entire subbasin
Nimp	roughness impervious (streets)
nPER	roughness pervious (grass)
STOIMP	detention storage (puddles) impervious
STOPER	detention storage (puddles) pervious
ADWF	base flow (cfs/acre)
PERM	soil permeability
POR	soil porosity (R:0.0-1.0)
SAT_INIT	soil saturation - initial (R:0.0-1.0)
SAT_FIN	soil saturation - final (R:0.0-1.0)
SUCT_HD	soil suction head (inches)
LEAK	infiltration (gpad)
CONIMP	% connected impervious
CONPER	% connected pervious
MOD	pointer to basin parameters files (aka BASPAR)

**Table A 4.** Description of parameters in the BasPar Table.

Name in Program	Description
STORLOSSONA	Flow out of trench storage not into pipes. This is rate at which trenches drain to ground when storage is greater than STORLOW_PERACRE (6). Lessens the rise slope and steepens decay slope for trench flow after storm. See also RATEPERAREA (12) for flow out of trench at lower levels.
AREAFAC	Adjusts amount of infiltrated water (soil moisture) added to trench storage. This is a "throttle valve" for flow into trench storage from the surrounding ground. Note that flow into trench storage is proportional to the CHANGE in soil moisture, not the soil moisture itself.
TRFLWFAC	Factor applied to trench flow into pipes. This is a trench flow scale factor.
TRFLWMAX	Maximum flow to sewer pipes from trenches. Trench flow upper limit (cap, ceiling). Set this very low when you want to adjust dry weather factors without interference.

Name in Program	Description
STORLOW_PERACRE	Trench storage volume at which inflow to sewer pipes starts. Minimum to start trench flow. This can be used to crop effects at the start and end of a storm. The difference between this and STORHI_PERACRE (7) is a good way to scale trench flow effects.
STORHI_PERACRE	Trench storage volume upper limit. Lowering this will tend to "flat line" trench flow at a maximum limit in the middle of the storm. The difference between this and STORLOW_PERACRE (6) is a good way to scale trench flow effects.
PARLEAK_PERACRE	Adjusts one part of the wet weather leakage (see 10 for other) once the net infiltrated volume exceeds the minimum (floor) set in FGA_LEAKMIN (14). The portion of wet weather leakage controlled by this factor does not increase further when soil moisture exceeds a ceiling set in FGA_LEAKMAX (13). Since there are two parts to wet weather leakage, look at (10) as well. If changes in this, (13) or (14) do not result in the effect desired, then (10) is likely dominating wet weather leakage.
HIRIAREAFAC	Intense storm scaling factor. Factor adjusts trench flow to pipes during intense rainfall events in two stages (> 0.02 inches, > 0.03 inches per timestep)
FGAFAC	Factor adjusts one part of wet weather leakage (see 8 for other). This factor and the soil moisture level are applied to the dry weather leakage set in the basin file (ZLEAK or LEAKAGE is item 26 in that file) to obtain this portion of the wet weather leakage rate. This factor is the soil moisture at which this part of wet weather leakage is equal to the dry weather leakage. Since there are two parts to the wet weather leakage, look at (8) if tweaking this is ineffectual. Note that since this factor is dependent on dry weather leakage and has no upper or lower limits, it is less preferable than using (8). To turn this factor "off", set it to 1000 or above.
t	Soil moisture GRAVITY decay rate and time after rain at which all surface storage is set dry. See also items 17, 18 and 19 below for evaporation decay effects. Lessens the rise slope and steepens the decay slope for wet weather flow. Use to decay the wet weather leakage faster. The gravity decay effects for soil moisture are at higher soil moistures than those for evaporation effects.
RATEPERAREA	Rate at which trench storage drains when level is below STORLOW_PERACRE (6). Use to clear trench storage at appropriate rate between events.
FGA_LEAKMAX	Maximum net infiltrated amount (ceiling) that impacts PARLEAK ( 8). This factor influences only the part of the wet weather leakage scaled by PARLEAK and has no influence on the part scaled by FGAFAC (10).
FGA_LEAKMIN	Minimum net infiltrated amount (floor) that impacts PARLEAK ( 8). This factor influences only the part of the wet weather leakage scaled by PARLEAK and has no influence on the part scaled by FGAFAC (10).
FLWHIRI_SWITCH	Switch that turns the high intensity storm effects on (1) and off (0). If this is off, HIRIAREAFAC (9) above has no effect on the program. Suggest this should be left off until other factors are adjusted.
LEAKFGA_SWITCH	Switch that turns the wet weather leakage effects on (1) and off (0). If this is off, item FGAFAC (10) above has no effect on the program. Suggest this should be left off until initial dry weather factors are adjusted.
T_EVAP	Soil moisture EVAPORATION decay rate and time after rain at which all surface storage is set dry. See also t (T, 11) above for gravity decay rate. Lessens the rise slope and steepens the decay slope for wet weather flow. Use to decay the wet weather leakage faster. Only works if items (17) and (18) are set correctly. This effect is at soil moistures below those where gravity effects work.
FGAEVAP	Soil moisture at which evaporation depletion effects take over from gravity depletion effects t (T, 11). The depletion rate is set proportional to this amount.
IFLAG_DECAY	Switch that turns the soil moisture evaporation effects on (1) and off (0). If this is on evaporation effects take over soil moisture depletion at the limit set in FGAEVAP (18). If this is off, T_EVAP and FGAEVAP (17 and 18) have no effect on the program and soil moisture depletion is calculated based on t (T, 11) throughout its entire range.

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2006 CSO Control Project

Comparing Modeled Flow Events against  
Observed Events: Determining Preferred Model  
for Estimating CSO Storage Volumes.

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## **1.1 Introduction**

In 2007 as part of the King County Barton, Murray, Magnolia, and North Beach CSO Projects, a short term flow monitoring program was implemented. Portable flow meters were selectively placed in the four basins to delineate how much basin flow came from each sub-basin and provide data for more refined basin model calibrations. After the flow monitoring period was over, the County found the portable metered data disagreed with measured pump station flows (Schock, 2009). This finding resulted in a decision to omit direct use of the portable flow meters for calibrating model sub-basins; however, sub-basin calibration was accomplished by disaggregating a single downstream hydrograph into sub-basin hydrographs based on the portable flow data (Carollo, 2009). This disaggregating approach was used for calibrating sub-basins in the Barton, Murray, and North Beach basins. The Mouse/RDII model was used for all four sub-basin calibrations, which was accomplished by Carollo Consultants. Prior to the Mouse/RDII calibration effort, the County calibrated its Runoff model for the four basins. The models were used for estimating CSO storage volumes to control CSO discharges. This report discusses the differences between the two modeling efforts.

## **1.2 Calibration Overview**

Before discussing basin CSO control requirements, a brief discussion is presented on potential differences between the County model results and the consultant model results; potential differences are outlined in Table 1. The four basins were initially calibrated by the County using the Runoff hydrologic model; however, the County is gradually replacing the Runoff model with Mouse/RDII. Mouse/RDII (within the Mike Urban platform) was selected for sub-basin flow simulations. The two models are structurally different and are likely to produce different hydrograph responses; however, even the same model will reproduce some storm events better than others. This difference in reproducibility is an inherent limitation of all models; a model will perform best to those storms it was calibrated against. The Runoff and Mouse/RDII models were calibrated to different storm conditions or time series. The Mouse/RDII model was calibrated to flow data obtained between December 2007 and June 2008 and the Runoff model was calibrated to flow data obtained between 2001 and 2005. Because the models were calibrated to different time series, the calibrated models represent potentially different basin conditions and temporal changes in flow meter and rain gage response. The models were calibrated to different time periods and by different people. Because model calibration is considered partly art, results are subjective to the individual. People will interpret calibration results differently as an individual and as a group, even the County found three viable calibration results for the Barton and Murray basins (Schock, 2009a and 2009b). While these differences can produce significantly different model results, they are acceptable and should be considered part of the variability or uncertainty inherent in computer modeling. Had either modeling study been viewed in isolation, their results would have been considered acceptable. Viewed together, these modeling differences present a nice case study into the potential variability or range CSO control size for a single facility. However, current design practices require a single CSO control size and this report presents a method for assessing which model appears to match the existing data set better.

**Table 1.** Calibration procedures that could result in different design requirements for CSO storage volumes.

Different Models
Calibrating to different storm series and number of storms
Inconsistent calibration protocols for assessing an acceptable calibration
Variability of flow meter and between flow meters
Different people doing the calibration
Variability of rain gauge

### 1.3 Modeled CSO Volume Requirements

Based on long term simulation from the two models, simulated basin CSO storage requirements are very different between models; the Carollo Mouse/RDII model predicts smaller storage requirements for three of the four basins (Table 2). For the Barton and Murray basins, Carollo storage requirement are statistically different from the County requirements at the 95<sup>th</sup> confidence intervals (CI). For Magnolia and North Beach, the CI cannot be computed because it requires knowing portable meter uncertainty. Because the storage volumes are substantially different, the County wants direction on which model should be used for estimating CSO storage volumes. The model selection is based on which model appears to match the existing data set better.

**Table 2.** Expected CSO storage requirements for the four Puget Sound Beaches CSO Projects; storage is based on the one-year recurrence interval. Upper and lower 95<sup>th</sup> confidence intervals were calculated using the group bias; total uncertainty propagates group bias and flow meter error.

Basin	Carollo	King County		
	Expected	Expected	Lower 95 <sup>th</sup>	Upper 95 <sup>th</sup>
Barton <sup>1</sup>	0.0	0.11	0.06	0.16
Murray <sup>2</sup>	1.2	1.0	0.83	1.13
Magnolia	0.95	1.78	NA	
North Beach	0.18	2.15	NA	

1. 95<sup>th</sup> CI based on a model bias of 4.7 and 5 observations.  
2. 95<sup>th</sup> CI based on a model bias of 3.1 and 8 observations.

#### 1.3.1 Methods

The two models were calibrated to observed basin flows and assessed using several measures of fit (Schock, 2007, 2007a, 2009a, 2009b; and Carollo, 2009a). Because these measures of fit indicated acceptable calibrations, additional measures of fit were required for assessing which model most correctly mimics basin response. The only other comparison method was reviewing overflow durations and frequencies, which are based on observed water level data near an overflow structure (weir); water level was the only other independent data set available. Overflow events are observed when the water level exceeds a defined weir elevation; these events were compared to simulated overflow events. A simulated overflow is realized when the simulated flows exceed

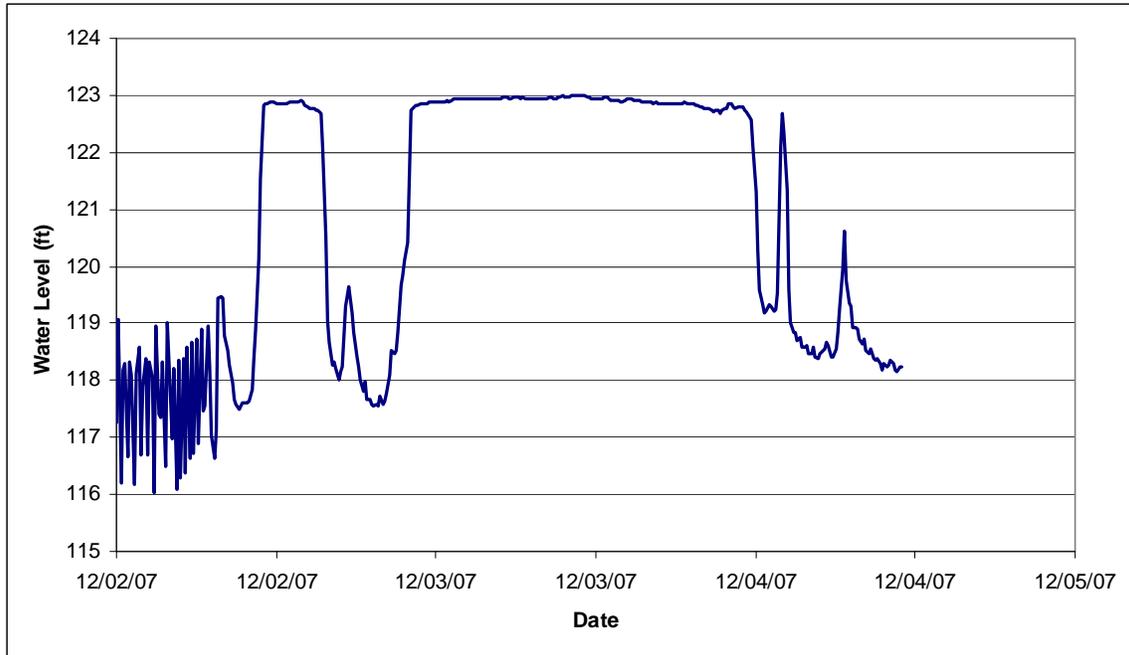
pump station capacity or system flow capacity. While this method is based on observed data, it still has potential problems.

Accurate identification or verification of overflow events is subject to accurate water level measurements, accurate weir elevations, and accurate pump capacity or system flow capacity information. Water level time series better identify or verify overflow events when water levels plateau between a steep incline and decline (Figure 1). Overflow events based on modeled flow and estimated pump capacity or system flow capacity are much more difficult to verify (Figure 2); they are usually verified with water level time series information. At best, accurate pump capacity is assessed using fill and draw methods and system capacity is assessed using general flow equations or portable flow meters, which can have significant bias (Schock, 2009). This flow capacity uncertainty is presented in the section assessing model results for the North Beach Basin. Given these caveats, overflow duration and frequency will be used for assessing which model is the most correct. Duration differences are expressed as the average of the absolute difference.

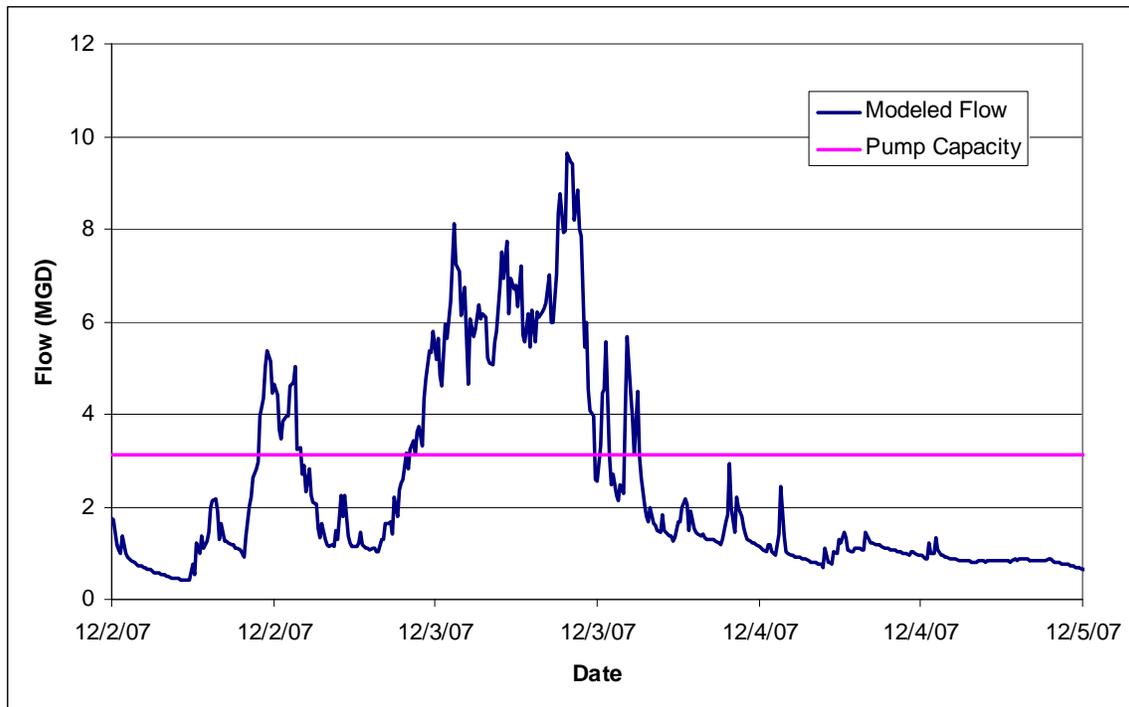
$$\Delta d = \frac{1}{N} \sum_{i=1}^N |d_{mdl} - d_{wl}_i| \quad (1.1)$$

Where  $\Delta d$  is the absolute duration error (ADE),  $d_{mdl}$  is the storm duration predicted by the model,  $d_{wl}$  is the storm duration estimated from water levels, and  $N$  is the number of observations. The absolute duration error is a more robust measure than the average duration error because the absolute error retains the bias for each observation while the average error allows observed biases to cancel. For example, the two hydrographs in Figure 3 have equal but opposite duration errors. The absolute duration error is  $b_1$ , but the average duration error is zero. For this example model, considering the hydrographs as a group the model has zero duration error, but for any specific hydrograph the model has an expected duration error of  $\pm b_1$ . The absolute duration error contains the average duration error plus a correction term for negative durations; the absolute duration equals zero only when the model perfectly represents observed durations. Because CSO control volumes are based on a single hydrograph, one would be more interested in how well a model represents a single hydrograph rather than an average of an ensemble of hydrographs, the smallest absolute duration error is desirable.

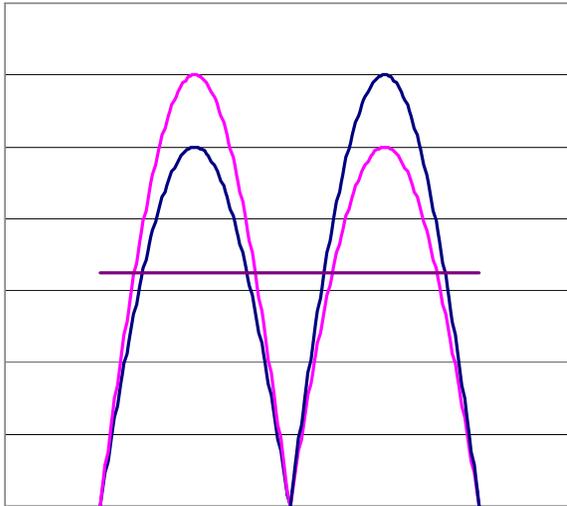
Overflow duration and frequency will be the primary parameters of interest; however, data consistency was considered in some cases.



**Figure 1.** Water level time series when flow is dissipated over a control structure. The overflow event occurred where the water level plateaus. Data is for the North Beach pump station.



**Figure 2.** Modeled flow time series and estimated pump capacity. The overflow event occurs when modeled flow exceeds pump capacity. Data is for the North Beach pump station for the same time period shown in Figure 1.



**Figure 3.** Two hydrographs with equal duration errors, but of opposite sign. The first hydrograph has duration error  $b_1$  and the second has duration error  $b_2=-b_1$ .

Because both model calibration results were considered acceptable, data consistency may show conditions changed between calibration periods i.e., basin characteristics or data collection conditions may have changed between periods. Consistency was checked using the double mass balance method; however, double mass balance allows assessing only data consistency.

### 1.3.2 Results

#### 1.3.2.1 Barton and Murray Basins

For the Barton and Murray pump stations, wet well water level data was obtained from the PI Historian data base, which retains data back to September 2005. Overflow events were initially identified when water levels were greater than weir elevations and verified when the data showed a plateau. These events were checked against simulated overflow events, which were identified when modeled flows exceeded estimated pump station capacities.

Based on Barton pump station wet well data and a weir elevation of 107.75 ft, about 27 overflow events were initially identified from December 2005 through June 2008; however, only 13 could be verified as true overflow events (Table 3). Between January 10, 2006 and February 14, 2006 the Barton force main broke and was under repair, this condition resulted in omitting 14 events. Of the 13 verified events, the Runoff model matched 6 and the Mouse/RDII model matched 3. Based on the 13 verified events, about 5 overflow events per year occurred for the water level events, 6 overflow events per year occurred for the Runoff model, and 2 overflow events per year occurred for the Mouse/RDII model. The two models concurrently matched only three events where storm durations could be compared; the Runoff model consistently over predicted durations and Mouse/RDII consistently under predicted, but the Runoff model had a smaller absolute error (Table 4). The Mouse/RDII performed poorly at matching actual events (23%) and event frequency and it has a higher absolute duration error (60 min).

While the Runoff model matched 46% of the actual overflow events, it does much better at matching event frequency and storm duration (37 min absolute duration error); the Runoff model is recommended because the model appears to match the existing data set better.

**Table 3.** Barton pump station overflow events based on wet well water levels and modeled flows assuming a 22 MGD pump capacity (Schock, 2009). The shaded area identifies 14 instances when the Barton force main was possibly impaired.

Wet Well	Runoff	Mouse/RDII	Wet Well	Runoff	Mouse/RDII
<b>24-Dec-05</b>	<b>24-Dec-05</b>		4-Nov-06		
10-Jan-06	10-Jan-06	16-Jan-06	<b>6-Nov-06</b>	<b>6-Nov-06</b>	
17-Jan-06	16-Jan-06		11-Dec-06		
18-Jan-06	4-Feb-06			13-Nov-06	
19-Jan-06			<b>14-Dec-06</b>	<b>14-Dec-06</b>	<b>14-Dec-06</b>
20-Jan-06			15-Dec-06		
21-Jan-06			26-Dec-06		
4-Feb-06			2-Jan-07		
5-Feb-06			<b>7-Jan-07</b>	<b>7-Jan-07</b>	
6-Feb-06				8-Jan-07	8-Jan-07
7-Feb-06				21-May-07	21-May-07
8-Feb-06				20-Aug-07	
10-Feb-06				26-Aug-07	
11-Feb-06				4-Sep-07	
14-Feb-06			<b>3-Dec-07</b>	<b>2-Dec-07</b>	<b>3-Dec-07</b>
8-Mar-06				8-Apr-08	
18-Mar-06			<b>6-Jun-08</b>	<b>6-Jun-08</b>	<b>6-Jun-08</b>
	14-Sep-06				
	2-Nov-06				

**Table 4.** Estimated overflow durations (hh:mm) for the three concurrent events identified in Table 3. The absolute error was 37 min for Runoff and 1:24 for Mouse/RDII. A complete list of durations is given in appendix A, Table A. 1.

Overflow Event	Water Level	Runoff	Mouse/RDII
<b>14-Dec-06</b>	2:30	2:43	1:12
<b>3-Dec-07</b>	12:10	13:30	9:35
<b>6-Jun-08</b>	0:40	1:00	0:21
<b>ADS</b>		00:37	1:24
<b>Avg. Bias</b>		00:37	1:24

Based on Murray pump station wet well water level data and a weir elevation of 108.5 ft, about 46 overflow events were initially identified from December 2005 through June 2008; however, only 16 could be verified as true overflow events but two were corroborated by the models (Table 5). Of the 18 events, the Runoff model matched 9 and the Mouse/RDII model matched 12. Based on the 16 verified events about 6.5 overflow events per year occurred, the Runoff model predicted about 7.7 overflow events per year and the Mouse/RDII model predicted about 11 overflow events per year.

Where the models matched observed overflow events, the Runoff model matched 50% of the observed events and the Mouse/RDII model matched 69%. The two models concurrently matched nine events, but the 24-Dec-05 event was omitted because of suspicious water level and pump data and the 02-Dec-07 and 03-Dec-07 events were considered the same event. The absolute duration errors differ slightly, Runoff was 1:20 (hh:mm) and Mouse/RDII was 1:34, and Runoff model over estimates duration by 1:10 and Mouse/RDII over estimates duration by 1:11 (Table 6). For overall storm frequency, percent of matched storms, and absolute duration error, the Runoff model performs slightly better than the Mouse/RDII model. The Runoff model is recommended because it appears to match the existing data set better.

**Table 5.** Murray pump station overflow events based on wet well water levels and events estimated from modeled flows using a 31.5 MGD pump capacity (Schock, 2009). The shaded area identifies seven instances when the Barton force main was possibly impaired.

Wet Well	Runoff	Mouse/RDII	Wet Well	Runoff	Mouse/RDII
22-Dec-05			12-Dec-06		
<b>24-Dec-05</b>	<b>24-Dec-05</b>	<b>24-Dec-05</b>		14-Dec-06	14-Dec-06
	24-Dec-05	24-Dec-05		14-Dec-06	
25-Dec-05					24-Dec-06
31-Dec-05				26-Dec-06	26-Dec-06
		5-Jan-06		26-Dec-06	
10-Jan-06	10-Jan-06	10-Jan-06			27-Dec-06
	16-Jan-06	16-Jan-06	<b>7-Jan-07</b>	<b>7-Jan-07</b>	<b>7-Jan-07</b>
		28-Jan-06		8-Jan-07	8-Jan-07
29-Jan-06		29-Jan-06	9-Jan-07		9-Jan-07
30-Jan-06	30-Jan-06	30-Jan-06		21-May-07	21-May-07
		1-Feb-06	19-Aug-07		
4-Feb-06	4-Feb-06	4-Feb-06		20-Aug-07	20-Aug-07
4-Jun-06		4-Jun-06		26-Aug-07	26-Aug-07
		14-Sep-06	<b>4-Sep-07</b>	<b>4-Sep-07</b>	<b>4-Sep-07</b>
	2-Nov-06	2-Nov-06		16-Nov-07	16-Nov-07
<b>4-Nov-06</b>	<b>4-Nov-06</b>	<b>4-Nov-06</b>		17-Nov-07	17-Nov-07
	4-Nov-06	4-Nov-06	<b>2-Dec-07</b>	<b>2-Dec-07</b>	<b>2-Dec-07</b>
		5-Nov-06			2-Dec-07
<b>6-Nov-06</b>	<b>6-Nov-06</b>	<b>6-Nov-06</b>	<b>3-Dec-07</b>	<b>3-Dec-07</b>	<b>3-Dec-07</b>
	12-Nov-06	12-Nov-06		8-Apr-08	8-Apr-08
	13-Nov-06	13-Nov-06	<b>6-Jun-08</b>	<b>6-Jun-08</b>	<b>6-Jun-08</b>
11-Dec-06		11-Dec-06			
<b>14-Dec-06</b>	<b>14-Dec-06</b>	<b>14-Dec-06</b>			

**Table 6.** Estimated overflow durations for the three concurrent events identified in Table 5. The absolute error is 1:20 (hh:mm) for Runoff and 1:34 for Mouse/RDII. A complete list of durations is given in appendix A, Table A. 2 .

Overflow Event	Water Level	Runoff	Mouse/RDII
<b>24-Dec-05</b>	sd <sup>a</sup>	--	--
<b>4-Nov-06</b>	1:00	0:10	0:10

<b>6-Nov-06</b>	5:10	2:20	2:30
<b>14-Dec-06</b>	4:40	4:00	5:00
<b>7-Jan-07</b>	2:00	0:40	0:30
<b>4-Sep-07</b>	0:20	1:00	1:00
<b>2-Dec-07</b>	17:20	14:20	12:30
<b>6-Jun-08</b>	1:00	1:00	1:10
<b>ADS</b>		1:20	1:34
<b>Avg Bias</b>		-1:08	-1:14
a. sd is suspicious data and duration error not computed.			

### 1.3.2.2 Magnolia Basin

For the Magnolia diversion structure, water level and flow data was obtained from the WTD Flow Monitoring Group; water level data since September 2006 was obtained because prior to September 2006 the data was deemed unreliable (personal communication Araya, 2009). Overflow events were identified when water levels exceeded about 39 inches (personal communication Johnson, 2010). Water level overflow events were compared against simulated overflow events, which were identified when modeled flows exceeded estimated diversion structure capacity of 4.3 MGD. In addition to the water level data, basin flow data was available from January 2007 and allowed assessing CSO storage differences between observed and modeled flows using the same 4.3 MGD diversion capacity. Water level overflow events and CSO storages were determined for the period January 2007 through June 2008.

#### 1.3.2.2.1 Water Level Based Storm Durations

Based on the diversion structure water level data, 60 overflow events were identified and the smallest storm duration was five minutes. Because Seattle Pump Station 77 discharges into the diversion structure, these two short events could be an artifact of the pump station rather than a true storm event. Based on analyses provided by Seattle, PS 77 discharge events had durations less than 6 minutes 95 percent of the time and a corresponding discharge of 1.9 MGD or less (email, Beedle, 2006). These events could be an artifact of the City of Seattle Pump Station 77; however, both models predicted events concurrent to the two and so they were retained. Where applicable, multiple inter-day events were combined into a single day (Table 7). This process resulted in 34 water level overflow events, the Runoff model predicted 33 events per year, and the Mouse/RDII model predicted 32 events per year. The Runoff model matched 97% of the observed water level overflows and Mouse/RDII matched 94%. For the absolute duration error, the Runoff model did worse because of the large error in the 02-Dec-07 storm; the Runoff absolute duration error was 3:02 (hh:mm) and the Mouse/RDII absolute duration error was 0:41 (Table 8). Eliminating the worst duration error in each model series profoundly affected the absolute duration error for Runoff, Runoff had an absolute duration error of 0:59 (hh:mm) and Mouse/RDII had an absolute duration error of 0:36. Runoff over predicted duration by 0:53 and Mouse/RDII over predicted duration by 0:15.

**Table 7.** Magnolia diversion structure overflow events based on water levels modeled flow using a 4.3 MGD diversion capacity.

Diversion Water Level	Runoff	Mouse/RDII	Diversion Water Level	Runoff	Mouse/RDII
-----------------------	--------	------------	-----------------------	--------	------------

<b>1-Jan-07</b>	<b>1-Jan-07</b>		<b>15-Nov-07</b>	<b>15-Nov-07</b>	<b>15-Nov-07</b>
<b>2-Jan-07</b>	<b>2-Jan-07</b>	<b>2-Jan-07</b>		16-Nov-07	
<b>3-Jan-07</b>	<b>3-Jan-07</b>		<b>17-Nov-07</b>	<b>17-Nov-07</b>	<b>17-Nov-07</b>
<b>5-Jan-07</b>	<b>5-Jan-07</b>	<b>5-Jan-07</b>	<b>26-Nov-07</b>	<b>26-Nov-07</b>	<b>26-Nov-07</b>
<b>7-Jan-07</b>	<b>7-Jan-07</b>	<b>7-Jan-07</b>		1-Dec-07	1-Dec-07
	16-Jan-07		<b>2-Dec-07</b>	<b>2-Dec-07</b>	<b>2-Dec-07</b>
	10-Feb-07		<b>4-Dec-07</b>		<b>4-Dec-07</b>
<b>8-Mar-07</b>	<b>8-Mar-07</b>	<b>8-Mar-07</b>		16-Dec-07	
<b>11-Mar-07</b>	<b>11-Mar-07</b>	<b>11-Mar-07</b>	<b>18-Dec-07</b>	<b>18-Dec-07</b>	<b>18-Dec-07</b>
<b>19-Mar-07</b>	<b>19-Mar-07</b>	<b>19-Mar-07</b>		19-Dec-07	
<b>20-Mar-07</b>	<b>20-May-07</b>	<b>20-May-07</b>	<b>22-Dec-07</b>	<b>22-Dec-07</b>	<b>22-Dec-07</b>
<b>21-May-07</b>	<b>21-May-07</b>	<b>21-May-07</b>	<b>27-Dec-07</b>	<b>27-Dec-07</b>	<b>27-Dec-07</b>
	21-May-07			2-Jan-08	
	20-Jul-07		<b>9-Jan-08</b>	<b>9-Jan-08</b>	<b>9-Jan-08</b>
	3-Sep-07	3-Sep-07		10-Jan-08	10-Jan-08
<b>4-Sep-07</b>	<b>4-Sep-07</b>		<b>12-Jan-08</b>	<b>12-Jan-08</b>	
	27-Sep-07		<b>14-Jan-08</b>	<b>14-Jan-08</b>	<b>14-Jan-08</b>
	27-Sep-07		<b>19-Jan-08</b>	<b>19-Jan-08</b>	<b>19-Jan-08</b>
	28-Sep-07			6-Feb-08	
<b>30-Sep-07</b>	<b>30-Sep-07</b>	<b>30-Sep-07</b>	<b>15-Mar-08</b>	<b>15-Mar-08</b>	<b>15-Mar-08</b>
30-Sep-07	30-Sep-07	30-Sep-07	<b>16-Mar-08</b>	<b>16-Mar-08</b>	<b>16-Mar-08</b>
	3-Oct-07	3-Oct-07	<b>23-Mar-08</b>	<b>23-Mar-08</b>	<b>23-Mar-08</b>
	7-Oct-07		<b>26-Mar-08</b>	<b>26-Mar-08</b>	<b>26-Mar-08</b>
<b>17-Oct-07</b>	<b>17-Oct-07</b>	<b>17-Oct-07</b>		28-Mar-08	28-Mar-08
	18-Oct-07			29-Mar-08	29-Mar-08
<b>19-Oct-07</b>	<b>19-Oct-07</b>	<b>19-Oct-07</b>		14-Apr-08	
<b>24-Oct-07</b>	<b>24-Oct-07</b>	<b>24-Oct-07</b>	<b>3-Jun-08</b>	<b>3-Jun-08</b>	<b>3-Jun-08</b>
<b>12-Nov-07</b>	<b>12-Nov-07</b>	<b>12-Nov-07</b>	<b>9-Jun-08</b>	<b>9-Jun-08</b>	<b>9-Jun-08</b>

**Table 8.** Estimated overflow durations for the concurrent events identified in Table 7. The absolute error is 3:02 (hh:mm) for Runoff and 0:41 for Mouse/RDII. Shaded areas identify worst absolute duration error in each model series. A complete list of durations is given in appendix A, Table A. 3.

<b>Date</b>	<b>Water Level</b>	<b>Runoff</b>	<b>Mouse/RDII</b>
<b>1-Jan-07</b>	00:10	0:20	
<b>2-Jan-07</b>	04:30	4:20	3:45
<b>3-Jan-07</b>	00:25		
<b>5-Jan-07</b>	03:05	3:20	3:03
<b>7-Jan-07</b>	01:40	1:30	1:23
<b>8-Mar-07</b>	00:40	0:40	0:20
<b>11-Mar-07</b>	00:45	1:20	0:20
<b>19-Mar-07</b>	00:50	1:10	0:30
<b>20-Mar-07</b>	02:20	1:50	0:41
<b>21-May-07</b>	01:40	1:50	2:02
<b>4-Sep-07</b>	00:10	0:20	
<b>30-Sep-07</b>	00:20	4:50	3:14
<b>17-Oct-07</b>	00:15	1:00	0:31
<b>19-Oct-07</b>	00:35	2:30	1:42

<b>24-Oct-07</b>	00:15	0:40	0:21
<b>12-Nov-07</b>	01:05	5:10	4:56
<b>15-Nov-07</b>	01:10	4:40	3:56
<b>17-Nov-07</b>	01:15	1:40	1:21
<b>26-Nov-07</b>	00:05	1:30	1:11
<b>2-Dec-07</b>	25:55	96:40	26:45
<b>4-Dec-07</b>	00:15		
<b>18-Dec-07</b>	00:40	0:50	0:51
<b>22-Dec-07</b>	00:35	1:50	0:31
<b>27-Dec-07</b>	00:15	0:30	0:11
<b>9-Jan-08</b>	00:40	0:40	0:41
<b>12-Jan-08</b>	00:10	0:30	
<b>14-Jan-08</b>	01:55	2:10	1:52
<b>19-Jan-08</b>	00:50	1:00	0:41
<b>15-Mar-08</b>	00:50	0:50	0:52
<b>16-Mar-08</b>	00:15	0:40	
<b>23-Mar-08</b>	01:15	4:10	2:44
<b>26-Mar-08</b>	00:30	1:40	0:40
<b>3-Jun-08</b>	03:25	8:30	6:17
<b>9-Jun-08</b>	00:10	0:30	0:10
<b>ADS</b>		3:02	00:41
<b>Avg Bias</b>		2:56	00:22

#### 1.3.2.2.2 Flow Based CSO Storage Volumes

CSO storage volumes were calculated for flow exceeding the capacity of the diversion structure. Observed flows were obtained by adding portable meter data in manholes MH026-104, MH026-006, and MH026-008. For a diversion capacity of 4.3 MGD and calculating storage volumes using a 24 hr separation, the predicted overflow events per year were 19 for the observed flow, 28 for the Runoff model, and 21 for the Mouse/RDII model (Table 9). The flow based overflow events differ from the water level overflow events, 19 events/yr compared to 26 events/yr. The Runoff model matched 92% of the observed flow based overflow events and Mouse/RDII matched 81%. Total volume weighted relative CSO volume error for Runoff it was 102% and for Mouse/RDII it was 36% (Table 10). When the 2-Dec-07 storm event was omitted, the errors were 18% for Runoff and 12% for Mouse/RDII and Runoff over predicted volumes by 55% and Mouse/RDII under predicted volumes by 10%. The volume weighted relative CSO volume error was computed as,

$$\Delta V_i = \frac{1}{\sum V_{obs}} \sum V_{obs} \frac{|V_{mdl} - V_{obs}|_i}{V_{obs}} \quad (1.2)$$

$$\Delta V_i = \sum \frac{|V_{mdl} - V_{obs}|_i}{\sum V_{obs}}$$

Where  $\Delta V_i$  is the  $i$ th observed volume weighted relative CSO volume error,  $V_{mdl}$  is the modeled CSO volume, and  $V_{obs}$  is the observed CSO volume.

**Table 9.** Magnolia diversion structure overflow events based on metered flow and modeled flow using a 4.3 MGD diversion capacity. The 1-Dec-07 and 2-Dec-07 events are considered the same event.

Diversion Flow	Runoff	Mouse/RDII	Diversion Flow	Runoff	Mouse/RDII
<b>1-Jan-07</b>	<b>1-Jan-07</b>		<b>17-Nov-07</b>	<b>17-Nov-07</b>	<b>17-Nov-07</b>
		2-Jan-07	<b>26-Nov-07</b>	<b>26-Nov-07</b>	<b>26-Nov-07</b>
<b>5-Jan-07</b>	<b>5-Jan-07</b>	<b>5-Jan-07</b>		1-Dec-07	1-Dec-07
<b>7-Jan-07</b>	<b>7-Jan-07</b>	<b>7-Jan-07</b>		2-Dec-07	
	16-Jan-07		<b>16-Dec-07</b>	<b>16-Dec-07</b>	
	10-Feb-07		<b>18-Dec-07</b>	<b>18-Dec-07</b>	<b>18-Dec-07</b>
<b>8-Mar-07</b>	<b>8-Mar-07</b>	<b>8-Mar-07</b>	<b>22-Dec-07</b>	<b>22-Dec-07</b>	<b>22-Dec-07</b>
<b>11-Mar-07</b>	<b>11-Mar-07</b>	<b>11-Mar-07</b>	<b>27-Dec-07</b>	<b>27-Dec-07</b>	<b>27-Dec-07</b>
<b>19-Mar-07</b>	<b>19-Mar-07</b>	<b>19-Mar-07</b>		2-Jan-08	
<b>20-May-07</b>	<b>20-May-07</b>	<b>20-May-07</b>	<b>9-Jan-08</b>	<b>9-Jan-08</b>	<b>9-Jan-08</b>
	20-Jul-07		<b>12-Jan-08</b>	<b>12-Jan-08</b>	
	3-Sep-07	3-Sep-07	<b>14-Jan-08</b>	<b>14-Jan-08</b>	<b>14-Jan-08</b>
4-Sep-07			<b>19-Jan-08</b>	<b>19-Jan-08</b>	<b>19-Jan-08</b>
	27-Sep-07			6-Feb-08	
<b>30-Sep-07</b>	<b>30-Sep-07</b>	<b>30-Sep-07</b>	<b>15-Mar-08</b>	<b>15-Mar-08</b>	<b>15-Mar-08</b>
	3-Oct-07	3-Oct-07	<b>23-Mar-08</b>	<b>23-Mar-08</b>	<b>23-Mar-08</b>
	7-Oct-07	17-Oct-07	25-Mar-08		
	17-Oct-07	19-Oct-07		26-Mar-08	26-Mar-08
	19-Oct-07			28-Mar-08	28-Mar-08
<b>24-Oct-07</b>	<b>24-Oct-07</b>	<b>24-Oct-07</b>		29-Mar-08	29-Mar-08
<b>12-Nov-07</b>	<b>12-Nov-07</b>	<b>12-Nov-07</b>		14-Apr-08	
<b>15-Nov-07</b>	<b>15-Nov-07</b>	<b>15-Nov-07</b>	<b>3-Jun-08</b>	<b>3-Jun-08</b>	<b>3-Jun-08</b>

**Table 10.** Estimated volume weighted relative CSO volume error for concurrent events identified in Table 9. The cumulative volume weight relative error is 102% for Runoff and 36% for Mouse/RDII.

Overflow Event	Runoff	Mouse/RDII
<b>5-Jan-07</b>	1.36%	1.74%
<b>7-Jan-07</b>	1.22%	1.48%
<b>8-Mar-07</b>	0.11%	0.29%
<b>11-Mar-07</b>	0.18%	0.59%
<b>19-Mar-07</b>	0.09%	0.55%
<b>20-May-07</b>	0.10%	1.01%
<b>30-Sep-07</b>	0.82%	0.10%
<b>24-Oct-07</b>	0.80%	0.30%
<b>12-Nov-07</b>	1.34%	0.17%
<b>15-Nov-07</b>	2.00%	1.04%
<b>17-Nov-07</b>	0.81%	0.03%
<b>26-Nov-07</b>	0.68%	0.10%
<b>2-Dec-07</b>	84%	24%
<b>18-Dec-07</b>	0.11%	0.14%
<b>22-Dec-07</b>	0.20%	0.32%
<b>27-Dec-07</b>	0.08%	0.05%

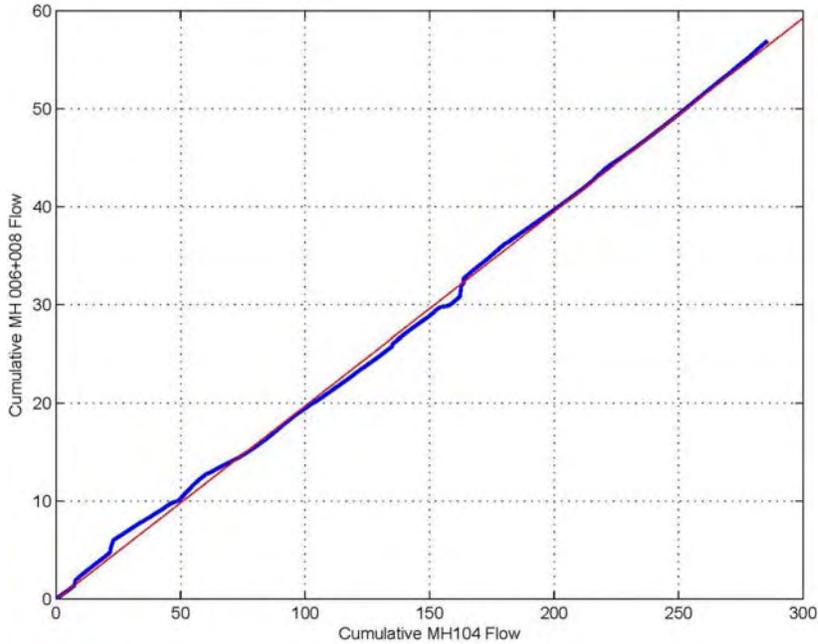
<b>9-Jan-08</b>	0.58%	0.10%
<b>14-Jan-08</b>	0.41%	0.36%
<b>19-Jan-08</b>	0.00%	0.51%
<b>15-Mar-08</b>	0.68%	0.11%
<b>23-Mar-08</b>	1.02%	0.23%
<b>3-Jun-08</b>	4.91%	2.81%

For the water level and flow based analyses, the Runoff model had better event frequency and number of matched events, but the Mouse/RDII model had better (lower) duration and volumetric errors. Runoff duration and volumetric errors improved substantially when the 2-Dec-07 storm was removed, but the duration and volumetric errors were still higher. This condition could be because Runoff was calibrated to flow data in 2005 and 2006 and Mouse/RDII was calibrated to flow data in 2007 and 2008. Between these time periods basin conditions, flow meters, and rain gauges may have changed and any changes would be apparent in a double mass analyses.

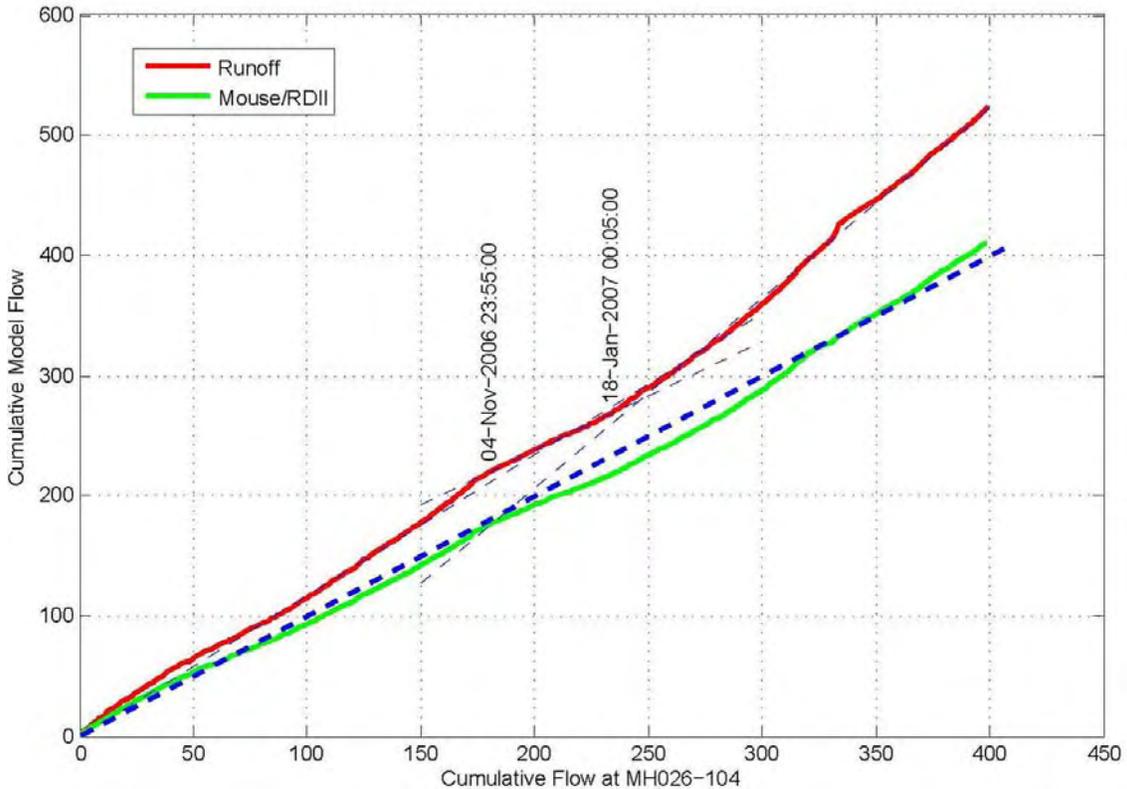
#### 1.3.2.2.3 Magnolia Double Mass Analysis

The double mass analysis compared modeled flows to observed portable metered flow. Because model parameters are consistent over time, an inconsistent response would derive from the flow meters, rain gauges, or basin changes. Metered flow from MH026-104 was used in the double mass analysis because it contained flow information over both calibration periods (2005 through 2008). The double mass method was also used to assess flow proportions between flow at MH026-104 and flow for MH026-006 and MH026-008; flows from MH026-006 and MH026-008 were about 20% of the flow from MH026-104 (Figure 4). Based on this ratio, modeled flows should be about 20% higher than MH026-104 flows. The Mouse/RDII model had the same average slope as MH026-104 and the Runoff model had average slope of 1.27 (Figure 5). For both models, three flow regimes are apparent in the double mass diagram. The first is from 3-Oct-05 to 4-Nov-06, the second is from 4-Nov-06 to 18-Jan-07, the third is from 18-Jan-07 onward (Figure 5). After around 18-Jan-07, the Runoff model predicts larger flows (slope is 1.58) compared to earlier flows (slope is 1.16). Because model parameters are consistent over time, this result suggests the flow regime changed between the two periods. This shift maybe from changes in rain gauges or basin characteristics because the flow meter double mass balance indicates the meters were fairly consistent between the two periods (Figure 4). While a flow regime shift is apparent, the double mass balance nor other available basin information allows assessing which flow regime is correct, or if the shift is a natural variation. The double mass balance does indicate that on average the Runoff model flows better resemble total basin flow, but probably over predicts flows after 18-Jan-07. And that on average the Mouse/RDII model under represents total basin flow, but could better resembles flows after 18-Jan-07.

Because the Runoff model produces better storm frequency, matched storm events, and average total flow representation, the Runoff model is recommended because the model appears to match the existing data set better.



**Figure 4.** Double mass diagram for flows at MH026-104 and combined flows in MH026-006 plus MH026-008 (blue line); the average slope is 0.197 (red line). Flow data series spans 25-Aug-06 through 31-Oct-08.



**Figure 5.** Double mass diagram for flows at MH026-104 and the Runoff model (red line) and the Mouse/RDII model (green line). The heavy dashed line has a 1:1 slope; the Mouse/RDII model has average slope 1.00; and Runoff model has average slope 1.27.

### 1.3.3 North Beach Basin

For the North Beach basin, CSO storage volume differences were more easily assessed because of observed bias in flow meters used for calibrating the models. The Runoff model was calibrated to three meters (one for each sub-basin) that were potentially biased high about 75% (NBCSO123); whereas the Mouse model was calibrated to a single meter biased high about 28% (NBCSO, Table 11). Therefore, the Mouse/RDII is recommended.

#### 1.3.3.1 Water Level Based Overflow Frequencies

The North Beach data set provides an opportunity to present potential uncertainty in the applied methods when assumed or estimated but unverified pump capacity or system capacity are used. In the North Beach basin, the station pumps were tested for peak flow rates when all portable meters and wet well bubblers were operating, meter locations are shown in Figure 6. The pump test provided information about potential portable meter errors and differences between assumed pump capacity and verified pump capacities. Previously, the pump capacity was thought to be 3.4 MGD; however, recent pump tests indicate pump capacity is about 2.7 MGD with a maximum of 2.9 MGD depending on the wet well level (Table 12 and Kaplan, 2010).

**Table 11.** Average inflow during the North Beach pump test (data reproduced from Table 12, in Schock, 2009).

Meter or Station	Flow (MGD)	Relative error from the pump test inflow.
NBCSO	0.63	28%
NBCSO123 <sup>a</sup>	0.86	75%
NBCHWETWELL	0.55	12%
12/17/08 Pump Test	0.49	NA
a. Sum of meters N.BeachCSO1, N.BeachCSO2, N.BeachCSO3.		

**Table 12.** Estimated North Beach pump station flow capacity based on pump test. Pumps were run at maximum speed for each test. The two large pumps were run concurrently for number combinations 1 & 2 (data reproduced from Table 11, in Schock, 2009).

Pump(s)	Calculated Peak (MGD)	Average Influent flow (MGD)
1	2.6	0.55
1 & 2	2.6	0.49
2	2.4	0.45
1 & 2	2.7	0.47
1 & 2	2.9	0.56
Kaplan (2010)	3.0	
Average	2.71	0.49
std dev	0.21	0.05
Rel. Error	8%	10%



**Figure 6.** Portable flows meters near the North Beach pump station.

**Table 13.** North Beach pump station portable meter equivalent nomenclature used between Figure 6 and text.

Figure 6 Nomenclature	Abbreviated name
North Beach pump station CSO	NBCSO
N. Beach CSO1 + CSO2 + CSO3	NBCSO123
North Beach pump station wet	NBCHWETWELL

Wet well water levels were obtained from the PI Historian and flow data was obtained from WTD Flow Monitoring Group. Overflow events were identified when water levels exceeded 122.73 ft and verified when water levels showed a plateau. For the wet well water level data, 17 possible events were identified and 15 were verified and between 2-Jan-07 through 3-Jun-08 (Table 14). Over the same period and for a 3.4 MGD pump capacity, the Mouse/RDII model predicted 15 events and matched 11 events; modeled event counts compare well for a threshold flow of 3.4 MGD.

The Mouse/RDII model and the NBHWETWELL flow meter had similar overflow event frequencies using a slightly shorter period and a 3.4 MGD capacity; the wet well flow meter predicted 11 events, the Mouse/RDII predicted 12 events, and the wet well water level calculated 11 events. These numbers compare well, but they are correct for the incorrect reason; a higher pump capacity was used, but it is correct because the NBCSO portable meter was biased high (it over estimated flow).

1.3.3.2 Incomplete Accounting of Flow Meter Bias

The simulated North Beach overflow statistics compared well because the high meter bias compensated for higher pump capacity. The NBCSO portable meter was biased high about 28% (Table 11), but the average pump capacity is 2.71 MGD (Table 12). If 2.7 MGD is the expected pump capacity, then for calculate the expected CSO storage the modeled flows should be adjusted downward by 28%. Or, one could increase the average pump capacity by 28%,  $(2.71)(1.28) = 3.47$  MGD, which is close to the 3.4 MGD capacity used in North Beach analyses. Adjusting the model hydrograph downward by 28% and using a 2.7 MGD pump capacity produced the same overflow events as the unadjusted hydrograph and a 3.4 MGD pump capacity (Table 16). The unadjusted hydrograph and 3.4 MGD capacity produces the right response for incorrect reasons. If one calculated CSO storage volumes for a 2.7 MGD pump capacity and did not adjust the hydrograph accordingly, the calculated CSO storage would be incorrect.

**Table 14.** North Beach pump station overflow events based on wet well water levels and events estimated from modeled flows using a 3.4 MGD pump capacity.

Wet Well Water Level	Mouse/RDII
<b>2-Jan-07</b>	<b>2-Jan-07</b>
3-Jan-07	
<b>5-Jan-07</b>	<b>5-Jan-07</b>
7-Jan-07	
	8-Jan-07
<b>19-Mar-07</b>	<b>19-Mar-07</b>
	20-May-07
	19-Aug-07
<b>20-Aug-07</b>	<b>20-Aug-07</b>
<b>19-Oct-07</b>	<b>19-Oct-07</b>
<b>17-Nov-07</b>	<b>17-Nov-07</b>
<b>2-Dec-07</b>	<b>2-Dec-07</b>
<b>3-Dec-07</b>	<b>3-Dec-07</b>
<b>4-Dec-07</b>	
<b>9-Jan-08</b>	<b>9-Jan-08</b>
<b>15-Mar-08</b>	<b>15-Mar-08</b>
<b>4-Apr-08</b>	
	7-Apr-08
<b>3-Jun-08</b>	<b>3-Jun-08</b>

**Table 15.** Estimated overflow durations between the Wet well water level and MOUSE/RDII model for the concurrent events identified in Table 14. The absolute error is 1:23 (hh:mm) for the Mouse/RDII mode. A complete list of durations is given in appendix A, Table A. 4.

Event	Wet Well Water Level	MOUSE/RDII
2-Jan-07	2:36	1:11
5-Jan-07	1:39	0:41
19-Mar-07	0:22	0:21
20-Aug-07	0:20	0:11
19-Oct-07	0:23	1:23
17-Nov-07	0:18	0:11
2-Dec-07	4:03	2:45
3-Dec-07	24:12	14:16
9-Jan-08	0:11	0:10
15-Mar-08	0:01	0:10
3-Jun-08	1:03	1:12
ADS		1:23
Avg Bias		-1:08

**Table 16.** Simulated overflow events for an unadjusted hydrograph and 3.4 MGD pump capacity and a hydrograph adjusted downward 28% and 2.7 MGD pump capacity. Between the two results, the absolute error is 51 seconds.

Event	Durations (hh:mm)	
	Hydrograph unadjusted and 3.4 MGD	Hydrograph adjusted down and 2.7 MGD
2-Jan-07	1:27	1:24
5-Jan-07	0:53	0:52
8-Jan-07	0:34	0:34
19-Mar-07	0:31	0:30
20-May-07	0:18	0:18
28-Jun-07	0:02	0:01
19-Aug-07	0:11	0:11
20-Aug-07	0:12	0:12
19-Oct-07	2:13	2:08
17-Nov-07	0:16	0:16
2-Dec-07	17:24	17:23
3-Dec-07	1:04	1:04
18-Dec-07	0:02	0:02
9-Jan-08	0:10	0:10
15-Mar-08	0:09	0:09
4-Apr-08	0:14	0:13
7-Apr-08	0:22	0:21
18-Apr-08	0:04	0:04
3-Jun-08	2:47	2:45

## 1.4 Summary and Conclusions

King County and Carollo CSO storage modeling results produced significantly different storage volumes but both models had acceptable calibration results. Because calibrations were acceptable, a different assessment method was employed to determine which model better matched observed data. The method reviewed overflow frequencies and durations based on water level measurement near overflow structures; the method was different or independent from the calibration methods employed. Based on the water level method, CSO storage volumes should be estimated using the preferred models given in Table 17.

The North Beach basin was the easiest basin to assess because field investigation revealed the Mouse/RDII basin calibration meter had a smaller relative error compared to the Runoff basin calibration meters; therefore the Mouse/RDII model is the preferred model. In the Barton basin, overflow frequency and storm durations was better simulated with the County's Runoff model and was picked for its better match to observed data. In the Murray basin results were a little less straight forward. Runoff predicted better overflow frequency and storm durations; Mouse/RDII better matched the number of observed overflow events. The Runoff model was selected because it was better at two out of three measures. The Magnolia basin was the most difficult basin to assess.

In Magnolia, the Runoff model predicted better overflow frequency and better matched number of observed storm events; however, the Runoff model had a much higher absolute duration error that was most affected by a single storm event (2-Dec-07). Removing the worst duration errors for both models significantly reduced the Runoff duration error but had a smaller effect on the Mouse/RDII duration error. Analyses indicated the Runoff model over predicted both storm duration and overflow volumes. This condition possibly resulted from a change in the basin flow regime, which occurred after the Runoff model was calibrated and during the period of the Mouse/RDII calibration. The regime change indicated the Runoff model should be predicting larger flows compared to the Mouse/RDII model after the change, but Mouse/RDII would under predict flows before the change. The flow regime change was determined using the double mass balance method, which also indicated the Runoff model predicted better average flow conditions compared to the Mouse/RDII model. Because Runoff better resembles total basin flow, it had better overflow frequency, and it better matched number of observed storm events it was selected as the preferred model.

Supplemental to the primary intent of this report, analyses for the North Beach basin indicated that some of the assumptions or system capacity estimates may produce the appropriate results but for inappropriate reasons. Analyses indicate that incomplete accounting of flow meter errors could produce inaccurate results pertaining to estimated CSO storage volumes for what are thought to be corrected system capacities. The results suggest all variable errors should be thoroughly considered before making final design recommendations.

**Table 17.** Preferred models for estimating CSO storage volumes in the four basins.

Basin	Model
-------	-------

Barton	Runoff, County
Murray	Runoff, County
Magnolia	Runoff, County
North Beach	Mouse/RDII, Carollo

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# Appendix A

This appendix provides the complete wet well and model storm durations used for comparing simulated storm duration to observed durations.

**Table A. 1.** Barton pump station overflow events based on wet well water levels and modeled flows assuming a 22 MGD pump capacity (Schock, 2009); durations have unit's hh:mm. The shaded area identifies when the Barton force main was possibly impaired.

Wet Well		Runoff		Mouse/RDII	
Date	Duration	Date	Duration	Date	Duration
24-Dec-05	0:40	24-Dec-05	1:30		
10-Jan-06		10-Jan-06		16-Jan-06	
17-Jan-06		16-Jan-06			
18-Jan-06		4-Feb-06			
19-Jan-06					
20-Jan-06					
21-Jan-06					
4-Feb-06					
5-Feb-06					
6-Feb-06					
7-Feb-06					
8-Feb-06					
10-Feb-06					
11-Feb-06					
14-Feb-06					
8-Mar-06	1:50				
18-Mar-06	2:00				
		14-Sep-06	0:00		
		2-Nov-06	0:20		
4-Nov-06	0:30				
6-Nov-06		6-Nov-06	2:10		
		13-Nov-06	0:10		
11-Dec-06	0:10				
14-Dec-06 <sup>a</sup>	2:30	14-Dec-06	2:43	14-Dec-06	1:12
15-Dec-06 <sup>a</sup>	21:10				
26-Dec-06	2:30				
2-Jan-07	1:00				
7-Jan-07	0:50	7-Jan-07	0:30		
		8-Jan-07	0:50	8-Jan-07	0:21
		21-May-07	0:40	21-May-07	0:21
		20-Aug-07	0:10		
		26-Aug-07	0:10		
		4-Sep-07	0:50		
3-Dec-07	12:10	2-Dec-07	13:30	3-Dec-07	9:35
		8-Apr-08	0:10		
6-Jun-08	0:40	6-Jun-08	1:00	6-Jun-08	0:21

a. Water level data looks suspicious.

**Table A. 2.** Murray pump station overflow events based on wet well water levels and events estimated from modeled flows using a 31.5 MGD pump capacity (Schock, 2009); durations have unit's hh:mm. The shaded area identifies seven instances when the Barton force main was possibly impaired.

Wet Well		Runoff		Mouse/RDII	
Date	Duration	Date	Duration	Date	Duration
22-Dec-05	0:20				
24-Dec-05 <sup>a</sup>	6:10	24-Dec-05	0:20	24-Dec-05	0:20
		24-Dec-05	0:20	24-Dec-05	0:30
25-Dec-05	0:50				
31-Dec-05	1:10				
				5-Jan-06	
10-Jan-06	1:00	10-Jan-06	0:10	10-Jan-06	0:20
		16-Jan-06	0:30	16-Jan-06	0:30
				28-Jan-06	
29-Jan-06	11:20			29-Jan-06	0:00
30-Jan-06		30-Jan-06	0:30	30-Jan-06	0:20
				1-Feb-06	
4-Feb-06	1:10	4-Feb-06	0:10	4-Feb-06	0:20
				4-Jun-06	0:10
				14-Sep-06	
		2-Nov-06		2-Nov-06	1:00
4-Nov-06	1:00	4-Nov-06	0:00	4-Nov-06	0:10
		4-Nov-06	0:10	4-Nov-06	0:10
				5-Nov-06	
6-Nov-06	5:10	6-Nov-06	2:20	6-Nov-06	2:30
		12-Nov-06	0:00	12-Nov-06	0:20
		13-Nov-06	0:00	13-Nov-06	0:20
11-Dec-06	0:50			11-Dec-06	0:10
12-Dec-06	0:20				
14-Dec-06	4:40	14-Dec-06	1:30	14-Dec-06	1:30
		14-Dec-06	1:00	14-Dec-06	3:30
		14-Dec-06	1:30		
				24-Dec-06	
		26-Dec-06	0:40	26-Dec-06	3:00
		26-Dec-06	0:40		
				27-Dec-06	
7-Jan-07	2:00	7-Jan-07	0:40	7-Jan-07	0:30
		8-Jan-07	0:50	8-Jan-07	0:50
9-Jan-07 <sup>a</sup>				9-Jan-07	0:10
		21-May-07	0:40	21-May-07	0:40
19-Aug-07	0:10				
		20-Aug-07	0:00	20-Aug-07	0:20
		26-Aug-07	0:10	26-Aug-07	0:20
4-Sep-07	0:20	4-Sep-07	1:00	4-Sep-07	1:00
		16-Nov-07	0:00	16-Nov-07	0:20
		17-Nov-07	0:10	17-Nov-07	0:10
2-Dec-07 <sup>b</sup>		2-Dec-07	14:20	2-Dec-07	0:10
				2-Dec-07	12:30
3-Dec-07 <sup>b</sup>	17:20	3-Dec-07	0:00	3-Dec-07	0:20
4-Dec-07	0:30				
		8-Apr-08		8-Apr-08	0:20
6-Jun-08	1:10	6-Jun-08	1:00	6-Jun-08	1:10

a. Water level data looks suspicious.

b. Dec. 2 and Dec. 3, 2007 durations were added together.

**Table A. 3.** Magnolia diversion structure overflow events based on water levels modeled flow using a 4.3 MGD diversion capacity); durations have unit's hh:mm. For the models, events having a single observation are denoted with a blank duration.

Diversion Water Level		Runoff		Mouse/RDII	
Date	Duration	Date	Duration	Date	Duration
1-Jan-07	00:10	1-Jan-07	0:20		
2-Jan-07	01:05	2-Jan-07	1:00	2-Jan-07	0:51
2-Jan-07	03:25	2-Jan-07	3:20	2-Jan-07	2:54
				2-Jan-07	
3-Jan-07	00:25	3-Jan-07			
5-Jan-07	00:35	5-Jan-07	3:20	5-Jan-07	3:03
5-Jan-07	02:30				
7-Jan-07	00:15	7-Jan-07	0:10	7-Jan-07	1:23
7-Jan-07	01:25	7-Jan-07	1:20		
		16-Jan-07			
		10-Feb-07	0:10		
8-Mar-07	00:40	8-Mar-07	0:40	8-Mar-07	0:20
11-Mar-07	00:30	11-Mar-07	1:20	11-Mar-07	0:10
11-Mar-07	00:15			11-Mar-07	0:10
19-Mar-07	00:15	19-Mar-07	1:10	19-Mar-07	0:30
19-Mar-07	00:35				
20-Mar-07	00:15	20-May-07	1:20	20-May-07	0:10
20-May-07	00:40	20-May-07	0:30	20-May-07	0:10
20-May-07	01:00			20-May-07	0:21
20-May-07	00:25				
21-May-07	01:40	21-May-07		21-May-07	2:02
		21-May-07	1:50		
		20-Jul-07			
		3-Sep-07	0:30	3-Sep-07	0:21
4-Sep-07	00:10	4-Sep-07	0:20		
		27-Sep-07			
		27-Sep-07	0:20		
		28-Sep-07			
30-Sep-07	00:05	30-Sep-07	4:40	30-Sep-07	0:10
30-Sep-07	00:15	30-Sep-07	0:10	30-Sep-07	3:04
		3-Oct-07	0:30	3-Oct-07	
		7-Oct-07	0:10		
17-Oct-07	00:15	17-Oct-07	0:30	17-Oct-07	0:10
		17-Oct-07	0:30	17-Oct-07	0:21
		18-Oct-07			
19-Oct-07	00:35	19-Oct-07	1:40	19-Oct-07	1:31
		19-Oct-07	0:20	19-Oct-07	0:11
		19-Oct-07	0:30	19-Oct-07	
24-Oct-07	00:15	24-Oct-07	0:30	24-Oct-07	0:21
		24-Oct-07	0:10	24-Oct-07	
12-Nov-07	00:45	12-Nov-07	5:10	12-Nov-07	4:56
12-Nov-07	00:20				

15-Nov-07	00:25	15-Nov-07	0:40	15-Nov-07	0:41
15-Nov-07	00:45	15-Nov-07	0:20	15-Nov-07	0:11
		15-Nov-07	2:30	15-Nov-07	0:10
				15-Nov-07	1:22
				15-Nov-07	1:32
		16-Nov-07	1:10		
17-Nov-07	01:15	17-Nov-07	1:40	17-Nov-07	1:21
26-Nov-07	00:05	26-Nov-07	1:30	26-Nov-07	1:11
		1-Dec-07	0:30	1-Dec-07	
		1-Dec-07	0:40	1-Dec-07	0:11
2-Dec-07	04:40	2-Dec-07	5:50	2-Dec-07	5:26
2-Dec-07	19:30	2-Dec-07	0:10	2-Dec-07	19:59
3-Dec-07	01:00	2-Dec-07	18:40	3-Dec-07	0:40
3-Dec-07	00:45			3-Dec-07	0:40
4-Dec-07	00:15			4-Dec-07	
		16-Dec-07	0:30		
18-Dec-07	00:40	18-Dec-07	0:50	18-Dec-07	0:51
		19-Dec-07			
		19-Dec-07			
22-Dec-07	00:35	22-Dec-07	1:50	22-Dec-07	0:21
				22-Dec-07	0:10
27-Dec-07	00:15	27-Dec-07	0:30	27-Dec-07	0:11
		2-Jan-08			
9-Jan-08	00:40	9-Jan-08	0:40	9-Jan-08	0:41
		10-Jan-08		10-Jan-08	0:10
12-Jan-08	00:10	12-Jan-08	0:30		
14-Jan-08	00:45	14-Jan-08	0:40	14-Jan-08	0:41
14-Jan-08	01:10	14-Jan-08	1:30	14-Jan-08	1:11
19-Jan-08	00:50	19-Jan-08	1:00	19-Jan-08	0:41
		6-Feb-08			
15-Mar-08	00:50	15-Mar-08	0:50	15-Mar-08	0:52
16-Mar-08	00:15	16-Mar-08	0:40	16-Mar-08	
23-Mar-08	00:10	23-Mar-08	0:50	23-Mar-08	
23-Mar-08	01:05	23-Mar-08	1:00	23-Mar-08	0:31
		23-Mar-08	2:20	23-Mar-08	2:13
26-Mar-08	00:30	26-Mar-08	0:40	26-Mar-08	0:10
		26-Mar-08	1:00	26-Mar-08	0:30
		28-Mar-08	0:20	28-Mar-08	
		29-Mar-08	1:00	29-Mar-08	0:11
		14-Apr-08	0:10		
3-Jun-08	00:40	3-Jun-08	3:10	3-Jun-08	2:23
3-Jun-08	02:45	3-Jun-08	1:00	3-Jun-08	3:54
		3-Jun-08	4:20		
9-Jun-08	00:10	9-Jun-08	0:30	9-Jun-08	0:10

**Table A. 4.** North Beach pump station overflow events based on wet well water levels and events estimated from modeled flows using a 3.4 MGD pump capacity. Portable meter data was available for a shorter observation period.

Wet Well Water Level		NBCHWetwell		Mouse/RDII	
Date	Duration	Date	Duration	Date	Duration
<b>2-Jan-07</b>	2:36	NA		<b>2-Jan-07</b>	1:11
3-Jan-07	0:14				
<b>5-Jan-07</b>	1:39			<b>5-Jan-07</b>	0:41
7-Jan-07	0:22				
				8-Jan-07	0:21
<b>19-Mar-07</b>	0:22	<b>19-Mar-07</b>	1:00	<b>19-Mar-07</b>	0:21
		20-May-07	0:30	20-May-07	0:00
				19-Aug-07	0:10
<b>20-Aug-07</b>	0:20	<b>20-Aug-07</b>	0:15	<b>20-Aug-07</b>	0:11
<b>19-Oct-07</b>	0:23	<b>19-Oct-07</b>	0:15	<b>19-Oct-07</b>	1:43
<b>17-Nov-07</b>	0:18	<b>17-Nov-07</b>	0:15	<b>17-Nov-07</b>	0:11
<b>2-Dec-07</b>	4:03	<b>2-Dec-07</b>	4:15	<b>2-Dec-07</b>	15:38
<b>3-Dec-07</b>	4:48	<b>2-Dec-07</b>	1:45	<b>3-Dec-07</b>	1:23
		4-Dec-07	0:15		
<b>9-Jan-08</b>	0:11	<b>9-Jan-08</b>	0:00	<b>9-Jan-08</b>	0:10
<b>15-Mar-08</b>	0:01			<b>15-Mar-08</b>	0:10
<b>4-Apr-08</b>	0:09	<b>4-Apr-08</b>	0:00		
				7-Apr-08	0:10
<b>3-Jun-08</b>	1:03	<b>3-Jun-08</b>	1:15	<b>3-Jun-08</b>	1:32

## **FLOWS AND STORAGE VOLUMES**



**Table A.1 Ranked Barton Basin Peak Flows and Storage Volumes**

<b>Rank</b>	<b>Start Time</b>	<b>End Time</b>	<b>Peak Flow Net (mgd)</b>	<b>Required Storage Volume (MG)</b>
1	8/8/99 6:03	8/8/99 9:28	22.91	2.79
2	12/3/07 2:54	12/3/07 10:11	13.32	1.67
3	12/12/95 19:45	12/12/95 20:38	60.49	1.54
4	1/16/00 14:43	1/16/00 17:54	60.49	1.49
5	10/5/81 22:32	10/6/81 13:36	28.33	1.02
6	12/14/06 11:44	12/14/06 17:18	60.49	1.01
7	1/18/86 12:37	1/18/86 19:23	17.19	0.72
8	3/9/95 16:43	3/9/95 17:13	59.15	0.70
9	12/8/93 20:56	12/8/93 22:26	47.46	0.67
10	11/23/94 0:28	11/23/94 0:57	59.89	0.58
11	5/21/07 19:35	5/21/07 20:15	34.64	0.57
12	6/6/08 16:13	6/6/08 16:56	27.62	0.46
13	8/29/05 13:23	8/29/05 13:52	39.91	0.46
14	9/2/79 14:23	9/2/79 14:57	36.25	0.42
15	1/8/07 11:28	1/8/07 12:09	17.95	0.32
16	3/3/99 5:22	3/3/99 5:46	32.34	0.28
17	12/29/96 9:15	12/29/96 15:57	15.95	0.24
18	12/14/00 23:02	12/14/00 23:24	30.62	0.24
19	12/13/01 22:32	12/13/01 22:54	29.14	0.22
20	8/4/99 7:31	8/4/99 8:03	16.00	0.22
21	9/22/78 16:58	9/22/78 19:18	14.30	0.21
22	2/19/81 2:45	2/19/81 3:10	16.83	0.196
23	4/26/97 23:09	4/26/97 23:52	11.30	0.189
24	2/6/99 16:59	2/6/99 17:22	23.07	0.183
25	5/31/05 18:00	5/31/05 18:32	11.42	0.156
26	8/22/04 6:01	8/22/04 6:52	9.96	0.146
27	10/20/03 8:46	10/20/03 15:24	3.65	0.143
28	11/2/84 9:29	11/2/84 9:54	14.72	0.132
29	11/20/98 23:24	11/20/98 23:41	19.30	0.117
30	8/16/98 15:56	8/16/98 16:13	11.46	0.092
31	3/3/87 14:52	3/3/87 15:16	7.60	0.084
32	8/22/01 16:16	8/22/01 17:23	7.82	0.081
33	12/23/03 7:20	12/23/03 7:42	7.42	0.065
34	11/22/88 11:28	11/22/88 11:46	9.50	0.060
35	7/11/80 15:38	7/11/80 15:57	5.64	0.044
36	1/16/06 22:43	1/16/06 22:58	8.59	0.043
37	6/7/94 16:28	6/7/94 16:44	6.44	0.043
38	11/27/96 21:49	11/27/96 22:35	3.90	0.040
39	12/14/79 21:00	12/14/79 21:38	2.41	0.039
40	11/28/01 8:00	11/28/01 8:24	2.71	0.029
41	1/1/97 13:14	1/1/97 13:31	3.46	0.026
42	8/14/89 14:06	8/14/89 14:17	7.34	0.026
43	11/5/80 19:17	11/5/80 19:27	5.89	0.021
44	7/10/97 18:06	7/10/97 18:14	6.44	0.020

**Table A.1 Ranked Barton Basin Peak Flows and Storage Volumes**

<b>Rank</b>	<b>Start Time</b>	<b>End Time</b>	<b>Peak Flow Net (mgd)</b>	<b>Required Storage Volume (MG)</b>
45	10/26/86 0:18	10/26/86 15:24	3.85	0.015
46	12/9/87 15:40	12/9/87 16:34	2.35	0.011
47	1/9/90 6:23	1/9/90 6:35	2.56	0.011
48	3/12/83 13:38	3/12/83 13:46	3.67	0.010
49	11/3/78 21:32	11/3/78 21:44	2.60	0.01
50	4/11/05 20:09	4/11/05 20:22	1.84	0.01
51	11/18/03 10:51	11/18/03 11:07	1.69	0.01
52	11/12/02 21:18	11/12/02 21:25	2.49	0.01
53	6/12/78 15:38	6/12/78 15:41	2.01	0.00
54	10/13/88 18:28	10/13/88 18:31	1.82	0.00
55	2/17/82 3:19	2/17/82 3:24	1.09	0.00
56	11/13/06 5:08	11/13/06 5:10	0.99	0.00
57	1/30/04 1:39	1/30/04 1:40	0.53	0.00
58	11/6/06 8:38	11/6/06 8:40	0.17	0.00
59	1/28/87 3:49	1/28/87 3:50	0.11	0.00

**Notes:**

1. Peak Flow = Peak Flow Net + 33 mgd

**Table A.2 Ranked Murray Basin Peak Flows and Storage Volumes**

Rank	Start Time	End Time	Peak Flow Net (mgd)	Required Storage Volume (MG)
1	12/2/07 22:54	12/3/07 21:50	39.92	14.01
2	1/18/86 8:14	1/18/86 21:06	38.80	8.98
3	10/20/03 3:11	10/20/03 18:05	30.54	7.06
4	10/5/81 17:47	10/6/81 16:48	38.16	4.97
5	8/8/99 6:03	8/8/99 9:49	37.14	4.73
6	12/29/96 9:16	12/29/96 18:11	31.27	4.23
7	12/14/06 11:16	12/14/06 18:03	60.44	3.13
8	1/9/90 4:46	1/9/90 9:26	26.78	2.85
9	1/16/00 14:42	1/16/00 18:12	75.61	2.82
10	11/24/90 6:30	11/24/90 14:25	20.45	2.67
11	11/18/03 8:57	11/19/03 6:26	26.65	2.50
12	10/25/86 3:04	10/26/86 15:48	24.71	2.20
13	11/28/01 6:28	11/29/01 2:24	29.93	2.18
14	12/12/95 19:45	12/12/95 21:03	70.48	2.01
15	9/22/78 16:40	9/22/78 19:47	30.22	1.77
16	12/14/79 20:39	12/14/79 23:52	25.46	1.58
17	12/3/82 8:02	12/3/82 14:36	19.82	1.54
18	1/17/05 8:53	1/17/05 14:23	15.89	1.52
19	8/22/04 5:48	8/22/04 9:09	30.48	1.40
20	8/22/01 16:08	8/22/01 17:46	31.01	1.33
21	11/27/96 15:55	11/27/96 23:05	21.37	1.27
22	12/17/79 11:28	12/17/79 18:04	20.41	1.23
23	12/8/93 20:53	12/8/93 22:45	34.83	1.21
24	5/31/97 6:04	5/31/97 10:20	16.72	1.20
25	1/1/97 11:59	1/2/97 6:10	27.95	1.09
26	11/3/78 20:37	11/3/78 22:52	24.25	1.07
27	11/1/84 13:06	11/2/84 10:14	26.10	1.07
28	5/21/07 19:36	5/21/07 20:33	42.13	1.01
29	3/3/87 14:33	3/3/87 16:24	28.86	1.00
30	11/21/80 9:48	11/21/80 12:17	24.10	0.97
31	11/6/06 8:08	11/6/06 10:42	23.75	0.97
32	6/6/08 16:13	6/6/08 17:30	29.12	0.95
33	12/9/87 15:25	12/9/87 17:04	23.36	0.94
34	9/2/79 14:15	9/2/79 15:25	37.07	0.91
35	5/31/05 17:51	5/31/05 18:53	30.86	0.84
36	4/23/96 6:38	4/23/96 18:24	13.65	0.84
37	4/26/97 23:03	4/27/97 0:09	25.56	0.82
38	1/8/07 11:27	1/8/07 12:26	29.63	0.75
39	11/22/88 8:48	11/22/88 12:03	25.32	0.74
40	3/9/95 16:45	3/9/95 17:28	34.80	0.61
41	11/23/94 0:28	11/23/94 1:16	31.07	0.56
42	2/19/81 2:45	2/19/81 3:29	29.14	0.54
43	11/17/82 5:37	11/17/82 7:06	12.26	0.54
44	1/14/88 10:18	1/14/88 12:37	19.24	0.54

**Table A.2 Ranked Murray Basin Peak Flows and Storage Volumes**

<b>Rank</b>	<b>Start Time</b>	<b>End Time</b>	<b>Peak Flow Net (mgd)</b>	<b>Required Storage Volume (MG)</b>
45	8/29/05 13:25	8/29/05 14:05	27.39	0.48
46	11/13/01 19:18	11/14/01 18:25	7.21	0.46
47	8/4/99 7:30	8/4/99 8:17	22.99	0.46
48	1/2/84 2:37	1/3/84 2:16	12.23	0.44
49	10/13/88 18:19	10/13/88 19:51	14.41	0.42
50	3/3/99 5:24	3/3/99 6:14	22.51	0.41
51	9/4/07 7:53	9/4/07 9:00	14.52	0.40
52	7/16/78 5:54	7/16/78 7:56	14.12	0.39
53	12/13/01 22:33	12/13/01 23:06	28.39	0.37
54	12/14/00 23:03	12/14/00 23:36	28.21	0.36
55	1/16/06 22:38	1/16/06 23:16	21.12	0.35
56	7/11/80 15:37	7/11/80 16:29	14.50	0.34
57	12/23/03 7:13	12/23/03 7:55	19.55	0.33
58	2/6/99 16:58	2/6/99 17:35	22.06	0.33
59	10/1/81 19:21	10/1/81 20:12	14.78	0.33
60	2/17/82 3:14	2/17/82 4:06	16.33	0.33
61	3/18/97 18:20	3/18/97 21:14	7.46	0.32
62	7/15/01 21:12	7/15/01 23:25	14.20	0.31
63	1/28/87 3:34	1/28/87 4:18	15.93	0.31
64	4/11/05 19:59	4/11/05 20:41	16.87	0.28
65	10/26/79 23:28	10/27/79 15:35	8.08	0.27
66	1/7/07 6:52	1/7/07 7:39	13.62	0.27
67	10/22/85 10:34	10/22/85 11:39	11.43	0.26
68	8/11/83 6:58	8/11/83 7:48	12.75	0.25
69	8/21/89 17:17	8/21/89 18:00	13.72	0.25
70	9/27/81 13:58	9/27/81 14:40	14.86	0.25
71	4/12/79 16:11	4/12/79 16:47	15.55	0.24
72	2/6/05 13:12	2/6/05 14:07	10.33	0.23
73	12/5/81 4:45	12/5/81 11:51	11.86	0.23
74	11/5/80 19:13	11/5/80 19:45	17.37	0.22
75	1/18/05 15:52	1/18/05 17:00	7.98	0.21
76	6/7/94 16:26	6/7/94 16:57	17.13	0.21
77	3/27/05 1:19	3/27/05 2:18	8.53	0.21
78	8/16/98 15:57	8/16/98 16:25	18.83	0.21
79	9/11/04 0:14	9/11/04 1:05	10.02	0.20
80	11/20/98 23:25	11/20/98 23:51	18.30	0.19
81	12/24/05 1:48	12/24/05 3:50	8.67	0.19
82	1/12/80 2:05	1/12/80 2:58	8.59	0.18
83	11/12/02 21:13	11/12/02 21:43	13.62	0.18
84	12/2/89 21:01	12/2/89 21:46	9.23	0.17
85	11/2/06 22:57	11/2/06 23:55	8.58	0.17
86	9/10/83 12:14	9/10/83 12:55	10.09	0.16
87	1/31/87 22:46	2/1/87 1:00	2.84	0.16
88	8/29/83 20:44	8/29/83 23:22	8.22	0.16

**Table A.2 Ranked Murray Basin Peak Flows and Storage Volumes**

<b>Rank</b>	<b>Start Time</b>	<b>End Time</b>	<b>Peak Flow Net (mgd)</b>	<b>Required Storage Volume (MG)</b>
89	10/29/97 6:15	10/30/97 5:26	6.72	0.15
90	3/12/83 13:36	3/12/83 14:01	14.49	0.15
91	9/25/98 13:13	9/25/98 13:43	10.75	0.15
92	1/30/04 1:33	1/30/04 2:01	12.21	0.15
93	11/6/80 23:15	11/7/80 16:09	8.75	0.14
94	2/4/06 0:16	2/4/06 0:45	12.46	0.14
95	10/23/78 20:39	10/23/78 21:22	7.12	0.14
96	12/26/06 21:20	12/26/06 23:52	3.91	0.14
97	8/14/89 14:05	8/14/89 14:28	12.10	0.13
98	5/12/88 19:43	5/12/88 20:20	8.89	0.13
99	10/26/94 13:28	10/26/94 14:32	4.78	0.12
100	10/31/90 18:24	10/31/90 18:59	8.28	0.12
101	10/28/82 16:47	10/28/82 18:04	4.95	0.11
102	7/10/97 18:05	7/10/97 18:30	9.42	0.11
103	8/2/96 16:17	8/2/96 16:47	8.83	0.11
104	5/15/05 7:42	5/15/05 8:12	9.05	0.11
105	6/24/99 2:24	6/24/99 2:57	7.30	0.10
106	5/28/88 3:16	5/28/88 3:42	9.62	0.10
107	9/3/94 10:31	9/3/94 10:58	9.21	0.10
108	11/3/83 0:41	11/3/83 13:06	6.57	0.10
109	11/10/99 15:22	11/10/99 15:59	5.41	0.09
110	11/12/06 21:21	11/13/06 5:23	9.94	0.08
111	4/7/87 21:36	4/7/87 22:14	4.98	0.08
112	6/27/01 11:14	6/27/01 11:41	6.52	0.08
113	1/27/83 8:56	1/27/83 9:32	5.09	0.08
114	8/26/07 4:33	8/26/07 4:58	6.55	0.08
115	6/12/78 15:34	6/12/78 15:56	9.02	0.08
116	2/17/83 14:08	2/17/83 14:33	7.85	0.08
117	4/14/80 14:28	4/14/80 14:48	9.54	0.08
118	1/28/90 12:27	1/28/90 12:51	7.69	0.07
119	11/5/88 14:06	11/5/88 15:10	3.17	0.07
120	11/23/86 5:58	11/23/86 6:57	4.56	0.07
121	1/5/90 16:48	1/5/90 17:17	5.82	0.07
122	12/15/99 10:49	12/15/99 11:21	4.05	0.06
123	2/11/79 18:39	2/11/79 19:04	5.86	0.06
124	4/16/05 5:55	4/16/05 6:22	4.58	0.06
125	2/8/96 5:47	2/8/96 6:19	4.28	0.06
126	6/7/85 5:52	6/7/85 6:22	4.65	0.05
127	7/16/99 5:38	7/16/99 5:59	6.75	0.05
128	4/19/97 23:04	4/20/97 0:15	3.25	0.05
129	11/19/80 1:48	11/19/80 2:09	5.79	0.05
130	10/20/85 3:15	10/20/85 3:40	4.21	0.05
131	12/10/04 0:06	12/10/04 0:51	2.56	0.05
132	12/14/02 15:30	12/14/02 15:52	6.11	0.05

**Table A.2 Ranked Murray Basin Peak Flows and Storage Volumes**

Rank	Start Time	End Time	Peak Flow Net (mgd)	Required Storage Volume (MG)
133	1/23/03 3:43	1/23/03 4:04	5.08	0.05
134	1/30/95 8:08	1/30/95 8:37	3.84	0.04
135	12/13/79 12:28	12/13/79 12:53	4.50	0.04
136	2/19/91 5:01	2/19/91 5:30	3.24	0.04
137	1/10/06 2:00	1/10/06 2:23	5.28	0.04
138	12/26/80 1:06	12/26/80 1:33	3.87	0.04
139	12/4/89 3:04	12/4/89 5:02	2.20	0.04
140	12/15/81 11:28	12/15/81 12:05	1.75	0.04
141	11/17/07 12:33	11/17/07 12:54	3.11	0.03
142	4/8/08 18:07	4/8/08 18:29	3.13	0.03
143	4/19/78 17:48	4/19/78 18:11	3.44	0.03
144	8/20/07 6:35	8/20/07 6:53	4.10	0.03
145	10/3/98 16:56	10/3/98 17:17	2.65	0.03
146	12/2/81 4:08	12/2/81 4:28	3.17	0.02
147	1/30/82 17:46	1/30/82 18:06	2.82	0.02
148	10/9/00 8:16	10/9/00 8:33	2.96	0.02
149	1/30/06 1:53	1/30/06 2:27	1.49	0.02
150	10/17/96 18:42	10/17/96 19:04	1.94	0.02
151	4/27/78 20:59	4/27/78 21:16	2.74	0.02
152	9/29/81 2:55	9/29/81 3:08	3.70	0.02
153	1/6/90 23:06	1/7/90 0:25	1.06	0.02
154	6/16/05 23:32	6/16/05 23:48	2.56	0.01
155	6/17/96 20:11	6/17/96 20:23	3.37	0.01
156	9/23/92 12:38	9/23/92 12:54	2.14	0.01
157	11/4/06 15:38	11/4/06 16:59	1.65	0.01
158	10/28/96 16:08	10/28/96 16:23	1.66	0.01
159	12/4/78 9:29	12/4/78 9:45	2.08	0.01
160	3/11/80 2:19	3/11/80 2:43	1.30	0.01
161	11/12/99 3:35	11/12/99 3:46	2.95	0.01
162	11/27/86 3:28	11/27/86 3:42	1.53	0.01
163	11/28/95 17:12	11/28/95 17:32	1.25	0.01
164	5/13/96 0:56	5/13/96 1:09	2.09	0.01
165	1/2/03 17:48	1/2/03 18:01	1.65	0.01
166	11/5/86 20:18	11/5/86 20:30	1.69	0.01
167	4/16/92 22:48	4/16/92 23:05	0.78	0.01
168	4/19/80 18:28	4/19/80 18:40	0.70	0.00
169	11/8/80 19:39	11/8/80 19:50	0.51	0.00
170	7/24/91 14:19	7/24/91 14:32	0.57	0.00
171	3/23/85 10:37	3/23/85 10:44	1.20	0.00
172	2/21/02 2:57	2/21/02 3:10	0.49	0.00
173	4/30/87 19:37	4/30/87 19:44	0.96	0.00
174	7/26/78 17:28	7/26/78 17:34	0.82	0.00
175	1/4/83 21:06	1/4/83 21:15	0.56	0.00
176	11/16/07 0:39	11/16/07 0:50	0.37	0.00

**Table A.2 Ranked Murray Basin Peak Flows and Storage Volumes**

<b>Rank</b>	<b>Start Time</b>	<b>End Time</b>	<b>Peak Flow Net (mgd)</b>	<b>Required Storage Volume (MG)</b>
177	3/5/83 19:59	3/5/83 20:01	0.93	0.00
178	4/4/91 17:28	4/4/91 17:34	0.34	0.00
179	12/19/94 19:18	12/19/94 19:23	0.29	0.00
180	6/10/83 2:47	6/10/83 2:50	0.37	0.00
181	9/5/84 10:29	9/5/84 10:32	0.39	0.00
182	1/27/92 17:47	1/27/92 17:50	0.26	0.00
183	6/17/86 20:29	6/17/86 20:31	0.42	0.00
184	7/18/87 21:08	7/18/87 21:11	0.32	0.00
185	6/18/02 11:49	6/18/02 11:50	0.10	0.00
186	3/15/92 3:39	3/15/92 3:40	0.01	0.00
187	3/22/03 6:19	3/22/03 6:20	0.08	0.00

**Notes:**

1. Peak Flow = Peak Flow Net + 31.5 mgd
2. Assumes Capacity of 33 mgd at Barton Pump Station and 31.56 mgd at Murray Pump Station



**TECHNICAL MEMORANDUM 600.5**  
**CSO BEACH PROJECTS**  
**DEMAND MANAGEMENT ANALYSIS**



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**Technical Memorandum 600.5**  
**CSO Beach Projects**  
**Demand Management Analysis**

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May 2010



**King County**

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# Acronyms

BMP	Best management practices
CSO	combined sewer overflow
CSS	combined sewer system
Ecology	Washington State Department of Ecology
GIS	geographic information system
GSI	green stormwater infrastructure
LID	low-impact development
MOUSE	modeling software used by WTD for conveyance system planning
MS4	municipal separate storm sewer system
NPDES	National Pollutant Discharge Elimination System
OECA	EPA's Office of Enforcement and Compliance Assurance
ROW	right-of-way
SPU	Seattle Public Utilities
EPA	U.S. Environmental Protection Agency
WERF	Water Environment Research Foundation
WTD	King County Wastewater Treatment Division

# EXECUTIVE SUMMARY

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King County's Wastewater Treatment Division is considering implementation of green stormwater infrastructure as one of several means to control its combined sewer overflows (CSOs) so that they meet the Washington State standard of no more than one overflow on average per year at each CSO site.

Four county CSO control projects, collectively called the Puget Sound beach projects, are in the predesign phase. Early in the process, stakeholders recommended that "demand management" techniques be considered. Such techniques serve to reduce peak flow into the combined sewer system. Green stormwater infrastructure (GSI) is a cost-effective, sustainable, and environmentally friendly demand management approach to diverting and managing stormwater. The four basins that drain to the Puget Sound beach CSOs were evaluated to determine if any of the basins would be suitable for CSO control through GSI, and if basins were identified, to develop planning-level GSI alternatives to be considered along with other CSO control alternatives for those basins.

The GSI analyses and results are as follows:

- A geographic information system (GIS) analysis identified the destinations of stormwater flows from both private parcels and public rights-of-way in the four basins (and their subbasins).
- A GIS spatial analysis identified the impervious acreages in the subbasins that drain to the combined sewer system and the level of mitigation that various GSI techniques could achieve. The analysis identified Subbasin 416 in the Barton basin as the most feasible for GSI implementation and roadside rain gardens as the GSI technique that would realize the greatest benefit. The level of mitigation through rooftop disconnections in the Murray and South Magnolia basins may be explored further in subsequent analyses.
- Modeling of a number of rain garden design factors indicates that a total bottom area of about 0.88 acre in rain gardens would be needed to control CSOs in the Barton basin. Approximately 174 roadside rain gardens would meet this requirement.
- The planning-level capital cost estimate for rain gardens in Subbasin 416, developed based on national and local projects, is \$8.3 million with contingency.

The GSI alternative and two storage alternatives for the Barton basin will be presented to the public in spring 2010. The public's input will help King County define a proposal that will, in spring 2011, go through the environmental review process required by state law. Design is expected to be completed and construction to begin on all Puget Sound beach projects in 2013.

# 1.0. INTRODUCTION

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King County’s Wastewater Treatment Division (WTD) plans to control all of its 38 combined sewer overflow (CSO) sites to an average of no more than one overflow per year by 2030.<sup>2</sup> Projects are under way to control four CSO sites near Puget Sound beaches—Barton Pump Station, Murray Pump Station, South Magnolia Overflow Weir, and North Beach Pump Station—all in the City of Seattle.

In addition to storage and treatment, WTD is investigating demand management options to control the Puget Sound beach CSOs. Demand management techniques reduce the amount of stormwater and groundwater in the combined sewer system. Examples include sewer separation, infiltration and inflow reduction, and stormwater diversion/management. Green stormwater infrastructure (GSI) is a cost-effective, sustainable, and environmentally friendly approach to diverting and managing stormwater.

The areas (basins) that send stormwater to the four Puget Sound beach CSOs were evaluated to determine whether GSI, either alone or in combination with other methods, can achieve CSO control.

This technical memorandum describes the methods and results of each step of the evaluation. The first step was to identify the sources of stormwater entering the combined sewer system. To do this, WTD conducted a geographic information system (GIS) analysis to calculate the acreages in assessed properties and in the right-of-way in the four Puget Sound beach CSO basins that contribute flow to the combined sewer system. Information from the GIS analysis was used to identify areas that showed potential for GSI applications. Subbasin 416 in the Barton basin emerged as the most promising area for GSI application. The next step was to determine appropriate GSI techniques for this basin and to estimate sizes of facilities and costs for implementing them. Initial analyses were done for areas with less potential. More information can be found in the technical memorandums that detail each step.<sup>3</sup>

The remainder of this chapter provides background on the alternatives development and review process, regulatory impetus for using GSI, and the study area for the Puget Sound beach projects.

## What is Green Infrastructure?

The concept of green infrastructure originated in the strategic conservation planning field. In this context, large forests, wetlands, greenbelts, and so forth—all part of the *natural* environment—are viewed as infrastructure because they support essential ecosystem functions (Great City, 2009).<sup>1</sup>

The term is increasingly being used to refer to *engineered* infrastructure at a smaller scale in relation to green stormwater management practices such as rain gardens and green roofs. These practices make use of soils and vegetation, in combination with other decentralized storage and infiltration approaches such as rain barrels and permeable pavement, to infiltrate, evaporate, capture, and reuse stormwater.

In addition to helping reduce CSOs and the amount of untreated stormwater that finds its way to surface water, green stormwater management facilitates natural processes that recharge groundwater, preserve baseflow in streams, moderate impacts to water and air temperature, and protect hydrologic and hydraulic stability.

Other names for green stormwater management include low impact development (LID), natural drainage, and water-sensitive design. This technical memorandum uses the term “green stormwater infrastructure” (GSI).

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<sup>1</sup> <http://www.greatcity.org/campaigns/green-infrastructure/>

<sup>2</sup> Averaged over a 20- year period.

<sup>3</sup> *Technical Memorandum 207.1, CSO Beach Project GIS Analysis*. September 2008.

*Technical Memorandum 600.1, CSO Beach Projects, Green Infrastructure Analysis*. December 2010.

*Technical Memorandum 600.3, Modeling for GSI Options*. March 2010.

## 1.1 Identifying and Reviewing CSO Control Alternatives

In 2007, King County held workshops with internal and external stakeholders to identify approaches to control each of the Puget Sound beach CSOs. Because rooftop disconnection was identified as a possible approach for one basin, demand management was added as an option for all four basins. The approaches under consideration are as follows:

- Store peak flows during large storms and send them to the West Point Treatment Plant after the storm.
- Increase pumping and conveyance capacity to direct peak flows to existing treatment facilities.
- Reduce peak flows of stormwater and groundwater into the combined sewer system (demand management).
- Treat peak flows at a new local treatment facility.
- Use combinations of the options.

In late 2009, the project team presented this range of approaches at public meetings. The GSI team then met with project staff to discuss how to apply the criteria used for evaluating other project approaches to GSI; the results of the meeting are in Appendix A.

In spring 2010, specific alternatives for CSO control in each basin will be presented to the public. The public's input will help King County define a proposal for each basin that will, in spring 2011, go through the environmental review process required by state law. Design is expected to be completed and construction to begin on all projects in 2013.

Three alternatives are being considered for the Barton basin: two storage alternatives and the GSI alternative presented in this technical memorandum. A planned upgrade of the Barton Pump Station will increase capacity to help control CSOs in the basin. Size limitations at the station do not allow for expanding capacity to manage the entire volume of peak flows necessary to achieve CSO control. The remaining volume that must be managed to meet regulatory requirements will depend on the type and location of each alternative being considered.<sup>4</sup>

The demand management analyses for the Puget Sound beach projects will be used as a basis for evaluating demand management alternatives for future CSO control projects.

## 1.2 Regulatory Context for Implementing GSI

King County's CSOs are regulated through the West Point Treatment Plant's National Pollutant Discharge Elimination System (NPDES) permit. The U.S. Environmental Protection Agency (EPA) has delegated management of NPDES permits in Washington State to the Washington State Department of Ecology (Ecology).

In March 2007, EPA's Office of Water sent a memorandum to EPA regional administrators stating that green infrastructure "can be both a cost effective and an environmentally preferable

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<sup>4</sup> For more information on the alternatives and schedule for the Puget Sound Beach CSO controls projects, see <http://www.kingcounty.gov/environment/wtd/Construction/Seattle/BeachCSO.aspx>.

approach to reduce stormwater and other excess flows entering combined or separate sewer systems in combination with, or in lieu of, centralized hard infrastructure solutions” (EPA, 2007b). In August of the same year, EPA’s Office of Enforcement and Compliance Assurance (OECA) sent a memorandum on use of green infrastructure in NPDES permits and enforcement to state NPDES directors, regional counsel/enforcement coordinators, and regional water division directors. In the memorandum, OECA encourages permitting authorities to structure permits and guidance/criteria for stormwater plans and long-term CSO control plans to encourage use of green infrastructure approaches where appropriate (EPA, 2007a). The memorandums are in Appendix B.

In January 2008, OECA audited King County’s wet-weather management programs. Such audits are occurring across the country. OECA selects agencies to be audited based on size, population served, and system complexity. City of Seattle programs underwent a similar audit at the same time. OECA and EPA Region 10 staff, accompanied by Ecology staff, performed an intensive inspection over five days. Since that time, King County has met with EPA and provided additional information on programs and activities. EPA has not yet made its findings public. EPA also conducted an audit of Ecology’s NPDES program around the same time.

Consent decrees often follow these audits. A consent decree is a legal document approved by a judge that formalizes an agreement between EPA and other parties. Recent consent decrees have required wastewater utilities to implement green infrastructure and/or to include evaluation of green infrastructure as a component of their long-term CSO control plans. Consent decrees for Washington D.C., Cincinnati, Philadelphia, Pittsburgh, and Mobile include green infrastructure clauses. Long-term CSO control plans for Philadelphia, Cleveland, Kansas City, Milwaukee, and Portland, to name a few, include green infrastructure in order to comply with EPA mandates.

To support these enforcement activities, EPA has issued guidance on employing green infrastructure for CSO control (EPA, 2008).<sup>5</sup>

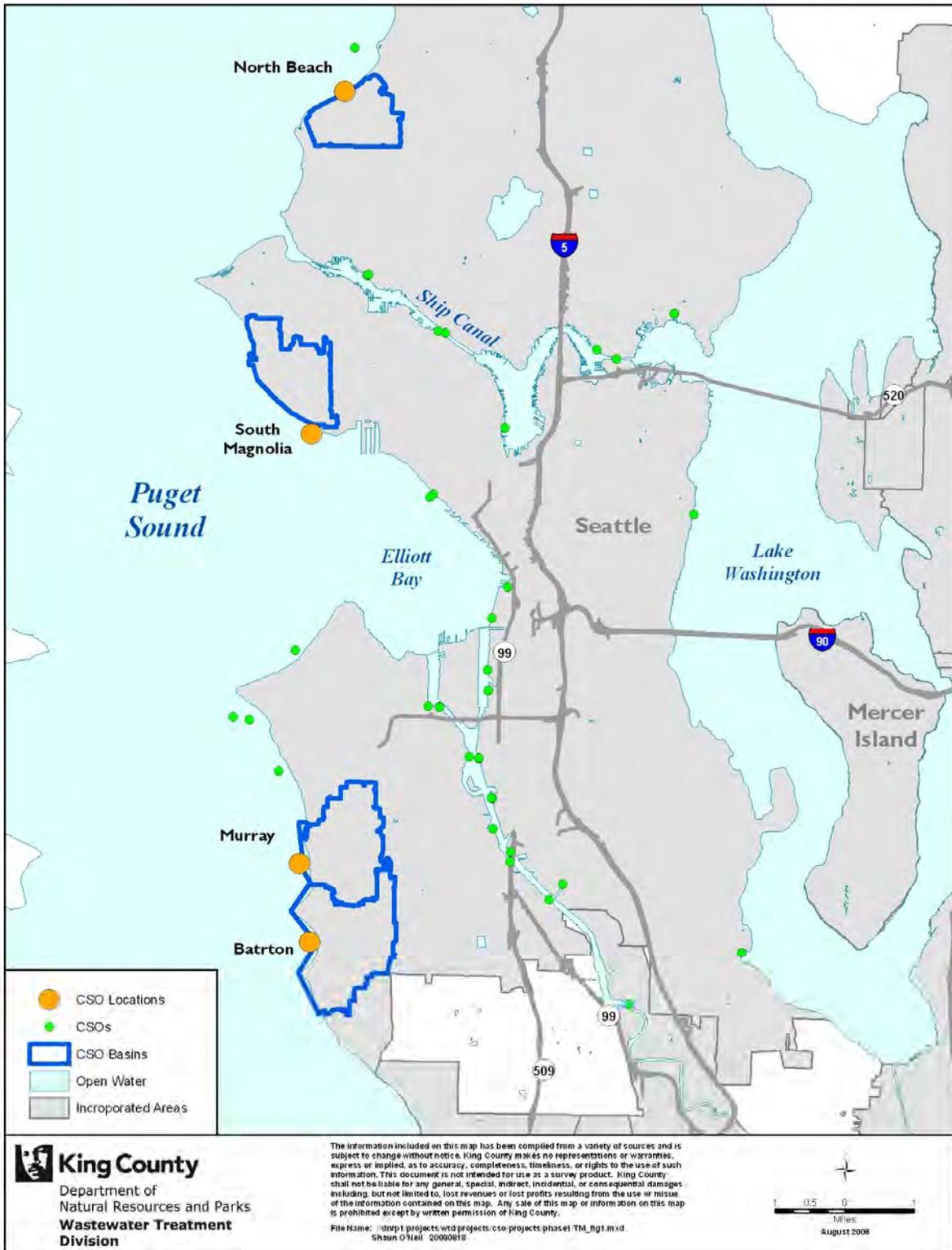
### 1.3 Study Area

The basins and subbasins that drain to the four Puget Sound beach CSOs are shown in Figure 1-1 and Figure 1-2.<sup>6</sup> Figure 1-1 also shows the locations of other King County CSOs. Stormwater in these basins flows directly to the combined sewer system, directly to the separate municipal storm sewer system, or overland to a receiving water body. Characteristics of the basins are as follows:

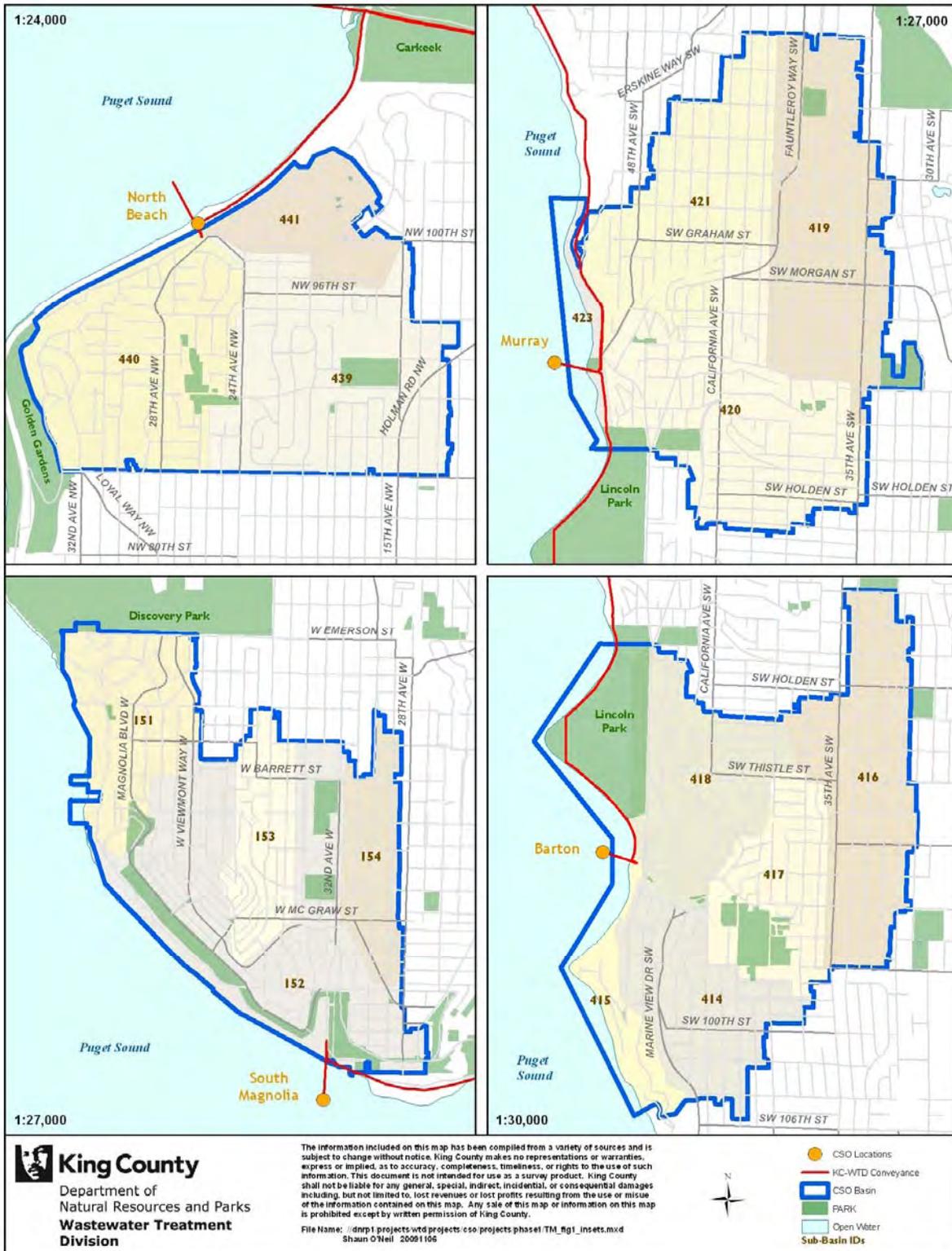
- The North Beach basin, in the northwest corner of Seattle on a northwest facing slope, is 863 acres divided into three subbasins: 439, 440, and 441.
- The South Magnolia basin, between the Lake Washington Ship Canal and Elliott Bay on the west side of the city, is 771 acres divided into four subbasins: 151, 152, 153, and 154.
- The Murray basin, in West Seattle just north of Lincoln Park, is 992 acres divided into four subbasins: 419, 420, 421, and 423.
- The Barton basin, just south of both Lincoln Park and the Murray basin, is 863 acres divided into five subbasins: 414, 415, 416, 417, and 418.

<sup>5</sup> [http://www.epa.gov/npdes/pubs/gi\\_action\\_strategy.pdf](http://www.epa.gov/npdes/pubs/gi_action_strategy.pdf)

<sup>6</sup> Subbasins were delineated for flow monitoring and modeling conducted in 2006.



**Figure 1-1. Location of Contributing Basins for Puget Sound Beach CSO Control Projects**



**Figure 1-2. Location of Subbasins for Puget Sound Beach CSO Control Projects**

## 2.0. IDENTIFYING POTENTIAL GSI AREAS AND OPTIONS

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CSO programs need a strategy to identify large areas of impervious area connected to the combined sewer system (CSS) to mitigate stormwater runoff. Areas such as streets and other public rights-of-way (ROW) are potentially large sources of stormwater. Parcel-based solutions tend to have a smaller impact. Using individual single-family parcels requires the voluntary participation of property owners, which often requires offering an incentive; this option will work only if enough area is disconnected from the CSS. However, large parcels that are commercial, industrial, or institutional should be looked at when the street areas are separated or when it is cost-effective to reduce impervious parcel areas to reduce CSOs.

WTD performed a GIS analysis in 2008. The analysis identified sources of stormwater to the CSS and the separate municipal storm sewer system (MS4) and the characteristics of the basins as they relate to these sources. Impervious, pervious, and rooftop areas were identified, along with the destination of any flows originating from these locations, on both assessed property and the street ROW. The analysis built on flow monitoring and modeling in the CSS conducted in 2006. The results of the analysis were used as inputs, along with rain and flow data, into a model of the basins to identify the scale and location of CSO control options for all basins.

Results of the GIS analyses were used to conduct a GIS spatial analysis to assess the feasibility of GSI implementation in the study area, to identify the most promising basins for GSI implementation, and to review and select GSI techniques that could achieve desired results.

The following sections describe the methods and results of these analyses.

### 2.1 Identifying Where Stormwater Flows From the CSO Basins

#### 2.1.1 Methodology

The GIS analysis of stormwater destinations in the four basins consisted of the following steps:

- Evaluated available King County and City of Seattle GIS data and selected applicable data.
- Input the data into a geodatabase and develop useable datasets.
- Developed a model for extracting information from the underlying datasets to identify characteristics for each parcel and ROW and their contributions to the CSS and MS4.
- Developed assumptions to account for inaccuracies in GIS data through an iterative process of data evaluation and comparison of GIS-identified impervious acres.
- Field-verified basin characteristics to check assumptions.
- Developed parcel and ROW acreages for each subbasin and the destinations of flows from these acreages.
- Identified subbasins with a significant area connected to the CSS.

To develop useable datasets, subsets of all available and pertinent GIS data were created for each of the four CSO basins. City of Seattle conveyance data were used as the base to delineate CSO basins; subbasins delineated in the 1990s before GIS data were available were adjusted to match the boundaries of their basins. Once the data were limited to the basin extents, the parcels and ROWs were characterized.

#### Parcel and ROW Characterization

The first step in parcel characterization involved investigating the entire basin area and including any parcel that was depicted as being directly connected to the MS4. A geoprocessing model was created that evaluated the existence of conveyance features—infiltration pits, storm drain laterals, sewer laterals, catch basins, and downspouts—in each parcel and then attributed the parcels in the GIS layer with this information. The various combinations of the existence of the conveyance features with any contributions to the MS4 provided all of the information needed to allocate the different areas of the parcel—rooftop, impervious, and pervious—to the CSS or MS4. The square footages for the different area categories in each parcel were then calculated. Finally, the destination of the flow coming from the rooftops and the impervious/pervious areas for two sets of assumptions (described below) was identified. For each field, the options were CSS, MS4, overland to receiving water body, via the ROW to the CSS, and via the ROW to the MS4. Each code was determined by selecting parcels that met the set of assumptions in that circumstance.

The ROW in each basin was characterized according to destination of flow using the terrain (described by 2-foot contours), catch basins, a ditch/culvert/curb system, and the underlying CSS and MS4 systems. The pervious and impervious areas of the ROW were split into three categories based on whether the flow from the ROW ended up in the CSS, the MS4, or the receiving water body via overland flow.

#### Assumptions and Field Verification

Because the GIS data are inconsistent in the depiction of features in different areas, assumptions were developed to help model catch basin, downspout, and conveyance locations and connectivity (Appendix C). Acreages were calculated for two scenarios, designated as Scenarios A and B, to provide a range of values for areas that contribute to the CSS. Each scenario had its own group of assumptions. Each was developed to capture as many combinations of depicted features that would indicate the accurate characteristics for a given property. Both scenarios are considered valid for estimating surface area that could potentially be diverted from the CSS.

Both King County and Seattle Public Utilities (SPU) conducted field investigations to test the assumptions and to gauge the level of confidence in the GIS data. County fieldwork consisted of visual surveys from the ROW to verify the existing downspout and catch basin locations in the GIS datasets and to identify any others not currently in the datasets. Overall, the GIS data regarding catch basins were accurate. The data representing downspouts were, as was expected, variable in accuracy across all four basins. In areas that drain to the CSS, about 15 to 30 percent of properties investigated had downspouts not in the GIS. For the two areas that were separated with no MS4 available to convey flow, 50 and 84 percent of the houses investigated, respectively, had downspouts that were not in the GIS and that conveyed flows from the roof or property into an underground conveyance, assumed to flow overland to the receiving water body.

In 2009, SPU performed a field investigation of the four CSO basins. The investigation indicated that the accuracy of King County's GIS approach was well within planning-level expectations

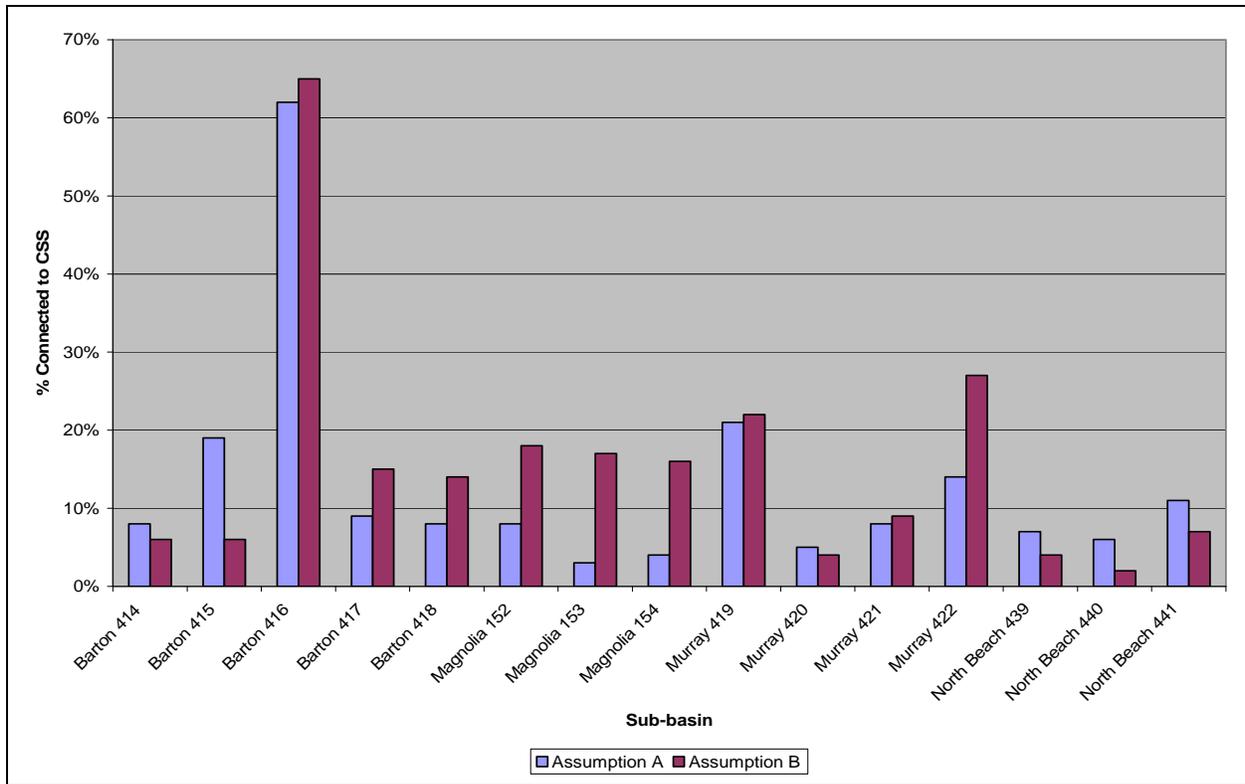
(SPU, 2009). Depending on the basin, the range of uncertainty is 10–39 percent. The assumptions result in conservatively low results with respect to parcels, more specifically to roofs connected to the CSS. The accuracy of the downspout data on which these connections rely depend, in part, on the year the structure was built. For example, houses built prior to 1979 tend to be connected to the sanitary sewer system, whereas houses built after 1979 tend to be connected to the MS4. The SPU testing shows that this method of estimating connections to the CSS will underestimate the number of homes connected. Areas connected to the CSS in a partially separated basin will be greater than shown in the GIS model.

### 2.1.2 Results

The analysis provided total square footage for the parcel rooftop, impervious, and pervious areas and the ROW impervious and pervious areas and the final destinations of the associated flows for the two scenarios outlined in the assumptions. The acreages for each basin, broken down by the component areas, are shown in Table 2-1. The acreages were further defined by subbasins. Figure 2-1 shows the percentage of impervious area with connections to the CSS in each subbasin.

**Table 2-1. Rooftop, Impervious, and Pervious Acreage by Basin**

	<b>Barton</b>		<b>Murray</b>		<b>North Beach</b>		<b>South Magnolia</b>	
	<b>Scenario A</b>	<b>Scenario B</b>	<b>Scenario A</b>	<b>Scenario B</b>	<b>Scenario A</b>	<b>Scenario B</b>	<b>Scenario A</b>	<b>Scenario B</b>
<b>ROW</b>	<b>287</b>	<b>287</b>	<b>281</b>	<b>281</b>	<b>152</b>	<b>152</b>	<b>243</b>	<b>243</b>
Impervious	224	224	232	232	119	119	195	195
Pervious	64	64	48	48	32	32	48	48
<b>Parcels</b>	<b>824</b>	<b>824</b>	<b>790</b>	<b>790</b>	<b>481</b>	<b>481</b>	<b>529</b>	<b>529</b>
Roof	185	185	184	184	128	128	144	144
Impervious	234	234	238	238	160	160	175	175
Pervious	405	405	368	368	193	193	210	210
<b>Total</b>	<b>1,112</b>	<b>1,112</b>	<b>1,071</b>	<b>1,071</b>	<b>633</b>	<b>633</b>	<b>771</b>	<b>771</b>



**Figure 2-1. Percentage of Connected Impervious Surface to Combined Sewer System by Subbasin**

## 2.2 GIS Spatial Analysis—Potential for Green Stormwater Infrastructure

King County based its feasibility analysis of the potential for GSI in the four CSO basins on a white paper published in October 2007 titled “Low Impact Development: San Francisco’s Green Approach to Stormwater Management” (Kennedy et al., 2007). The San Francisco approach appears to be a cost-effective way to evaluate large areas of a city for GSI potential. WTD is using this approach as a basis for developing its GSI program. The City of Seattle is also developing an approach for GSI in its CSO control program. WTD is consulting with the city and modifying its approach as more is learned from completed city projects and as improved flow information becomes available.

San Francisco conducted a literature review and case studies, reviewed existing San Francisco programs that could complement or support GSI, conducted a GIS spatial analysis of potential GSI implementation, modeled GSI scenarios in the collection system model, and conducted a cost-benefit analysis. The GIS spatial analysis relied on a set of criteria developed to help identify suitable locations for each of five GSI techniques: Ecoroofs (green roofs), roof disconnection, street trees, bioretention, and permeable pavement. This section describes the methods and results of King County’s GIS spatial analysis.

## 2.2.1 Methodology

The steps in King County's GSI feasibility analysis were as follows:

- Developed criteria to identify types of areas suitable for application the five GSI techniques, starting with the San Francisco criteria and modifying them to accommodate data available for Seattle (Table 2-2).
- For each GSI technique, identified the number of acres connected to the CSS in each of the 16 subbasins where stormwater could potentially be diverted or attenuated.
- Recommended one subbasin and one GSI technique for further analysis.

With the exception of areas identified for street tree planting, the analysis did not identify specific locations for GSI facilities. The facilities may be located outside an area that contributes to the CSS. For example, bioretention may occur on a property that will attenuate flow from the adjacent ROW that would otherwise have gone into the CSS.

Each GSI technique was evaluated for both Scenarios A and B. All of the criteria for a given scenario and source of flow—rooftop, impervious, or pervious—had to be met for that area to be considered as a source of flow for GSI techniques. Acreages identified for one GSI technique could also be included for another technique. For example, the acres under green roofs for a subbasin are also included in acres under roof disconnection for the same subbasin.

### GSI Techniques

**Ecoroofs (green roofs)** consist of shallow layers of growing medium, low-growing vegetation, subsurface drainage, and a waterproof membrane.

**Roof disconnection** is a type of rainwater harvesting that involves removing water that flows from a roof through a downspout to a CSS and redirecting it to some other location. It is not considered a GSI technique, but rather an alternative to be considered for reducing flows to the CSS.

**Street trees** are different from tree boxes, which filter runoff from streets and other impervious surfaces. Street trees retain some rain in their canopies and uptake a portion of the rain that infiltrates to the soil.

**Bioretention** involves dispersed small-scale landscape features designed to attenuate and treat stormwater (Kennedy et al., 2007). These features are typically vegetation-filled areas, such as rain gardens and swales, with a drainage mechanism, often located in parking lots, median strips, or streets.

**Permeable pavement** allows rainfall to penetrate the pavement into a porous material that retains stormwater before it enters a combined sewer, thereby attenuating or removing the effects of the stormwater on the sewer. Permeable pavement is not suited for high-traffic areas.



Rain Garden in a Residential Area



Green Roof on Chicago's City Hall

**Table 2-2. Criteria Used to Identify Areas Suitable for Green Stormwater Infrastructure Techniques**

<b>Technique</b>	<b>Criteria</b>
<b>Green roofs</b>	Roofs connected to CSS Roofs over 5,000 square feet Roofs with slopes between 5 and 20 degrees Buildings and garages selected from City of Seattle building footprint dataset (does not include decks, patios, etc.)
<b>Roof disconnection</b>	Roofs connected to the CSS
<b>Street trees</b>	Areas identified in LIDAR as less than 5 feet higher than ground elevation Areas in the right-of-way Areas connected to the CSS Pervious areas
<b>Bioretention</b>	Non-rooftop areas in the right-of-way or on private property Impervious areas Areas connected to the CSS Ground slope less than 5%
<b>Permeable pavement</b>	Impervious areas of low-traffic streets, alleys, and parking lots greater than 10,000 square feet Areas connected to the CSS Ground slope less than 5%

CSS = combined sewer system; LIDAR = Light Detection and Ranging.

In addition, King County looked at other CSO programs in the country to see which GSI techniques were used in urban areas. Specifically, the team looked for projects that involved large areas of impervious surfaces that were in the public ROW:

- The City of Portland has implemented many projects using curb-contained rain gardens.
- SPU is planning on constructing similar roadside rain gardens to control city CSOs in the Ballard neighborhood.
- Chicago has implemented several projects using permeable pavers in alleyways.
- Rooftop disconnection programs exist in most CSO communities, including some in Washington State.

### 2.2.2 Results

The results of the GSI feasibility analysis are shown in Table 2-3. For each GSI technique, the table shows the number of acres connected to the CSS where stormwater could potentially be diverted or attenuated. The analysis indicates that Subbasin 416 in the Barton basin holds the highest potential across all GSI techniques, that Subbasin 152 in the South Magnolia basin holds a similar potential but only for roof disconnection, that the Murray basin holds some potential for roof disconnection, and that the North Beach basin shows little potential for GSI implementation.

A preliminary analysis of the Murray and South Magnolia basins, documented in Appendix D, indicates that these basins do not have enough ROW area to support roadside rain gardens and that the estimated volume of stormwater removed from the CSS through the city’s Residential RainWise Program, which promotes GSI on private properties with rooftops connected to the

CSS, would not meet target reductions in CSO storage volumes. Additional analyses may be conducted for these basins to supplement the preliminary RainWise analysis.

Subbasin 416 was carried forward for further evaluation for feasible GSI techniques. As shown in Table 2-3, roof disconnection, bioretention, and permeable pavement would mitigate the greatest number of acres in the basin. For this and other reasons, green roofs and street trees were eliminated from further consideration. Green roofs may show more potential in commercial and industrial areas of the city where large roofs are prevalent. A more robust analysis of potential benefits from street trees could be performed; however, the probability of using this technique for CSO control for the CSO beach projects is low. The time necessary for an evergreen tree to grow to maturity is too long, and waiting to realize the potential of this technique would delay implementation of the King County CSO Control Program.

**Table 2-3. Acreages Connected to the Combined Sewer System that Show Potential for Green Stormwater Infrastructure Techniques**

Subbasin	Green Roofs		Roof Disconnection		Street Trees		Bioretention		Permeable Pavement	
	Scenario									
	A	B	A	B	A	B	A	B	A	B
<b>Barton</b>										
414	0.8	1.2	3.6	7.2	0.0	0.1	0.9	0.4	0.1	0.1
415	1.0	0.8	2.5	2.2	0.0	0.1	1.5	0.8	1.2	0.4
416	5.1	5.4	37.8	48.6	8.1	10.9	40.1	40.1	26.3	26.3
417	1.2	1.6	2.9	18	0.2	0.3	1.4	1.4	2.5	2.9
418	1.2	4.1	5.6	28.2	0.0	0.0	2.8	2.3	2.7	2.7
<b>Murray</b>										
419	3.1	2.1	12.2	29.4	2.1	2.1	10.6	10.3	8.4	8.4
420	0.4	0.0	5.2	7.9	0.0	0.0	1.2	0.7	0.3	0.6
421	2.3	3.3	6.7	23.4	0.1	0.1	3.5	3.2	1.9	3.2
423	0.3	0.3	0.9	0.6	0.0	0.0	0.1	0.1	0.3	0.3
<b>South Magnolia</b>										
151	2.0	5.1	0.0	0.0	0.7	0.7	3.0	2.4	1.7	0.5
152	1.8	8.7	4.5	48.6	0.0	0.0	2.6	1.6	0.7	0.4
153	0.4	1.1	1.1	18.2	0.0	0.0	0.3	0.1	0.0	0.0
154	0.8	2.4	1.4	15.1	0.0	0.0	0.7	0.6	0.0	0.0
<b>North Beach</b>										
439	2.8	4.4	6.9	5.2	0.0	0.0	3.4	5.4	3.8	3.8
440	0.7	0.9	3.7	3.1	0.0	0.0	0.2	0.9	0.2	0.2
441	0.5	1.0	2.5	1.5	0.0	0.0	1.0	1.0	3.3	3.3

Note: The highlighted cells indicate the subbasin with highest potential for each GSI technique.

Roadside rain gardens were recommended as the GSI technique for Barton Subbasin 416. Most rain gardens are between 500 and 800 square feet. They can be constructed in curb bulb, planting strip, or central rotary (roundabout) locations. The primary reasons for selecting rain gardens are as follows:

- A rain garden acts as a retention/infiltration facility rather than a conveyance facility. This means that the stormwater retained by the rain gardens is completely kept out of the CSS, leaving less stormwater to flow to downstream pump stations and treatment plants.
- Because roadside rain gardens are used in areas with an existing curb and gutter system, they do not require reconstruction of the entire ROW. Existing planter strips are modified, including moving the curb out into the parking area of the roadway for a short distance.
- Existing SPU and City of Portland specifications, drawings, and performance data can be used in developing planning-level calculations.
- SPU recommends that King County use rain gardens for CSO Control Program projects that include a GSI component. If necessary, roadside rain gardens can be supplemented with permeable alleyway systems.

### 2.2.3 Additional Data Collection

After roadside rain gardens were selected as the recommended GSI option, additional preliminary data were collected on Subbasin 416 to help identify prospective areas for rain gardens:

- A windshield survey was conducted in 2009 to look at the ways streets were used during different times of the week. The survey noted streets that were used for parking, patterns of street use, and flow of stormwater into catch basins and along streets (Appendix E).
- A GIS topographical analysis using digital elevation modeling was conducted to better understand the general flow of surface water through streets and to identify which streets had higher concentrations of surface water runoff (Appendix F).
- Utility-related infrastructure locations were reviewed to identify utility impediments to roadside rain garden construction. Except for fire hydrants and water and sewer lines, there are no apparent impediments (Appendix G). Gas lines were not located during this review. Their locations will be included in more detailed investigations if the GSI alternative is selected for Barton.
- Infiltration rates in the subbasin areas were identified as high (0.25 inch/hour), medium (0.5 inch/hour), and low (1 inch/hour). A map showing the infiltration rates is included in Appendix H.

# 3.0. ESTIMATING RAIN GARDEN SIZE AND COSTS

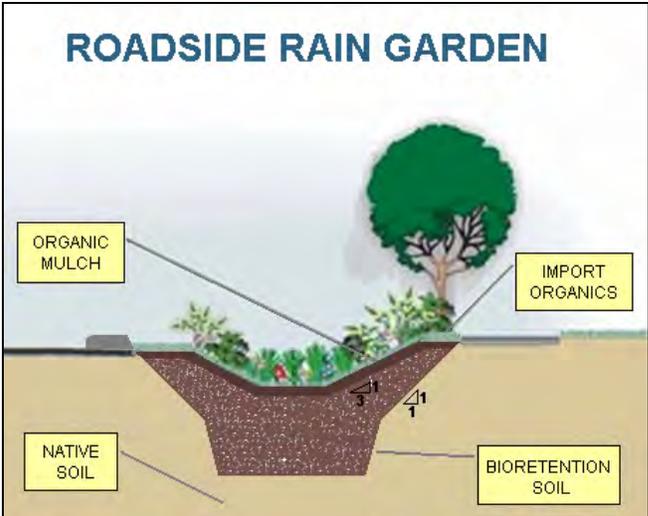
Roadside rain gardens were simulated mathematically to help determine the approximate size of the total rain garden area needed in Barton Subbasin 416. The calculations did not assume that all stormwater that enters the CSS from the subbasin would be captured by the rain gardens—only the amount needed, after the capacity of the Barton Pump Station has been expanded, to reduce the flow into the CSS to the extent that the Barton CSO is controlled to the state standard.

Structures, such as tanks, simply store the water once the flow into the pump station has surpassed the station’s maximum capacity. When the flow becomes less than the maximum capacity, the tank begins to release the detained stormwater back into the system. A rain garden, on the other hand, begins collecting stormwater as soon as the rain starts and continues retaining water until the storm has passed. The performance of rain gardens and other GSI methods, therefore, has to be considered for an entire storm event, not just the peak of the storm.

After estimating the total area that would be needed for rain gardens in the subbasin, planning-level cost estimates were prepared.



Roadside Rain Garden in Portland



Cross-Section of Typical Roadside Rain Garden

## 3.1 Rain Garden Area Estimate

### 3.1.1 Methodology

Microsoft Excel worksheets were used to simulate flow to the CSS from Subbasin 416 and calculate the size of rain gardens required to control the Barton CSO. The bottom area of the rain garden is determined through the calculations. Because the sides of rain gardens are usually sloped, the surface area can be calculated based on the side slope ratio. The actual ground area needed for the rain gardens will be calculated as part of the design of specific rain gardens.

Three worksheets were tested to arrive at a method that most suits King County’s needs for sizing rain gardens:

- The City of Seattle’s GSI pre-sizing model
- A King County–modified version of the city’s model, using additional data and recommendations from a consultant’s memorandum to the city<sup>7</sup>
- A mass balance worksheet, which balances the rain falling on the mitigated area with the stormwater entering the rain garden and the flow into the Barton Pump Station.

The worksheets relied on a number of factors, both constants and variables, to calculate rain garden bottom area.<sup>8</sup> For example, one constant used in all the worksheets was a 26-acre mitigated area. This area was estimated using WTD’s MOUSE hydraulic model for conveyance system planning.

The design storm varied depending on the worksheet. The 24-hour event with a 2-year recurrence interval was built into the first two worksheets (Seattle’s model and King County’s adaptation of the model). The mass balance worksheet used a storm event with a 1-year recurrence interval. This is the storm event used in the MOUSE model to calculate the size of storage needed to control CSOs in the system. The MOUSE model allows for analysis in 10-minute time increments to account for different intensities of rain during the event. These intensities need to be considered because the dependency on soil infiltration rates may make it difficult for rain gardens to control sharp peaks in rainfall during a storm.

Although all worksheets resulted in similar estimates of rain garden size, the mass balance worksheet provides more flexibility and thus is recommended for sizing rain gardens in the Barton basin. The mass balance worksheet (1) can be modified to fit an individual storm and time increments to a degree that is not possible in the other two worksheets, (2) allows for analysis of attenuation as flow moves toward the pump station, and (3) provides a conservative estimate of the amount of rain garden area needed because the worksheet requires a balance between water in and water out. Table 3-1 shows values for factors used in the mass balance worksheet. MOUSE modeling provided values for base wastewater flow into the Barton Pump Station (1 mgd) and percent of total flow to the station contributed by Subbasin 416 (54 percent).

#### Rain Garden Simulation Factors

**Design storm.** A storm of a determined frequency of occurrence used to size rain gardens. The duration and intensity of the storm are modeled based on historical record.

**Entrance factor.** The percent of water flowing down the street toward the rain garden that is assumed to enter the garden.

**Infiltration rate.** The amount of stormwater that can enter the soil in a specified time interval.

**Mitigated area.** The impervious area contributing stormwater to rain gardens.

**Ponding depth.** The maximum depth of standing water in a rain garden at any point during the design storm.

**Rain depth.** The total number of inches of water that falls during the design storm during a specified time interval. It is equivalent to the depth of water that would accumulate in a bucket left outside during that time.

**Sizing factor.** The calculated relationship between the size of the rain garden and the mitigated area.

**Volume of water controlled.** The amount of stormwater a rain garden keeps out of the CSS through detention and infiltration. The volume is calculated by multiplying the rain depth and the mitigated area by the entrance factor and then subtracting the volume of water not captured by the rain garden.

<sup>7</sup> Herrera Environmental Consultants. 2009. *Pre-Sized Approach for City of Seattle Stormwater BMPs*. Technical memorandum prepared for Seattle Public Utilities.

<sup>8</sup> Appendix C shows the assumptions used in the worksheets.

**Table 3-1. Modeling Values Used in Mass Balance Model to Estimate Rain Garden Size**

<b>Factor</b>	<b>Value Assigned</b>	<b>Source</b>
<b>Ponding depth</b>	10 inches	Director's Rule 17-2009, SPU 2009-005, Volume III, Stormwater Flow Control and Water Quality Treatment Technical Requirements Manual: <ul style="list-style-type: none"> <li>• 12-inch maximum</li> <li>• 6-inch maximum in high-density ROW</li> <li>• 24-hour maximum time for water at maximum ponding depth to infiltrate into soil</li> </ul> <a href="http://www.cityofseattle.net/dpd/Codes/StormwaterCode/DirectorsRules/default.asp">http://www.cityofseattle.net/dpd/Codes/StormwaterCode/DirectorsRules/default.asp</a>
<b>Mitigated area</b>	26 acres (1.3 million square feet) of impervious surface area	WTD's MOUSE model for conveyance system planning
<b>Design storm</b>	1-year recurring storm	WTD's MOUSE model for conveyance system planning
<b>Side slope</b>	3 feet:1 foot	Herrera, 2009.
<b>Native soil infiltration rate</b>	0.5 inch per hour	The Pacific Northwest Center for Geologic Mapping <a href="http://geomapnw.ess.washington.edu/">http://geomapnw.ess.washington.edu/</a>
<b>Bioretention soil</b>	<ul style="list-style-type: none"> <li>• Depth: 18 inches</li> <li>• Infiltration rate: 2.5 inches per hour</li> <li>• Porosity: 40 percent</li> </ul>	SPU's specifications for bioretention soil

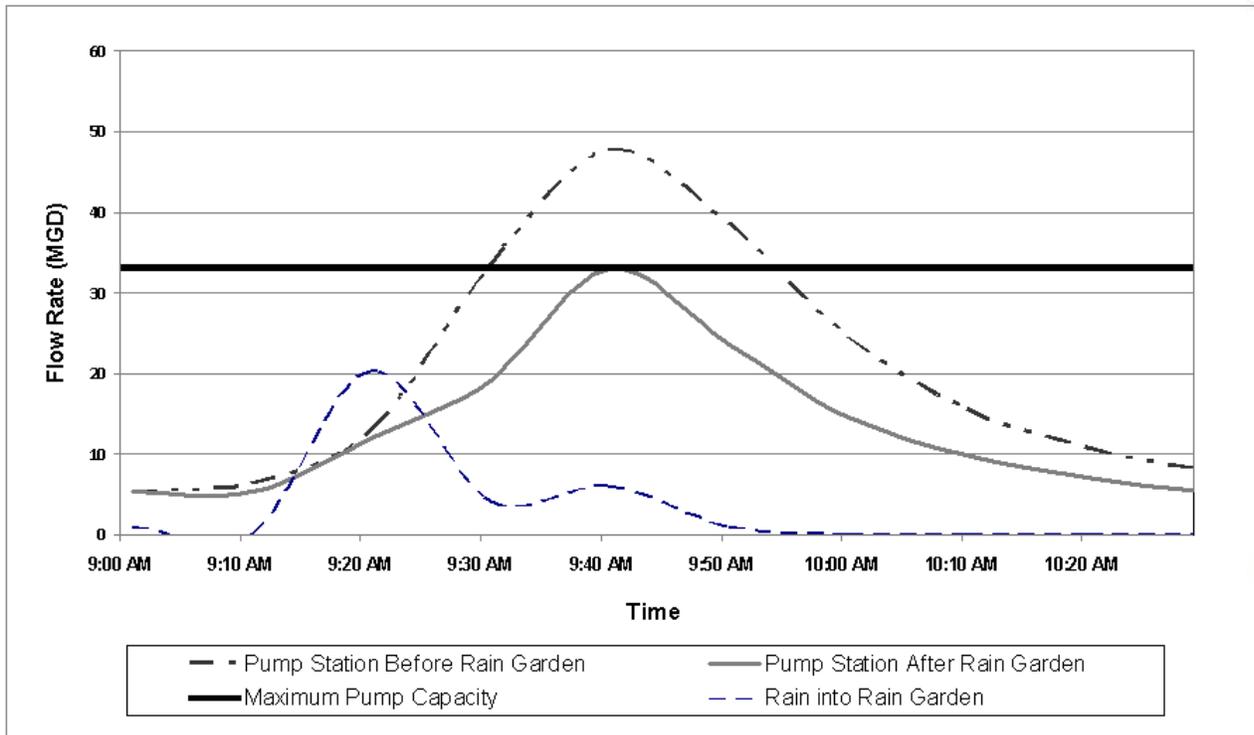
Another version of the mass balance worksheet was used to determine the number of rain gardens that would be needed in Subbasin 416. Inputs included the overall bottom area required to mitigate a 26-acre area, the number and dimensions of streets and blocks in the subbasin, and the constraints on rain garden size by type of street. For example, the city restricts rain garden size on north-south streets to an area equivalent to one parking space but allows multiple rain gardens on each block. Three historical storms with associated CSOs were run through this “block” mass balance simulation. The November 1–2, 1984, storm was the design storm used in previous simulations. This storm was a long storm with a sudden peak, making it the hardest of the three to control. The November 2– 22, 1988, storm was short with an extended dry period before the heavy rain started, and the March 1–2, 1987, storm had a lot of rain before the peak of the storm.

### 3.1.2 Results

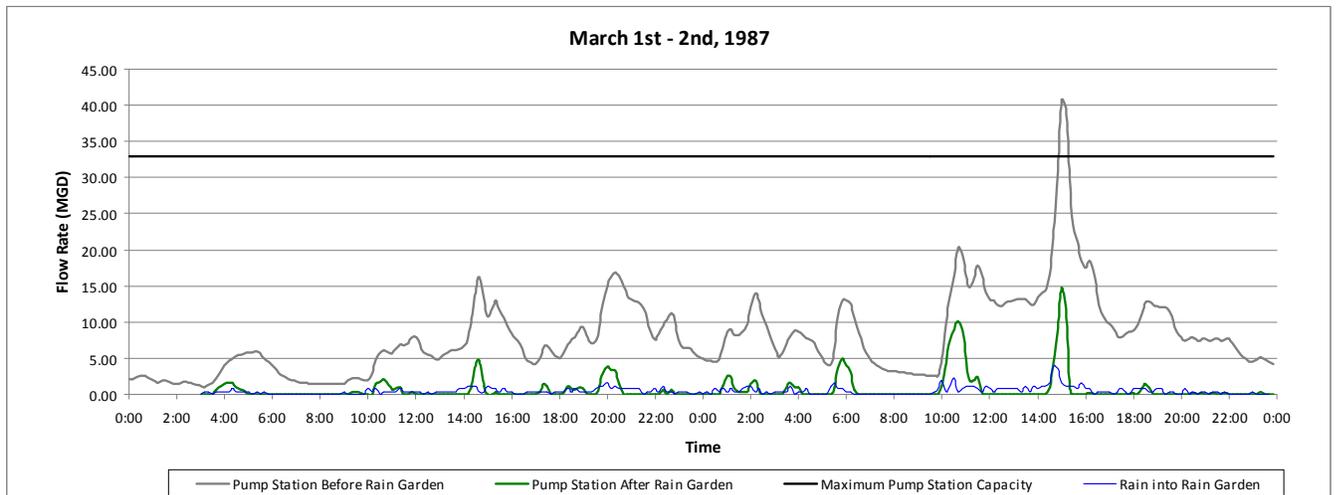
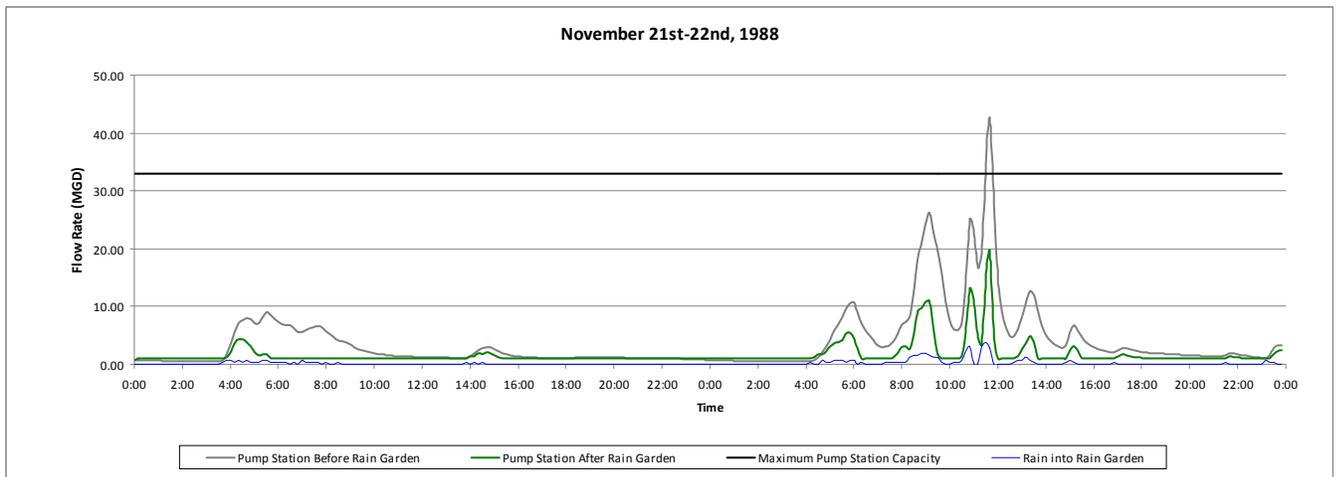
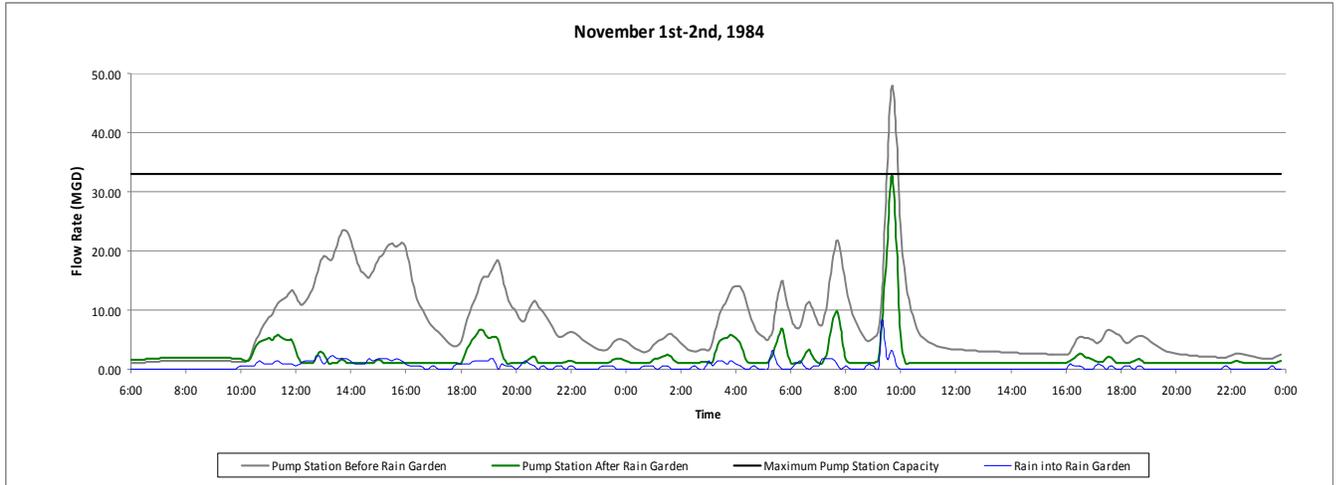
King County is using the preliminary results of the mass balance worksheet as the starting point for rain garden design in the Barton basin. Table 3-2 shows that a total of 0.88 acre of rain garden bottom area would reduce peak flow at the Barton Pump Station by 15 mgd, the amount required to control the Barton CSO to one event on average per year. Figure 3-1 and Figure 3-2 illustrate how by capturing the high-intensity rainfall at the peak and throughout the duration of the design storm, rain gardens with the total required area both delay and reduce peak flow into the pump station.

**Table 3-2. Results of Each Storm Event Modeled**

November 1st - 2nd, 1984			November 21st - 22nd, 1988			March 1st - 2nd, 1987		
<b>CSO Total Volume (gal)</b>			<b>CSO Total Volume (gal)</b>			<b>CSO Total Volume (gal)</b>		
Before RG	After RG	Retained	Before RG	After RG	Retained	Before RG	After RG	Retained
146,845	0	146,845	77,842	0	77,842	77,842	0	77,842
<b>Max Flow into PS (MGD)</b>			<b>Max Flow into PS (MGD)</b>			<b>Max Flow into PS (MGD)</b>		
Before RG	After RG	PS Capacity	Before RG	After RG	PS Capacity	Before RG	After RG	PS Capacity
47.81	32.83	33	42.58	18.22	33	40.68	16.22	33
<b>Total Volume – Rain Garden (gal)</b>			<b>Total Volume – Rain Garden (gal)</b>			<b>Total Volume – Rain Garden (gal)</b>		
Entering	Retained		Entering	Retained		Entering	Retained	
780,845	780,845		528,951	522,797		1,007,042	1,002,421	



**Figure 3-1. Estimated Flows Captured by Rain Gardens and Diverted from the Barton Pump Station During 30-Minute Period of High-Intensity Rainfall**



**Figure 3-2. Estimated Flows Captured by Rain Gardens and Diverted from the Barton Pump Station During Design Storms**

Table 3-3 shows the estimated number and the surface and bottom areas of rain gardens by type of street in Subbasin 416. Surface area is used to determine the land needed for each rain garden. The actual number and size of individual rain gardens will be determined during project design, if this alternative is selected for the Barton basin.

**Table 3-3. Estimated Rain Garden Number and Sizes by Streets in Subbasin 416**

Street Direction	Number of Streets	No. of Rain Gardens per Block	Surface Area of Each Rain Garden	Total No. of Rain Gardens	Total Rain Garden Surface Area	Total Rain Garden Bottom Area
North-west	30	5	450 sq. ft.	150	67,500 sq. ft.	37,500 sq. ft.
East-west	6	4	500 sq. ft.	24	12,000 sq. ft.	5,400 sq. ft.
				<b>174</b>	<b>79,500 sq. ft.</b>	<b>42,900 sq. ft.</b>

## 3.2 Cost Estimates

King County estimated planning-level costs to construct, operate, and maintain rain gardens in Barton Subbasin 416 with a total surface area of 79,500 square feet. The estimate was based on the average cost per square foot for projects in Portland, Seattle, and Chicago, ranging from \$55 to \$69 per square foot. King County’s estimate uses \$69, which includes allied costs. The total cost in this estimate, including contingency, is around \$8.3 million. Table 3-4 shows a breakdown of the estimate.

Planning-level cost estimates are based on generic facility concepts. Specific details of a project such as location, technologies, and environmental impacts and potential mitigation of such impacts are determined later during project pre-design. Costs for projects in planning can have a rough order-of-magnitude estimate in the range of -50 to +100 percent. By the time a project enters the construction phase, estimates typically narrow to a range of -10 to +15 percent of the final cost.

**Table 3-4. Planning-Level Cost Estimate for Barton Rain Gardens**

Cost per square foot	\$69
Total square feet (surface area)	79,500
Base facility cost (cost per square foot times total square feet)	\$5,485,500
Cost adjustment for retrofit (16% of base cost)	\$877,680
<b>Total Facility Cost</b>	<b>\$6,363,180</b>
Contingency (30%)	\$8,272,134

## 4.0. NEXT STEPS

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King County has identified Barton Subbasin 416 as the area with the greatest potential for implementing GSI in the study area. The GIS analyses identified roof disconnection, rain gardens, and permeable paving as feasible GSI options in the subbasin. The results of preliminary screening of these options led to the recommendation of curb-contained roadside rain gardens as an alternative for CSO control in the Barton basin.

Because the stormwater captured in a rain garden and other GSI options never enters the CSS, downstream capacity in the CSS is freed up to handle other flows. Less flow enters the West Point Treatment Plant, thus reducing the cost to convey and treat the flow. GSI alternatives are especially useful in Barton because the water flowing from the Barton Pump Station continues downstream to several other pump stations that could benefit from reduced flows.

If the GSI alternative is selected as the preferred alternative for Barton, detailed site-specific investigations should be conducted during the next phase of alternatives development and evaluation. Examples include conducting additional soil and groundwater investigations and infiltration tests, developing WTD-specific operating and maintenance cost estimates, and adjusting final rain garden size and locations based on input from residents. In addition, King County, in cooperation with SPU and the Puget Sound Partnership, will need to establish a project monitoring program, including preconstruction and post-construction monitoring of system performance.

## 5.0. REFERENCES

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## **GREEN STORMWATER INFRASTRUCTURE ANALYSIS**





**Overview Update**  
**Barton Basin: King County CSO Beach Projects**  
**Green Stormwater Infrastructure Analysis**

DATE: November 22, 2010

TO: Brian Matson, P.E. Carollo Engineers

FROM: SvR Design Company  
Peg Staeheli, ASLA, LEED AP  
Greg Giraldo, P.E.

RE: **Analysis and Recommendations**  
**GSI Planning and Analysis Confirmation**  
SvR Project No. 06053

This memorandum is an overview of SvR's analysis and recommendations resulting from the green stormwater infrastructure (GSI) planning confirmation task for the Barton Basin. This summarizes more detailed information from the following documents previously provided to King County and Carollo:

1. Technical Memorandum 600.6, dated May 13, 2010, revised June 22, 2010
2. Addendum to Technical Memorandum 600.6, dated May 27, 2010
3. Addendum #2 to Technical Memorandum 600.6, dated June 29, 2010

SvR reviewed King County's feasibility analysis of using GSI to manage stormwater runoff to the Barton Combined Sewer Pump Station. King County's analysis focused on Combined Sewer Subbasin 416, in the Barton Basin (See the vicinity map on the attached graphic summary). SvR reviewed King County's approach to GSI planning and recommended refinements to their model.

SvR's steps included the following:

- 1) Reviewed of King County's mass balance model and analysis of feasible locations for GSI within Subbasin 416.
- 2) Refinement of the assumptions and approach used in King County's analysis
- 3) Re-ran the analysis and comparison of the results to King County's analysis.
- 4) Recommendations for sizing and locating GSI within Subbasin 416
- 5) Provided maintenance guidelines
- 6) Provided an estimate of planning level construction costs
- 7) Provided planning level maintenance costs.

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## **Modeling**

### **King County's Model**

King County performed its analysis at a rough level to determine the basic feasibility of the GSI approach. King County modeled Subbasin 416 as one large catchment area flowing to a single raingarden. The model used a 1984 storm event as the Design Storm event and a targeted peak flow reduction of roughly 14.6 million gallons/day (MGD). Flows were assumed to come from the right-of-way only and all surfaces were assumed to be impervious; the model did not account for differences in land cover that could delay flows reaching the raingarden or for potential runoff contribution from adjacent parcels. The model sized one raingarden with vertical sides. The single rain garden bottom area was partitioned throughout the basin and an estimate of rough costs was developed based on the resulting rain garden linear feet. King County's analysis concluded that GSI would be a feasible approach for stormwater management within the basin.

King County's location feasibility analysis assumed square footages for two rain garden configurations: a corner rain garden and a midblock rain garden. Both configurations were assumed to have a 10-foot bottom width and vertical sides. King County positioned the two configurations across Subbasin 416 and concluded that the Subbasin contained enough feasible locations to implement the GSI alternative.

### **Feasibility Refinement**

In order to review the feasibility of King County's conclusions, SvR refined the model to more closely reflect field conditions within the subbasin. Refinements to the model included:

- Extending the model to include rainfall that occurred on the day previous to the 1984 Design Storm event, since consecutive storm events impact a rain garden's available capacity for any single event. SvR used a Design Storm event that commenced on 11/1/1984 at 10:00 and ended on 11/2/1984 at 9:50 (total event duration - 23.83 hours).
- Modeling the subbasin as individual half-block catchment areas, rather than as a single catchment. Each half-block consisted of half a residential block (from the alley to the right-of-way), plus half the right-of-way on one north/south and two east/west streets (See attached graphic summary). This approach distributed runoff flows and rain gardens across the subbasin, more closely reflecting how actual flows and storage will behave during a storm event.
- Modeling rain gardens using two different approaches to determine contributing tributary areas.
  - In the first approach, it was assumed that only flows from the impervious right-of-way would reach the rain gardens, consistent with the King County sewer basin models.
  - In the second approach, it was assumed that flows from the impervious



right-of-way plus flows from the pervious and impervious areas of the adjacent parcels would reach the rain gardens. This second approach was consistent with field observations.

- Adjusting for land cover types and additional runoff sources.
  - Half of each residential parcel's impervious and pervious surfaces were assumed to contribute sheet flow to the rain gardens.
  - 60-percent of all downspouts within the subbasin were also assumed to be disconnected and to sheet flow to the rain gardens.
  - Curve Numbers, used to represent different land covers in the model, were adjusted to take into account the various areas within the basin.
- Three raingarden configurations were modeled with varying slopes and bottom widths in order to capture the variation in rain garden design that would best accommodate site conditions. Two of these configurations, Section 2b (narrow rain garden installed within existing planting strip) and Section 3b (wide rain garden that bulbs into the existing parking aisle), were used to develop the final recommendations and cost estimate.

## Results

The refined model indicated that employing GSI across subbasin 416 to manage stormwater volume would provide approximately two million gallons (2 MG) of storage, which would in turn meet the peak flow reduction target of 14.6 MGD. The required area of impact (number of half-blocks) required to achieve the target storage volume of 2 MG varied by rain garden configuration and whether the contributing tributary area included right-of-way plus parcel flows or only right-of-way flows (see attached graphic of a half block). Although the physical area of impact varied between 32 and 65 half-blocks, the cost to install the required rain garden volume over 32 or 65 half-blocks remained relatively close.

SvR then assessed Subbasin 416 for feasible locations for rain gardens. Locations were considered difficult to implement if they had one or more of the following conditions:

- Slopes greater than 5-percent;
- Poor soils or drainage patterns;
- Space constrained by planting strip width, road width and/or driveways
- Located on an arterial street;
- Hydrants, street trees and other obstructions present in the planting strip.

Feasible locations were then ranked into most feasible, moderately feasible, and less feasible locations (see the attached Location Feasibility Diagram). The assessment indicated that there is sufficient space within the subbasin to provide the required storage volume.



## **Planning Level Cost Estimate**

### **Estimate Basis**

SvR's estimate is based on:

- Seattle Public Utility's (SPU) Engineer's Estimate and the eleven Contractor Bids for Seattle's Ballard Roadside Raingardens project which is currently under construction in north Ballard.
- Seattle Department of Transportation's Bids for Mercer Street
- Previous bids for phase of the High Point Project natural drainage system and rain gardens in Port Townsend.

The Ballard and Mercer bids represent current economic conditions and costing for materials, as well as economies of scale.

### **Escalation**

As in the planning level cost estimates for the other CSO management alternatives under consideration for Barton Basin, the planning level cost estimate for GSI includes the following factors: escalation to time of construction, contingency, engineering design, construction management, and sales tax.

For calculating escalation, the assumed time lag until the midpoint of construction from the beginning of design is three years. This assumes it will be 6 months before the design process begins, design and permitting will take two years and construction and plant establishment will take two years. Per Engineering News Records' website (<http://enr.construction.com/economics/default.asp>), the annual escalation measured by the Construction Cost Index is currently 4.2-percent in the month of November. Therefore, an escalation of 12.6-percent was applied to the construction cost.

A 25-percent contingency was applied to reflect the level of confidence with costs, design elements and potential impacts.

Engineering design and construction management factors were held to 10-percent due to the project's low complexity and the redundancy of project elements.

Allied costs such as agency permitting fees, agency construction management fees and costs associated with community outreach are separate from this estimate. SvR did speak with SDOT to review construction street use permit fees. They indicated it is unusual to pay for closures or use fees for this type of linear surface improvement. The construction is typically managed to avoid closure and use periods are generally under one month for a block length. It is possible that a cost for staging in the right of way may be necessary unless the contract arranges for an off right of way staging location.

### **Probable Construction Cost**

SvR's estimated probable construction cost for providing 2 MG of rain garden storage within subbasin 416 is \$11.3 million. This cost is based on the average cost of Section 2b rain gardens installed along 65 half-blocks (i.e., narrow rain gardens spread over a wide area within the subbasin) and Section 3b rain gardens installed along 32 half-blocks (i.e., wide rain gardens spread over a smaller area within the subbasin).



## **Operations and Maintenance**

### **Requirements**

The raingardens purpose is for CSO control. General maintenance requirements follow those for standard landscaped areas. Rain garden maintenance focuses on two primary concerns: making sure water can move freely into and through the facility; and making sure plants are healthy and growing.

As with other planting areas, the first few years of plant establishment (Years 1 and 2) are crucial to long term performance. Weeding, removal of dead plant material and replanting of bare spots are primary tasks in the spring and fall. Extra care during these first years establishes healthy, strong plants, which reduce long term maintenance requirements and costs. During the first year's growing season, plants should be watered twice a week during the first six weeks of the season, then weekly for the remainder of the growing season. In the second year, plants should be watered once a week during the growing season. This will establish a strong root system that will prepare the plants for a reduced watering schedule during the rest of their lives.

Certain maintenance activities are seasonal. In spring tasks include weeding, removal of dead plant material and top dressing with mulch. Once plants are established (year 3 and thereafter), the rain gardens should be watered infrequently but thoroughly (i.e., every three weeks during the dry season or when plants appear stressed). Raingardens should be weeded in the fall and top dressed with mulch.

### **Operations**

The most critical activity is removing leaf debris from the curb cuts once a week for two months in the fall to ensure stormwater is directed to the raingardens. Unscheduled maintenance activities include inspecting inflow and outflow points for clogging after large storm events (a heavy downpour or over one inch of rainfall in 24 hours). Routine monthly maintenance involves removing leaf litter, debris, and built-up sediment.

### **Maintenance Costs**

Maintenance costs for the rain gardens are estimated to be \$171,500 for the first two years during construction plant establishment and an average of \$37,300/year for 18 years thereafter. Maintenance costs were derived by reviewing previous projects and then modifying to account for the types of activities that would be required for the intended landscape type (non-grass) within the rain gardens. Maintenance costs were estimated based on three main activity types:

1. Major maintenance of landscape areas, such as pruning, weeding etc at two times per year for a crew.
2. Maintenance two times per week for two months by a crew during the wet weather/fall leaf drop.
3. Monthly maintenance review of areas by a crew for the remaining ten months.

Maintenance costs also include sediment removal and the top layer of mulch to be replaced every three years. The costs assume that the mulch layer is considered non-hazardous waste and will be disposed of accordingly.



### **Conclusions**

SvR's analysis confirms King County's analysis that GSI is feasible for managing stormwater flows in subbasin 416 in Barton Basin. The estimated probable construction cost for providing 2 MG of rain garden storage to achieve a peak flow reduction target of 14.6 MGD is \$11.3 million.

### **Next Steps Recommendations**

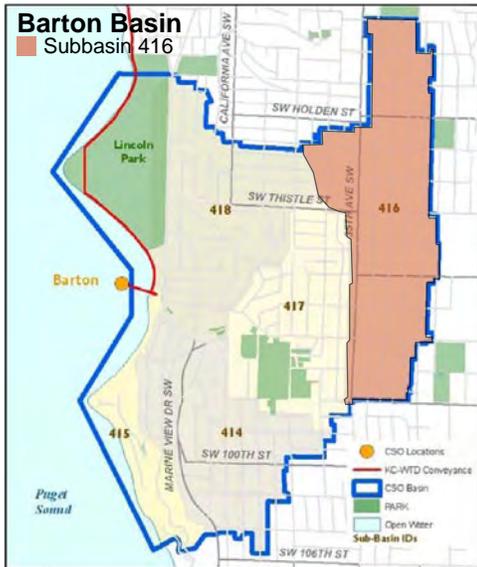
We recommend that King County consider including the following items in its implementation steps for GSI:

1. Contributing Area Analysis – Conduct block scale field reconnaissance and flow monitoring to refine assumptions made regarding the amount of runoff contributed by the study area (right-of-way only vs. parcel plus right-of-way). The contributing area flowing to the rain gardens has a significant impact on rain garden sizing (including cross section of the rain garden) and the area of impact required for implementation of GSI; however, the impact on cost is not as significant.
2. Modeling - During design, consider using an EPA-SWMM or other appropriate network basin model that is suitable for GSI implementation on a block scale and that can take account of the routing of each block.
3. Location Selection – Selection should start with a detailed in-field assessment of the locations identified on the Location Feasibility Map. Location assessment should be prioritized starting with the most feasible locations. The following considerations should be taken into account:
  - Planting strip longitudinal slope;
  - Variations in projected subsurface soil infiltration rates and in-field infiltration tests;
  - Parking constraints;
  - Existing utility services and mature trees to preserve in the planting strip;
  - Adjacent property owner/occupant acceptance;
  - The presence of disconnected downspouts within the block and Seattle's Rainwise program implementation;
  - Pedestrian, bike and vehicle traffic safety issues such as sight lines

A larger impact area may need to be considered based on the contributing area analysis, block scale monitoring and modeling described in Recommendations 1 and 2, and the refinement of potential locations described in Recommendation 3. The assumed construction cost of \$11.3 million includes a contingency to account for such additional rain gardens.

Attachments: Vicinity Map and Graphic Summary; Location Feasibility Diagram

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VICINITY MAP

**Legend**

- - - GSI Project Study Area

Subbasin 416

**Drainage Mainlines**

Combined

Storm

Sewer

**Feasible Locations**

High/Most Feasible  
0-3% Slope, 10ft. Planter

Moderately Feasible  
4-5% Slope, 10ft. Planter

Less Feasible  
0-3% Slope, <10ft. Planter

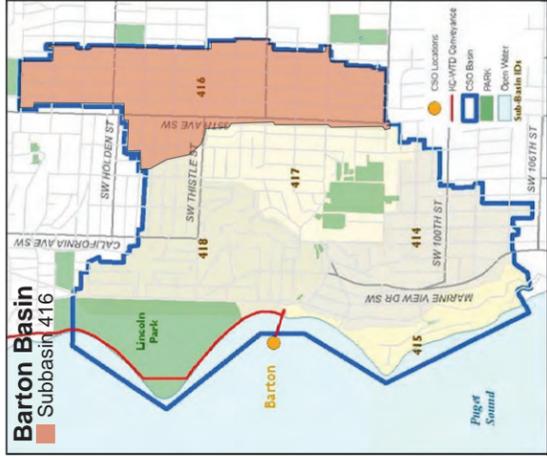
**Difficult Locations**

Soils or Drainage Pattern Issues



LOCATION FEASIBILITY DIAGRAM





VICINITY MAP



SAMPLE LAYOUT OF POTENTIAL  
RAIN GARDEN CELLS ON A TYPICAL BLOCK

## PROJECT ELEMENTS

- Roadside rain gardens installed over multiple blocks within the GSI Project Study Area.
- Rain gardens to be located within roadside planting strip and/or within a new curb bulb along the street.
- Reduce peak stormwater flows entering the combined sewer and draining to pump station.
- Maintain minimum on-street parking setback requirements as set by City of Seattle (COS).

## PLANNING LEVEL COST ESTIMATE

- Required Half-blocks - 32-65 half-blocks
- Storage Volume Provided - 2 million gallons
- Construction Cost Estimate - \$11.3 Million (includes escalation, contingency, engineering, construction management, sales tax)

## BENEFITS

- Reduce peak flow rate and volume of stormwater to existing wastewater facilities.
- Provides traffic calming along streets through use of curb bulbs
- Improves streetscape, habitat and enhances neighborhood. identity through landscaping and street trees.
- Strong interest from community and support from regulatory agencies.

## CHALLENGES

- Coordination with COS for public right-of-way improvements including obtaining approval of Street Improvement Permitting plans from COS.
- Maintenance measures (e.g. landscaping) are different from what Wastewater Treatment Division has done in the past.
- Coordination with adjacent property owners during construction of improvements in right-of-way.
- Obtaining flow monitoring at the block scale for better calibration of models.



POTENTIAL APPEARANCE W/ RAIN GARDEN STRIP BEFORE & AFTER VIEW



**SUMMARY OF TECHNICAL MEMORANDUMS & SvR  
RECOMMENDATIONS  
GSI PLANNING AND ANALYSIS CONFIRMATION**





## Summary Memorandum

DATE: June 30, 2010

TO: Brian Matson, PE Carollo Engineers  
Allen deSteiguer, PE, Carollo Engineers

FROM: Greg Giraldo, PE  
Kathryn Gwilym, PE

RE: Summary of Technical Memorandums and SvR Recommendations  
**GSI Planning and Analysis Confirmation**  
**King County CSO Beach Projects - Barton Basin**  
SvR Project No. 06053

Enclosed are the following Technical Memorandums and Addenda that SvR Design Company has prepared for the Green Stormwater Infrastructure (GSI) Planning and Feasibility Analysis in the Barton Basin:

1. Technical Memorandum 600.6 – GSI Planning and Analysis Confirmation, initially issued May 13, 2010 with follow-up revisions dated June 22, 2010.
2. Addendum to Technical Memorandum 600.6 – Sensitivity Analysis for GSI alternative modeling, issued May 27, 2010.
3. Addendum #2 to Technical Memorandum 600.6 – Volume Comparison and GSI Recommendation, issued June 29, 2010.

Please note that the Addenda were issued to provide further analysis requested in follow-up to Technical Memorandum 600.6 and subsequent meetings and discussion from the initial issuance of the memo in May.

The Technical Memorandum 600.6 demonstrates the two methods of analysis employed by SvR, aside from SvR's review of King County's GSI analysis for subbasin 416. SvR's first analysis determined the locations within the 416 basin where GSI is most feasible. The second analysis used existing hydrologic information and a mass water balance to determine the quantity of GSI necessary to reduce peak flows. For the purpose of the two analyses, SvR assumed runoff from the parcel would contribute flow to the rain gardens. It is important to note that this assumption is contrary to assumptions made by King County in their GSI sizing. Based on the mass water balance analysis and modeling assumptions, SvR recommended 32 half blocks of GSI be installed to reduce peak flows by 14.6 MGD.

The mass water balance methodology is limited as it does not account for the time delay in routing of stormwater through GSI on a block scale. In order to provide additional information regarding the sensitivity of the model and describe the limitations, SvR prepared "Addendum to Technical Memorandum 600.6 –



Sensitivity Analysis” dated May 27, 2010. The results of the sensitivity analysis demonstrated that by adjusting the contributing area and the time of concentration, the SvR water balance model can more closely reflect King County modeling results.

The second “Addendum #2 to the Technical Memorandum 600.6 – Volume Comparison and GSI Recommendation” provides a comparison of volume for GSI calculated from the model and volume available from SvR’s sizing of the rain gardens within the feasible streets. The results of this analysis demonstrated that the 32 half blocks of GSI as recommended in TM 600.6 can be located within the basin using the strategy described by Option B in Addendum #2. The strategy involves locating GSI along the high/most feasible streets. During design, additional streets may be added based on revised modeling and block scale monitoring. The construction cost of \$10.2 million includes a contingency to account for secondary or additional streets for rain gardens.

As we proceed with the project, the design phase should include block scale field reconnaissance and flow monitoring at the block scale to test assumptions made regarding the amount of runoff contributing from the parcel. As demonstrated in the volume and sensitivity analysis, the assumption for tributary area flowing to the rain gardens has significant impact on the sizing (including cross section of the rain garden) and the number of streets required for implementation of GSI; however, the impact with cost is not as significant. In addition, we recommend that a model, such as EPA-SWMM or other network basin model, be used during design that is suitable for GSI implementation on a block scale and one that can take account of the routing of each block.

During the design phase we anticipate that the location and number of streets will be adjusted due to a number of factors including field infiltration tests and modeling results. Should additional storage volume be required, we recommend implementing GSI on additional streets that have moderate feasibility and green public alleys (porous pavement) as a potential method for maximizing the reduction in flows off the basin.

Reference:

- Technical Memorandum 600.6 – GSI Planning and Analysis Confirmation, initially issued May 13, 2010 with follow-up revisions dated June 22, 2010.
- Addendum to Technical Memorandum 600.6 – Sensitivity Analysis for GSI alternative modeling, issued May 27, 2010.
- Addendum #2 to Technical Memorandum 600.6 – Volume Comparison and GSI Recommendation, issued June 29, 2010.



DESIGN COMPANY

# **GSI Planning and Analysis Confirmation Technical Memorandum 600.6**

## **Addendum to Technical Memorandum 600.5**

### **King County CSO Beach Projects – Barton Basin Green Stormwater Infrastructure Evaluation**

May 13, 2010

Revised May 26, 2010

Revised June 22, 2010

Prepared for: Carollo Engineers  
1218 Third Avenue, Suite 1600  
Seattle, WA 98101

Owner: King County Department of Natural Resources and Parks  
Wastewater Treatment Division  
Barton, Murray, Magnolia and North Beach CSP Facilities

Prepared by: SvR Design Company  
GSI Consultant 1205 Second Avenue, Suite 200  
for Barton Seattle, WA 98101  
206-223-0326 (p)  
206-223-0125 (f)



DESIGN COMPANY

# GSI Planning and Analysis Confirmation Technical Memorandum 600.6

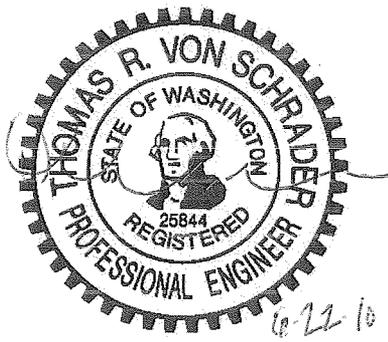
## Addendum to Technical Memorandum 600.5

### King County CSO Beach Projects – Barton Basin Green Stormwater Infrastructure Evaluation

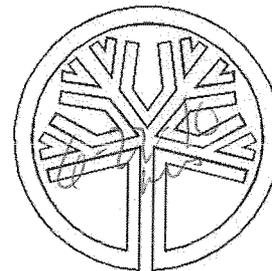
May 13, 2010

Revised May 26, 2010

Revised June 22, 2010



QA/QC REVIEWER  
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## EXECUTIVE SUMMARY

The purpose of this technical memorandum is to document findings and review analysis and results related to King County's (KC) feasibility analysis of using green stormwater infrastructure (GSI) to manage combined sewer overflows at the Barton Combined Sewer Pump Station. King County's analysis focuses on the combined sewer subbasin 416, in the Barton Basin.

This technical memorandum covers the following items:

1. Review of KC modeling approach for Green Stormwater Infrastructure (GSI) in the Barton basin as described in Draft King County Technical Memorandums 600.3 and 600.5.
2. Review of KC proposed GSI rain garden locations within subbasin 416 project study area as described in Draft King County Technical Memorandum 600.5. Project study area is from SW Othello Street to SW Barton Street and from 34<sup>th</sup> Avenue SW to approximately 30<sup>th</sup> Avenue SW.
3. Recommendations for an alternative model analysis for preliminary design and sizing of rain gardens including modifications to proposed KC location of rain gardens.
4. Planning level estimate of probable costs for rain garden retrofit construction.
5. Recommendations for consideration during risk analysis and design phase.

Based on SvR's analysis of the basin field conditions and modeling runs, GSI is feasible for decreasing the peak flow rate by 14.6 MGD in subbasin 416 in Barton Basin for the 1984 Design Storm event. The 14.6 MGD peak flow rate reduction target was calculated (King County using MOUSE) by removing 26 acres of impervious area from the subbasin. As a check of KC's analysis and size of rain gardens, a modified Santa Barbara Urban Hydrograph (SBUH) modeling analysis was used to calculate that approximately 32 half blocks are needed to collect, store and infiltrate the runoff from the right-of-way and the parcels within subbasin 416 GSI study area to achieve this 14.6 MGD peak flow reduction. One half block is defined by rain gardens in the planting strip along one half of a north/south and one half of an east/west street.

The following assumptions were used for the SBUH comparison analysis:

1. Each half block area accommodates rain gardens within the planting strip of the public right-of-way. The number of rain gardens would vary depending on the slope of the street. We estimate between 9 and 13 rain gardens per block for average slopes of 2-percent and 3-percent, respectively.
2. Runoff from 100-percent of the right-of-way and 50-percent of the parcel areas (parcel's pavement plus landscaping) flow to the rain gardens.
3. 60-percent of the roofs are disconnected and contributing flow to the rain gardens
4. Curb bulbs will be constructed to provide additional area for the rain gardens.
5. The cross section of the rain garden has the following dimensions:
  - a. 1.5:1 side slopes (Deviation from SPU or SDOT standard cross section – to improve reliability).
  - b. 18 inch depth for bioretention soil.
  - c. 10 inch depth for ponding.
6. Design infiltration rate of 0.5in/hr was used for native soils.

Site constraints were generally accounted for in the modified SBUH analysis. However, the following site specific constraints should be further evaluated, including additional field monitoring, along each frontage during the design phase:

- Amount of parcel area sheetflowing into the public right-of-way and thus contributing flow to the rain gardens. This can in part be measured by monitoring flows entering each street's downstream catchbasin that discharges to CSS.
- Longitudinal Slope of planting strip
- Variations in the subsurface soil infiltration rate and groundwater elevation.
- Parking constraints
- Existing utility services. Mature trees to preserve
- Property Owner/Occupant acceptance
- Seattle's Rainwise program implementation and review of disconnected downspouts for each block to receive GSI. Field monitoring for disconnected downspouts could be measured in part through smoke testing of the existing CSS.

The planning estimate of probable construction cost for 32 half blocks is \$10.2 million. Soft costs such as design, agency permitting and construction fees are not included in this estimate. Maintenance costs for establishment are not included in this estimate. GSI will require a different type of long term maintenance than a traditional pipe/vault system. Rain garden maintenance activities include, but are not limited to, weeding, watering, replanting, and leaf and other debris removal.

Aside from reducing peak flows to the pump station, the GSI alternative would also reduce stormwater volume entering the piped combined sewer system infiltration into the native subgrade; thus reducing the volume of water required for treatment downstream. While not included in this study, during design, we recommend this benefit be considered for review.

We recommend including the following items in the risk analysis:

1. Time of Concentration – Conduct a sensitivity analysis for stormwater runoff from Barton subbasin 416 and from the GSI project study area within subbasin 416 considering the time of concentration through subbasin 416 and to the pump station for the 1984 Design Storm event.
2. Contributing Areas - Conduct a sensitivity analysis based on varying assumptions for the tributary area draining to rain gardens (right-of-way only compared to parcel plus right-of-way) to evaluate upper and lower limits for number of blocks requiring rain gardens for the 1984 Design Storm event.
3. Additional Storm Events – Analyze rain garden functions for other storm events using the revised modeling approach based on runoff from 416.
4. Planning Construction Costs – Compare preliminary planning capital costs considering number of half blocks needed based on the runoff from subbasin 416 (upper and lower limits tabulated in #2).
5. Include contractors in planning analysis to understand thresholds for scale of work and how that would effect costs and schedule.

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## **PURPOSE**

The purpose of this technical memorandum is to document findings and review analysis and results related to King County's (KC) feasibility analysis of using green stormwater infrastructure (GSI) to manage combined sewer overflows at the Barton Combined Sewer Pump Station. King County's analysis focuses on the combined sewer subbasin 416, in the Barton Basin.

## **REVIEW BACKGROUND INFORMATION**

### **Information used for preliminary review of GSI feasibility.**

1. Technical Memorandum (TM) CSO Beach Project GIS Analysis, issued September 2008, (draft August 22, 2008) prepared by King County (TM 2008).
2. Technical Memorandum 600.1 CSO Beach Projects Green Infrastructure GIS Analysis, issued November 2009, prepared by King County (TM 600.1).
3. Draft Technical Memorandum 600.3, prepared by King County, received April 12, 2010 (TM 600.3).
4. Draft Technical Memorandum 600.5 CSO Beach Projects Demand Management Analysis Draft, March 31, 2010, prepared by King County and received April 1, 2010 (TM 600.5).
5. Preliminary geological/geotechnical evaluation of Barton alternatives as prepared by Shannon & Wilson, Inc., dated March 26, 2010 (SW 2010).
6. GIS mapping layers for the Barton basin as provided by KC.
7. Modeled rainfall data from four storms selected and provided by KC.
8. KC Mass balance models (excel spreadsheets).
9. Meeting notes and email correspondence with KC staff.
10. Green Infrastructure and CSO Case Studies as provided by KC staff.
11. City of Seattle Street Improvement Permitting Plans for retrofitting rain gardens into one of Seattle Public Utilities' (SPU) combined sewer basins in the Ballard neighborhood (vault plan no. 774-664).
12. Recent City of Seattle Ballard Neighborhood bid results (project plans in vault plan no 774-664) from 11 bidders and SPU engineer's estimate.

### **Review of KC Preliminary Modeling for GSI in Barton Basin**

Table 1 contains the SvR review comments related to KC's mass balance model analysis of the feasibility of implementing GSI in the Barton basin, as documented in Draft Technical Memorandum 600.3 and Draft Technical Memorandum 600.5.

**Table 1 - Comments on KC Planning Analysis for Sizing GSI**

<b>KC Assumption for Analysis as described in Referenced Draft TMs</b>	<b>SvR Comment</b>
<p>1. KC analysis uses a mass balance model to size a single rain garden for a 15 MGD peak flow reduction (draft TM 600.5 and 600.3). (Note: KC stated that the peak flow was rounded from 14.6MGD to 15MGD for TM 600.5 report).</p>	<p>King County and the Carollo team and agreed to use the mass balance excel spreadsheet as an appropriate approach for modeling GSI in subbasin 416. For this stage of analysis, SvR has prepared a separate mass balance spreadsheet based on a “typical” block to confirm the approach. The intent of the approach is to confirm KCs targeted reduction in peak flow.</p>
<p>2. Draft TM 600.3 discusses King County’s Rain Garden Size Estimate Worksheets, Seattle Public Utilities Pre-Sized Calculator, and Western Washington Hydraulic Model (WWHM).</p>	<p>SvR did not review alternate approaches to rain garden sizing. King County directed SvR to use the Mass-Balance approach.</p>
<p>3. KC modeling analysis concluded that a bottom area of 0.88 acres of rain garden is required to mitigate a 15 MGD peak flow reduction to control Barton CSO Basin. (Draft TM 600.5 Table 3-2 and 600.3 Table 4).</p>	<p>In the initial KC mass balance model spreadsheet, the infiltration potential was being doubled counted. However, this discrepancy did not have a large impact on the required bottom area of rain gardens produced from the mass balance analysis. The infiltration rate is much smaller than the flow rate entering the rain gardens. We received confirmation from KC on March 30, 2010 agreeing that the infiltration potential had been double counted.</p> <p>The result of 0.88 acres of rain garden bottom area required to achieve a 15 MGD peak flow reduction was modeled based on the rain event beginning on 11/02/84 at 0:40 as seen in file forwarded to SvR on 04/15/10. This initial KC analysis did not take into account the rainfall occurring on the previous day that utilizes some of the capacity of the rain garden system. This observation was forwarded to KC for review.</p>

<b>KC Assumption for Analysis as described in Referenced Draft TMs</b>	<b>SvR Comment</b>
<p>4. KC modeling analysis concluded that a rain garden bottom area of 0.5 acres is needed to mitigate a 15 acre impervious surface basin to control Barton CSO Basin. (Draft TM 600.3 paragraph after Table 5.).</p>	<p>KC's spreadsheet was forwarded to SvR on 04/19/10. The information forwarded indicates that the listed results (0.53 acres) are for a rain garden whose bioretention soil depth is 24-inches and not 18-inches as listed in Draft TM 600.3 – Table 5. Another spreadsheet was forwarded the same day with a bioretention soil depth of 18-inches. This resulted in 0.58 acres (or rounding to 0.6 acres) of rain garden bottom area required.</p> <p>The results of the two spreadsheets also assumed the rain event began on 11/02/84 at 0:40. This analysis does not take into account the rainfall occurring on the previous day that utilizes some of the capacity of the rain garden system.</p> <p>The double counting of the infiltration appears to be repeated in the spreadsheets received on 04/19/10. This discrepancy does not have a large impact on the overall results produced from the spreadsheet and was corrected in following King County updates.</p>
<p>5. Runoff produced using the Mass Balance spreadsheet assumes that 100-percent of the runoff from an impervious surface is instantaneously directed to the rain gardens. (Draft TM 600.3 and 600.5).</p>	<p>The Mass Balance spreadsheet does not take into account various land covers and delay of runoff flow reaching the rain gardens. Review of GIS data and field visits indicate that runoff from parcels have the potential to sheet flow into the rain gardens. We recommend that the analysis include some percentage of the tributary flows from the parcels.</p>

<b>KC Assumption for Analysis as described in Referenced Draft TMs</b>	<b>SvR Comment</b>
<p>6. TM 600.5 notes that bioretention facilities/rain gardens were the recommended GSI technology. KC assumed that non-roof top impervious areas (walks and roadway) currently draining to the CSS with ground slope less than 5-percent. With this assumption, it is assumed that 100-percent of the roof is connected to the existing CSS piped system and would not flow to rain gardens.</p>	<p>For preliminary sizing, KC assumed that pervious surfaces and roof downspouts disconnected from the CSS would not contribute flow to the sizing of the rain garden. This assumption can be used as a rough approximation for looking at the feasibility of GSI. However, SvR performed further modeling analysis on sheet flow from parcels that would contribute to the rain garden at a block level. In TM 2008 the number of downspouts currently connected to CSS or disconnected with sheet flow is difficult to identify due to discrepancies between GIS data and field conditions. City of Seattle has been implementing outreach measures to encourage residents throughout Seattle to install rain gardens and rain barrels on their properties. There is a potential that as the SPU Rainwise Program is developed, the amount of runoff flowing to the rain gardens may increase as downspouts become disconnected. We recommend including pervious areas and a portion of disconnected downspouts in the sizing of the rain gardens.</p>
<p>7. Runoff only from roadway (curb to curb) is assumed to be directed to the rain gardens with an entrance factor of 100-percent to account for some potential runoff from adjacent ROW planter strip and sidewalk (draft TM 600.3).</p>	<p>This assumption does not take into account the potential for private building downspouts being disconnected and runoff from impervious and pervious private parcel areas flowing to the right-of-way. This potential runoff may result in the rain garden being undersized. See SvR comment for #6 above.</p>
<p>8. King County assumed the storage capacity of the rain gardens only includes the storage available above the bottom area. King County excluded any storage along the 3:1 side slopes of the rain garden (draft TM 600.3).</p>	<p>We recommend that the volume provided via the side slopes be included for the analysis.</p>
<p>9. The longitudinal slope of the rain gardens is assumed to be zero (draft TM 600.5 and 600.3).</p>	<p>We recommend that an average longitudinal slope be accounted for in the analysis for sizing the number of rain gardens. The existing streets are sloped and unless additional measures are implemented to create a flat bottom, the rain gardens would be installed on a sloped condition.</p>

<b>KC Assumption for Analysis as described in Referenced Draft TMs</b>	<b>SvR Comment</b>
10. Model inputs assumed native soil infiltration rate of 0.5 in/hr (draft TM 600.5 and 600.3).	As noted in Shannon & Wilson’s March 26, 2010 geotechnical evaluation, a majority of the basin is Vashon subglacial till with some pockets of Vashon advance outwash. SvR used a design infiltration rate of 0.5 in/hr for review of King County modeling. However, given the variability and low permeability of the Vashon subglacial till (which could be less than 0.5 in/hr) found in this area of Seattle, we recommend field testing be conducted throughout the project area as part of the design phase to determine the varying design infiltration rates throughout the basin in accordance with City of Seattle street improvement requirements and SPU design requirements.
11. Rain garden ponding depth of 10 inches (draft TM 600.5 and 600.3).	This is within the design guidelines set forth by SPU for rain gardens in the City.
12. Bioretention Soil dimensions of 18-inch depth with bioretention soil infiltration rate of 2.5 in/hr and a soil porosity of 40-percent (draft TM 600.5 and 600.3).	This is within the guidelines set forth by SPU for rain gardens in the City.
13. Preliminary unit cost based on the bottom square foot area of one large rain garden (draft TM 600.5).	The KC analysis was based on the unit cost of one large rain garden with 0.88 acres of bottom surface area. In order to more accurately reflect quantity and costs, SvR recommends that total area be converted to lineal foot cost based on a planter width (such as 10 feet) which accounts for both the bottom area and side slopes of the rain garden. Rain garden cross sections with side slopes distributed throughout the project would have different construction requirements.

### **Review of KC proposed locations for GSI rain gardens noted in TM 600.5**

KC proposed locations for GSI rain gardens were provided in the map included in Appendix E of draft TM 600.5 and in the KC generated GIS layer “curb bulbs.” SvR reviewed KC’s proposed locations of the rain gardens during a field visit in March 2010 and using the available GIS data provided by KC. Each intersection and proposed midblock location was reviewed for slope constraints and planter strip widths (see Figure 1A and 1B). SvR then used the GIS data to assess each street’s feasibility for rain gardens. Characteristics reviewed included existing surface slopes, catch basins, overhead electrical utilities, and building locations.

The Green Stormwater Infrastructure Map included in Appendix E in draft TM 600.5 notes that the County assumed that midblock rain gardens have a bottom area of 350 square feet (sf) and corner rain gardens have a bottom area of 470 sf. The map states that the total bottom area of all the rain gardens shown is 33,750 sf. The rain gardens are represented in the map and the underlying GIS data as polygons around the corner of an intersection and at the midblock.

As previously noted, based on the information provided in draft TM 600.5, KC used a rain garden cross section with vertical sides and a bottom width of 10ft. In order to determine the length of KC’s rain garden section, SvR divided the polygons shown on the map by 10ft, which is the maximum width of the existing planting strips.

### **Analysis of Proposed Locations for General Modeling Purposes**

GIS was used to analyze KC’s proposed rain garden locations and eliminate locations that would be unsuitable for rain gardens. SvR used the following process and assumptions to determine feasibility for each proposed location:

1. Identify locations that are unsuitable due to soils and drainage patterns.

In the geotechnical evaluation for the basin prepared by Shannon & Wilson dated March 26, 2010, Shannon & Wilson recommend against placing any rain gardens or green alleys northwest of the intersection of SW Webster Street and 32<sup>nd</sup> Avenue SW and south of SW Barton Street due to the proximity of steep and potential unstable ground area. We included this constraint in our analysis and removed these locations as options for rain garden placement.

There are also several locations within subbasin 416 GSI study area where the properties adjacent to the right-of-way are below the road elevation of the right-of-way. Rain gardens located adjacent to such properties could cause some subsurface flow in the properties depending upon underlying soil conditions. We excluded these locations as options for rain garden placement.

In GIS data received from King County, rain garden opportunities were identified at locations outside of the subbasin 416 GSI study area. These locations were not included in our analysis.

2. Evaluate whether a curb bulb is required.

SvR assessed each location to determine whether the existing planting strip is wide enough to support a rain garden. If not wide enough, a curb bulb would be needed. As noted above, we assumed each rain garden has a 10-foot bottom width. Therefore, any planting strip which has a width less than 10 feet would require a curb bulb.

3. Identify locations where curb bulbs should not be located due to spatial constraints.

For the 25-foot wide residential streets (curb to curb) within subbasin 416 GSI study area, SDOT design standards require a minimum road width of 20 feet when there is a curb bulb, without seeking a variance from SDOT. As a result, two curb bulbs across from each other on the streets within the Study Area would not be feasible unless the curb bulbs were staggered to maintain the minimum 20-foot road width. As a result, one curb bulb from each location was eliminated where the SvR analysis indicated curb bulbs would be necessary and KC had indicated two rain gardens opposite each other. (Note: In the past, SDOT has provided a variance for road widths less than 20-feet; however, for the purpose of this analysis we excluded the narrower width as an option).

Curb bulbs along arterial streets need to be specifically designed in coordination with SDOT. For the purpose of this analysis we excluded rain gardens shown at these locations.

4. Eliminate rain garden locations on streets with slopes greater than 5-percent.

In TM 600.5, KC states that rain gardens may only be located on slopes of less than 5-percent. Accordingly, we eliminated all facilities at locations where slopes exceeded 5-percent as estimated through contours provided in GIS.

5. Analysis of other constraints.

At this phase of the analysis, SvR made a general allowance to accommodate for street trees, hydrants, light poles, and driveways during future design. During the Design Phase, these elements will be identified and brought into the analysis to refine potential raingarden locations.

Please see Figure 3 for a sample of image of an existing street in subbasin 416 GSI study area before and after a hypothetical rain garden installation.

#### **Analysis of Available Square Footage of KC proposed Rain Garden Locations**

After eliminating all KC proposed rain gardens located in unsuitable areas, SvR calculated the total available square footage of the KC proposed rain gardens.

KC provided assumptions for the square footage of corner rain gardens and midblock rain gardens. Assumptions for their lengths were not provided. In order to fit KC's square footage for rain gardens within the existing planting strips along each block, a cross section with a bottom width of 10 feet (from back of curb to face of walk) and vertical sides was used. Based on these dimensions, each midblock rain garden would be 35 feet long. Since the corner rain gardens must be located away from the walkway/ADA ramp paving at the intersections, we split the corner rain gardens into two rain gardens which would each have a length of 23.5 feet, see Figure 1A and 1B.

Using the assumptions noted above, SvR estimated that of the proposed KC rain gardens locations identified in TM 600.5 approximately 20,000 square feet (sf) (see Figure 1A & 1B) was available. This is approximately half of the total rain garden area of 39,000 sf (as indicated in the KC mass balance model) required to manage stormwater in the basin. As a result, additional rain gardens along the streets would be required.

### **SvR review of feasible locations for rain gardens**

Upon review of KC's proposed locations, SvR then reviewed the full street length for each block within subbasin 416 GSI study area. SvR used the GSI data to assess each street for existing longitudinal slope, building locations, and planter strip width. Locations that were noted as unsuitable for rain gardens per Shannon & Wilson's geotechnical report were excluded as were areas adjacent to houses whose first floor elevations are below the public right-of-way sidewalk grade. Figures 2A and 2B summarize the potential locations for rain gardens within the project study area and Figure 2C shows the same locations but within the context of Subbasin 416. The ideal locations would be along streets with existing 10-foot wide planter strips and slopes less than 3-percent. The next tier of feasibility would include streets with 3-5% slopes and existing planter strips of 10 foot width. This assessment of feasible locations for rain gardens was used for the revised modeling approach conducted by SvR as described below.

## **SVR REVISED MODELING APPROACH**

### **Modeling Assumptions and Modifications**

SvR used an alternative modeling analysis for preliminary design and sizing of rain gardens in order to compare the results for number of rain gardens King County estimated using a mass-balance approach. SvR also made some modifications to proposed KC location of rain gardens. SvR evaluated rain garden performance to meet the peak flow reduction goal of 14.6MGD during the 1984 storm event (Note: KC confirmed via correspondence that they rounded up to 15MGD in their analysis).

SvR calculated the runoff during the 1984 storm event for a typical half block catchment area. A half block catchment area represented half of the residential block plus half of the street right-of-way on one north/south and one east/west street. The rain gardens were distributed over subbasin 416 to provide the peak flow reduction. The Santa Barbara Unit Hydrograph (SBUH) Method was used to create the hydrograph of the runoff leaving the half block catchment area. For this planning level review, SBUH was chosen for the

comparative analysis with King County's rain garden results, since it is a similar simplified water balance model that can be used at a small scale for sizing infiltration facilities (rain gardens) for specified single storm events. Rainfall data for the 1984 storm event that was provided by King County was entered into the SBUH model. Using GIS data and information provided in TM 600.3 and 600.5, SvR estimated typical land cover area for the half block catchment area.

The dimensions for the rain gardens were included in the model to identify the storage and overflow within each time step. The resulting output hydrograph for the half block was aggregated to identify how many rain gardens would be required to reduce the peak flow by 14.6MGD within subbasin 416 that flowed to the pump station. The following modeling and tributary area assumptions were used in the analyses:

1. The half block catchment area is made up of the adjacent right-of-way to the centerline of the roadway and the alley, approximately 111,000 sf of area. In general, based on site reconnaissance overview, alleys are paved or graded to intercept runoff surface flow from the uphill half of block.
2. Half of the parcel's impervious (pavement) and pervious (lawn/landscaping) surfaces, excluding roof runoff within the private parcels, are assumed to contribute sheet flow to the rain gardens. This assumption is based on general field observations that sheet flow from parcels has been observed flowing off of housing lots into the public right-of-way during multiple day rain events. This assumption is a rough approximation since there is no available field data to estimate the parcel's contributing areas that sheet flow off a parcel at this time.
3. The curve numbers of all impervious and pervious surfaces on the parcel (non-right-of-way) are assumed to be 86. Based on the geotechnical report preliminary review, the existing soils are assumed to be Hydrologic Soil Group C. CN of 86 for Type C soils correlates to lawn/landscaping in accordance with Table 2.2, in Volume III of the Washington State Department of Ecology Stormwater Management Manual for Western Washington. The parcels impervious area sheet flows across the pervious areas on the lots interrupted by the undulating landscape so a CN=98 would not be applicable. In order to account for the undulation and without available data to reflect a modified CN, we assumed the CN would be similar to pervious areas on the parcel.
4. 60-percent of roof downspout connections are assumed disconnected from the piped system and sheet flow to the rain gardens. The assumed percentage of disconnected roof downspouts is based on an analysis of downspout connections shown in GIS provided by King County and data provided for a sample block in Appendix C of TM 2008. The curve number for the roof area runoff is also assumed to be 86 to represent the variability of the undulating landscape on the parcel where the flow from the disconnected downspouts would discharge onto. Without available field data to reflect a modified CN, we assumed the CN would be similar to pervious areas.
5. Rain gardens are installed in locations where there is an existing 10-foot wide public right-of-way planting strip. All planting strips adjacent to the half block are 10-feet wide (See Figure 4 for cross sections 1a, 1b, 2a & 2b). In locations of curb bulbs (See Figure 4 for cross sections 3a & 3b), the 10-foot wide planting strip is expanded to 15-feet.

6. For Sections 1a-2b, 70-percent of the total lengths of the planting strips around the perimeter of the half block can be retrofitted with rain gardens. The remaining 30-percent is an allowance to account for existing constraints including but not limited to trees, driveways, poles, and fire hydrants that restrict rain garden installation (See Figure 5). For Sections 3a/3b, 50-percent of the total lengths of the planting strip around the perimeter of the half block was assumed to be retrofitted with rain gardens and the remaining 50% is an allowance for the existing constraints as noted previously along with additional space needed for transitioning the curb bulbs to existing curb
7. The bioretention soil depth in the rain garden is 18 inches with 40-percent porosity (consistent with King County modeling).
8. Design infiltration rate of the native subgrade is 0.5 in/hour (consistent with King County modeling).
9. Design infiltration rate through the bioretention soil is 2.5 in/hr (consistent with King County modeling). Since the infiltration rate of the bioretention soil is assumed to be greater than the infiltration rate into the native subgrade, the infiltration through the bioretention soil is not a limiting factor and excluded from the analysis.
10. Three rain garden cross sections were analyzed (See Figure 4). Each cross section was used to model two scenarios: a) 3-percent longitudinal slope and b) 2-percent longitudinal slope. Table 2 summarizes our assumptions for the rain garden cross sections.

**Table 2 - Rain Garden Section Assumptions (See Figure 4)**

Section	Bottom Slope	Bottom Length (ft)	Rain Gardens per Half Block	% of planter used <sup>1</sup>	Ponding Depth (inches)	Side Slopes	Bottom Width (ft)	Is Parking Removed?	Variance required with SDOT?
1a	3%	16.7	24	70%	6	3:1 & 2.5:1	1.64	No	No
1b	2%	25	18	70%					
2a	3%	27.8	16	70%	10	1.5:1 & 1.5:1	3.28	No	Yes for side slopes
2b	2%	41.7	12	70%					
3a	3%	27.8	13	50%	10	1.5:1 & 1.5:1	8.45	Yes (curb bulbs required)	Yes for side slopes & curb bulb
3b	2%	41.7	9	50%					

Note: The rain gardens in all cases would be vegetated with ground cover and shrubs to prevent erosion and provide water quality treatment for road runoff prior to infiltrating into the subgrade.

1. Percent of existing planter used is the percent of the existing planting strip length used for retrofitting with rain gardens. So 70-percent is equivalent to 70-percent of the street length frontage being retrofitted for rain gardens including their transitions zones/pathways between cells.

To summarize the comparison of the modeled sections shown in Table 2, Sections 3a and 3b would provide the most volume for storage within the rain garden, with Section 2a and 2b second and Section 1a and 1b third in available storage. Section 1a and 1b would not require a variance from SDOT, so permitting may take less time. Section 2a, 2b, 3a, and 3b would require variance with SDOT given the assumptions for side slopes and curb locations. Costs for each will be discussed later in this memorandum but to summarize, Sections 1a, 1b, 2a, and 2b are the least expensive (see costs in Appendix) per half block because the existing curb would not have to be relocated to install a curb bulb to make room for a larger rain garden. Sections 3a and 3b are more expensive given the wider curb bulb rain garden section and required curb retrofit.

Using the half block assumptions (for both tributary areas of ROW only and ROW + Parcel runoff) previously listed and applying them to subbasin 416, the runoff hydrographs from the 1984 storm with and without GSI were developed. For the tributary area assumption that includes both the ROW + Parcel runoff, the results, as included in Appendix A, show the runoff rate from subbasin 416 without GSI is greater than the King County MOUSE model. However, for the tributary area assumption that includes just the ROW, the peak runoff rate from subbasin 416 without GSI is less than the King County MOUSE model. Subbasin 416 footprint acreage of area contributing flow to the combined sewer was averaged using information from Table D8 in King County Technical Memorandum 200.7. The SvR approach determined runoff flows from each block by adding blocks together to create the hydrographs. This simplified method for initial planning does not account for the variability in each block’s time of concentration, and as such may result in a higher peak flow rate than what was calculated using King County MOUSE Model.

**SvR Modeling Results**

SvR modeling compared two tributary areas draining to the rain gardens: ROW only and ROW + Parcel runoff. Table 3 compares the number of half blocks required to reduce the peak flow by 14.6MGD with rain gardens receiving runoff from the right-of-way only and rain gardens receiving runoff from a portion of the private parcels plus right-of-way.

**Table 3 - Comparison of Modeling Analysis for Number of Half Blocks to Reduce Peak by 14.6 MGD and Tributary Area**

<b># of Half Blocks to lower peak to 14.6MGD</b>		
<b>Section #</b>	<b>SBUH Model</b>	
	<b>ROW only</b>	<b>ROW + Parcel</b>
2b	65	n/a*
3a	65	35
3b	65	28

\*Number of half blocks exceeds area available within project study area given modeling assumptions used for analysis.

The number of half blocks required varied depending upon modeling assumptions and cross section assumed for the rain gardens. Assuming both right-of-way and private parcel areas contribute flow to the rain garden, our initial analysis determined that cross

sections 1a, 1b, 2a, and 2b resulted in more half blocks needing rain gardens than available within project study area of subbasin 416 to match a peak flow reduction of 14.6MGD. Further modeling analysis of these sections was not evaluated. Using cross sections 3a and 3b and assuming both right-of-way and private parcels contribute flow, 28 to 35 half blocks, or an average of 32 half blocks, would need rain gardens in order to reduce the peak flow from subbasin 416 by 14.6 MGD. See results in Table 3 and Figure 4 for a description of each cross section. A sample layout of applying Section 3a and 3b to a typical block in the GSI study area is provided in Figure 6.

SvR also modeled cross sections 2b, 3a and 3b using the KC assumption that only runoff from the right-of-way (no runoff from parcels) contributes to the rain gardens. This approach is similar to what City of Seattle used for sizing Phase I rain gardens in Ballard Basin for CSO reduction. With these assumptions, then 65 half blocks with rain garden retrofit in the ROW would be required; however it could be provided using the cross section without the curb bulb as demonstrated with Section 2b.

Table 4 shows how much impervious and pervious areas would contribute to the rain gardens within Barton subbasin 416 based on the number of half blocks required as shown in Table 3.

**Table 4 - Comparison of Modeling Analysis and Tributary Area to Rain Gardens**

Assumptions of Contributing Area to Rain Gardens		
Section #	SBUH Model	
	ROW only	ROW + Parcel
2b	28 acre ROW Impervious 13 acre ROW Pervious	n/a* (See Table 3 footnote)
3a	28 acre ROW Impervious 13 acre ROW Pervious	15 acre ROW Impervious 10.2 acre Parcel Roofs 11.2 acre Parcel Pavement 7.0 acre ROW Pervious 13.7 acre Parcel Pervious
3b	28 acre ROW Impervious 13 acre ROW Pervious	12 acre ROW Impervious 8.1 acre Parcel Roofs 9.0 acre Parcel Pavement 5.6 ROW Pervious 10.9 acre Parcel Pervious

Based on field reconnaissance and GIS analysis, as compiled in Figures 2A and 2B, there are approximately 34 north/south (N/S) half streets and 22 east/west (E/W) half streets (half of the right-of-way) that had 10-foot wide planters with 3-percent or less slope, which were identified as most feasible to allow placement of a rain garden or curb bulb rain garden (See Table 5). Another 13 N/S half streets and 4 E/W streets are available in areas with slopes between 3 to 5-percent with an existing 10-foot planting strip. For this planning analysis, we did not include streets with existing longitudinal slopes over 5-

percent because the storage efficiency for ponding would decrease significantly without implementing structural measures. However, if more storage is needed, then during design, those streets over 5-percent and/or those with slopes of 0-3-percent but with existing plantings less than 10 feet, should be considered. For the preliminary modeling analysis it was assumed (and for simplification of the model) that each half block has one north/south half street and one east/west half street. As a result, approximately 22 half blocks with an additional 12 north/south streets would be most feasible for installing rain gardens. Table 5 summarizes the number of half streets north/south and east/west that are available for GSI.

**Table 5 – Available Locations for Rain Gardens (See Figures 2A-2C)**

Slope/Existing Planter Width	Half Streets North/South	Half Streets East/West	Equivalent # of half blocks
0 to 3% / 10' wide	34	22	22 plus excess of 12 N/S half streets.
<3 to 5% / 10' wide	13	4	4 plus excess of 9 N/S half streets

Given the number of half blocks estimated from SvR’s modeling for tributary area including right-of-way plus parcel runoff and the number of half streets available within the subbasin 416 GSI study Area shown in Table 5, we concluded that there is enough area within the right-of-way to implement the rain gardens. During design we recommend that additional field investigations be conducted to further analyze the length of rain gardens that can fit within the existing conditions including street trees, driveways, and slope of planter strip.

**PLANNING LEVEL ESTIMATE OF PROBABLE CONSTRUCTION COST**

For SvR’s preliminary planning construction cost estimate for rain gardens, SvR used recent Seattle Public Utilities and SvR project cost data. We included allowances for mobilization, general conditions, management and layout, temporary erosion and sediment control, demolition, excavation, bioretention soil, landscaping, street trees, replacing curb\*, allowance for removing and replacing sidewalk and ADA ramps at intersections\*, irrigation, and an allowance for utility service adjustments along with a 30-percent contingency. (Note: those items marked with \* applies to only Sections 3a and 3b where curb bulb was reviewed). Taxes and design and administration costs, such as design consultant and agency fees, permitting review and fees, agency permit and construction inspection fees, were not estimated.

Table 6 summarizes the construction cost for each half block and modeled section. As previously noted, section 2b would require a variance from SDOT for the steeper side slopes and sections 3a and 3b would require variance from SDOT given the assumptions for the steeper side slope and curb bulb.

**Table 6 – Planning Construction Costs per half block for each Rain Garden Section**

Section #	Cost per half block
2b	\$183,000
3a	\$337,000
3b	\$304,000

Table 7 summarizes the planning costs for each section given the modeling approach and assumptions and number of half blocks required.

**Table 7 – Planning Costs for GSI Based on Modeling Approach and Assumptions**

Planning Costs for GSI		
Section #	SBUH Model	
	ROW only	ROW + Parcel
2b	\$11.9M	n/a*
3a	n/a**	\$11.8M
3b	n/a**	\$8.5M

\*Number of half blocks exceeds area available w/n project study area given modeling assumptions used for analysis so not included.

\*\*Not shown since smaller section 2b is feasible for the analysis as compared to larger sections (3a&3b)

M=Million

As shown in Table 7, using Section 2b, SBUH model, and assuming only the right-of-way flows to the rain garden, the estimated construction cost is approximately \$11.9 million. If runoff from the parcel flowing to the rain garden is included in the modeling assumptions, then Sections 3a and 3b would be required, and based on the modeled results, the cost for that approach is estimated between \$8.5 million and \$11.8 million or rather an average of \$10.2 million since slope varies within the feasible blocks.

## RECOMMENDATIONS

Based on the modeling results and assumptions, the rain garden retrofit is a feasible option for CSO control using cross sections 3a and 3b. For the planning estimate, the same rain garden cross section was applied around the perimeter of the half block along the street. However, the design should be flexible to include an application of all three cross sections depending upon existing site conditions. Successful green stormwater infrastructure implementation requires location specific design for each rain garden location.

As shown in the analysis, depending upon assumptions for tributary area draining to the rain garden, the number of streets requiring retrofit varies. As a result, we recommend that for the design phase, (aside from site assessment and soil testing) field investigation and monitoring be conducted to better determine the amount of flow that comes from the parcels and that flows into catch basins at the block scale. The performance of the rain gardens during the peak of the storm is dependent upon how much water it is storing prior to the peak. Subsequently, the tributary area draining to the rain garden affects how much the rain garden can handle by the time the peak is reached. We also recommend that field testing (such as smoke or dye testing) be conducted to better estimate the amount of roof area that is directly connected to the CSS pipe versus the amount of roof area that flows to disconnected downspouts and sheet flows across the parcel. In addition, during design, individual catchment areas should be analyzed, then results aggregated to the basin scale to account for differing time lags from these catchment areas reaching the pump station. With the additional field monitoring and data collection, the information can be incorporated into the model for better calibration.

As described in the executive summary for the risk analysis, we recommend that a sensitivity analysis be conducted to review the impacts of various modeling assumptions on time of concentration and tributary area to number of rain gardens required. We also recommend that other design storm events be considered in the sensitivity analysis to see if it would affect the sizing of the rain gardens.

# FIGURES



## Legend

- Study Area Limits
- 2ft. Contours
- Catchbasins
- Soil Issues per Geotech
- Adjacent Building Below ROW Grade
- Public Road/Alley
- Private Pavement (approx.)
- Buildings

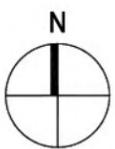
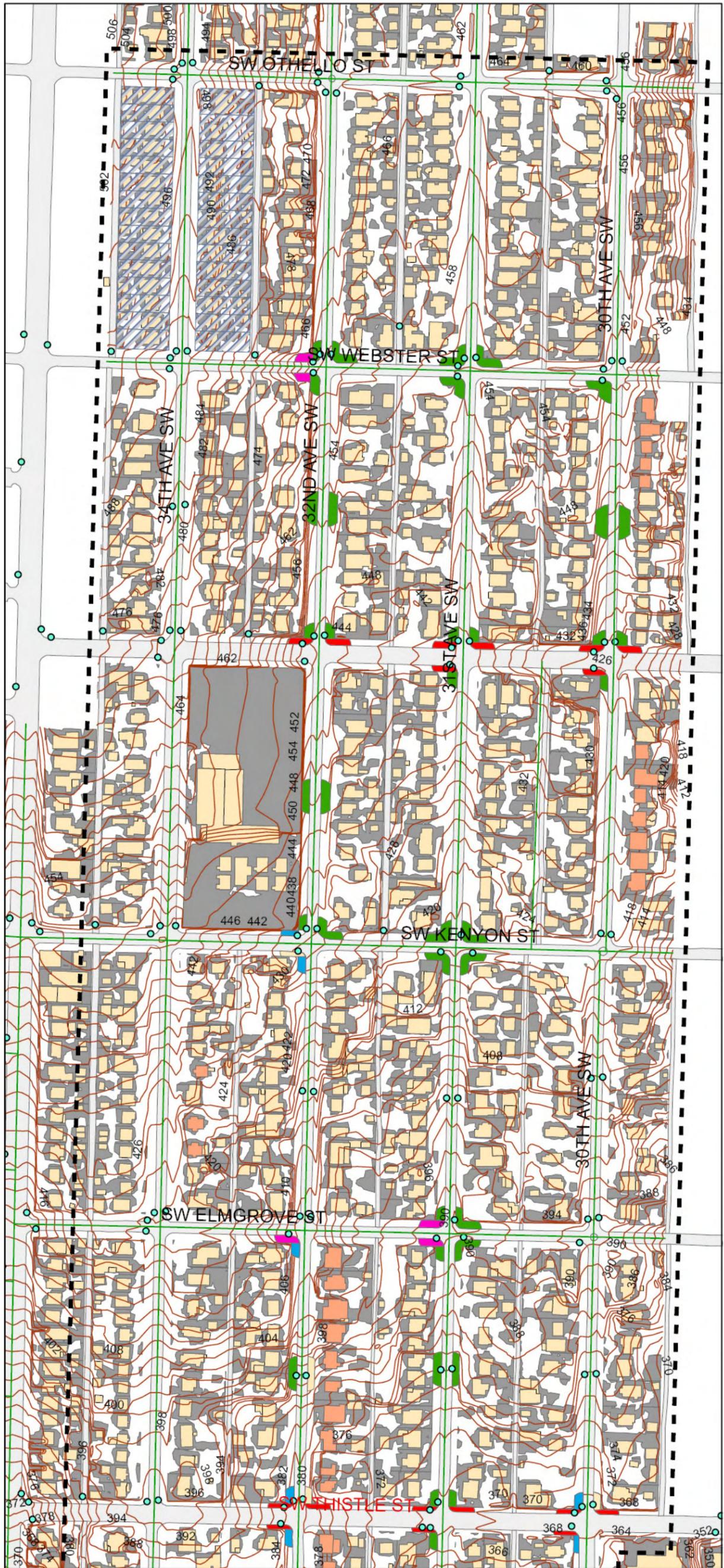
## Suitable Locations for Raingardens

- Curb Bulb Required
- Use Existing Planting Strip

## Locations determined to be unsuitable

- Arterial
- Curb Bulb Across
- Slope 5% or Greater

\*\*Initial suitability analysis did not include locations of trees, hydrants, light poles and driveways



**Figure 1A**  
**North from Othello Street - Thistle Street**  
**Analysis of King County Proposed**  
**Raingarden Locations**  
 Barton Subbasin 416 GSI Project Study Area



**Legend**

- - - Study Area Limits
- 2ft. Contours
- Catchbasins
- ▨ Soil Issues per Geotech
- Adjacent Building Below ROW Grade
- Public Road/Alley
- Private Pavement (approx.)
- Buildings

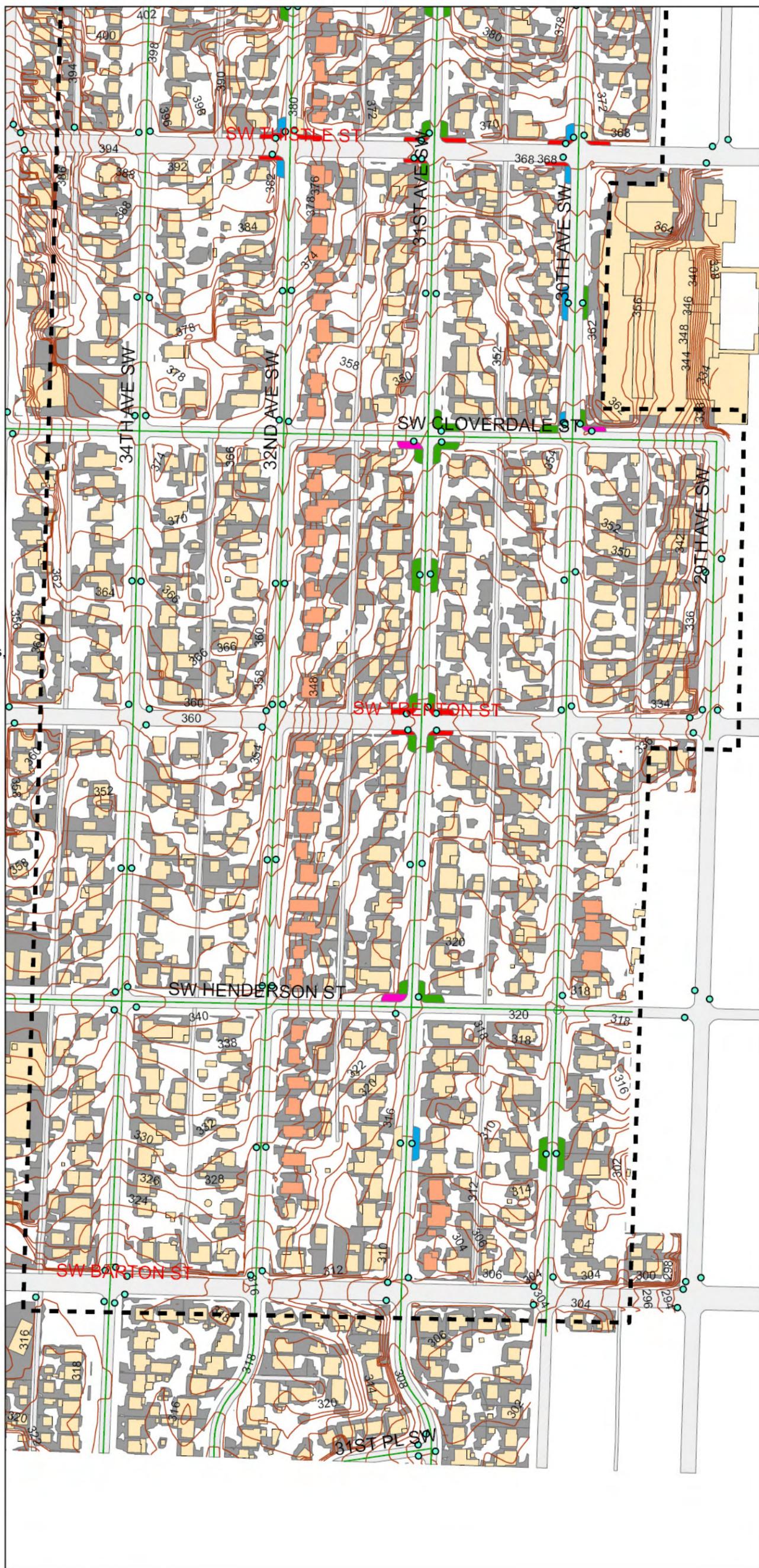
**Suitable Locations for Raingardens**

- Curb Bulb Required
- Use Existing Planting Strip

**Locations determined to be unsuitable**

- Arterial
- Curb Bulb Across
- Slope 5% or Greater

\*\*Initial suitability analysis did not include locations of trees, hydrants, light poles and driveways



**Figure 1B**  
**South from Thistle Street - Barton Street**  
**Analysis of King County Proposed**  
**Raingarden Locations**  
 Barton Subbasin 416 GSI Project Study Area



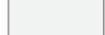
## Legend

-  Soils or Drainage Pattern Issues
-  Study Area Limits
-  Catchbasins
-  Soil Issues per Geotech
-  Adjacent Building Below ROW Grade
-  2ft. Contours

## Slope

-  0.00 - 3.40
-  3.41 - 5.00
-  5.01 - 15.00

## Planting Strip Width

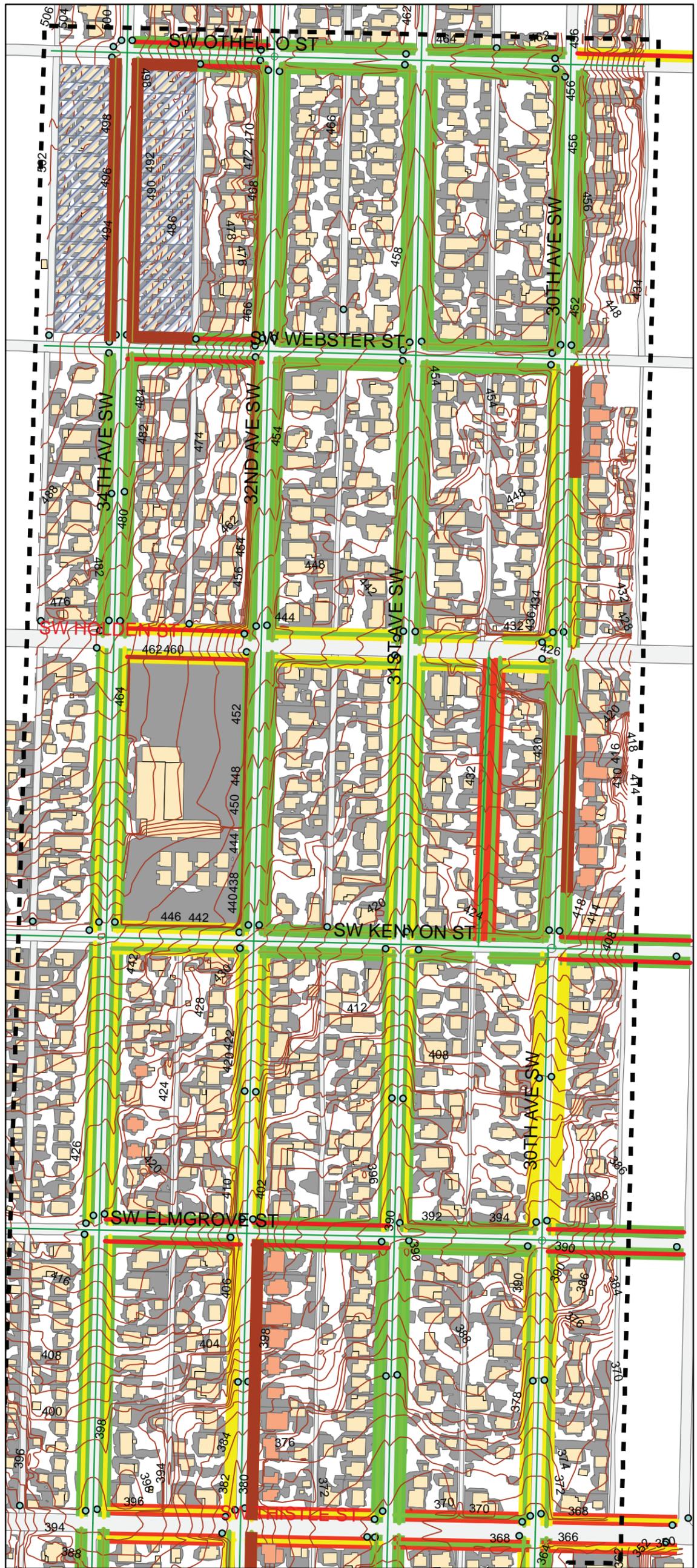
-  0-3 ft.
-  3.1-9.9 ft.
-  10 ft.
-  Public Road/Alley
-  Private Pavement (approx.)
-  Buildings

\*\*Initial suitability analysis did not include locations of trees, hydrants, light poles and driveways

## Feasible Locations for Raingardens

-  3% Slope, 10 ft. wide planting strip
-  4-5% Slope, 10 ft. wide planting strip
-  3% Slope, 3-9.9 ft. wide planting strip
-  4-5% Slope, 3-9.9 ft. wide planting strip

\*\*Slopes have been rounded to the nearest percent



**Figure 2A:**  
**North from Othello Street - Thistle Street**  
**GSI Block Feasibility Assessment**  
 Barton Subbasin 416 GSI Project Study Area



**Legend**

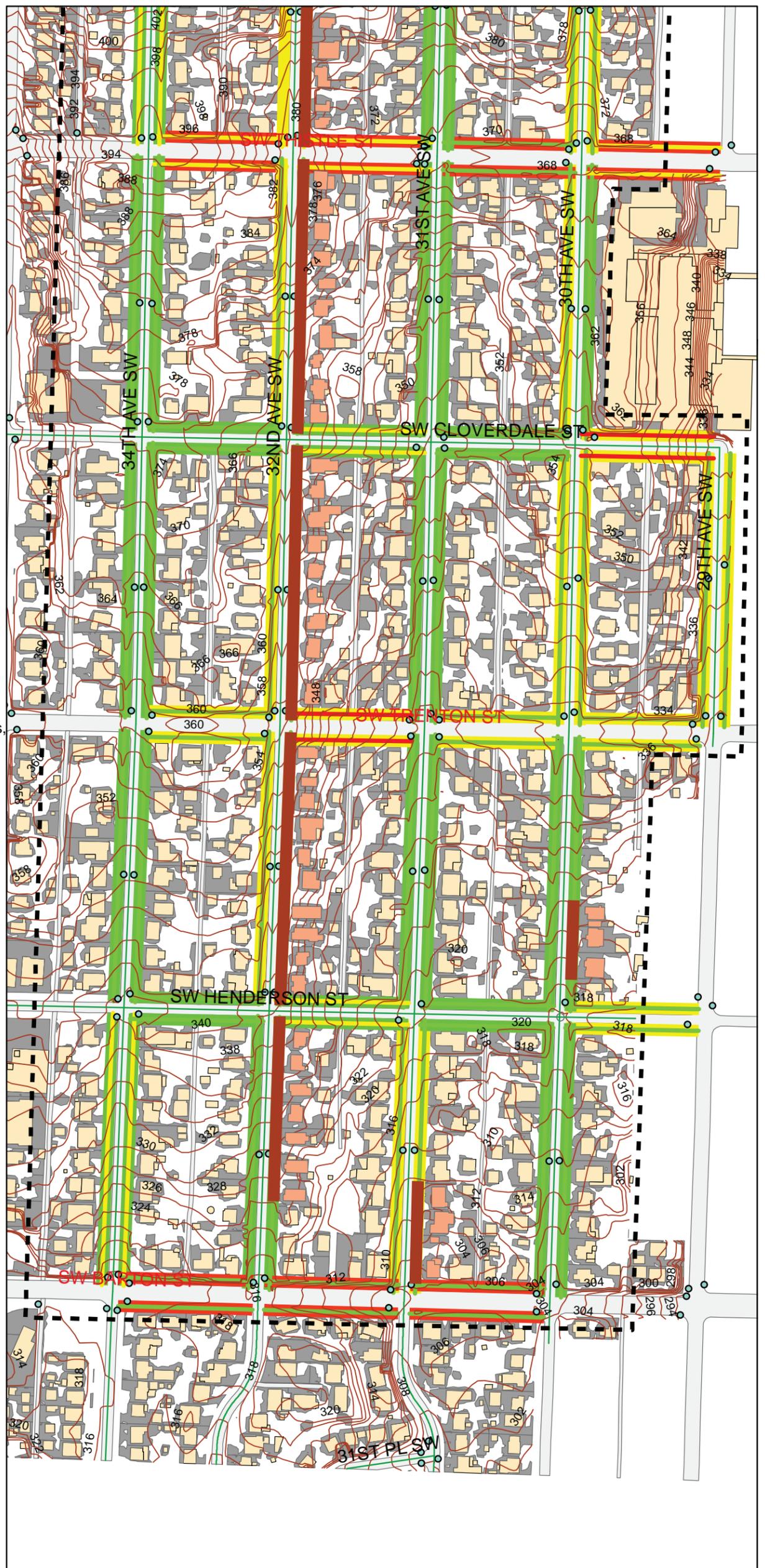
-  Soils or Drainage Pattern Issues
-  Study Area Limits
-  Catchbasins
-  Soil Issues per Geotech
-  Adjacent Building Below ROW Grade
-  2ft. Contours
- Slope**
-  0.00 - 3.40
-  3.41 - 5.00
-  5.01 - 15.00
- Planting Strip Width**
-  0-3 ft.
-  3.1-9.9 ft.
-  10 ft.
-  Public Road/Alley
-  Private Pavement (approx.)
-  Buildings

\*\*Initial suitability analysis did not include locations of trees, hydrants, light poles and driveways

**Feasible Locations for Raingardens**

-  3% Slope, 10 ft. wide planting strip
-  4-5% Slope, 10 ft. wide planting strip
-  3% Slope, 3-9.9 ft. wide planting strip
-  4-5% Slope, 3-9.9 ft. wide planting strip

\*\*Slopes have been rounded to the nearest percent



**Figure 2B:**  
**South from Thistle Street - Barton Street**  
**GSI Block Feasibility Assessment**  
 Barton Subbasin 416 GSI Project Study Area



# Legend

--- GSI Project Study Area

Subbasin 416

## Drainage Mainlines

Combined

Storm

Sewer

## Feasible Locations

High/Most Feasible  
0-3% Slope, 10ft. Planter

Moderately Feasible  
4-5% Slope, 10ft. Planter

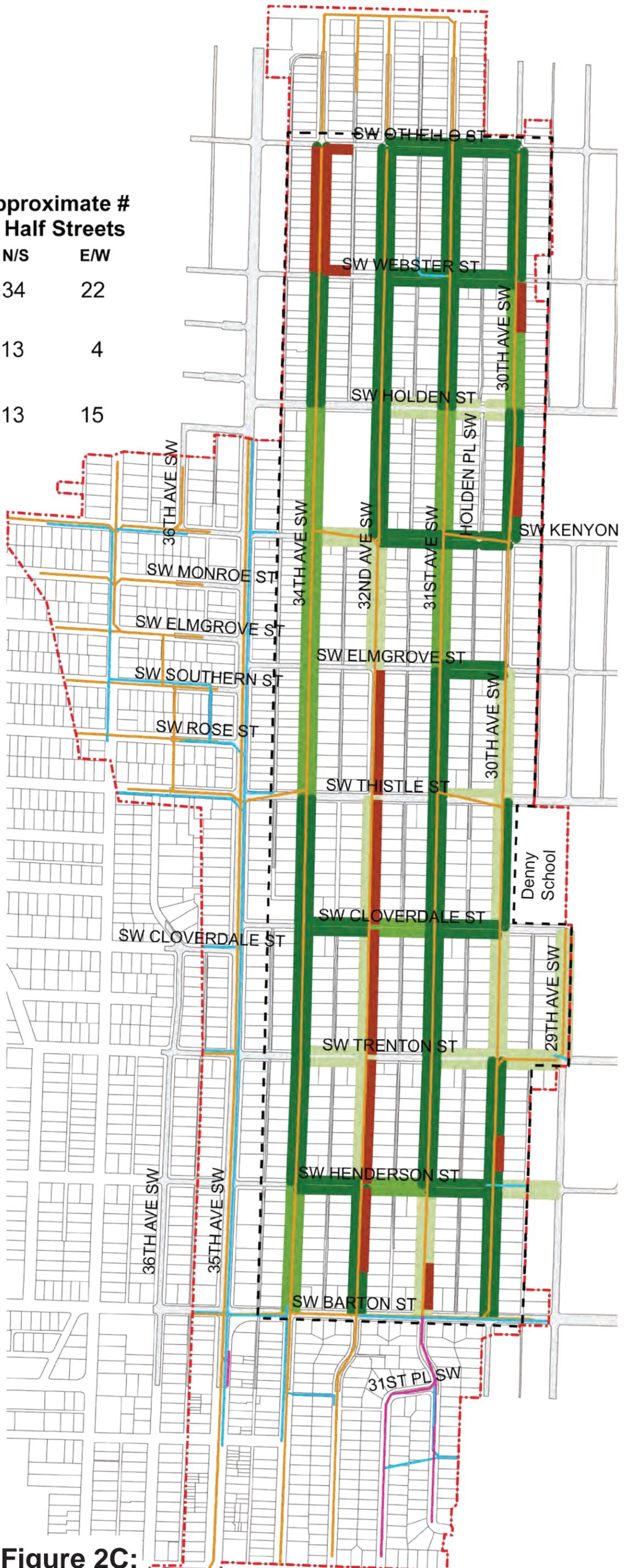
Less Feasible  
0-3% Slope, <10ft. Planter

## Difficult Locations

Soils or Drainage Pattern Issues

### Approximate # of Half Streets

N/S	E/W
34	22
13	4
13	15



June 21, 2010  
SvR #06053

**Figure 2C:**  
**Compiled Street Frontage Assessment for GSI**  
Barton Subbasin 416 GSI Project Study Area



Figure 3: Sample of Existing Street in Barton GSI Study Area (Before & After GSI)



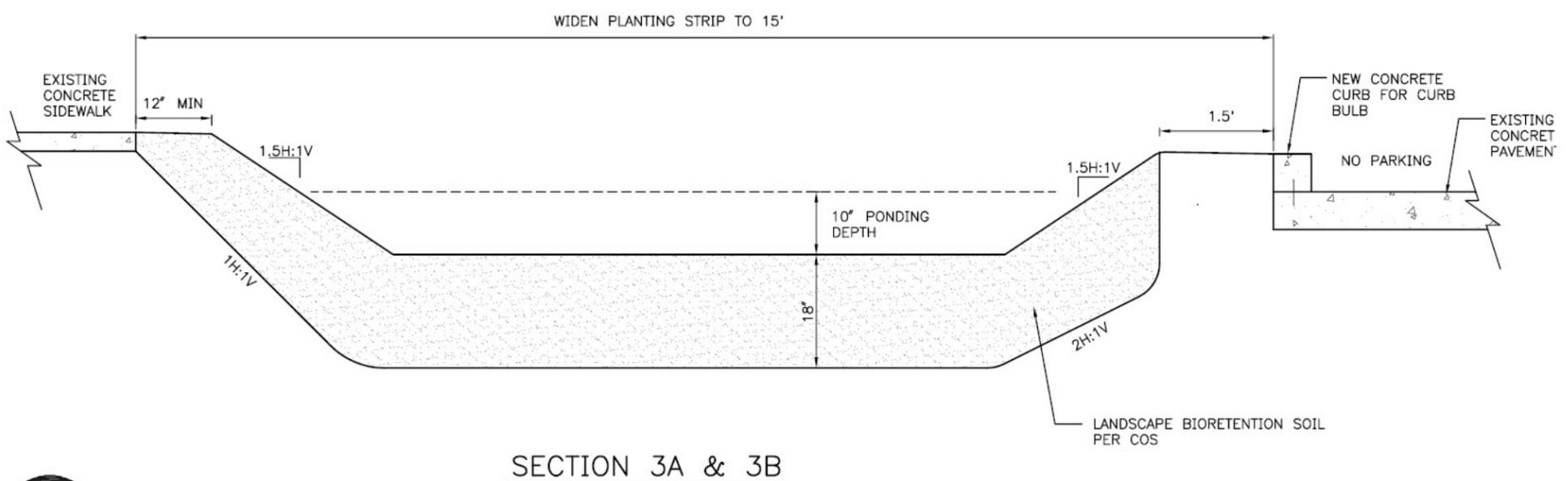
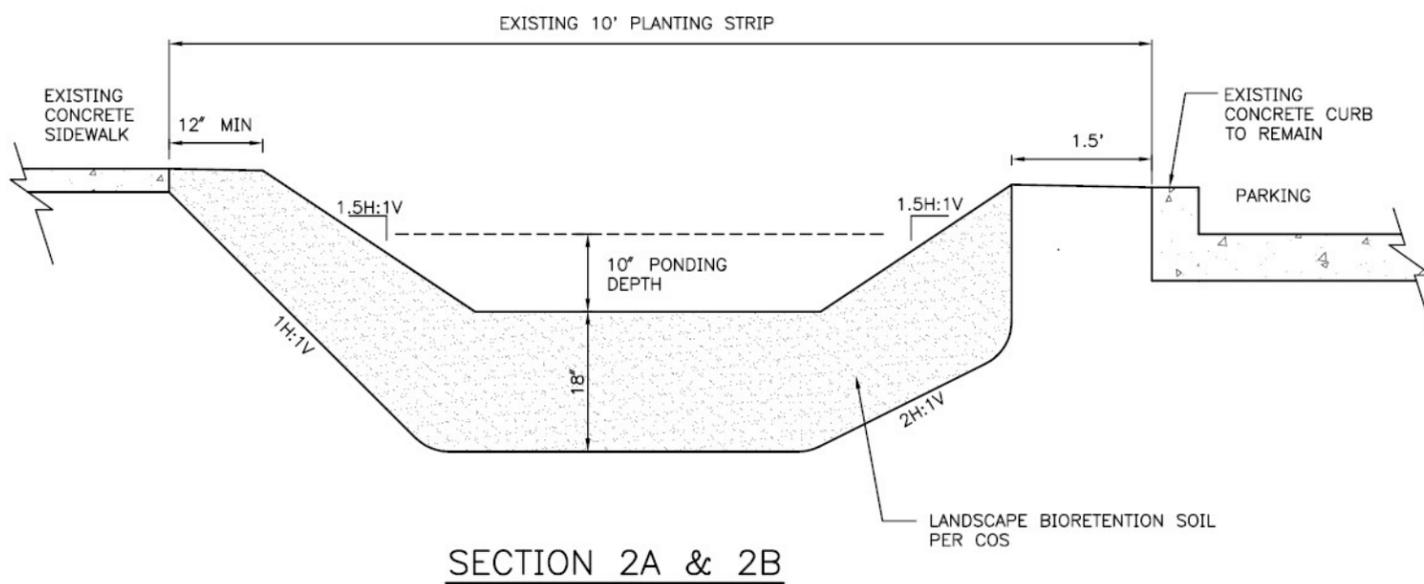
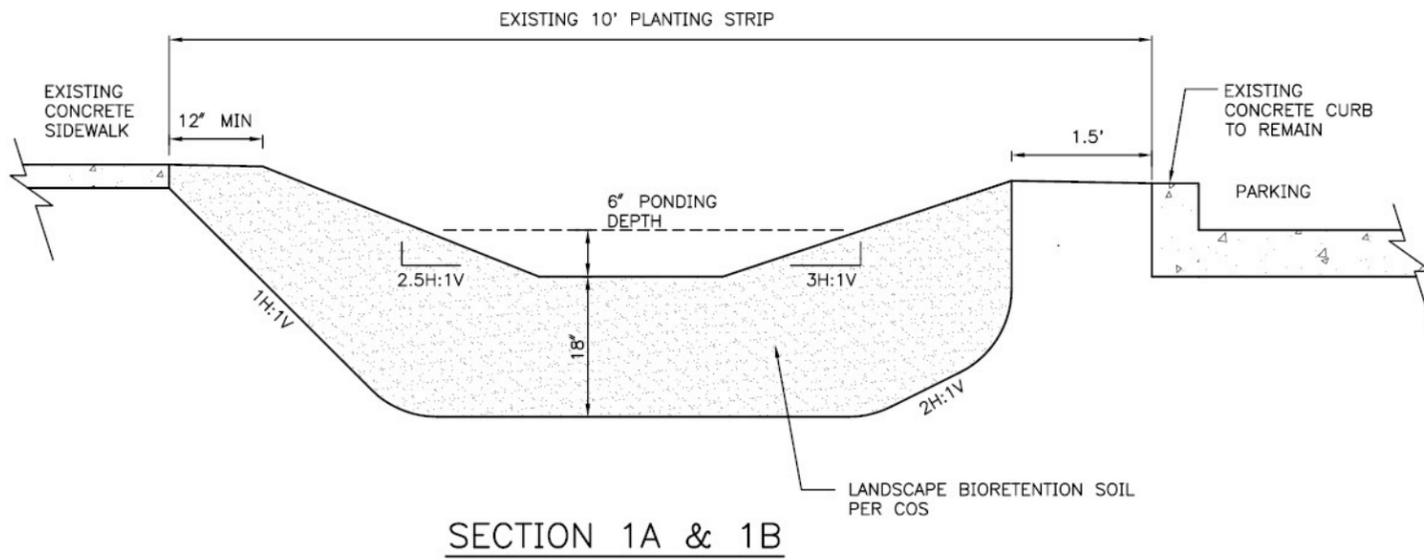
A - Before GSI – Sample 10’ planting strip w/n GSI project study area.



B - After GSI

King County CSO  
Barton GSI Review  
SvR#06053









**Legend**

- Water lines
- Drainage Lines to CSS
- Catch Basins
- Fire Hydrants
- ★ Street Lights
- 2ft. Contours
- Electrical Lines (aerial)
- Parcel Boundaries
- Pavement Edges
- Suitable Frontage for Raingarden
- Constrained Frontage



**Figure 5**  
**Typical Block Constraints for**  
**Raingarden Locations**  
 Barton Subbasin 416 GSI Project Study Area



**Legend**

- Water lines
- Drainage/Sewer Lines to CSS
- Catch Basins
- Fire Hydrants
- 2ft. Contours
- ★ Street Lights/PP
- Electrical Lines (aerial)
- Parcel Boundaries
- Pavement Edges
- Curb Bulbs with Raingardens



**Figure 6**  
**Sample Layout of**  
**Raingarden Cells on a Typical Block**  
 Barton Subbasin 416 GSI Project Study Area



## **Appendix A – Planning Calculations**

- SBUH modeling printouts for reviewing rain garden sizing.
- Downspout disconnect calculations for developing modeling assumption.
- Summary of planning level construction cost for each modeled section by half block.



Assumptions for Roof Disconnect from sample blocks in Basin 416. With City's Rainwise program and potential for homeowners to disconnect for various reasons in the older neighborhood number of disconnects could increase. For planning modeling assumed 60% disconnect in future. During design phase, study of each individual blocks # of disconnects should be evaluated.

Draft Appendix C, August 22, 2008

View 01  
 $51 + 33 = 84$   
 $46 + 43 = 89$

$\frac{84}{(84 + 89)} = 49\%$  of roof downspouts are disconnected

View 02  
 $57 + 33 = 90$   
 $39 + 29 = 68$

$\frac{90}{(90 + 68)} = 57\%$  of roof downspouts are disconnected



**King County**  
 Department of  
 Natural Resources and Parks  
**Wastewater Treatment  
 Division**

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File Name: U:\2008\Interns\GPS\Summer\Downspout testing\Barton\_CSO.pdf  
 Data Source: Bryan Yoon, WTD Intern

**Barton CSO Downspout Survey**

King County  
 500 4th Ave  
 Seattle, WA 98101  
 206/462-3000  
 www.kingcounty.gov

Roof Downspouts disconnected %  
 (roof to Rain Gardens)



Event durations and rainfall data is provided by KC on 03/16/10

STORM 1984				STORM 1987				STORM 1979				STORM 1988			
Total duration (hours)		47.83		Total duration (hours)		62.17		Total duration (hours)		75.33		Total duration (hours)		77.67	
Total Depth (inches)		2.52		Total Depth (inches)		3.25		Total Depth (inches)		4.7		Total Depth (inches)		1.8	
Event Duration (hours)		23.83		Event Duration (hours)		46		Event Duration (hours)		51		Event Duration (hours)		46.17	
Start Time		11/1/1984 10:00		Start Time		3/2/1987 3:10		Start Time		12/13/1979 2:06		Start Time		11/22/1988 3:51	
End Time		11/2/1984 9:50		End Time		3/4/1987 1:10		End Time		12/15/1979 5:06		End Time		11/24/1988 2:01	
Event Rainfall Depth (inches)		2.39		Event Rainfall Depth (inches)		3.22		Event Rainfall Depth (inches)		4.35		Event Rainfall Depth (inches)		1.45	
Last Time Increment		144		Last Time Increment		277		Last Time Increment		307		Last Time Increment		278	
Date/Time	Time Increment	Precip (inches)	Fraction	Date/Time	Time Increment	Precip (inches)	Fraction	Date/Time	Time Increment	Precip (inches)	Fraction	Date/Time	Time Increment	Precip (inches)	Fraction
11/1/1984 0:00		0		3/2/87 0:00		0		12/13/79 0:06		0		11/21/88 0:01		0	
11/1/1984 0:10		0		3/2/87 0:10		0		12/13/79 0:16		0		11/21/88 0:11		0	
11/1/1984 0:20		0		3/2/87 0:20		0.01		12/13/79 0:26		0		11/21/88 0:21		0	
11/1/1984 0:30		0		3/2/87 0:30		0		12/13/79 0:36		0		11/21/88 0:31		0	
11/1/1984 0:40		0		3/2/87 0:40		0		12/13/79 0:46		0		11/21/88 0:41		0	
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11/1/1984 1:30		0		3/2/87 1:30		0		12/13/79 1:36		0		11/21/88 1:31		0	
11/1/1984 1:40		0		3/2/87 1:40		0		12/13/79 1:46		0		11/21/88 1:41		0	
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11/1/1984 2:00		0		3/2/87 2:00		0		12/13/79 2:06	1	0.01	0.002299	11/21/88 2:01		0	
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11/1/1984 10:10	2	0.01	0.004184	3/2/87 10:10	43	0.01	0.003106	12/13/79 10:16	50	0.01	0.002299	11/21/88 10:11		0	
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11/1/1984 10:30	4	0.01	0.004184	3/2/87 10:30	45	0	0	12/13/79 10:36	52	0.01	0.002299	11/21/88 10:31		0	
11/1/1984 10:40	5	0.03	0.012552	3/2/87 10:40	46	0.01	0.003106	12/13/79 10:46	53	0.02	0.004598	11/21/88 10:41		0	
11/1/1984 10:50	6	0.02	0.008368	3/2/87 10:50	47	0.01	0.003106	12/13/79 10:56	54	0.01	0.002299	11/21/88 10:51		0	
11/1/1984 11:00	7	0.02	0.008368	3/2/87 11:00	48	0.01	0.003106	12/13/79 11:06	55	0.02	0.004598	11/21/88 11:01		0	
11/1/1984 11:10	8	0.02	0.008368	3/2/87 11:10	49	0.01	0.003106	12/13/79 11:16	56	0.02	0.004598	11/21/88 11:11		0	
11/1/1984 11:20	9	0.03	0.012552	3/2/87 11:20	50	0.02	0.006211	12/13/79 11:26	57	0.02	0.004598	11/21/88 11:21		0	
11/1/1984 11:30	10	0.02	0.008368	3/2/87 11:30	51	0.01	0.003106	12/13/79 11:36	58	0.02	0.004598	11/21/88 11:31		0	
11/1/1984 11:40	11	0.02	0.008368	3/2/87 11:40	52	0.01	0.003106	12/13/79 11:46	59	0.02	0.004598	11/21/88 11:41		0	
11/1/1984 11:50	12	0.02	0.008368	3/2/87 11:50	53	0.01	0.003106	12/13/79 11:56	60	0.04	0.009195	11/21/88 11:51		0	
11/1/1984 12:00	13	0.01	0.004184	3/2/87 12:00	54	0.01	0.003106	12/13/79 12:06	61	0.02	0.004598	11/21/8			



11/1/1984 12:10	14	0.02	0.008368	3/2/87 12:10	55	0.01	0.003106	12/13/79 12:16	62	0.05	0.011494	11/21/88 12:11	0
11/1/1984 12:20	15	0.03	0.012552	3/2/87 12:20	56	0	0	12/13/79 12:26	63	0.05	0.011494	11/21/88 12:21	0
11/1/1984 12:30	16	0.03	0.012552	3/2/87 12:30	57	0.01	0.003106	12/13/79 12:36	64	0.03	0.006897	11/21/88 12:31	0
11/1/1984 12:40	17	0.03	0.012552	3/2/87 12:40	58	0	0	12/13/79 12:46	65	0.01	0.002299	11/21/88 12:41	0
11/1/1984 12:50	18	0.05	0.020921	3/2/87 12:50	59	0.01	0.003106	12/13/79 12:56	66	0.01	0.002299	11/21/88 12:51	0
11/1/1984 13:00	19	0.02	0.008368	3/2/87 13:00	60	0.01	0.003106	12/13/79 13:06	67	0.01	0.002299	11/21/88 13:01	0
11/1/1984 13:10	20	0.04	0.016736	3/2/87 13:10	61	0.01	0.003106	12/13/79 13:16	68	0.02	0.004598	11/21/88 13:11	0
11/1/1984 13:20	21	0.05	0.020921	3/2/87 13:20	62	0.01	0.003106	12/13/79 13:26	69	0.02	0.004598	11/21/88 13:21	0
11/1/1984 13:30	22	0.04	0.016736	3/2/87 13:30	63	0.01	0.003106	12/13/79 13:36	70	0.01	0.002299	11/21/88 13:31	0
11/1/1984 13:40	23	0.04	0.016736	3/2/87 13:40	64	0.01	0.003106	12/13/79 13:46	71	0.01	0.002299	11/21/88 13:41	0.01
11/1/1984 13:50	24	0.04	0.016736	3/2/87 13:50	65	0.02	0.006211	12/13/79 13:56	72	0.02	0.004598	11/21/88 13:51	0
11/1/1984 14:00	25	0.03	0.012552	3/2/87 14:00	66	0.02	0.006211	12/13/79 14:06	73	0.02	0.004598	11/21/88 14:01	0.01
11/1/1984 14:10	26	0.02	0.008368	3/2/87 14:10	67	0.03	0.009317	12/13/79 14:16	74	0.03	0.006897	11/21/88 14:11	0
11/1/1984 14:20	27	0.02	0.008368	3/2/87 14:20	68	0.03	0.009317	12/13/79 14:26	75	0.02	0.004598	11/21/88 14:21	0.01
11/1/1984 14:30	28	0.02	0.008368	3/2/87 14:30	69	0.03	0.009317	12/13/79 14:36	76	0.02	0.004598	11/21/88 14:31	0
11/1/1984 14:40	29	0.04	0.016736	3/2/87 14:40	70	0.01	0.003106	12/13/79 14:46	77	0.01	0.002299	11/21/88 14:41	0
11/1/1984 14:50	30	0.03	0.012552	3/2/87 14:50	71	0.01	0.003106	12/13/79 14:56	78	0.02	0.004598	11/21/88 14:51	0
11/1/1984 15:00	31	0.04	0.016736	3/2/87 15:00	72	0.03	0.009317	12/13/79 15:06	79	0.02	0.004598	11/21/88 15:01	0
11/1/1984 15:10	32	0.04	0.016736	3/2/87 15:10	73	0.02	0.006211	12/13/79 15:16	80	0.03	0.006897	11/21/88 15:11	0
11/1/1984 15:20	33	0.04	0.016736	3/2/87 15:20	74	0.02	0.006211	12/13/79 15:26	81	0.03	0.006897	11/21/88 15:21	0
11/1/1984 15:30	34	0.03	0.012552	3/2/87 15:30	75	0.01	0.003106	12/13/79 15:36	82	0.02	0.004598	11/21/88 15:31	0
11/1/1984 15:40	35	0.04	0.016736	3/2/87 15:40	76	0.02	0.006211	12/13/79 15:46	83	0.02	0.004598	11/21/88 15:41	0
11/1/1984 15:50	36	0.03	0.012552	3/2/87 15:50	77	0.01	0.003106	12/13/79 15:56	84	0.03	0.006897	11/21/88 15:51	0
11/1/1984 16:00	37	0.02	0.008368	3/2/87 16:00	78	0.01	0.003106	12/13/79 16:06	85	0.03	0.006897	11/21/88 16:01	0
11/1/1984 16:10	38	0.01	0.004184	3/2/87 16:10	79	0	0	12/13/79 16:16	86	0.03	0.006897	11/21/88 16:11	0
11/1/1984 16:20	39	0.01	0.004184	3/2/87 16:20	80	0	0	12/13/79 16:26	87	0.03	0.006897	11/21/88 16:21	0
11/1/1984 16:30	40	0.01	0.004184	3/2/87 16:30	81	0	0	12/13/79 16:36	88	0.03	0.006897	11/21/88 16:31	0
11/1/1984 16:40	41	0	0	3/2/87 16:40	82	0.01	0.003106	12/13/79 16:46	89	0.03	0.006897	11/21/88 16:41	0
11/1/1984 16:50	42	0	0	3/2/87 16:50	83	0.01	0.003106	12/13/79 16:56	90	0.02	0.004598	11/21/88 16:51	0
11/1/1984 17:00	43	0.01	0.004184	3/2/87 17:00	84	0.01	0.003106	12/13/79 17:06	91	0.01	0.002299	11/21/88 17:01	0
11/1/1984 17:10	44	0	0	3/2/87 17:10	85	0.01	0.003106	12/13/79 17:16	92	0.01	0.002299	11/21/88 17:11	0
11/1/1984 17:20	45	0	0	3/2/87 17:20	86	0.01	0.003106	12/13/79 17:26	93	0.01	0.002299	11/21/88 17:21	0
11/1/1984 17:30	46	0	0	3/2/87 17:30	87	0.01	0.003106	12/13/79 17:36	94	0	0	11/21/88 17:31	0
11/1/1984 17:40	47	0	0	3/2/87 17:40	88	0	0	12/13/79 17:46	95	0.02	0.004598	11/21/88 17:41	0
11/1/1984 17:50	48	0.02	0.008368	3/2/87 17:50	89	0.01	0.003106	12/13/79 17:56	96	0	0	11/21/88 17:51	0
11/1/1984 18:00	49	0.02	0.008368	3/2/87 18:00	90	0.01	0.003106	12/13/79 18:06	97	0.02	0.004598	11/21/88 18:01	0
11/1/1984 18:10	50	0.02	0.008368	3/2/87 18:10	91	0.01	0.003106	12/13/79 18:16	98	0.01	0.002299	11/21/88 18:11	0
11/1/1984 18:20	51	0.02	0.008368	3/2/87 18:20	92	0.02	0.006211	12/13/79 18:26	99	0.01	0.002299	11/21/88 18:21	0
11/1/1984 18:30	52	0.03	0.012552	3/2/87 18:30	93	0.01	0.003106	12/13/79 18:36	100	0.02	0.004598	11/21/88 18:31	0
11/1/1984 18:40	53	0.03	0.012552	3/2/87 18:40	94	0.02	0.006211	12/13/79 18:46	101	0.01	0.002299	11/21/88 18:41	0
11/1/1984 18:50	54	0.03	0.012552	3/2/87 18:50	95	0.01	0.003106	12/13/79 18:56	102	0.01	0.002299	11/21/88 18:51	0
11/1/1984 19:00	55	0.03	0.012552	3/2/87 19:00	96	0.01	0.003106	12/13/79 19:06	103	0.02	0.004598	11/21/88 19:01	0
11/1/1984 19:10	56	0.04	0.016736	3/2/87 19:10	97	0.01	0.003106	12/13/79 19:16	104	0.02	0.004598	11/21/88 19:11	0
11/1/1984 19:20	57	0	0	3/2/87 19:20	98	0.01	0.003106	12/13/79 19:26	105	0.01	0.002299	11/21/88 19:21	0
11/1/1984 19:30	58	0.02	0.008368	3/2/87 19:30	99	0.02	0.006211	12/13/79 19:36	106	0.02	0.004598	11/21/88 19:31	0
11/1/1984 19:40	59	0.01	0.004184	3/2/87 19:40	100	0.03	0.009317	12/13/79 19:46	107	0.02	0.004598	11/21/88 19:41	0
11/1/1984 19:50	60	0.01	0.004184	3/2/87 19:50	101	0.03	0.009317	12/13/79 19:56	108	0.02	0.004598	11/21/88 19:51	0
11/1/1984 20:00	61	0	0	3/2/87 20:00	102	0.04	0.012422	12/13/79 20:06	109	0.02	0.004598	11/21/88 20:01	0
11/1/1984 20:10	62	0.01	0.004184	3/2/87 20:10	103	0.02	0.006211	12/13/79 20:16	110	0.01	0.002299	11/21/88 20:11	0
11/1/1984 20:20	63	0.03	0.012552	3/2/87 20:20	104	0.03	0.009317	12/13/79 20:26	111	0.01	0.002299	11/21/88 20:21	0
11/1/1984 20:30	64	0.02	0.008368	3/2/87 20:30	105	0.02	0.006211	12/13/79 20:36	112	0.01	0.002299	11/21/88 20:31	0
11/1/1984 20:40	65	0.01	0.004184	3/2/87 20:40	106	0.02	0.006211	12/13/79 20:46	113	0.01	0.002299	11/21/88 20:41	0
11/1/1984 20:50	66	0	0	3/2/87 20:50	107	0.02	0.006211	12/13/79 20:56	114	0.01	0.002299	11/21/88 20:51	0
11/1/1984 21:00	67	0.01	0.004184	3/2/87 21:00	108	0.02	0.006211	12/13/79 21:06	115	0.01	0.002299	11/21/88 21:01	0
11/1/1984 21:10	68	0	0	3/2/87 21:10	109	0.02	0.006211	12/13/79 21:16	116	0	0	11/21/88 21:11	0
11/1/1984 21:20	69	0	0	3/2/87 21:20	110	0.02	0.006211	12/13/79 21:26	117	0.02	0.004598	11/21/88 21:21	0
11/1/1984 21:30	70	0.01	0.004184	3/2/87 21:30	111	0	0	12/13/79 21:36	118	0.01	0.002299	11/21/88 21:31	0
11/1/1984 21:40	71	0.01	0.004184	3/2/87 21:40	112	0.01	0.003106	12/13/79 21:46	119	0.02	0.004598	11/21/88 21:41	0
11/1/1984 21:50	72	0	0	3/2/87 21:50	113	0.01	0.003106	12/13/79 21:56	120	0.01	0.002299	11/21/88 21:51	0
11/1/1984 22:00	73	0.01	0.004184	3/2/87 22:00	114	0.02	0.006211	12/13/79 22:06	121	0.02	0.004598	11/21/88 22:01	0
11/1/1984 22:10	74	0	0	3/2/87 22:10	115	0.01	0.003106	12/13/79 22:16	122	0.01	0.002299	11/21/88 22:11	0
11/1/1984 22:20	75	0	0	3/2/87 22:20	116	0.03	0.009317	12/13/79 22:26	123	0.02	0.004598	11/21/88 22:21	0
11/1/1984 22:30	76	0	0	3/2/87 22:30	117	0.01	0.003106	12/13/79 22:36	124	0.03	0.006897	11/21/88 22:31	0
11/1/1984 22:40	77	0	0	3/2/87 22:40	118	0.01	0.003106	12/13/79 22:46	125	0.02	0.004598	11/21/88 22:41	0
11/1/1984 22:50	78	0	0	3/2/87 22:50	119	0	0	12/13/79 22:56	126	0.02	0.004598	11/21/88 22:51	0
11/1/1984 23:00	79	0	0	3/2/87 23:00	120	0.01	0.003106	12/13/79 23:06	127	0.02	0.004598	11/21/88 23:01	0
11/1/1984 23:10	80	0.01	0.004184	3/2/87 23:10	121	0.01	0.003106	12/13/79 23:16	128	0.02	0.004598	11/21/88 23:11	0
11/1/1984 23:20	81	0.01	0.004184	3/2/87 23:20	122	0.01	0.003106	12/13/79 23:26	129	0.01	0.002299	11/21/88 23:21	0
11/1/1984 23:30	82	0.01	0.004184	3/2/87 23:30	123	0	0	12/13/79 23:36	130	0.02	0.004598	11/21/88 23:31	0
11/1/1984 23:40	83	0	0	3/2/87 23:40	124	0	0	12/13/79 23:46	131	0.02	0.004598	11/21/88 23:41	0
11/1/1984 23:50	84	0	0	3/2/87 23:50	125	0.01	0.003106	12/13/79 23:56	132	0.03	0.006897	11/21/88 23:51	0
11/2/1984 0:00	85	0	0	3/3/87 0:00	126	0	0	12/14/79 0:06	133	0.02	0.004598	11/22/88 0:01	0
11/2/1984 0:10	86	0	0	3/3/87 0:10	127	0.01	0.003106	12/14/79 0:16	134	0.01	0.002299	11/22/88 0:11	0
11/2/1984													



11/2/1984 2:00	97	0	0	3/3/87 2:00	138	0.03	0.009317	12/14/79 2:06	145	0.01	0.002299	11/22/88 2:01		0	
11/2/1984 2:10	98	0	0	3/3/87 2:10	139	0.01	0.003106	12/14/79 2:16	146	0.02	0.004598	11/22/88 2:11		0	
11/2/1984 2:20	99	0	0	3/3/87 2:20	140	0.02	0.006211	12/14/79 2:26	147	0.02	0.004598	11/22/88 2:21		0	
11/2/1984 2:30	100	0.01	0.004184	3/3/87 2:30	141	0	0	12/14/79 2:36	148	0.02	0.004598	11/22/88 2:31		0	
11/2/1984 2:40	101	0	0	3/3/87 2:40	142	0.01	0.003106	12/14/79 2:46	149	0.01	0.002299	11/22/88 2:41		0	
11/2/1984 2:50	102	0	0	3/3/87 2:50	143	0	0	12/14/79 2:56	150	0.02	0.004598	11/22/88 2:51		0	
11/2/1984 3:00	103	0.03	0.012552	3/3/87 3:00	144	0.01	0.003106	12/14/79 3:06	151	0.01	0.002299	11/22/88 3:01		0	
11/2/1984 3:10	104	0.01	0.004184	3/3/87 3:10	145	0.01	0.003106	12/14/79 3:16	152	0.03	0.006897	11/22/88 3:11		0	
11/2/1984 3:20	105	0.03	0.012552	3/3/87 3:20	146	0.01	0.003106	12/14/79 3:26	153	0.01	0.002299	11/22/88 3:21		0	
11/2/1984 3:30	106	0.03	0.012552	3/3/87 3:30	147	0.01	0.003106	12/14/79 3:36	154	0.03	0.006897	11/22/88 3:31		0	
11/2/1984 3:40	107	0.02	0.008368	3/3/87 3:40	148	0.03	0.009317	12/14/79 3:46	155	0.02	0.004598	11/22/88 3:41		0	
11/2/1984 3:50	108	0.03	0.012552	3/3/87 3:50	149	0	0	12/14/79 3:56	156	0.01	0.002299	11/22/88 3:51	1	0	
11/2/1984 4:00	109	0.02	0.008368	3/3/87 4:00	150	0.01	0.003106	12/14/79 4:06	157	0.01	0.002299	11/22/88 4:01	2	0.01	0.006897
11/2/1984 4:10	110	0.01	0.004184	3/3/87 4:10	151	0.01	0.003106	12/14/79 4:16	158	0.02	0.004598	11/22/88 4:11	3	0	0
11/2/1984 4:20	111	0	0	3/3/87 4:20	152	0.02	0.006211	12/14/79 4:26	159	0.01	0.002299	11/22/88 4:21	4	0	0
11/2/1984 4:30	112	0	0	3/3/87 4:30	153	0	0	12/14/79 4:36	160	0.01	0.002299	11/22/88 4:31	5	0.02	0.013793
11/2/1984 4:40	113	0.01	0.004184	3/3/87 4:40	154	0	0	12/14/79 4:46	161	0.01	0.002299	11/22/88 4:41	6	0.01	0.006897
11/2/1984 4:50	114	0	0	3/3/87 4:50	155	0	0	12/14/79 4:56	162	0.01	0.002299	11/22/88 4:51	7	0.01	0.006897
11/2/1984 5:00	115	0	0	3/3/87 5:00	156	0	0	12/14/79 5:06	163	0	0	11/22/88 5:01	8	0.02	0.013793
11/2/1984 5:10	116	0	0	3/3/87 5:10	157	0	0	12/14/79 5:16	164	0	0	11/22/88 5:11	9	0.02	0.013793
11/2/1984 5:20	117	0.07	0.029289	3/3/87 5:20	158	0.03	0.009317	12/14/79 5:26	165	0.01	0.002299	11/22/88 5:21	10	0.02	0.013793
11/2/1984 5:30	118	0.02	0.008368	3/3/87 5:30	159	0.04	0.012422	12/14/79 5:36	166	0	0	11/22/88 5:31	11	0.01	0.006897
11/2/1984 5:40	119	0	0	3/3/87 5:40	160	0.02	0.006211	12/14/79 5:46	167	0.02	0.004598	11/22/88 5:41	12	0.02	0.013793
11/2/1984 5:50	120	0	0	3/3/87 5:50	161	0.02	0.006211	12/14/79 5:56	168	0.03	0.006897	11/22/88 5:51	13	0.02	0.013793
11/2/1984 6:00	121	0	0	3/3/87 6:00	162	0.01	0.003106	12/14/79 6:06	169	0.03	0.006897	11/22/88 6:01	14	0	0
11/2/1984 6:10	122	0.02	0.008368	3/3/87 6:10	163	0.01	0.003106	12/14/79 6:16	170	0.03	0.006897	11/22/88 6:11	15	0.01	0.006897
11/2/1984 6:20	123	0.03	0.012552	3/3/87 6:20	164	0	0	12/14/79 6:26	171	0.03	0.006897	11/22/88 6:21	16	0	0
11/2/1984 6:30	124	0.01	0.004184	3/3/87 6:30	165	0	0	12/14/79 6:36	172	0.01	0.002299	11/22/88 6:31	17	0	0
11/2/1984 6:40	125	0	0	3/3/87 6:40	166	0	0	12/14/79 6:46	173	0.01	0.002299	11/22/88 6:41	18	0	0
11/2/1984 6:50	126	0.01	0.004184	3/3/87 6:50	167	0	0	12/14/79 6:56	174	0	0	11/22/88 6:51	19	0	0
11/2/1984 7:00	127	0.01	0.004184	3/3/87 7:00	168	0	0	12/14/79 7:06	175	0.01	0.002299	11/22/88 7:01	20	0	0
11/2/1984 7:10	128	0.04	0.016736	3/3/87 7:10	169	0	0	12/14/79 7:16	176	0	0	11/22/88 7:11	21	0.01	0.006897
11/2/1984 7:20	129	0.04	0.016736	3/3/87 7:20	170	0	0	12/14/79 7:26	177	0.01	0.002299	11/22/88 7:21	22	0.01	0.006897
11/2/1984 7:30	130	0.04	0.016736	3/3/87 7:30	171	0	0	12/14/79 7:36	178	0	0	11/22/88 7:31	23	0.01	0.006897
11/2/1984 7:40	131	0.02	0.008368	3/3/87 7:40	172	0	0	12/14/79 7:46	179	0	0	11/22/88 7:41	24	0.01	0.006897
11/2/1984 7:50	132	0	0	3/3/87 7:50	173	0	0	12/14/79 7:56	180	0	0	11/22/88 7:51	25	0.01	0.006897
11/2/1984 8:00	133	0.01	0.004184	3/3/87 8:00	174	0	0	12/14/79 8:06	181	0	0	11/22/88 8:01	26	0.01	0.006897
11/2/1984 8:10	134	0	0	3/3/87 8:10	175	0	0	12/14/79 8:16	182	0.01	0.002299	11/22/88 8:11	27	0.03	0.02069
11/2/1984 8:20	135	0	0	3/3/87 8:20	176	0	0	12/14/79 8:26	183	0.01	0.002299	11/22/88 8:21	28	0.04	0.027586
11/2/1984 8:30	136	0	0	3/3/87 8:30	177	0	0	12/14/79 8:36	184	0	0	11/22/88 8:31	29	0.04	0.027586
11/2/1984 8:40	137	0	0	3/3/87 8:40	178	0	0	12/14/79 8:46	185	0	0	11/22/88 8:41	30	0.05	0.034483
11/2/1984 8:50	138	0.02	0.008368	3/3/87 8:50	179	0	0	12/14/79 8:56	186	0	0	11/22/88 8:51	31	0.05	0.034483
11/2/1984 9:00	139	0.01	0.004184	3/3/87 9:00	180	0	0	12/14/79 9:06	187	0	0	11/22/88 9:01	32	0.04	0.027586
11/2/1984 9:10	140	0	0	3/3/87 9:10	181	0	0	12/14/79 9:16	188	0.01	0.002299	11/22/88 9:11	33	0.03	0.02069
11/2/1984 9:20	141	0.19	0.079498	3/3/87 9:20	182	0	0	12/14/79 9:26	189	0.01	0.002299	11/22/88 9:21	34	0.03	0.02069
11/2/1984 9:30	142	0.04	0.016736	3/3/87 9:30	183	0	0	12/14/79 9:36	190	0	0	11/22/88 9:31	35	0.01	0.006897
11/2/1984 9:40	143	0.07	0.029289	3/3/87 9:40	184	0.01	0.003106	12/14/79 9:46	191	0.01	0.002299	11/22/88 9:41	36	0	0
11/2/1984 9:50	144	0.01	0.004184	3/3/87 9:50	185	0.02	0.006211	12/14/79 9:56	192	0.01	0.002299	11/22/88 9:51	37	0	0
11/2/1984 10:00		0	1	3/3/87 10:00	186	0.05	0.015528	12/14/79 10:06	193	0	0	11/22/88 10:01	38	0.01	0.006897
11/2/1984 10:10		0		3/3/87 10:10	187	0.01	0.003106	12/14/79 10:16	194	0.02	0.004598	11/22/88 10:11	39	0.01	0.006897
11/2/1984 10:20		0		3/3/87 10:20	188	0.03	0.009317	12/14/79 10:26	195	0.01	0.002299	11/22/88 10:21	40	0.02	0.013793
11/2/1984 10:30		0		3/3/87 10:30	189	0.06	0.018634	12/14/79 10:36	196	0.01	0.002299	11/22/88 10:31	41	0.06	0.041379
11/2/1984 10:40		0		3/3/87 10:40	190	0.01	0.003106	12/14/79 10:46	197	0	0	11/22/88 10:41	42	0.08	0.055172
11/2/1984 10:50		0		3/3/87 10:50	191	0.02	0.006211	12/14/79 10:56	198	0.01	0.002299	11/22/88 10:51	43	0	0
11/2/1984 11:00		0		3/3/87 11:00	192	0.03	0.009317	12/14/79 11:06	199	0.01	0.002299	11/22/88 11:01	44	0	0
11/2/1984 11:10		0		3/3/87 11:10	193	0.03	0.009317	12/14/79 11:16	200	0.01	0.002299	11/22/88 11:11	45	0.08	0.055172
11/2/1984 11:20		0		3/3/87 11:20	194	0.03	0.009317	12/14/79 11:26	201	0.01	0.002299	11/22/88 11:21	46	0.1	0.068966
11/2/1984 11:30		0		3/3/87 11:30	195	0.02	0.006211	12/14/79 11:36	202	0.01	0.002299	11/22/88 11:31	47	0.07	0.048276
11/2/1984 11:40		0		3/3/87 11:40	196	0.01	0.003106	12/14/79 11:46	203	0.02	0.004598	11/22/88 11:41	48	0	0
11/2/1984 11:50		0		3/3/87 11:50	197	0.03	0.009317	12/14/79 11:56	204	0.01	0.002299	11/22/88 11:51	49	0	0
11/2/1984 12:00		0		3/3/87 12:00	198	0.02	0.006211	12/14/79 12:06	205	0.01	0.002299	11/22/88 12:01	50	0	0
11/2/1984 12:10		0		3/3/87 12:10	199	0.01	0.003106	12/14/79 12:16	206	0.02	0.004598	11/22/88 12:11	51	0	0
11/2/1984 12:20		0		3/3/87 12:20	200	0.02	0.006211	12/14/79 12:26	207	0.01	0.002299	11/22/88 12:21	52	0	0
11/2/1984 12:30		0		3/3/87 12:30	201	0.02	0.006211	12/14/79 12:36	208	0.01	0.002299	11/22/88 12:31	53	0.01	0.006897
11/2/1984 12:40		0		3/3/87 12:40	202	0.02	0.006211	12/14/79 12:46	209	0.01	0.002299	11/22/88 12:41	54	0.02	0.013793
11/2/1984 12:50		0		3/3/87 12:50	203	0.02	0.006211	12/14/79 12:56	210	0.01	0.002299	11/22/88 12:51	55	0.02	0.013793
11/2/1984 13:00		0		3/3/87 13:00	204	0.02	0.006211	12/14/79 13:06	211	0.01	0.002299	11/22/88 13:01	56	0.03	0.02069
11/2/1984 13:10		0		3/3/87 13:10	205	0.02	0.006211	12/14/79 13:16	212	0.01	0.002299	11/22/88 13:11	57	0.02	0.013793
11/2/1984 13:20		0		3/3/87 13:20	206	0.01	0.003106	12/14/79 13:26	213	0	0	11/22/88 13:21	58	0.01	0.006897
11/2/1984 13:30		0		3/3/87 13:30	207	0.03	0.009317	12/14/79 13:36	214	0.01	0.002299	11/22/88 13:31	59	0	0
11/2/1984 13:40		0</													



11/2/1984 15:50	0	3/3/87 15:50	221	0.04	0.012422	12/14/79 15:56	228	0.02	0.004598	11/22/88 15:51	73	0	0
11/2/1984 16:00	0	3/3/87 16:00	222	0.02	0.006211	12/14/79 16:06	229	0.01	0.002299	11/22/88 16:01	74	0	0
11/2/1984 16:10	0.02	3/3/87 16:10	223	0.02	0.006211	12/14/79 16:16	230	0.01	0.002299	11/22/88 16:11	75	0	0
11/2/1984 16:20	0.01	3/3/87 16:20	224	0	0	12/14/79 16:26	231	0.01	0.002299	11/22/88 16:21	76	0	0
11/2/1984 16:30	0.01	3/3/87 16:30	225	0.01	0.003106	12/14/79 16:36	232	0.01	0.002299	11/22/88 16:31	77	0	0
11/2/1984 16:40	0	3/3/87 16:40	226	0.01	0.003106	12/14/79 16:46	233	0.02	0.004598	11/22/88 16:41	78	0.01	0.006897
11/2/1984 16:50	0	3/3/87 16:50	227	0.01	0.003106	12/14/79 16:56	234	0.02	0.004598	11/22/88 16:51	79	0	0
11/2/1984 17:00	0	3/3/87 17:00	228	0.01	0.003106	12/14/79 17:06	235	0.01	0.002299	11/22/88 17:01	80	0	0
11/2/1984 17:10	0.02	3/3/87 17:10	229	0	0	12/14/79 17:16	236	0.01	0.002299	11/22/88 17:11	81	0	0
11/2/1984 17:20	0.01	3/3/87 17:20	230	0.01	0.003106	12/14/79 17:26	237	0.01	0.002299	11/22/88 17:21	82	0	0
11/2/1984 17:30	0	3/3/87 17:30	231	0.02	0.006211	12/14/79 17:36	238	0.02	0.004598	11/22/88 17:31	83	0	0
11/2/1984 17:40	0.01	3/3/87 17:40	232	0.01	0.003106	12/14/79 17:46	239	0.01	0.002299	11/22/88 17:41	84	0	0
11/2/1984 17:50	0	3/3/87 17:50	233	0	0	12/14/79 17:56	240	0.01	0.002299	11/22/88 17:51	85	0	0
11/2/1984 18:00	0	3/3/87 18:00	234	0.02	0.006211	12/14/79 18:06	241	0.02	0.004598	11/22/88 18:01	86	0	0
11/2/1984 18:10	0.01	3/3/87 18:10	235	0.02	0.006211	12/14/79 18:16	242	0.02	0.004598	11/22/88 18:11	87	0	0
11/2/1984 18:20	0.01	3/3/87 18:20	236	0.02	0.006211	12/14/79 18:26	243	0.03	0.006897	11/22/88 18:21	88	0	0
11/2/1984 18:30	0	3/3/87 18:30	237	0.02	0.006211	12/14/79 18:36	244	0.02	0.004598	11/22/88 18:31	89	0	0
11/2/1984 18:40	0.01	3/3/87 18:40	238	0.01	0.003106	12/14/79 18:46	245	0.01	0.002299	11/22/88 18:41	90	0	0
11/2/1984 18:50	0	3/3/87 18:50	239	0.01	0.003106	12/14/79 18:56	246	0.01	0.002299	11/22/88 18:51	91	0	0
11/2/1984 19:00	0	3/3/87 19:00	240	0.02	0.006211	12/14/79 19:06	247	0.01	0.002299	11/22/88 19:01	92	0	0
11/2/1984 19:10	0	3/3/87 19:10	241	0.02	0.006211	12/14/79 19:16	248	0.01	0.002299	11/22/88 19:11	93	0	0
11/2/1984 19:20	0	3/3/87 19:20	242	0	0	12/14/79 19:26	249	0.01	0.002299	11/22/88 19:21	94	0	0
11/2/1984 19:30	0	3/3/87 19:30	243	0.01	0.003106	12/14/79 19:36	250	0	0	11/22/88 19:31	95	0	0
11/2/1984 19:40	0	3/3/87 19:40	244	0.01	0.003106	12/14/79 19:46	251	0	0	11/22/88 19:41	96	0	0
11/2/1984 19:50	0	3/3/87 19:50	245	0	0	12/14/79 19:56	252	0	0	11/22/88 19:51	97	0	0
11/2/1984 20:00	0	3/3/87 20:00	246	0	0	12/14/79 20:06	253	0.01	0.002299	11/22/88 20:01	98	0	0
11/2/1984 20:10	0	3/3/87 20:10	247	0.02	0.006211	12/14/79 20:16	254	0.02	0.004598	11/22/88 20:11	99	0	0
11/2/1984 20:20	0	3/3/87 20:20	248	0	0	12/14/79 20:26	255	0.06	0.013793	11/22/88 20:21	100	0	0
11/2/1984 20:30	0	3/3/87 20:30	249	0.01	0.003106	12/14/79 20:36	256	0.06	0.013793	11/22/88 20:31	101	0	0
11/2/1984 20:40	0	3/3/87 20:40	250	0	0	12/14/79 20:46	257	0.05	0.011494	11/22/88 20:41	102	0	0
11/2/1984 20:50	0	3/3/87 20:50	251	0.01	0.003106	12/14/79 20:56	258	0.07	0.016092	11/22/88 20:51	103	0	0
11/2/1984 21:00	0	3/3/87 21:00	252	0.01	0.003106	12/14/79 21:06	259	0.06	0.013793	11/22/88 21:01	104	0	0
11/2/1984 21:10	0	3/3/87 21:10	253	0	0	12/14/79 21:16	260	0.06	0.013793	11/22/88 21:11	105	0	0
11/2/1984 21:20	0	3/3/87 21:20	254	0.01	0.003106	12/14/79 21:26	261	0.05	0.011494	11/22/88 21:21	106	0.01	0.006897
11/2/1984 21:30	0	3/3/87 21:30	255	0.01	0.003106	12/14/79 21:36	262	0.05	0.011494	11/22/88 21:31	107	0	0
11/2/1984 21:40	0	3/3/87 21:40	256	0	0	12/14/79 21:46	263	0.04	0.009195	11/22/88 21:41	108	0	0
11/2/1984 21:50	0.01	3/3/87 21:50	257	0.01	0.003106	12/14/79 21:56	264	0.03	0.006897	11/22/88 21:51	109	0	0
11/2/1984 22:00	0	3/3/87 22:00	258	0	0	12/14/79 22:06	265	0.02	0.004598	11/22/88 22:01	110	0	0
11/2/1984 22:10	0	3/3/87 22:10	259	0	0	12/14/79 22:16	266	0.03	0.006897	11/22/88 22:11	111	0	0
11/2/1984 22:20	0	3/3/87 22:20	260	0	0	12/14/79 22:26	267	0.03	0.006897	11/22/88 22:21	112	0	0
11/2/1984 22:30	0	3/3/87 22:30	261	0	0	12/14/79 22:36	268	0.02	0.004598	11/22/88 22:31	113	0	0
11/2/1984 22:40	0	3/3/87 22:40	262	0	0	12/14/79 22:46	269	0.02	0.004598	11/22/88 22:41	114	0	0
11/2/1984 22:50	0	3/3/87 22:50	263	0	0	12/14/79 22:56	270	0.03	0.006897	11/22/88 22:51	115	0	0
11/2/1984 23:00	0	3/3/87 23:00	264	0.01	0.003106	12/14/79 23:06	271	0.03	0.006897	11/22/88 23:01	116	0.02	0.013793
11/2/1984 23:10	0	3/3/87 23:10	265	0	0	12/14/79 23:16	272	0.02	0.004598	11/22/88 23:11	117	0.01	0.006897
11/2/1984 23:20	0	3/3/87 23:20	266	0	0	12/14/79 23:26	273	0.02	0.004598	11/22/88 23:21	118	0.01	0.006897
11/2/1984 23:30	0.01	3/3/87 23:30	267	0	0	12/14/79 23:36	274	0.02	0.004598	11/22/88 23:31	119	0	0
11/2/1984 23:40	0	3/3/87 23:40	268	0	0	12/14/79 23:46	275	0.02	0.004598	11/22/88 23:41	120	0	0
11/2/1984 23:50	0	3/3/87 23:50	269	0	0	12/14/79 23:56	276	0.02	0.004598	11/22/88 23:51	121	0.03	0.02069
		3/4/87 0:00	270	0.01	0.003106	12/15/79 0:06	277	0.01	0.002299	11/23/88 0:01	122	0	0
		3/4/87 0:10	271	0	0	12/15/79 0:16	278	0.01	0.002299	11/23/88 0:11	123	0	0
		3/4/87 0:20	272	0.01	0.003106	12/15/79 0:26	279	0.02	0.004598	11/23/88 0:21	124	0	0
		3/4/87 0:30	273	0	0	12/15/79 0:36	280	0.01	0.002299	11/23/88 0:31	125	0	0
		3/4/87 0:40	274	0	0	12/15/79 0:46	281	0.02	0.004598	11/23/88 0:41	126	0	0
		3/4/87 0:50	275	0	0	12/15/79 0:56	282	0.01	0.002299	11/23/88 0:51	127	0	0
		3/4/87 1:00	276	0	0	12/15/79 1:06	283	0.01	0.002299	11/23/88 1:01	128	0	0
		3/4/87 1:10	277	0.01	0.003106	12/15/79 1:16	284	0.01	0.002299	11/23/88 1:11	129	0.01	0.006897
		3/4/87 1:20		0		12/15/79 1:26	285	0.02	0.004598	11/23/88 1:21	130	0	0
		3/4/87 1:30		0		12/15/79 1:36	286	0.01	0.002299	11/23/88 1:31	131	0	0
		3/4/87 1:40		0		12/15/79 1:46	287	0.02	0.004598	11/23/88 1:41	132	0	0
		3/4/87 1:50		0		12/15/79 1:56	288	0.01	0.002299	11/23/88 1:51	133	0	0
		3/4/87 2:00		0		12/15/79 2:06	289	0.01	0.002299	11/23/88 2:01	134	0	0
		3/4/87 2:10		0		12/15/79 2:16	290	0.01	0.002299	11/23/88 2:11	135	0	0
		3/4/87 2:20		0		12/15/79 2:26	291	0.01	0.002299	11/23/88 2:21	136	0	0
		3/4/87 2:30		0		12/15/79 2:36	292	0	0	11/23/88 2:31	137	0	0
		3/4/87 2:40		0		12/15/79 2:46	293	0.01	0.002299	11/23/88 2:41	138	0	0
		3/4/87 2:50		0		12/15/79 2:56	294	0.01	0.002299	11/23/88 2:51	139	0	0
		3/4/87 3:00		0		12/15/79 3:06	295	0	0	11/23/88 3:01	140	0	0
		3/4/87 3:10		0		12/15/79 3:16	296	0.01	0.002299	11/23/88 3:11	141	0	0
		3/4/87 3:20		0		12/15/79 3:26	297	0.01	0.002299	11/23/88 3:21	142	0	0
		3/4/87 3:30		0		12/15/79 3:36	298	0.02	0.004598	11/23/88 3:31	143	0	0
		3/4/87 3:40		0		12/15/79 3:46	299	0	0	11/23/88 3:41	144	0	0
		3/4/87 3:50		0		12/15/79 3:56	300	0.01	0.002299	11/23/88 3:51	145	0	0
		3/4/87 4:00		0		12/15/79 4:06	301	0.01	0.002299	11/23/88 4:01	146	0	0
		3/4/87 4:10		0		12/15/79 4:16	302	0.01	0.002299	11/23/88 4:11	147	0	0
		3/4/87 4:20		0		12/15/79 4:26	303	0	0	11/23/88 4:21	148	0	0
		3/4/87 4:30		0		12/15/79 4:36	304	0.01	0.002299	11/23/88 4:31	149	0	0
		3/4/87 4:40		0		12/15/79 4:46	305	0.01	0.002299	11/23/88 4:41	150	0	0
		3/4/87 4:50		0		12/15/79 4:56	306	0.01	0.002299	11/23/88 4:51	151	0	0
		3/4/87 5:00		0		12/15/79 5:06	307	0	0	11/23/88 5:01	152	0	0
		3/4/87 5:10		0		12/15/79 5:16		0	0	11/23/88 5:11	153	0	0
		3/4/87 5:20		0		12/15/79 5:26		0	0	11/23/88 5:21	154	0	0
		3/4/87 5:30		0		12/15/79 5:36		0	0	11/23/88 5:31	155	0	0



3/4/87 5:40	0	12/15/79 5:46	0	11/23/88 5:41	156	0	0
3/4/87 5:50	0	12/15/79 5:56	0	11/23/88 5:51	157	0	0
3/4/87 6:00	0	12/15/79 6:06	0.01	11/23/88 6:01	158	0	0
3/4/87 6:10	0	12/15/79 6:16	0	11/23/88 6:11	159	0	0
3/4/87 6:20	0	12/15/79 6:26	0.01	11/23/88 6:21	160	0	0
3/4/87 6:30	0	12/15/79 6:36	0.02	11/23/88 6:31	161	0	0
3/4/87 6:40	0	12/15/79 6:46	0.01	11/23/88 6:41	162	0	0
3/4/87 6:50	0	12/15/79 6:56	0.01	11/23/88 6:51	163	0	0
3/4/87 7:00	0	12/15/79 7:06	0	11/23/88 7:01	164	0	0
3/4/87 7:10	0	12/15/79 7:16	0.01	11/23/88 7:11	165	0	0
3/4/87 7:20	0	12/15/79 7:26	0.01	11/23/88 7:21	166	0	0
3/4/87 7:30	0	12/15/79 7:36	0.01	11/23/88 7:31	167	0	0
3/4/87 7:40	0	12/15/79 7:46	0.01	11/23/88 7:41	168	0	0
3/4/87 7:50	0	12/15/79 7:56	0.01	11/23/88 7:51	169	0	0
3/4/87 8:00	0	12/15/79 8:06	0.02	11/23/88 8:01	170	0	0
3/4/87 8:10	0	12/15/79 8:16	0.01	11/23/88 8:11	171	0	0
3/4/87 8:20	0	12/15/79 8:26	0	11/23/88 8:21	172	0	0
3/4/87 8:30	0	12/15/79 8:36	0.01	11/23/88 8:31	173	0	0
3/4/87 8:40	0	12/15/79 8:46	0.01	11/23/88 8:41	174	0	0
3/4/87 8:50	0	12/15/79 8:56	0	11/23/88 8:51	175	0	0
3/4/87 9:00	0	12/15/79 9:06	0	11/23/88 9:01	176	0	0
3/4/87 9:10	0	12/15/79 9:16	0	11/23/88 9:11	177	0	0
3/4/87 9:20	0	12/15/79 9:26	0	11/23/88 9:21	178	0	0
3/4/87 9:30	0	12/15/79 9:36	0.01	11/23/88 9:31	179	0	0
3/4/87 9:40	0	12/15/79 9:46	0	11/23/88 9:41	180	0	0
3/4/87 9:50	0	12/15/79 9:56	0	11/23/88 9:51	181	0	0
3/4/87 10:00	0	12/15/79 10:06	0	11/23/88 10:01	182	0	0
3/4/87 10:10	0	12/15/79 10:16	0	11/23/88 10:11	183	0	0
3/4/87 10:20	0	12/15/79 10:26	0	11/23/88 10:21	184	0	0
3/4/87 10:30	0	12/15/79 10:36	0	11/23/88 10:31	185	0	0
3/4/87 10:40	0	12/15/79 10:46	0	11/23/88 10:41	186	0	0
3/4/87 10:50	0	12/15/79 10:56	0	11/23/88 10:51	187	0	0
3/4/87 11:00	0	12/15/79 11:06	0	11/23/88 11:01	188	0	0
3/4/87 11:10	0	12/15/79 11:16	0	11/23/88 11:11	189	0	0
3/4/87 11:20	0	12/15/79 11:26	0	11/23/88 11:21	190	0	0
3/4/87 11:30	0	12/15/79 11:36	0	11/23/88 11:31	191	0	0
3/4/87 11:40	0	12/15/79 11:46	0	11/23/88 11:41	192	0	0
3/4/87 11:50	0	12/15/79 11:56	0	11/23/88 11:51	193	0	0
3/4/87 12:00	0	12/15/79 12:06	0	11/23/88 12:01	194	0	0
3/4/87 12:10	0	12/15/79 12:16	0	11/23/88 12:11	195	0	0
3/4/87 12:20	0	12/15/79 12:26	0	11/23/88 12:21	196	0	0
3/4/87 12:30	0	12/15/79 12:36	0	11/23/88 12:31	197	0	0
3/4/87 12:40	0	12/15/79 12:46	0	11/23/88 12:41	198	0	0
3/4/87 12:50	0	12/15/79 12:56	0	11/23/88 12:51	199	0	0
3/4/87 13:00	0	12/15/79 13:06	0	11/23/88 13:01	200	0	0
3/4/87 13:10	0	12/15/79 13:16	0.01	11/23/88 13:11	201	0	0
3/4/87 13:20	0	12/15/79 13:26	0	11/23/88 13:21	202	0	0
3/4/87 13:30	0	12/15/79 13:36	0	11/23/88 13:31	203	0	0
3/4/87 13:40	0	12/15/79 13:46	0	11/23/88 13:41	204	0	0
3/4/87 13:50	0	12/15/79 13:56	0	11/23/88 13:51	205	0	0
3/4/87 14:00	0	12/15/79 14:06	0	11/23/88 14:01	206	0	0
3/4/87 14:10	0	12/15/79 14:16	0.01	11/23/88 14:11	207	0	0
		12/15/79 14:26	0	11/23/88 14:21	208	0	0
		12/15/79 14:36	0.01	11/23/88 14:31	209	0	0
		12/15/79 14:46	0.01	11/23/88 14:41	210	0	0
		12/15/79 14:56	0	11/23/88 14:51	211	0	0
		12/15/79 15:06	0.01	11/23/88 15:01	212	0	0
		12/15/79 15:16	0.01	11/23/88 15:11	213	0	0
		12/15/79 15:26	0	11/23/88 15:21	214	0	0
		12/15/79 15:36	0.01	11/23/88 15:31	215	0	0
		12/15/79 15:46	0.01	11/23/88 15:41	216	0	0
		12/15/79 15:56	0.01	11/23/88 15:51	217	0	0
		12/15/79 16:06	0	11/23/88 16:01	218	0	0
		12/15/79 16:16	0.01	11/23/88 16:11	219	0	0
		12/15/79 16:26	0.01	11/23/88 16:21	220	0	0
		12/15/79 16:36	0.01	11/23/88 16:31	221	0	0
		12/15/79 16:46	0.01	11/23/88 16:41	222	0	0
		12/15/79 16:56	0	11/23/88 16:51	223	0	0
		12/15/79 17:06	0.01	11/23/88 17:01	224	0	0
		12/15/79 17:16	0	11/23/88 17:11	225	0	0
		12/15/79 17:26	0	11/23/88 17:21	226	0	0
		12/15/79 17:36	0	11/23/88 17:31	227	0	0
		12/15/79 17:46	0.01	11/23/88 17:41	228	0	0
		12/15/79 17:56	0	11/23/88 17:51	229	0	0
		12/15/79 18:06	0	11/23/88 18:01	230	0	0
		12/15/79 18:16	0	11/23/88 18:11	231	0	0
		12/15/79 18:26	0	11/23/88 18:21	232	0	0
		12/15/79 18:36	0	11/23/88 18:31	233	0	0
		12/15/79 18:46	0	11/23/88 18:41	234	0	0
		12/15/79 18:56	0.01	11/23/88 18:51	235	0	0
		12/15/79 19:06	0	11/23/88 19:01	236	0	0
		12/15/79 19:16	0	11/23/88 19:11	237	0.01	0.006897
		12/15/79 19:26	0	11/23/88 19:21	238	0	0







Unit Hydrographs  
of Storm Events for  
SBUH Method

Time Increment	Rainfall Distribution	Rainfall Distribution	Rainfall Distribution	Rainfall Distribution
	STORM 1984 (fraction)	STORM 1987 (fraction)	STORM 1979 (fraction)	STORM 1988 (fraction)
1	3	3	3	3
0	0.0000	0.0000	0.0000	0.0000
1	0.0042	0.0031	0.0023	0.0000
2	0.0042	0.0031	0.0000	0.0069
3	0.0042	0.0000	0.0023	0.0000
4	0.0042	0.0031	0.0000	0.0000
5	0.0126	0.0031	0.0023	0.0138
6	0.0084	0.0031	0.0000	0.0069
7	0.0084	0.0031	0.0023	0.0069
8	0.0084	0.0062	0.0023	0.0138
9	0.0126	0.0031	0.0046	0.0138
10	0.0084	0.0031	0.0023	0.0138
11	0.0084	0.0031	0.0023	0.0069
12	0.0084	0.0031	0.0000	0.0138
13	0.0042	0.0000	0.0023	0.0138
14	0.0084	0.0031	0.0000	0.0000
15	0.0126	0.0000	0.0000	0.0069
16	0.0126	0.0031	0.0000	0.0000
17	0.0126	0.0000	0.0023	0.0000
18	0.0209	0.0000	0.0000	0.0000
19	0.0084	0.0000	0.0000	0.0000
20	0.0167	0.0000	0.0023	0.0000
21	0.0209	0.0000	0.0023	0.0069
22	0.0167	0.0000	0.0000	0.0069
23	0.0167	0.0000	0.0023	0.0069
24	0.0167	0.0000	0.0000	0.0069
25	0.0126	0.0000	0.0023	0.0069
26	0.0084	0.0000	0.0000	0.0069
27	0.0084	0.0000	0.0023	0.0207
28	0.0084	0.0000	0.0023	0.0276
29	0.0167	0.0000	0.0023	0.0276
30	0.0126	0.0000	0.0046	0.0345
31	0.0167	0.0000	0.0000	0.0345
32	0.0167	0.0000	0.0023	0.0276
33	0.0167	0.0000	0.0023	0.0207
34	0.0126	0.0000	0.0023	0.0207
35	0.0167	0.0000	0.0023	0.0069
36	0.0126	0.0031	0.0023	0.0000
37	0.0084	0.0000	0.0000	0.0000
38	0.0042	0.0000	0.0023	0.0069
39	0.0042	0.0000	0.0023	0.0069
40	0.0042	0.0000	0.0000	0.0138
41	0.0000	0.0000	0.0023	0.0414
42	0.0000	0.0062	0.0000	0.0552
43	0.0042	0.0031	0.0023	0.0000
44	0.0000	0.0062	0.0000	0.0000
45	0.0000	0.0000	0.0023	0.0552
46	0.0000	0.0031	0.0000	0.0690
47	0.0000	0.0031	0.0023	0.0483
48	0.0084	0.0031	0.0000	0.0000
49	0.0084	0.0031	0.0023	0.0000
50	0.0084	0.0062	0.0023	0.0000
51	0.0084	0.0031	0.0023	0.0000
52	0.0126	0.0031	0.0023	0.0000
53	0.0126	0.0031	0.0046	0.0069
54	0.0126	0.0031	0.0023	0.0138
55	0.0126	0.0031	0.0046	0.0138
56	0.0167	0.0000	0.0046	0.0207
57	0.0000	0.0031	0.0046	0.0138
58	0.0084	0.0000	0.0046	0.0069
59	0.0042	0.0031	0.0046	0.0000
60	0.0042	0.0031	0.0092	0.0000
61	0.0000	0.0031	0.0046	0.0000
62	0.0042	0.0031	0.0115	0.0000



63	0.0126	0.0031	0.0115	0.0000
64	0.0084	0.0031	0.0069	0.0000
65	0.0042	0.0062	0.0023	0.0000
66	0.0000	0.0062	0.0023	0.0069
67	0.0042	0.0093	0.0023	0.0138
68	0.0000	0.0093	0.0046	0.0069
69	0.0000	0.0093	0.0046	0.0000
70	0.0042	0.0031	0.0023	0.0000
71	0.0042	0.0031	0.0023	0.0000
72	0.0000	0.0093	0.0046	0.0000
73	0.0042	0.0062	0.0046	0.0000
74	0.0000	0.0062	0.0069	0.0000
75	0.0000	0.0031	0.0046	0.0000
76	0.0000	0.0062	0.0046	0.0000
77	0.0000	0.0031	0.0023	0.0000
78	0.0000	0.0031	0.0046	0.0069
79	0.0000	0.0000	0.0046	0.0000
80	0.0042	0.0000	0.0069	0.0000
81	0.0042	0.0000	0.0069	0.0000
82	0.0042	0.0031	0.0046	0.0000
83	0.0000	0.0031	0.0046	0.0000
84	0.0000	0.0031	0.0069	0.0000
85	0.0000	0.0031	0.0069	0.0000
86	0.0000	0.0031	0.0069	0.0000
87	0.0000	0.0031	0.0069	0.0000
88	0.0000	0.0000	0.0069	0.0000
89	0.0042	0.0031	0.0069	0.0000
90	0.0042	0.0031	0.0046	0.0000
91	0.0042	0.0031	0.0023	0.0000
92	0.0000	0.0062	0.0023	0.0000
93	0.0042	0.0031	0.0023	0.0000
94	0.0042	0.0062	0.0000	0.0000
95	0.0000	0.0031	0.0046	0.0000
96	0.0000	0.0031	0.0000	0.0000
97	0.0000	0.0031	0.0046	0.0000
98	0.0000	0.0031	0.0023	0.0000
99	0.0000	0.0062	0.0023	0.0000
100	0.0042	0.0093	0.0046	0.0000
101	0.0000	0.0093	0.0023	0.0000
102	0.0000	0.0124	0.0023	0.0000
103	0.0126	0.0062	0.0046	0.0000
104	0.0042	0.0093	0.0046	0.0000
105	0.0126	0.0062	0.0023	0.0000
106	0.0126	0.0062	0.0046	0.0069
107	0.0084	0.0062	0.0046	0.0000
108	0.0126	0.0062	0.0046	0.0000
109	0.0084	0.0062	0.0046	0.0000
110	0.0042	0.0062	0.0023	0.0000
111	0.0000	0.0000	0.0023	0.0000
112	0.0000	0.0031	0.0023	0.0000
113	0.0042	0.0031	0.0023	0.0000
114	0.0000	0.0062	0.0023	0.0000
115	0.0000	0.0031	0.0023	0.0000
116	0.0000	0.0093	0.0000	0.0138
117	0.0293	0.0031	0.0046	0.0069
118	0.0084	0.0031	0.0023	0.0069
119	0.0000	0.0000	0.0046	0.0000
120	0.0000	0.0031	0.0023	0.0000
121	0.0000	0.0031	0.0046	0.0207
122	0.0084	0.0031	0.0023	0.0000
123	0.0126	0.0000	0.0046	0.0000
124	0.0042	0.0000	0.0069	0.0000
125	0.0000	0.0031	0.0046	0.0000
126	0.0042	0.0000	0.0046	0.0000
127	0.0042	0.0031	0.0046	0.0000
128	0.0167	0.0000	0.0046	0.0000
129	0.0167	0.0062	0.0023	0.0069
130	0.0167	0.0031	0.0046	0.0000



131	0.0084	0.0062	0.0046	0.0000
132	0.0000	0.0031	0.0069	0.0000
133	0.0042	0.0062	0.0046	0.0000
134	0.0000	0.0031	0.0023	0.0000
135	0.0000	0.0031	0.0023	0.0000
136	0.0000	0.0062	0.0023	0.0000
137	0.0000	0.0093	0.0000	0.0000
138	0.0084	0.0093	0.0000	0.0000
139	0.0042	0.0031	0.0023	0.0000
140	0.0000	0.0062	0.0000	0.0000
141	0.0795	0.0000	0.0023	0.0000
142	0.0167	0.0031	0.0023	0.0000
143	0.0293	0.0000	0.0023	0.0000
144	0.0042	0.0031	0.0000	0.0000
145		0.0031	0.0023	0.0000
146		0.0031	0.0046	0.0000
147		0.0031	0.0046	0.0000
148		0.0093	0.0046	0.0000
149		0.0000	0.0023	0.0000
150		0.0031	0.0046	0.0000
151		0.0031	0.0023	0.0000
152		0.0062	0.0069	0.0000
153		0.0000	0.0023	0.0000
154		0.0000	0.0069	0.0000
155		0.0000	0.0046	0.0000
156		0.0000	0.0023	0.0000
157		0.0000	0.0023	0.0000
158		0.0093	0.0046	0.0000
159		0.0124	0.0023	0.0000
160		0.0062	0.0023	0.0000
161		0.0062	0.0023	0.0000
162		0.0031	0.0023	0.0000
163		0.0031	0.0000	0.0000
164		0.0000	0.0000	0.0000
165		0.0000	0.0023	0.0000
166		0.0000	0.0000	0.0000
167		0.0000	0.0046	0.0000
168		0.0000	0.0069	0.0000
169		0.0000	0.0069	0.0000
170		0.0000	0.0069	0.0000
171		0.0000	0.0069	0.0000
172		0.0000	0.0023	0.0000
173		0.0000	0.0023	0.0000
174		0.0000	0.0000	0.0000
175		0.0000	0.0023	0.0000
176		0.0000	0.0000	0.0000
177		0.0000	0.0023	0.0000
178		0.0000	0.0000	0.0000
179		0.0000	0.0000	0.0000
180		0.0000	0.0000	0.0000
181		0.0000	0.0000	0.0000
182		0.0000	0.0023	0.0000
183		0.0000	0.0023	0.0000
184		0.0031	0.0000	0.0000
185		0.0062	0.0000	0.0000
186		0.0155	0.0000	0.0000
187		0.0031	0.0000	0.0000
188		0.0093	0.0023	0.0000
189		0.0186	0.0023	0.0000
190		0.0031	0.0000	0.0000
191		0.0062	0.0023	0.0000
192		0.0093	0.0023	0.0000
193		0.0093	0.0000	0.0000
194		0.0093	0.0046	0.0000
195		0.0062	0.0023	0.0000
196		0.0031	0.0023	0.0000
197		0.0093	0.0000	0.0000
198		0.0062	0.0023	0.0000



199	0.0031	0.0023	0.0000
200	0.0062	0.0023	0.0000
201	0.0062	0.0023	0.0000
202	0.0062	0.0023	0.0000
203	0.0062	0.0046	0.0000
204	0.0062	0.0023	0.0000
205	0.0062	0.0023	0.0000
206	0.0031	0.0046	0.0000
207	0.0093	0.0023	0.0000
208	0.0031	0.0023	0.0000
209	0.0093	0.0023	0.0000
210	0.0062	0.0023	0.0000
211	0.0093	0.0023	0.0000
212	0.0093	0.0023	0.0000
213	0.0124	0.0000	0.0000
214	0.0311	0.0023	0.0000
215	0.0280	0.0000	0.0000
216	0.0124	0.0023	0.0000
217	0.0093	0.0046	0.0000
218	0.0093	0.0046	0.0000
219	0.0093	0.0046	0.0000
220	0.0062	0.0023	0.0000
221	0.0124	0.0046	0.0000
222	0.0062	0.0069	0.0000
223	0.0062	0.0046	0.0000
224	0.0000	0.0046	0.0000
225	0.0031	0.0046	0.0000
226	0.0031	0.0023	0.0000
227	0.0031	0.0023	0.0000
228	0.0031	0.0046	0.0000
229	0.0000	0.0023	0.0000
230	0.0031	0.0023	0.0000
231	0.0062	0.0023	0.0000
232	0.0031	0.0023	0.0000
233	0.0000	0.0046	0.0000
234	0.0062	0.0046	0.0000
235	0.0062	0.0023	0.0000
236	0.0062	0.0023	0.0000
237	0.0062	0.0023	0.0069
238	0.0031	0.0046	0.0000
239	0.0031	0.0023	0.0000
240	0.0062	0.0023	0.0000
241	0.0062	0.0046	0.0000
242	0.0000	0.0046	0.0000
243	0.0031	0.0069	0.0069
244	0.0031	0.0046	0.0000
245	0.0000	0.0023	0.0000
246	0.0000	0.0023	0.0069
247	0.0062	0.0023	0.0069
248	0.0000	0.0023	0.0138
249	0.0031	0.0023	0.0069
250	0.0000	0.0000	0.0069
251	0.0031	0.0000	0.0138
252	0.0031	0.0000	0.0069
253	0.0000	0.0023	0.0000
254	0.0031	0.0046	0.0000
255	0.0031	0.0138	0.0000
256	0.0000	0.0138	0.0069
257	0.0031	0.0115	0.0000
258	0.0000	0.0161	0.0069
259	0.0000	0.0138	0.0069
260	0.0000	0.0138	0.0138
261	0.0000	0.0115	0.0069
262	0.0000	0.0115	0.0138
263	0.0000	0.0092	0.0138
264	0.0031	0.0069	0.0069
265	0.0000	0.0046	0.0000
266	0.0000	0.0069	0.0000



267		0.0000	0.0069	0.0000
268		0.0000	0.0046	0.0000
269		0.0000	0.0046	0.0000
270		0.0031	0.0069	0.0000
271		0.0000	0.0069	0.0000
272		0.0031	0.0046	0.0000
273		0.0000	0.0046	0.0000
274		0.0000	0.0046	0.0000
275		0.0000	0.0046	0.0000
276		0.0000	0.0046	0.0000
277		0.0031	0.0023	0.0000
278			0.0023	0.0000
279			0.0046	
280			0.0023	
281			0.0046	
282			0.0023	
283			0.0023	
284			0.0023	
285			0.0046	
286			0.0023	
287			0.0046	
288			0.0023	
289			0.0023	
290			0.0023	
291			0.0023	
292			0.0000	
293			0.0023	
294			0.0023	
295			0.0000	
296			0.0023	
297			0.0023	
298			0.0046	
299			0.0000	
300			0.0023	
301			0.0023	
302			0.0023	
303			0.0000	
304			0.0023	
305			0.0023	
306			0.0023	
307			0.0000	
	1.0000	1.0000	1.0000	1.0000

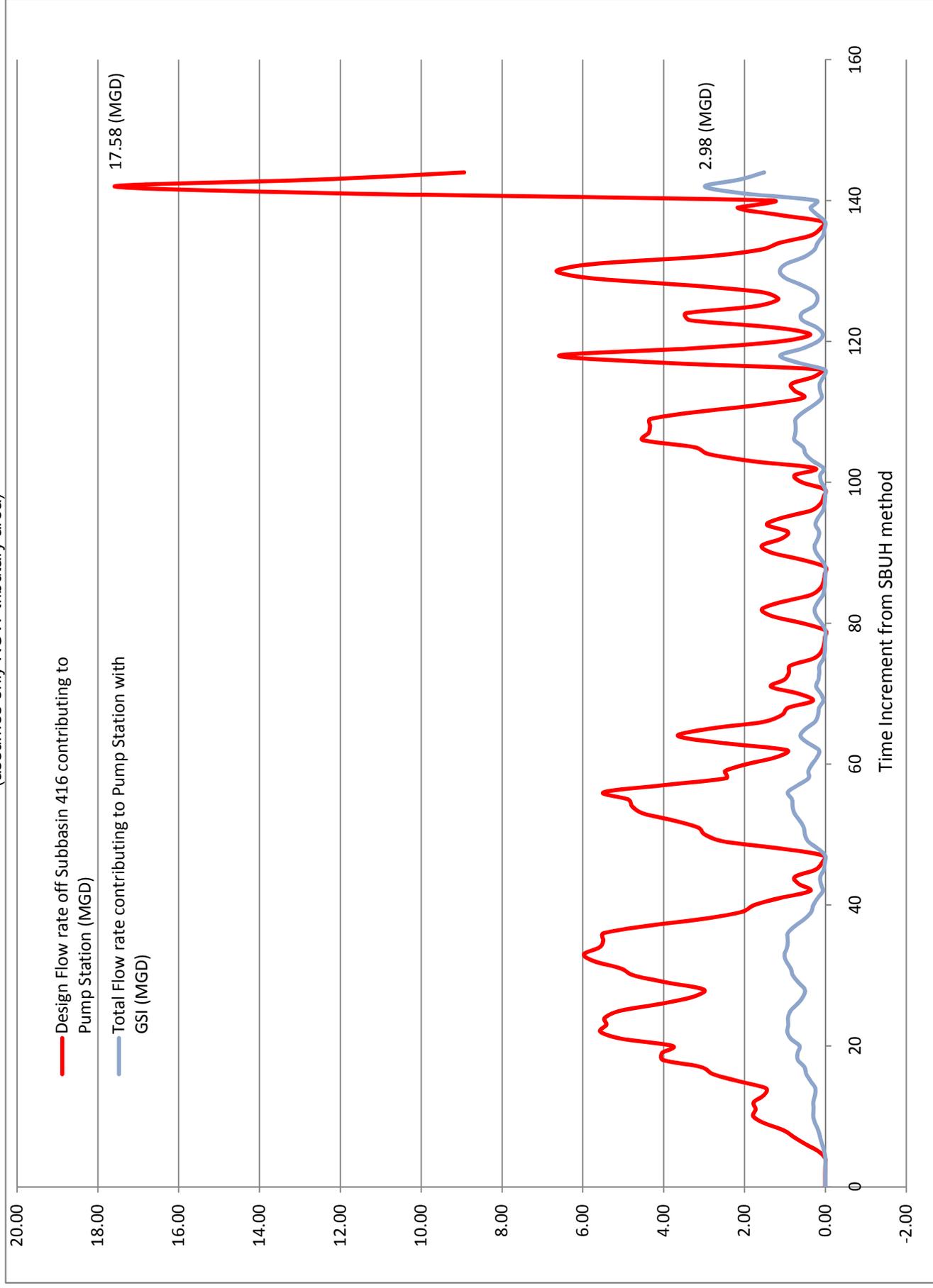


Modeling Results for  
Section 2b  
With Only ROW Tributary Area



SvR Modeled Subbasin 416 Design Flow Rate to Pump Station during 1984 Storm (assumes only ROW tributary area)

SECTION 2b







**King County CSO**  
**Barton Basin Subbasin 416 GSI Analysis**  
 SvR Project No. 06053  
 Date: 05/11/2010

**Santa Barbara Urban Hydrograph Method (SBUH)**

red text is user entered  
 Rainfall data provided by King County  
 conversion from sf to acre 43560 sf/acre  
 assume that both sides of a street have the same planter width  
 alleys are assumed to be negligible  
 a time increment of 9999 indicates that the rain event (provided by King County) has finished  
 corners at roadway intersections are counted as impervious in the N/S ROW areas  
 assumes crowned roadway

**Typical One Block Characteristics**

Block (N/S) per GIS (lf)	601	
Block (E/W) per GIS (lf)	276	
Private Parcel Area (sf)	165,876	3.81 (ac)
Roof Area of Private Parcels per Block per GIS (sf)	41,451	0.95 (ac)
Non Roof Impervious Area of Private Parcels per Block per GIS (sf)	55,937	1.28 (ac)
Pervious Area of Private Parcels per Block including alleys (sf)	68,488	1.57 (ac)
ROW width (N/S) (lf)	60	
Planter Width (N/S) (lf)	10	
Width of Impervious in ROW (N/S) (lf)	40	
ROW width (E/W) (lf)	60	
Planter Width (E/W) (lf)	10	
Width of Impervious in ROW (E/W) (lf)	40	
ROW Impervious Area (N/S) (sf)	26440	0.61 (ac)
ROW Pervious Area (N/S) (sf)	12020	0.28 (ac)
ROW Impervious Area (E/W) (sf)	11040	0.25 (ac)
ROW Pervious Area (E/W) (sf)	5520	0.13 (ac)

	Percentage to RG	Effective Area to RG	CN	Impervious to RG (ac)	Pervious to RG (ac)	Percentage Impervious	Percentage Pervious
<b>PRIVATE PARCEL CHARACTERISTICS</b>							
Block Area to RG (ac)	0%						
Total Roof Area per One Block (ac)	0.95	100%					
Roof Area disconnected		60%	86	0.00	0.00	0.00%	0.00%
Total Non-Roof Impervious Area Per One Block (ac)	1.28						
Non-Roof Impervious Area to RG (ac)		50%	86	0.00	0.00	0.00%	0.00%
Total Pervious Area per One Block (ac)	1.57						
Pervious Area to RG (ac)		50%	86	0.00	0.00	0.00%	0.00%
<b>N/S ROADWAY CHARACTERISTICS</b>							
One N/S ROW to RG per One Block		50%					
Total ROW Impervious Area (N/S) fronting a Block (ac)	0.61						
ROW Impervious Area (N/S) to RG (ac)			98	0.30	0	11.97%	0.00%
Total ROW Pervious Area (N/S) fronting a Block (ac)	0.28						
ROW Pervious Area (N/S) to RG (ac)			86	0	0.14	0.00%	5.44%
<b>E/W ROADWAY CHARACTERISTICS</b>							
One E/W ROW to RG per One Block		50%					
Total ROW Impervious Area (E/W) fronting One Block(ac)	0.25						
ROW Impervious Area (E/W) to RG (ac)			98	0.13	0	5.00%	0.00%
Total ROW Pervious Area (E/W) fronting One Block(ac)	0.13						
ROW Pervious Area (E/W) to RG (ac)			86	0	0.06	0.00%	2.50%
						16.97%	7.94%

Impervious to RG (ac)	0.43	Pervious to RG (ac)	0.20	Total Area contributing flow to rain garden (ac)	0.63	Total Foot Print Area of Half Block (ac)	2.54
CN	98		86				

**Rainfall Distribution: 1984 Storm** this field needs to be year of storm followed a space then "Storm". Example "1984 Storm"

Max Time Increment 144  
 Pt = 2.39 inches Tc = 10 minutes w = 0.33  
 Sp = 1.63 dt = 10 minutes  
 Si = 0.20

Time Increment	Time	Rainfall Distribution	Incremental Rainfall	Accumulated Rainfall	Pervious Accumulated Runoff	Pervious Area Increment Runoff	Impervious Accumulated Runoff	Impervious Area Incr. Runoff	Total Runoff	Instant Flow rate	Design Flow rate	Difference Between Instant and Design Flow
	(minutes)	(fraction)	(inches)	(inches)	(inches)	(inches)	(inches)	(inches)	(inches)	(cfs)	(cfs)	
0	0	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
1	10	0.0042	0.0100	0.010	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
2	20	0.0042	0.0100	0.020	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
3	30	0.0042	0.0100	0.030	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
4	40	0.0042	0.0100	0.040	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
5	50	0.0126	0.0300	0.070	0.000	0.000	0.004	0.004	0.002	0.01	0.003	0.01
6	60	0.0084	0.0200	0.090	0.000	0.000	0.010	0.006	0.004	0.02	0.009	0.01
7	70	0.0084	0.0200	0.110	0.000	0.000	0.018	0.008	0.005	0.02	0.015	0.01
8	80	0.0084	0.0200	0.130	0.000	0.000	0.027	0.010	0.007	0.03	0.020	0.00
9	90	0.0126	0.0300	0.160	0.000	0.000	0.044	0.017	0.011	0.04	0.030	0.01
10	100	0.0084	0.0200	0.180	0.000	0.000	0.056	0.012	0.009	0.03	0.035	0.00
11	110	0.0084	0.0200	0.200	0.000	0.000	0.070	0.013	0.009	0.03	0.034	0.00
12	120	0.0084	0.0200	0.220	0.000	0.000	0.084	0.014	0.010	0.04	0.035	0.00
13	130	0.0042	0.0100	0.230	0.000	0.000	0.091	0.007	0.005	0.02	0.030	-0.01
14	140	0.0084	0.0200	0.250	0.000	0.000	0.106	0.015	0.010	0.04	0.029	0.01
15	150	0.0126	0.0300	0.280	0.000	0.000	0.129	0.023	0.016	0.06	0.043	0.02
16	160	0.0126	0.0300	0.310	0.000	0.000	0.153	0.024	0.016	0.06	0.055	0.01
17	170	0.0126	0.0300	0.340	0.000	0.000	0.178	0.025	0.017	0.06	0.061	0.00
18	180	0.0209	0.0500	0.390	0.002	0.002	0.220	0.043	0.030	0.11	0.080	0.03
19	190	0.0084	0.0200	0.410	0.004	0.002	0.238	0.017	0.012	0.05	0.080	-0.03
20	200	0.0167	0.0400	0.450	0.009	0.005	0.273	0.035	0.026	0.10	0.075	0.02
21	210	0.0209	0.0500	0.500	0.017	0.008	0.318	0.045	0.033	0.13	0.100	0.03
22	220	0.0167	0.0400	0.540	0.025	0.008	0.354	0.036	0.027	0.10	0.110	-0.01
23	230	0.0167	0.0400	0.580	0.034	0.009	0.391	0.037	0.028	0.11	0.107	0.00
24	240	0.0167	0.0400	0.620	0.045	0.011	0.428	0.037	0.029	0.11	0.108	0.00
25	250	0.0126	0.0300	0.650	0.054	0.009	0.456	0.028	0.022	0.08	0.101	-0.02
26	260	0.0084	0.0200	0.670	0.060	0.006	0.475	0.019	0.015	0.06	0.080	-0.02
27	270	0.0084	0.0200	0.690	0.067	0.007	0.494	0.019	0.015	0.06	0.065	-0.01
28	280	0.0084	0.0200	0.710	0.073	0.007	0.513	0.019	0.015	0.06	0.060	0.00
29	290	0.0167	0.0400	0.750	0.088	0.014	0.551	0.038	0.030	0.12	0.078	0.04
30	300	0.0126	0.0300	0.780	0.099	0.011	0.579	0.029	0.023	0.09	0.094	-0.01
31	310	0.0167	0.0400	0.820	0.115	0.016	0.617	0.038	0.031	0.12	0.100	0.02
32	320	0.0167	0.0400	0.860	0.132	0.017	0.656	0.038	0.032	0.12	0.113	0.01
33	330	0.0167	0.0400	0.900	0.150	0.018	0.694	0.038	0.032	0.12	0.118	0.00
34	340	0.0126	0.0300	0.930	0.164	0.014	0.723	0.029	0.024	0.09	0.111	-0.02
35	350	0.0167	0.0400	0.970	0.183	0.019	0.762	0.039	0.032	0.12	0.109	0.01
36	360	0.0126	0.0300	1.000	0.198	0.015	0.791	0.029	0.025	0.09	0.109	-0.02
37	370	0.0084	0.0200	1.020	0.208	0.010	0.810	0.019	0.016	0.06	0.088	-0.03
38	380	0.0042	0.0100	1.030	0.213	0.005	0.820	0.010	0.008	0.03	0.061	-0.03
39	390	0.0042	0.0100	1.040	0.218	0.005	0.830	0.010	0.008	0.03	0.041	-0.01
40	400	0.0042	0.0100	1.050	0.223	0.005	0.839	0.010	0.008	0.03	0.035	0.00
41	410	0.0000	0.0000	1.050	0.223	0.000	0.839	0.000	0.000	0.00	0.022	-0.02
42	420	0.0000	0.0000	1.050	0.223	0.000	0.839	0.000	0.000	0.00	0.007	-0.01
43	430	0.0042	0.0100	1.060	0.228	0.005	0.849	0.010	0.008	0.03	0.013	0.02
44	440	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	0.015	-0.01
45	450	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	0.005	0.00
46	460	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	0.002	0.00
47	470	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	0.001	0.00
48	480	0.0084	0.0200	1.080	0.239	0.011	0.869	0.019	0.017	0.06	0.021	0.04
49	490	0.0084	0.0200	1.100	0.250	0.011	0.888	0.019	0.017	0.06	0.050	0.01
50	500	0.0084	0.0200	1.120	0.261	0.011	0.908	0.019	0.017	0.06	0.059	0.00
51	510	0.0084	0.0200	1.140	0.272	0.011	0.927	0.020	0.017	0.06	0.062	0.00
52	520	0.0126	0.0300	1.170	0.288	0.017	0.956	0.029	0.025	0.10	0.074	0.02
53	530	0.0126	0.0300	1.200	0.306	0.017	0.986	0.029	0.025	0.10	0.089	0.01
54	540	0.0126	0.0300	1.230	0.323	0.017	1.015	0.029	0.026	0.10	0.095	0.00
55	550	0.0126	0.0300	1.260	0.341	0.018	1.044	0.029	0.026	0.10	0.097	0.00
56	560	0.0167	0.0400	1.300	0.365	0.024	1.084	0.039	0.034	0.13	0.109	0.02
57	570	0.0000	0.0000	1.300	0.365	0.000	1.084	0.000	0.000	0.00	0.080	-0.08
58	580	0.0084	0.0200	1.320	0.377	0.012	1.103	0.020	0.017	0.07	0.049	0.02













**King County CSO**  
**Barton Basin Subbasin 416 - GSI Option**  
 SvR Project No. 06053  
 DATE: 05/11/2010

RAIN GARDEN SYSTEM COMPONENTS			
	Infiltration Rate into Native Subgrade (in/hr)		<b>0.50</b>
<b>SECTION 01 RG</b>	1.5	25.00	2.00% (biosoil depth/lf/slope)
	Number of Section 1 Rain Gardens for Basin (ea)		<b>0</b>
	Total Infiltration Area for Section 1 Rain Gardens (sf)*		0
	Storage Capacity for a single Section 1 Rain Garden (cf)		88
	Total Storage Capacity for Section 1 Rain Gardens (cf)		0
<b>SECTION 02 RG</b>	1.5	42	2.00% (biosoil depth/lf/slope)
	Number of Section 2 Rain Gardens for Basin (ea)		<b>12</b>
	Total Infiltration Area for Section 2 Rain Gardens (sf)*		2890
	Storage Capacity for a single Section 2 Rain Garden (cf)		232
	Total Storage Capacity for Section 2 Rain Gardens (cf)		2782
<b>SECTION 03 RG</b>	1.5	42	2.00% (biosoil depth/lf/slope)
	Number of Section 3 Rain Gardens for Basin (ea)		<b>0</b>
	Total Infiltration Area for Section 3 Rain Gardens (sf)*		0
	Storage Capacity for a single Section 3 Rain Garden (cf)		451
	Total Storage Capacity for Section 3 Rain Gardens (cf)		0

**CONVERSION FACTORS**

conversion factor from cfs to MGD:	0.6452
conversion factor from cfs to cf/per time step:	600

Routing Flow through Rain Garden to Estimate Flow Reduction by Half Block

**Results Summary**

Total Volume of Runoff Removed of entire storm event duration (cf)	4,155	(per GSI half block)
Total Volume of Runoff Removed of entire storm event duration (gal)	31080.17	(per GSI half block)
Total volume of runoff removed from 8:50 to 9:50 of the 1984 storm	4927.257668	(gal per GSI half block)
	319791.1828	(gal)

**Rainfall Distribution: 1984 Storm**

**RAIN GARDEN SYSTEM SUMMARY**

Total Infiltration Flow (cfs)	0.0334
Total Swale Storage Capacity (cf)	2781.9

Flow reduction from subbasin 416 (MGD)	<b>14.6</b>	per John Phillips
Flow reduction from assumed half block at peak flow(MGD)	0.224952925	

**Number of half blocks needed to get total flow reduction out of subbasin 416**

**65**

Time (hours)	Time (minutes)	Design Flow Rate from Rain Event (cfs)	Inflow Water Volume (cf)	Inflow Cumm. Volume (cf)	Initial Exfiltration to Native Subgrade of Inflow (cfs)	Infiltration into Native Subgrade of Stored Water (cfs)	Total Infiltration into Native Subgrade (cfs)	Inflow to Swale After Infiltration into Native Subgrade (cfs)	Swale Storage before Overflow Volume (cf)	Overtop Flow to Pump Station (cfs)	Runoff Stored in Swale Storage Volume (cf)	Volume of Runoff Removed From Pump Station (cf)	Date & Time	Amount Flow Reduced to Pump Station (cfs)	Amount Flow Reduced to Pump Station (MGD)
0	0	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0			
0.17	10	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:00	0.000	
0.33	20	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:10	0.000	
0.50	30	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:20	0.000	
0.67	40	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:30	0.000	
0.83	50	0.003	1.90	1.90	0.0032	0.0000	0.0032	0.0000	0.00	0.00	0.00	1.900626807	11/1/1984 10:40	0.003	
1.00	60	0.009	5.61	7.51	0.0093	0.0000	0.0093	0.0000	0.00	0.00	0.00	5.605567335	11/1/1984 10:50	0.009	
1.17	70	0.015	9.09	16.59	0.0151	0.0000	0.0151	0.0000	0.00	0.00	0.00	9.085690673	11/1/1984 11:00	0.015	
1.33	80	0.020	12.17	28.77	0.0203	0.0000	0.0203	0.0000	0.00	0.00	0.00	12.17466638	11/1/1984 11:10	0.020	
1.50	90	0.030	17.81	46.58	0.0297	0.0000	0.0297	0.0000	0.00	0.00	0.00	17.8143958	11/1/1984 11:20	0.030	
1.67	100	0.035	21.20	67.78	0.0334	0.0000	0.0334	0.0019	1.13	0.00	1.13	21.19743158	11/1/1984 11:30	0.035	
1.83	110	0.034	20.50	88.28	0.0334	0.0000	0.0334	0.0007	1.56	0.00	1.56	20.50300898	11/1/1984 11:40	0.034	
2.00	120	0.035	21.06	109.35	0.0334	0.0000	0.0334	0.0017	2.56	0.00	2.56	21.06473615	11/1/1984 11:50	0.035	
2.17	130	0.030	18.09	127.43	0.0301	0.0033	0.0334	0.0000	0.57	0.00	0.57	18.08536098	11/1/1984 12:00	0.030	
2.33	140	0.029	17.54	144.97	0.0292	0.0042	0.0334	0.0000	-1.96	0.00	0.00	17.53865912	11/1/1984 12:10	0.029	
2.50	150	0.043	25.66	170.63	0.0334	0.0000	0.0334	0.0093	5.59	0.00	5.59	25.6553555	11/1/1984 12:20	0.043	
2.67	160	0.055	33.13	203.76	0.0334	0.0000	0.0334	0.0218	18.65	0.00	18.65	33.13403255	11/1/1984 12:30	0.055	
2.83	170	0.061	36.48	240.24	0.0334	0.0000	0.0334	0.0273	35.06	0.00	35.06	36.47754794	11/1/1984 12:40	0.061	
3.00	180	0.080	47.78	288.01	0.0334	0.0000	0.0334	0.0462	62.77	0.00	62.77	47.77688775	11/1/1984 12:50	0.080	
3.17	190	0.080	48.09	336.10	0.0334	0.0000	0.0334	0.0467	90.78	0.00	90.78	48.08714279	11/1/1984 13:00	0.080	
3.33	200	0.075	44.98	381.08	0.0334	0.0000	0.0334	0.0415	115.70	0.00	115.70	44.98314287	11/1/1984 13:10	0.075	
3.50	210	0.100	59.81	440.89	0.0334	0.0000	0.0334	0.0662	155.44	0.00	155.44	59.81060881	11/1/1984 13:20	0.100	
3.67	220	0.110	66.19	507.08	0.0334	0.0000	0.0334	0.0769	201.56	0.00	201.56	66.18986175	11/1/1984 13:30	0.110	
3.83	230	0.107	64.45	571.54	0.0334	0.0000	0.0334	0.0740	245.94	0.00	245.94	64.45468198	11/1/1984 13:40	0.107	
4.00	240	0.108	64.89	636.43	0.0334	0.0000	0.0334	0.0747	290.76	0.00	290.76	64.88628415	11/1/1984 13:50	0.108	
4.17	250	0.101	60.31	696.74	0.0334	0.0000	0.0334	0.0671	331.00	0.00	331.00	60.31248582	11/1/1984 14:00	0.101	
4.33	260	0.080	48.14	744.88	0.0334	0.0000	0.0334	0.0468	359.07	0.00	359.07	48.13781342	11/1/1984 14:10	0.080	
4.50	270	0.065	38.72	783.60	0.0334	0.0000	0.0334	0.0311	377.73	0.00	377.73	38.72385189	11/1/1984 14:20	0.065	
4.67	280	0.060	35.78	819.38	0.0334	0.0000	0.0334	0.0262	393.43	0.00	393.43	35.77643213	11/1/1984 14:30	0.060	
4.83	290	0.078	46.63	866.01	0.0334	0.0000	0.0334	0.0443	420.00	0.00	420.00	46.63284372	11/1/1984 14:40	0.078	
5.00	300	0.094	56.41	922.42	0.0334	0.0000	0.0334	0.0606	456.34	0.00	456.34	56.40882598	11/1/1984 14:50	0.094	
5.17	310	0.100	60.23	982.65	0.0334	0.0000	0.0334	0.0669	496.50	0.00	496.50	60.22934692	11/1/1984 15:00	0.100	
5.33	320	0.113	67.94	1050.59	0.0334	0.0000	0.0334	0.0798	544.37	0.00	544.37	67.94245789	11/1/1984 15:10	0.113	
5.50	330	0.118	71.07	1121.66	0.0334	0.0000	0.0334	0.0850	595.37	0.00	595.37	71.07203902	11/1/1984 15:20	0.118	
5.67	340	0.111	66.46	1188.13	0.0334	0.0000	0.0334	0.0773	641.77	0.00	641.77	66.46357161	11/1/1984 15:30	0.111	
5.83	350	0.109	65.36	1253.48	0.0334	0.0000	0.0334	0.0755	687.05	0.00	687.05	65.35638515	11/1/1984 15:40	0.109	
6.00	360	0.109	65.29	1318.77	0.0334	0.0000	0.0334	0.0754	732.27	0.00	732.27	65.2909189	11/1/1984 15:50	0.109	
6.17	370	0.088	53.05	1371.82	0.0334	0.0000	0.0334	0.0550	765.25	0.00	765.25	53.04664664	11/1/1984 16:00	0.088	
6.33	380	0.061	36.53	1408.35	0.0334	0.0000	0.0334	0.0274	781.71	0.00	781.71	36.53184299	11/1/1984 16:10	0.061	
6.50	390	0.041	24.78	1433.13	0.0334	0.0000	0.0334	0.0079	786.43	0.00	786.43	24.7824167	11/1/1984 16:20	0.041	
6.67	400	0.035	20.89	1454.02	0.0334	0.0000	0.0334	0.0014	787.25	0.00	787.25	20.89120721	11/1/1984 16:30	0.035	
6.83	410	0.022	13.29	1467.31	0.0221	0.0113	0.0334	0.0000	780.46	0.00	780.46	13.28520482	11/1/1984 16:40	0.022	
7.00	420	0.007	4.43	1471.74	0.0074	0.0261	0.0334	0.0000	764.82	0.00	764.82	4.428401606	11/1/1984 16:50	0.007	
7.17	430	0.013	7.81	1479.55	0.0130	0.0204	0.0334	0.0000	752.56	0.00	752.56	7.809950826	11/1/1984 17:00	0.013	



7.33	440	0.015	8.94	1488.49	0.0149	0.0186	0.0334	0.0000	741.43	0.00	741.43	8.9371339	11/1/1984 17:10	0.015
7.50	450	0.005	2.98	1491.46	0.0050	0.0285	0.0334	0.0000	724.34	0.00	724.34	2.979044633	11/1/1984 17:20	0.005
7.67	460	0.002	0.99	1492.46	0.0017	0.0318	0.0334	0.0000	705.27	0.00	705.27	0.993014878	11/1/1984 17:30	0.002
7.83	470	0.001	0.33	1492.79	0.0006	0.0329	0.0334	0.0000	685.53	0.00	685.53	0.331004959	11/1/1984 17:40	0.001
8.00	480	0.021	12.81	1505.60	0.0214	0.0121	0.0334	0.0000	678.27	0.00	678.27	12.81427851	11/1/1984 17:50	0.021
8.17	490	0.050	29.73	1535.33	0.0334	0.0000	0.0334	0.0161	687.93	0.00	687.93	29.72654198	11/1/1984 18:00	0.050
8.33	500	0.059	35.46	1570.79	0.0334	0.0000	0.0334	0.0256	703.32	0.00	703.32	35.45705237	11/1/1984 18:10	0.059
8.50	510	0.062	37.46	1608.24	0.0334	0.0000	0.0334	0.0290	720.70	0.00	720.70	37.45763197	11/1/1984 18:20	0.062
8.67	520	0.074	44.67	1652.91	0.0334	0.0000	0.0334	0.0410	745.31	0.00	745.31	44.67062384	11/1/1984 18:30	0.074
8.83	530	0.089	53.67	1706.58	0.0334	0.0000	0.0334	0.0560	778.91	0.00	778.91	53.66992088	11/1/1984 18:40	0.089
9.00	540	0.095	56.85	1763.44	0.0334	0.0000	0.0334	0.0613	815.69	0.00	815.69	56.85265588	11/1/1984 18:50	0.095
9.17	550	0.097	58.09	1821.53	0.0334	0.0000	0.0334	0.0634	853.71	0.00	853.71	58.08915945	11/1/1984 19:00	0.097
9.33	560	0.109	65.25	1886.78	0.0334	0.0000	0.0334	0.0753	898.89	0.00	898.89	65.25268773	11/1/1984 19:10	0.109
9.50	570	0.080	48.03	1934.81	0.0334	0.0000	0.0334	0.0466	926.85	0.00	926.85	48.0283904	11/1/1984 19:20	0.080
9.67	580	0.049	29.20	1964.01	0.0334	0.0000	0.0334	0.0152	935.98	0.00	935.98	29.20093819	11/1/1984 19:30	0.049
9.83	590	0.049	29.53	1993.54	0.0334	0.0000	0.0334	0.0158	945.45	0.00	945.45	29.53364677	11/1/1984 19:40	0.049
10.00	600	0.038	23.07	2016.61	0.0334	0.0000	0.0334	0.0050	948.45	0.00	948.45	23.06998223	11/1/1984 19:50	0.038
10.17	610	0.024	14.31	2030.92	0.0238	0.0096	0.0334	0.0000	942.68	0.00	942.68	14.3069014	11/1/1984 20:00	0.024
10.33	620	0.019	11.39	2042.31	0.0190	0.0145	0.0334	0.0000	934.01	0.00	934.01	11.3941499	11/1/1984 20:10	0.019
10.50	630	0.051	30.35	2072.66	0.0334	0.0000	0.0334	0.0171	944.29	0.00	944.29	30.34740281	11/1/1984 20:20	0.051
10.67	640	0.072	43.36	2116.02	0.0334	0.0000	0.0334	0.0388	967.58	0.00	967.58	43.36226966	11/1/1984 20:30	0.072
10.83	650	0.057	34.45	2150.47	0.0334	0.0000	0.0334	0.0240	981.96	0.00	981.96	34.44910265	11/1/1984 20:40	0.057
11.00	660	0.030	18.16	2168.63	0.0303	0.0032	0.0334	0.0000	980.05	0.00	980.05	18.15574833	11/1/1984 20:50	0.030
11.17	670	0.021	12.73	2181.36	0.0212	0.0122	0.0334	0.0000	972.71	0.00	972.71	12.73221472	11/1/1984 21:00	0.021
11.33	680	0.018	10.92	2192.28	0.0182	0.0152	0.0334	0.0000	963.56	0.00	963.56	10.92437018	11/1/1984 21:10	0.018
11.50	690	0.006	3.64	2195.93	0.0061	0.0274	0.0334	0.0000	947.14	0.00	947.14	3.641456727	11/1/1984 21:20	0.006
11.67	700	0.013	7.90	2203.83	0.0132	0.0203	0.0334	0.0000	934.97	0.00	934.97	7.90161	11/1/1984 21:30	0.013
11.83	710	0.027	16.02	2219.84	0.0267	0.0068	0.0334	0.0000	930.92	0.00	930.92	16.01685421	11/1/1984 21:40	0.027
12.00	720	0.020	12.03	2231.88	0.0201	0.0134	0.0334	0.0000	922.88	0.00	922.88	12.03414452	11/1/1984 21:50	0.020
12.17	730	0.018	10.71	2242.59	0.0179	0.0156	0.0334	0.0000	913.52	0.00	913.52	10.71388771	11/1/1984 22:00	0.018
12.33	740	0.017	10.27	2252.87	0.0171	0.0163	0.0334	0.0000	903.73	0.00	903.73	10.27380211	11/1/1984 22:10	0.017
12.50	750	0.006	3.42	2256.29	0.0057	0.0277	0.0334	0.0000	887.08	0.00	887.08	3.424600704	11/1/1984 22:20	0.006
12.67	760	0.002	1.14	2257.43	0.0019	0.0315	0.0334	0.0000	868.16	0.00	868.16	1.141533568	11/1/1984 22:30	0.002
12.83	770	0.001	0.38	2257.81	0.0006	0.0328	0.0334	0.0000	848.47	0.00	848.47	0.380511189	11/1/1984 22:40	0.001
13.00	780	0.000	0.13	2257.94	0.0002	0.0332	0.0334	0.0000	828.52	0.00	828.52	0.126837063	11/1/1984 22:50	0.000
13.17	790	0.000	0.04	2257.98	0.0001	0.0334	0.0334	0.0000	808.50	0.00	808.50	0.042279021	11/1/1984 23:00	0.000
13.33	800	0.011	6.72	2264.71	0.0112	0.0222	0.0334	0.0000	795.15	0.00	795.15	6.723824864	11/1/1984 23:10	0.011
13.50	810	0.026	15.67	2280.37	0.0261	0.0073	0.0334	0.0000	790.75	0.00	790.75	15.66787833	11/1/1984 23:20	0.026
13.67	820	0.031	18.66	2299.04	0.0311	0.0023	0.0334	0.0000	789.34	0.00	789.34	18.66342426	11/1/1984 23:30	0.031
13.83	830	0.022	12.95	2311.98	0.0216	0.0119	0.0334	0.0000	782.22	0.00	782.22	12.94506805	11/1/1984 23:40	0.022
14.00	840	0.007	4.32	2316.30	0.0072	0.0263	0.0334	0.0000	766.47	0.00	766.47	4.315022683	11/1/1984 23:50	0.007
14.17	850	0.002	1.44	2317.74	0.0024	0.0311	0.0334	0.0000	747.83	0.00	747.83	1.438340894	11/2/1984 0:00	0.002
14.33	860	0.001	0.48	2318.21	0.0008	0.0326	0.0334	0.0000	728.24	0.00	728.24	0.479446965	11/2/1984 0:10	0.001
14.50	870	0.000	0.16	2318.37	0.0003	0.0332	0.0334	0.0000	708.33	0.00	708.33	0.159815655	11/2/1984 0:20	0.000
14.67	880	0.000	0.05	2318.43	0.0001	0.0334	0.0334	0.0000	688.32	0.00	688.32	0.053271885	11/2/1984 0:30	0.000
14.83	890	0.011	6.75	2325.18	0.0112	0.0222	0.0334	0.0000	675.00	0.00	675.00	6.748655864	11/2/1984 0:40	0.011
15.00	900	0.026	15.72	2340.89	0.0262	0.0073	0.0334	0.0000	670.65	0.00	670.65	15.71823923	11/2/1984 0:50	0.026
15.17	910	0.031	18.72	2359.62	0.0312	0.0022	0.0334	0.0000	669.30	0.00	669.30	18.72180016	11/2/1984 1:00	0.031
15.33	920	0.022	12.99	2372.60	0.0216	0.0118	0.0334	0.0000	662.21	0.00	662.21	12.98519843	11/2/1984 1:10	0.022
15.50	930	0.018	11.08	2383.68	0.0185	0.0150	0.0334	0.0000	653.23	0.00	653.23	11.07972836	11/2/1984 1:20	0.018
15.67	940	0.029	17.20	2400.88	0.0287	0.0048	0.0334	0.0000	650.36	0.00	650.36	17.20255319	11/2/1984 1:30	0.029
15.83	950	0.021	12.49	2413.38	0.0208	0.0126	0.0334	0.0000	642.78	0.00	642.78	12.49216591	11/2/1984 1:40	0.021
16.00	960	0.007	4.16	2417.54	0.0069	0.0265	0.0334	0.0000	626.88	0.00	626.88	4.164055302	11/2/1984 1:50	0.007
16.17	970	0.002	1.39	2418.93	0.0023	0.0311	0.0334	0.0000	608.19	0.00	608.19	1.388018434	11/2/1984 2:00	0.002
16.33	980	0.001	0.46	2419.39	0.0008	0.0327	0.0334	0.0000	588.59	0.00	588.59	0.462672811	11/2/1984 2:10	0.001
16.50	990	0.000	0.15	2419.55	0.0003	0.0332	0.0334	0.0000	568.67	0.00	568.67	0.15422427	11/2/1984 2:20	0.000
16.67	1000	0.011	6.82	2426.36	0.0114	0.0221	0.0334	0.0000	555.42	0.00	555.42	6.81596559	11/2/1984 2:30	0.011
16.83	1010	0.015	9.04	2435.40	0.0151	0.0184	0.0334	0.0000	544.39	0.00	544.39	9.03654603	11/2/1984 2:40	0.015
17.00	1020	0.005	3.01	2438.41	0.0050	0.0284	0.0334	0.0000	527.33	0.00	527.33	3.01218201	11/2/1984 2:50	0.005
17.17	1030	0.036	21.34	2459.75	0.0334	0.0000	0.0334	0.0021	528.60	0.00	528.60	21.33644097	11/2/1984 3:00	0.036
17.33	1040	0.057	34.23	2493.98	0.0334	0.0000	0.0334	0.0236	542.76	0.00	542.76	34.2346465	11/2/1984 3:10	0.057
17.50	1050	0.064	38.61	2532.59	0.0334	0.0000	0.0334	0.0309	561.30	0.00	561.30	38.60901216	11/2/1984 3:20	0.064
17.67	1060	0.090	53.74	2586.33	0.0334	0.0000	0.0334	0.0561	594.97	0.00	594.97	53.73840931	11/2/1984 3:30	0.090
17.83	1070	0.087	52.04	2638.37	0.0334	0.0000	0.0334	0.0533	626.94	0.00	626.94	52.04427864	11/2/1984 3:40	0.087
18.00	1080	0.086	51.57	2689.94	0.0334	0.0000	0.0334	0.0525	658.44	0.00	658.44	51.56576199	11/2/1984 3:50	0.086
18.17	1090	0.086	51.46	2741.40	0.0334	0.0000	0.0334	0.0523	689.83	0.00	689.83	51.46217019	11/2/1984 4:00	0.086
18.33	1100	0.063	37.75	2779.15	0.0334	0.0000	0.0334	0.0295	707.51	0.00	707.51	37.75115306	11/2/1984 4:10	0.063
18.50	1110	0.032	19.45	2798.61	0.0324	0.0010	0.0334	0.0000	706.90	0.00	706.90	19.4548192	11/2/1984 4:20	0.032
18.67	1120	0.011	6.48	2805.09	0.0108	0.0226	0.0334	0.0000	693.32	0.00	693.32	6.484939734	11/2/1984 4:30	0.011
18.83	1130	0.015	9.04	2814.13	0.0151	0.0184	0.0334	0.0000	682.28	0.00	682.28	9.038074298	11/2/1984 4:40	0.015
19.00	1140	0.016	9.89	2824.02	0.0165	0.0170	0.0334	0.0000	6					



19.83	1190	0.067	39.95	2995.34	0.0334	0.0000	0.0334	0.0331	743.08	0.00	743.08	39.95024716	11/2/1984 5:40	0.067	
20.00	1200	0.022	13.32	3008.66	0.0222	0.0113	0.0334	0.0000	736.33	0.00	736.33	13.31674905	11/2/1984 5:50	0.022	
20.17	1210	0.007	4.44	3013.10	0.0074	0.0261	0.0334	0.0000	720.70	0.00	720.70	4.438916352	11/2/1984 6:00	0.007	
20.33	1220	0.026	15.34	3028.44	0.0256	0.0079	0.0334	0.0000	715.97	0.00	715.97	15.33782866	11/2/1984 6:10	0.026	
20.50	1230	0.066	39.79	3068.23	0.0334	0.0000	0.0334	0.0329	735.69	0.00	735.69	39.79322295	11/2/1984 6:20	0.066	
20.67	1240	0.068	41.04	3109.27	0.0334	0.0000	0.0334	0.0349	756.66	0.00	756.66	41.03682138	11/2/1984 6:30	0.068	
20.83	1250	0.034	20.63	3129.90	0.0334	0.0000	0.0334	0.0009	757.22	0.00	757.22	20.62893067	11/2/1984 6:40	0.034	
21.00	1260	0.023	13.83	3143.73	0.0231	0.0104	0.0334	0.0000	750.98	0.00	750.98	13.83081518	11/2/1984 6:50	0.023	
21.17	1270	0.031	18.52	3162.25	0.0309	0.0026	0.0334	0.0000	749.43	0.00	749.43	18.52375145	11/2/1984 7:00	0.031	
21.33	1280	0.068	41.01	3203.26	0.0334	0.0000	0.0334	0.0349	770.38	0.00	770.38	41.01327857	11/2/1984 7:10	0.068	
21.50	1290	0.116	69.50	3272.76	0.0334	0.0000	0.0334	0.0824	819.81	0.00	819.81	69.49861027	11/2/1984 7:20	0.116	
21.67	1300	0.132	79.13	3351.89	0.0334	0.0000	0.0334	0.0984	878.86	0.00	878.86	79.12727626	11/2/1984 7:30	0.132	
21.83	1310	0.114	68.42	3420.31	0.0334	0.0000	0.0334	0.0806	927.21	0.00	927.21	68.41945057	11/2/1984 7:40	0.114	
22.00	1320	0.061	36.84	3457.15	0.0334	0.0000	0.0334	0.0279	943.98	0.00	943.98	36.83689993	11/2/1984 7:50	0.061	
22.17	1330	0.032	19.30	3476.45	0.0322	0.0013	0.0334	0.0000	943.21	0.00	943.21	19.29988862	11/2/1984 8:00	0.032	
22.33	1340	0.022	13.45	3489.90	0.0224	0.0110	0.0334	0.0000	936.60	0.00	936.60	13.45435151	11/2/1984 8:10	0.022	
22.50	1350	0.007	4.48	3494.39	0.0075	0.0260	0.0334	0.0000	921.01	0.00	921.01	4.484783837	11/2/1984 8:20	0.007	
22.67	1360	0.002	1.49	3495.88	0.0025	0.0310	0.0334	0.0000	902.44	0.00	902.44	1.494927946	11/2/1984 8:30	0.002	
22.83	1370	0.001	0.50	3496.38	0.0008	0.0326	0.0334	0.0000	882.87	0.00	882.87	0.498309315	11/2/1984 8:40	0.001	
23.00	1380	0.024	14.22	3510.60	0.0237	0.0097	0.0334	0.0000	877.02	0.00	877.02	14.21959294	11/2/1984 8:50	0.024	
23.17	1390	0.043	25.83	3536.42	0.0334	0.0000	0.0334	0.0096	882.77	0.00	882.77	25.82575075	11/2/1984 9:00	0.043	
23.33	1400	0.026	15.64	3552.06	0.0261	0.0074	0.0334	0.0000	878.34	0.00	878.34	15.64098018	11/2/1984 9:10	0.026	
23.50	1410	0.232	139.50	3691.56	0.0334	0.0000	0.0334	0.1990	997.77	0.00	997.77	139.4988459	11/2/1984 9:20	0.232	0.149998759
23.67	1420	0.349	209.21	3900.77	0.0334	0.0000	0.0334	0.3152	1186.91	0.00	1186.91	209.2062202	11/2/1984 9:30	0.349	0.224952925
23.83	1430	0.247	148.01	4048.78	0.0334	0.0000	0.0334	0.2132	1314.85	0.00	1314.85	148.0098299	11/2/1984 9:40	0.247	0.159150355
24.00	1440	0.177	106.32	4155.10	0.0334	0.0000	0.0334	0.1438	1401.10	0.00	1401.10	106.3230673	11/2/1984 9:50	0.177	
24.17	1450	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1381.04	0.00	1381.04	0	11/2/1984 10:00	0.000	
24.33	1460	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1360.97	0.00	1360.97	0	11/2/1984 10:10	0.000	
24.50	1470	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1340.90	0.00	1340.90	0	11/2/1984 10:20	0.000	
24.67	1480	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1320.83	0.00	1320.83	0	11/2/1984 10:30	0.000	
24.83	1490	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1300.76	0.00	1300.76	0	11/2/1984 10:40	0.000	
25.00	1500	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1280.69	0.00	1280.69	0	11/2/1984 10:50	0.000	
25.17	1510	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1260.62	0.00	1260.62	0	11/2/1984 11:00	0.000	
25.33	1520	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1240.55	0.00	1240.55	0	11/2/1984 11:10	0.000	
25.50	1530	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1220.48	0.00	1220.48	0	11/2/1984 11:20	0.000	
25.67	1540	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1200.41	0.00	1200.41	0	11/2/1984 11:30	0.000	
25.83	1550	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1180.34	0.00	1180.34	0	11/2/1984 11:40	0.000	
26.00	1560	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1160.27	0.00	1160.27	0	11/2/1984 11:50	0.000	
26.17	1570	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1140.20	0.00	1140.20	0	11/2/1984 12:00	0.000	
26.33	1580	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1120.13	0.00	1120.13	0	11/2/1984 12:10	0.000	
26.50	1590	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1100.06	0.00	1100.06	0	11/2/1984 12:20	0.000	
26.67	1600	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1079.99	0.00	1079.99	0	11/2/1984 12:30	0.000	
26.83	1610	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1059.92	0.00	1059.92	0	11/2/1984 12:40	0.000	
27.00	1620	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1039.85	0.00	1039.85	0	11/2/1984 12:50	0.000	
27.17	1630	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1019.79	0.00	1019.79	0	11/2/1984 13:00	0.000	
27.33	1640	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	999.72	0.00	999.72	0	11/2/1984 13:10	0.000	
27.50	1650	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	979.65	0.00	979.65	0	11/2/1984 13:20	0.000	
27.67	1660	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	959.58	0.00	959.58	0	11/2/1984 13:30	0.000	
27.83	1670	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	939.51	0.00	939.51	0	11/2/1984 13:40	0.000	
28.00	1680	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	919.44	0.00	919.44	0	11/2/1984 13:50	0.000	
28.17	1690	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	899.37	0.00	899.37	0	11/2/1984 14:00	0.000	
28.33	1700	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	879.30	0.00	879.30	0	11/2/1984 14:10	0.000	
28.50	1710	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	859.23	0.00	859.23	0	11/2/1984 14:20	0.000	
28.67	1720	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	839.16	0.00	839.16	0	11/2/1984 14:30	0.000	
28.83	1730	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	819.09	0.00	819.09	0	11/2/1984 14:40	0.000	
29.00	1740	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	799.02	0.00	799.02	0	11/2/1984 14:50	0.000	
29.17	1750	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	778.95	0.00	778.95	0	11/2/1984 15:00	0.000	
29.33	1760	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	758.88	0.00	758.88	0	11/2/1984 15:10	0.000	
29.50	1770	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	738.81	0.00	738.81	0	11/2/1984 15:20	0.000	
29.67	1780	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	718.74	0.00	718.74	0	11/2/1984 15:30	0.000	
29.83	1790	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	698.67	0.00	698.67	0	11/2/1984 15:40	0.000	
30.00	1800	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	678.60	0.00	678.60	0	11/2/1984 15:50	0.000	
30.17	1810	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	658.54	0.00	658.54	0	11/2/1984 16:00	0.000	
30.33	1820	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	638.47	0.00	638.47	0	11/2/1984 16:10	0.000	
30.50	1830	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	618.40	0.00	618.40	0	11/2/1984 16:20	0.000	
30.67	1840	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	598.33	0.00	598.33	0	11/2/1984 16:30	0.000	



30.83	1850	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	578.26	0.00	578.26	0	11/2/1984 16:40	0.000
31.00	1860	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	558.19	0.00	558.19	0	11/2/1984 16:50	0.000
31.17	1870	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	538.12	0.00	538.12	0	11/2/1984 17:00	0.000
31.33	1880	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	518.05	0.00	518.05	0	11/2/1984 17:10	0.000
31.50	1890	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	497.98	0.00	497.98	0	11/2/1984 17:20	0.000
31.67	1900	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	477.91	0.00	477.91	0	11/2/1984 17:30	0.000
31.83	1910	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	457.84	0.00	457.84	0	11/2/1984 17:40	0.000
32.00	1920	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	437.77	0.00	437.77	0	11/2/1984 17:50	0.000
32.17	1930	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	417.70	0.00	417.70	0	11/2/1984 18:00	0.000
32.33	1940	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	397.63	0.00	397.63	0	11/2/1984 18:10	0.000
32.50	1950	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	377.56	0.00	377.56	0	11/2/1984 18:20	0.000
32.67	1960	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	357.49	0.00	357.49	0	11/2/1984 18:30	0.000
32.83	1970	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	337.42	0.00	337.42	0	11/2/1984 18:40	0.000
33.00	1980	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	317.35	0.00	317.35	0	11/2/1984 18:50	0.000
33.17	1990	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	297.29	0.00	297.29	0	11/2/1984 19:00	0.000
33.33	2000	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	277.22	0.00	277.22	0	11/2/1984 19:10	0.000
33.50	2010	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	257.15	0.00	257.15	0	11/2/1984 19:20	0.000
33.67	2020	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	237.08	0.00	237.08	0	11/2/1984 19:30	0.000
33.83	2030	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	217.01	0.00	217.01	0	11/2/1984 19:40	0.000
34.00	2040	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	196.94	0.00	196.94	0	11/2/1984 19:50	0.000
34.17	2050	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	176.87	0.00	176.87	0	11/2/1984 20:00	0.000
34.33	2060	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	156.80	0.00	156.80	0	11/2/1984 20:10	0.000
34.50	2070	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	136.73	0.00	136.73	0	11/2/1984 20:20	0.000
34.67	2080	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	116.66	0.00	116.66	0	11/2/1984 20:30	0.000
34.83	2090	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	96.59	0.00	96.59	0	11/2/1984 20:40	0.000
35.00	2100	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	76.52	0.00	76.52	0	11/2/1984 20:50	0.000
35.17	2110	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	56.45	0.00	56.45	0	11/2/1984 21:00	0.000
35.33	2120	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	36.38	0.00	36.38	0	11/2/1984 21:10	0.000
35.50	2130	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	16.31	0.00	16.31	0	11/2/1984 21:20	0.000
35.67	2140	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	-3.76	0.00	0.00	0	11/2/1984 21:30	0.000
35.83	2150	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 21:40	0.000
36.00	2160	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 21:50	0.000
36.17	2170	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 22:00	0.000
36.33	2180	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 22:10	0.000
36.50	2190	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 22:20	0.000
36.67	2200	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 22:30	0.000
36.83	2210	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 22:40	0.000
37.00	2220	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 22:50	0.000
37.17	2230	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 23:00	0.000
37.33	2240	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 23:10	0.000
37.50	2250	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 23:20	0.000
37.67	2260	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 23:30	0.000
37.83	2270	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 23:40	0.000
38.00	2280	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 23:50	0.000
38.17	2290	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
38.33	2300	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
38.50	2310	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
38.67	2320	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
38.83	2330	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
39.00	2340	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
39.17	2350	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
39.33	2360	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
39.50	2370	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
39.67	2380	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
39.83	2390	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
40.00	2400	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
40.17	2410	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
40.33	2420	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
40.50	2430	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
40.67	2440	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
40.83	2450	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
41.00	2460	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
41.17	2470	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
41.33	2480	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
41.50	2490	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
41.67	2500	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
41.83	2510	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
42.00	2520	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
42.16	2530	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
42.33	2540	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
42.50	2550	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
42.66	2560	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
42.83	2570	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
43.00	2580	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
43.16	2590	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000







Modeling Results for  
Section 3a  
With Only ROW Tributary Area

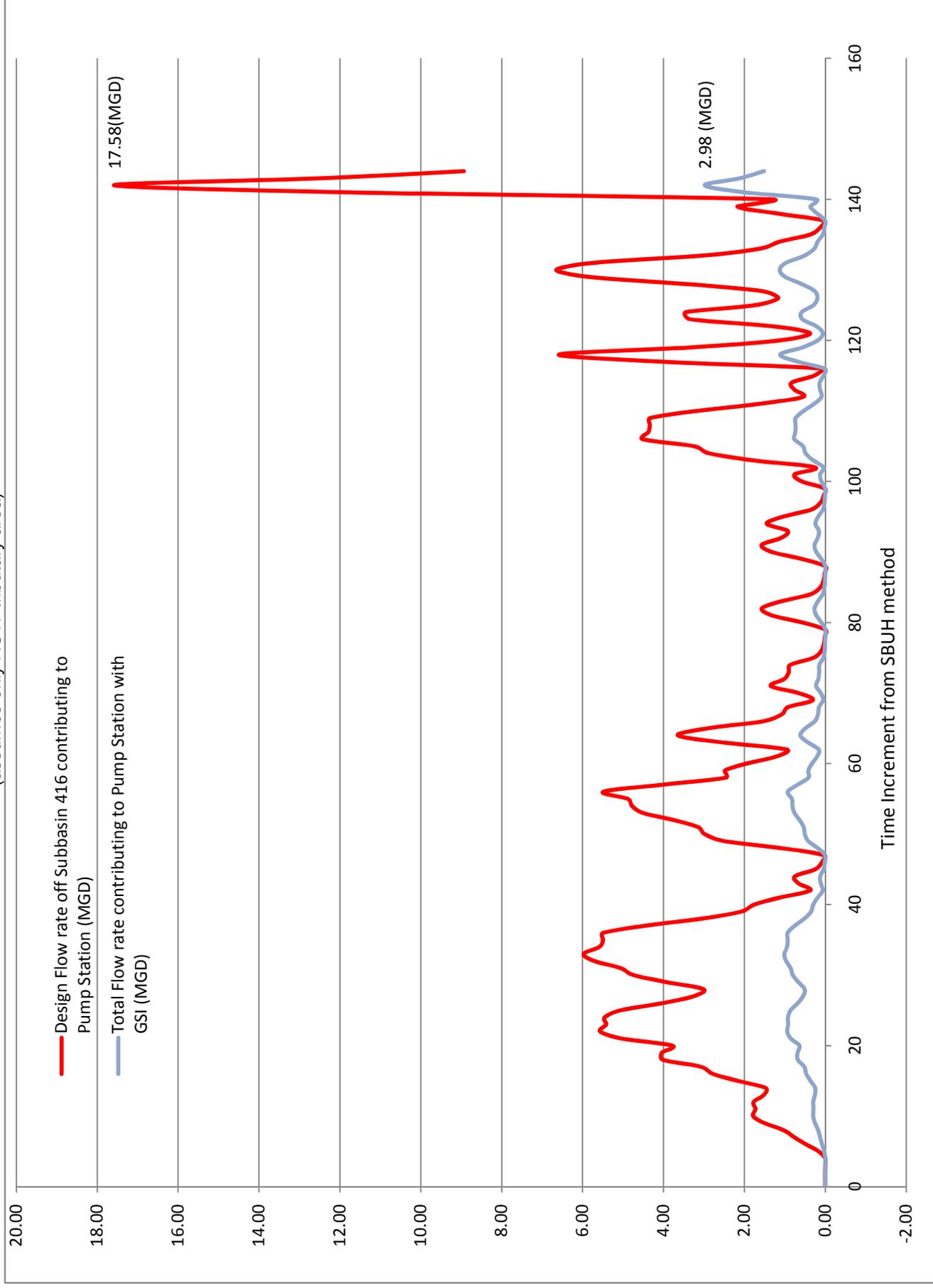


SvR Modeled Subbasin 416 Design Flow Rate to Pump Station

SECTION 3a

during 1984 Storm

(assumes only ROW tributary area)







**King County CSO**  
**Barton Basin Subbasin 416 GSI Analysis**  
 SvR Project No. 06053  
 Date: 05/11/2010

**Santa Barbara Urban Hydrograph Method (SBUH)**

red text is user entered

Rainfall data provided by King County

conversion from sf to acre

assume that both sides of a street have the same planter width

alleys are assumed to be negligible

a time increment of 9999 indicates that the rain event (provided by King County) has finished

corners at roadway intersections are counted as impervious in the N/S ROW areas

assumes crowned roadway

**Typical One Block Characteristics**

Block (N/S) per GIS (lf)	601	
Block (E/W) per GIS (lf)	276	
Private Parcel Area (sf)	165,876	3.81 (ac)
Roof Area of Private Parcels per Block per GIS (sf)	41,451	0.95 (ac)
Non Roof Impervious Area of Private Parcels per Block per GIS (sf)	55,937	1.28 (ac)
Pervious Area of Private Parcels per Block including alleys (sf)	68,488	1.57 (ac)
ROW width (N/S) (lf)	60	
Planter Width (N/S) (lf)	10	
Width of Impervious in ROW (N/S) (lf)	40	
ROW width (E/W) (lf)	60	
Planter Width (E/W) (lf)	10	
Width of Impervious in ROW (E/W) (lf)	40	
ROW Impervious Area (N/S) (sf)	26440	0.61 (ac)
ROW Pervious Area (N/S) (sf)	12020	0.28 (ac)
ROW Impervious Area (E/W) (sf)	11040	0.25 (ac)
ROW Pervious Area (E/W) (sf)	5520	0.13 (ac)

	Percentage to RG	Effective Area to RG	CN	Impervious to RG (ac)	Pervious to RG (ac)	Percentage Impervious	Percentage Pervious
<b>PRIVATE PARCEL CHARACTERISTICS</b>							
Block Area to RG (ac)	0%						
Total Roof Area per One Block (ac)	0.95	100%					
Roof Area disconnected		60%	86	0.00	0.00	0.00%	0.00%
Total Non-Roof Impervious Area Per One Block (ac)	1.28						
Non-Roof Impervious Area to RG (ac)		50%	86	0.00	0.00	0.00%	0.00%
Total Pervious Area per One Block (ac)	1.57						
Pervious Area to RG (ac)		50%	86	0.00	0.00	0.00%	0.00%
<b>N/S ROADWAY CHARACTERISTICS</b>							
One N/S ROW to RG per One Block		50%					
Total ROW Impervious Area (N/S) fronting a Block (ac)	0.61						
ROW Impervious Area (N/S) to RG (ac)			98	0.30	0	11.97%	0.00%
Total ROW Pervious Area (N/S) fronting a Block (ac)	0.28						
ROW Pervious Area (N/S) to RG (ac)			86	0	0.14	0.00%	5.44%
<b>E/W ROADWAY CHARACTERISTICS</b>							
One E/W ROW to RG per One Block		50%					
Total ROW Impervious Area (E/W) fronting One Block(ac)	0.25						
ROW Impervious Area (E/W) to RG (ac)			98	0.13	0	5.00%	0.00%
Total ROW Pervious Area (E/W) fronting One Block(ac)	0.13						
ROW Pervious Area (E/W) to RG (ac)			86	0	0.06	0.00%	2.50%
						16.97%	7.94%

Impervious to RG (ac)	0.43	Pervious to RG (ac)	0.20	Total Area contributing flow to rain garden (ac)	0.63	Total Foot Print Area of Half Block (ac)	2.54
CN	98		86				

**Rainfall Distribution: 1984 Storm** this field needs to be year of storm followed a space then "Storm". Example "1984 Storm"

Max Time Increment 144  
 Pt = 2.39 inches Tc = 10 minutes w = 0.33  
 Sp = 1.63 dt = 10 minutes  
 Si = 0.20

Time Increment	Time	Rainfall Distribution	Incremental Rainfall	Accumulated Rainfall	Pervious Accumulated Runoff	Pervious Area Increment Runoff	Impervious Accumulated Runoff	Impervious Area Incr. Runoff	Total Runoff	Instant Flow rate	Design Flow rate	Difference Between Instant and Design Flow
	(minutes)	(fraction)	(inches)	(inches)	(inches)	(inches)	(inches)	(inches)	(inches)	(cfs)	(cfs)	
0	0	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
1	10	0.0042	0.0100	0.010	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
2	20	0.0042	0.0100	0.020	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
3	30	0.0042	0.0100	0.030	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
4	40	0.0042	0.0100	0.040	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
5	50	0.0126	0.0300	0.070	0.000	0.000	0.004	0.004	0.002	0.01	0.003	0.01
6	60	0.0084	0.0200	0.090	0.000	0.000	0.010	0.006	0.004	0.02	0.009	0.01
7	70	0.0084	0.0200	0.110	0.000	0.000	0.018	0.008	0.005	0.02	0.015	0.01
8	80	0.0084	0.0200	0.130	0.000	0.000	0.027	0.010	0.007	0.03	0.020	0.00
9	90	0.0126	0.0300	0.160	0.000	0.000	0.044	0.017	0.011	0.04	0.030	0.01
10	100	0.0084	0.0200	0.180	0.000	0.000	0.056	0.012	0.009	0.03	0.035	0.00
11	110	0.0084	0.0200	0.200	0.000	0.000	0.070	0.013	0.009	0.03	0.034	0.00
12	120	0.0084	0.0200	0.220	0.000	0.000	0.084	0.014	0.010	0.04	0.035	0.00
13	130	0.0042	0.0100	0.230	0.000	0.000	0.091	0.007	0.005	0.02	0.030	-0.01
14	140	0.0084	0.0200	0.250	0.000	0.000	0.106	0.015	0.010	0.04	0.029	0.01
15	150	0.0126	0.0300	0.280	0.000	0.000	0.129	0.023	0.016	0.06	0.043	0.02
16	160	0.0126	0.0300	0.310	0.000	0.000	0.153	0.024	0.016	0.06	0.055	0.01
17	170	0.0126	0.0300	0.340	0.000	0.000	0.178	0.025	0.017	0.06	0.061	0.00
18	180	0.0209	0.0500	0.390	0.002	0.002	0.220	0.043	0.030	0.11	0.080	0.03
19	190	0.0084	0.0200	0.410	0.004	0.002	0.238	0.017	0.012	0.05	0.080	-0.03
20	200	0.0167	0.0400	0.450	0.009	0.005	0.273	0.035	0.026	0.10	0.075	0.02
21	210	0.0209	0.0500	0.500	0.017	0.008	0.318	0.045	0.033	0.13	0.100	0.03
22	220	0.0167	0.0400	0.540	0.025	0.008	0.354	0.036	0.027	0.10	0.110	-0.01
23	230	0.0167	0.0400	0.580	0.034	0.009	0.391	0.037	0.028	0.11	0.107	0.00
24	240	0.0167	0.0400	0.620	0.045	0.011	0.428	0.037	0.029	0.11	0.108	0.00
25	250	0.0126	0.0300	0.650	0.054	0.009	0.456	0.028	0.022	0.08	0.101	-0.02
26	260	0.0084	0.0200	0.670	0.060	0.006	0.475	0.019	0.015	0.06	0.080	-0.02
27	270	0.0084	0.0200	0.690	0.067	0.007	0.494	0.019	0.015	0.06	0.065	-0.01
28	280	0.0084	0.0200	0.710	0.073	0.007	0.513	0.019	0.015	0.06	0.060	0.00
29	290	0.0167	0.0400	0.750	0.088	0.014	0.551	0.038	0.030	0.12	0.078	0.04
30	300	0.0126	0.0300	0.780	0.099	0.011	0.579	0.029	0.023	0.09	0.094	-0.01
31	310	0.0167	0.0400	0.820	0.115	0.016	0.617	0.038	0.031	0.12	0.100	0.02
32	320	0.0167	0.0400	0.860	0.132	0.017	0.656	0.038	0.032	0.12	0.113	0.01
33	330	0.0167	0.0400	0.900	0.150	0.018	0.694	0.038	0.032	0.12	0.118	0.00
34	340	0.0126	0.0300	0.930	0.164	0.014	0.723	0.029	0.024	0.09	0.111	-0.02
35	350	0.0167	0.0400	0.970	0.183	0.019	0.762	0.039	0.032	0.12	0.109	0.01
36	360	0.0126	0.0300	1.000	0.198	0.015	0.791	0.029	0.025	0.09	0.109	-0.02
37	370	0.0084	0.0200	1.020	0.208	0.010	0.810	0.019	0.016	0.06	0.088	-0.03
38	380	0.0042	0.0100	1.030	0.213	0.005	0.820	0.010	0.008	0.03	0.061	-0.03
39	390	0.0042	0.0100	1.040	0.218	0.005	0.830	0.010	0.008	0.03	0.041	-0.01
40	400	0.0042	0.0100	1.050	0.223	0.005	0.839	0.010	0.008	0.03	0.035	0.00
41	410	0.0000	0.0000	1.050	0.223	0.000	0.839	0.000	0.000	0.00	0.022	-0.02
42	420	0.0000	0.0000	1.050	0.223	0.000	0.839	0.000	0.000	0.00	0.007	-0.01
43	430	0.0042	0.0100	1.060	0.228	0.005	0.849	0.010	0.008	0.03	0.013	0.02
44	440	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	0.015	-0.01
45	450	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	0.005	0.00
46	460	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	0.002	0.00
47	470	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	0.001	0.00
48	480	0.0084	0.0200	1.080	0.239	0.011	0.869	0.019	0.017	0.06	0.021	0.04
49	490	0.0084	0.0200	1.100	0.250	0.011	0.888	0.019	0.017	0.06	0.050	0.01
50	500	0.0084	0.0200	1.120	0.261	0.011	0.908	0.019	0.017	0.06	0.059	0.00
51	510	0.0084	0.0200	1.140	0.272	0.011	0.927	0.020	0.017	0.06	0.062	0.00
52	520	0.0126	0.0300	1.170	0.288	0.017	0.956	0.029	0.025	0.10	0.074	0.02
53	530	0.0126	0.0300	1.200	0.306	0.017	0.986	0.029	0.025	0.10	0.089	0.01
54	540	0.0126	0.0300	1.230	0.323	0.017	1.015	0.029	0.026	0.10	0.095	0.00
55	550	0.0126	0.0300	1.260	0.341	0.018	1.044	0.029	0.026	0.10	0.097	0.00
56	560	0.0167	0.0400	1.300	0.365	0.024	1.084	0.039	0.034	0.13	0.109	0.02
57	570	0.0000	0.0000	1.300	0.365	0.000	1.084	0.000	0.000	0.00	0.080	-0.08
58	580	0.0084	0.0200	1.320	0.377	0.012	1.103	0.020	0.017	0.07	0.049	0.02













**King County CSO**  
**Barton Basin Subbasin 416 - GSI Option**  
 SvR Project No. 06053  
 DATE: 05/11/2010

RAIN GARDEN SYSTEM COMPONENTS			
	Infiltration Rate into Native Subgrade (in/hr)		<b>0.50</b>
<b>SECTION 01 RG</b>	1.5	25.00	2.00% (biosoil depth/lf/slope)
	Number of Section 1 Rain Gardens for Basin (ea)		<b>0</b>
	Total Infiltration Area for Section 1 Rain Gardens (sf)*		0
	Storage Capacity for a single Section 1 Rain Garden (cf)		88
	Total Storage Capacity for Section 1 Rain Gardens (cf)		0
<b>SECTION 02 RG</b>	1.5	42	2.00% (biosoil depth/lf/slope)
	Number of Section 2 Rain Gardens for Basin (ea)		<b>0</b>
	Total Infiltration Area for Section 2 Rain Gardens (sf)*		0
	Storage Capacity for a single Section 2 Rain Garden (cf)		232
	Total Storage Capacity for Section 2 Rain Gardens (cf)		0
<b>SECTION 03 RG</b>	1.5	28	3.00% (biosoil depth/lf/slope)
	Number of Section 3 Rain Gardens for Basin (ea)		<b>13</b>
	Total Infiltration Area for Section 3 Rain Gardens (sf)*		3954
	Storage Capacity for a single Section 3 Rain Garden (cf)		301
	Total Storage Capacity for Section 3 Rain Gardens (cf)		3907

**CONVERSION FACTORS**

conversion factor from cfs to MGD:	0.6452
conversion factor from cfs to cf/per time step:	600

Routing Flow through Rain Garden to Estimate Flow Reduction by Half Block

**Results Summary**

Total Volume of Runoff Removed of entire storm event duration (cf)	4,155	(per GSI half block)
Total Volume of Runoff Removed of entire storm event duration (gal)	31080.17	(per GSI half block)
Total volume of runoff removed from 8:50 to 9:50 of the 1984 storm	4927.257668	(gal per GSI half block)
	319791.1828	(gal)

**Rainfall Distribution: 1984 Storm**

**RAIN GARDEN SYSTEM SUMMARY**

Total Infiltration Flow (cfs)	0.0458
Total Swale Storage Capacity (cf)	3907.2

Flow reduction from subbasin 416 (MGD)	<b>14.6</b>	per John Phillips
Flow reduction from assumed half block at peak flow(MGD)	0.224952925	

**Number of half blocks needed to get total flow reduction out of subbasin 416**

**65**

Time (hours)	Time (minutes)	Design Flow Rate from Rain Event (cfs)	Inflow Water Volume (cf)	Inflow Cumm. Volume (cf)	Initial Exfiltration to Native Subgrade of Inflow (cfs)	Infiltration into Native Subgrade of Stored Water (cfs)	Total Infiltration into Native Subgrade (cfs)	Inflow to Swale After Infiltration into Native Subgrade (cfs)	Swale Storage before Overflow Volume (cf)	Overtop Flow to Pump Station (cfs)	Runoff Stored in Swale Storage Volume (cf)	Volume of Runoff Removed From Pump Station (cf)	Date & Time	Amount Flow Reduced to Pump Station (cfs)	Amount Flow Reduced to Pump Station (MGD)
0	0	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0			
0.17	10	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:00	0.000	
0.33	20	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:10	0.000	
0.50	30	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:20	0.000	
0.67	40	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:30	0.000	
0.83	50	0.003	1.90	1.90	0.0032	0.0000	0.0032	0.0000	0.00	0.00	0.00	1.900626807	11/1/1984 10:40	0.003	
1.00	60	0.009	5.61	7.51	0.0093	0.0000	0.0093	0.0000	0.00	0.00	0.00	5.605567335	11/1/1984 10:50	0.009	
1.17	70	0.015	9.09	16.59	0.0151	0.0000	0.0151	0.0000	0.00	0.00	0.00	9.085690673	11/1/1984 11:00	0.015	
1.33	80	0.020	12.17	28.77	0.0203	0.0000	0.0203	0.0000	0.00	0.00	0.00	12.17466638	11/1/1984 11:10	0.020	
1.50	90	0.030	17.81	46.58	0.0297	0.0000	0.0297	0.0000	0.00	0.00	0.00	17.8143958	11/1/1984 11:20	0.030	
1.67	100	0.035	21.20	67.78	0.0353	0.0000	0.0353	0.0000	0.00	0.00	0.00	21.19743158	11/1/1984 11:30	0.035	
1.83	110	0.034	20.50	88.28	0.0342	0.0000	0.0342	0.0000	0.00	0.00	0.00	20.50300898	11/1/1984 11:40	0.034	
2.00	120	0.035	21.06	109.35	0.0351	0.0000	0.0351	0.0000	0.00	0.00	0.00	21.06473615	11/1/1984 11:50	0.035	
2.17	130	0.030	18.09	127.43	0.0301	0.0000	0.0301	0.0000	0.00	0.00	0.00	18.08536098	11/1/1984 12:00	0.030	
2.33	140	0.029	17.54	144.97	0.0292	0.0000	0.0292	0.0000	0.00	0.00	0.00	17.53865912	11/1/1984 12:10	0.029	
2.50	150	0.043	25.66	170.63	0.0428	0.0000	0.0428	0.0000	0.00	0.00	0.00	25.6553555	11/1/1984 12:20	0.043	
2.67	160	0.055	33.13	203.76	0.0458	0.0000	0.0458	0.0095	5.68	0.00	5.68	33.13403255	11/1/1984 12:30	0.055	
2.83	170	0.061	36.48	240.24	0.0458	0.0000	0.0458	0.0150	14.69	0.00	14.69	36.47754794	11/1/1984 12:40	0.061	
3.00	180	0.080	47.78	288.01	0.0458	0.0000	0.0458	0.0339	35.01	0.00	35.01	47.77688775	11/1/1984 12:50	0.080	
3.17	190	0.080	48.09	336.10	0.0458	0.0000	0.0458	0.0344	55.64	0.00	55.64	48.08714279	11/1/1984 13:00	0.080	
3.33	200	0.075	44.98	381.08	0.0458	0.0000	0.0458	0.0292	73.17	0.00	73.17	44.98314287	11/1/1984 13:10	0.075	
3.50	210	0.100	59.81	440.89	0.0458	0.0000	0.0458	0.0539	105.52	0.00	105.52	59.81060881	11/1/1984 13:20	0.100	
3.67	220	0.110	66.19	507.08	0.0458	0.0000	0.0458	0.0646	144.25	0.00	144.25	66.18986175	11/1/1984 13:30	0.110	
3.83	230	0.107	64.45	571.54	0.0458	0.0000	0.0458	0.0617	181.24	0.00	181.24	64.45468198	11/1/1984 13:40	0.107	
4.00	240	0.108	64.89	636.43	0.0458	0.0000	0.0458	0.0624	218.67	0.00	218.67	64.88628415	11/1/1984 13:50	0.108	
4.17	250	0.101	60.31	696.74	0.0458	0.0000	0.0458	0.0548	251.53	0.00	251.53	60.31248582	11/1/1984 14:00	0.101	
4.33	260	0.080	48.14	744.88	0.0458	0.0000	0.0458	0.0345	272.20	0.00	272.20	48.13781342	11/1/1984 14:10	0.080	
4.50	270	0.065	38.72	783.60	0.0458	0.0000	0.0458	0.0188	283.47	0.00	283.47	38.72385189	11/1/1984 14:20	0.065	
4.67	280	0.060	35.78	819.38	0.0458	0.0000	0.0458	0.0139	291.79	0.00	291.79	35.77643213	11/1/1984 14:30	0.060	
4.83	290	0.078	46.63	866.01	0.0458	0.0000	0.0458	0.0320	310.96	0.00	310.96	46.63284372	11/1/1984 14:40	0.078	
5.00	300	0.094	56.41	922.42	0.0458	0.0000	0.0458	0.0483	339.91	0.00	339.91	56.40882598	11/1/1984 14:50	0.094	
5.17	310	0.100	60.23	982.65	0.0458	0.0000	0.0458	0.0546	372.68	0.00	372.68	60.22934692	11/1/1984 15:00	0.100	
5.33	320	0.113	67.94	1050.59	0.0458	0.0000	0.0458	0.0675	413.17	0.00	413.17	67.94245789	11/1/1984 15:10	0.113	
5.50	330	0.118	71.07	1121.66	0.0458	0.0000	0.0458	0.0727	456.78	0.00	456.78	71.07203902	11/1/1984 15:20	0.118	
5.67	340	0.111	66.46	1188.13	0.0458	0.0000	0.0458	0.0650	495.78	0.00	495.78	66.46357161	11/1/1984 15:30	0.111	
5.83	350	0.109	65.36	1253.48	0.0458	0.0000	0.0458	0.0632	533.68	0.00	533.68	65.35638515	11/1/1984 15:40	0.109	
6.00	360	0.109	65.29	1318.77	0.0458	0.0000	0.0458	0.0631	571.51	0.00	571.51	65.2909189	11/1/1984 15:50	0.109	
6.17	370	0.088	53.05	1371.82	0.0458	0.0000	0.0458	0.0426	597.10	0.00	597.10	53.04664664	11/1/1984 16:00	0.088	
6.33	380	0.061	36.53	1408.35	0.0458	0.0000	0.0458	0.0151	606.18	0.00	606.18	36.53184299	11/1/1984 16:10	0.061	
6.50	390	0.041	24.78	1433.13	0.0413	0.0045	0.0458	0.0000	603.50	0.00	603.50	24.7824167	11/1/1984 16:20	0.041	
6.67	400	0.035	20.89	1454.02	0.0348	0.0109	0.0458	0.0000	596.93	0.00	596.93	20.89120721	11/1/1984 16:30	0.035	
6.83	410	0.022	13.29	1467.31	0.0221	0.0236	0.0458	0.0000	582.76	0.00	582.76	13.28520482	11/1/1984 16:40	0.022	
7.00	420	0.007	4.43	1471.74	0.0074	0.0384	0.0458	0.0000	559.73	0.00	559.73	4.428401606	11/1/1984 16:50	0.007	
7.17	430	0.013	7.81	1479.55	0.0130	0.0327	0.0458	0.0000	540.08	0.00	540.08	7.809950826	11/1/1984 17:00	0.013	



7.33	440	0.015	8.94	1488.49	0.0149	0.0309	0.0458	0.0000	521.56	0.00	521.56	8.9371339	11/1/1984 17:10	0.015
7.50	450	0.005	2.98	1491.46	0.0050	0.0408	0.0458	0.0000	497.08	0.00	497.08	2.979044633	11/1/1984 17:20	0.005
7.67	460	0.002	0.99	1492.46	0.0017	0.0441	0.0458	0.0000	470.61	0.00	470.61	0.993014878	11/1/1984 17:30	0.002
7.83	470	0.001	0.33	1492.79	0.0006	0.0452	0.0458	0.0000	443.48	0.00	443.48	0.331004959	11/1/1984 17:40	0.001
8.00	480	0.021	12.81	1505.60	0.0214	0.0244	0.0458	0.0000	428.84	0.00	428.84	12.81427851	11/1/1984 17:50	0.021
8.17	490	0.050	29.73	1535.33	0.0458	0.0000	0.0458	0.0038	431.11	0.00	431.11	29.72654198	11/1/1984 18:00	0.050
8.33	500	0.059	35.46	1570.79	0.0458	0.0000	0.0458	0.0133	439.11	0.00	439.11	35.45705237	11/1/1984 18:10	0.059
8.50	510	0.062	37.46	1608.24	0.0458	0.0000	0.0458	0.0167	449.10	0.00	449.10	37.45763197	11/1/1984 18:20	0.062
8.67	520	0.074	44.67	1652.91	0.0458	0.0000	0.0458	0.0287	466.32	0.00	466.32	44.67062384	11/1/1984 18:30	0.074
8.83	530	0.089	53.67	1706.58	0.0458	0.0000	0.0458	0.0437	492.53	0.00	492.53	53.66992088	11/1/1984 18:40	0.089
9.00	540	0.095	56.85	1763.44	0.0458	0.0000	0.0458	0.0490	521.92	0.00	521.92	56.85265588	11/1/1984 18:50	0.095
9.17	550	0.097	58.09	1821.53	0.0458	0.0000	0.0458	0.0511	552.55	0.00	552.55	58.08915945	11/1/1984 19:00	0.097
9.33	560	0.109	65.25	1886.78	0.0458	0.0000	0.0458	0.0630	590.35	0.00	590.35	65.25268773	11/1/1984 19:10	0.109
9.50	570	0.080	48.03	1934.81	0.0458	0.0000	0.0458	0.0343	610.92	0.00	610.92	48.0283904	11/1/1984 19:20	0.080
9.67	580	0.049	29.20	1964.01	0.0458	0.0000	0.0458	0.0029	612.66	0.00	612.66	29.20093819	11/1/1984 19:30	0.049
9.83	590	0.049	29.53	1993.54	0.0458	0.0000	0.0458	0.0035	614.73	0.00	614.73	29.53364677	11/1/1984 19:40	0.049
10.00	600	0.038	23.07	2016.61	0.0384	0.0073	0.0458	0.0000	610.34	0.00	610.34	23.06998223	11/1/1984 19:50	0.038
10.17	610	0.024	14.31	2030.92	0.0238	0.0219	0.0458	0.0000	597.19	0.00	597.19	14.3069014	11/1/1984 20:00	0.024
10.33	620	0.019	11.39	2042.31	0.0190	0.0268	0.0458	0.0000	581.13	0.00	581.13	11.3941499	11/1/1984 20:10	0.019
10.50	630	0.051	30.35	2072.66	0.0458	0.0000	0.0458	0.0048	584.02	0.00	584.02	30.34740281	11/1/1984 20:20	0.051
10.67	640	0.072	43.36	2116.02	0.0458	0.0000	0.0458	0.0265	599.92	0.00	599.92	43.36226966	11/1/1984 20:30	0.072
10.83	650	0.057	34.45	2150.47	0.0458	0.0000	0.0458	0.0117	606.91	0.00	606.91	34.44910265	11/1/1984 20:40	0.057
11.00	660	0.030	18.16	2168.63	0.0303	0.0155	0.0458	0.0000	597.61	0.00	597.61	18.15574833	11/1/1984 20:50	0.030
11.17	670	0.021	12.73	2181.36	0.0212	0.0245	0.0458	0.0000	582.88	0.00	582.88	12.73221472	11/1/1984 21:00	0.021
11.33	680	0.018	10.92	2192.28	0.0182	0.0276	0.0458	0.0000	566.35	0.00	566.35	10.92437018	11/1/1984 21:10	0.018
11.50	690	0.006	3.64	2195.93	0.0061	0.0397	0.0458	0.0000	542.53	0.00	542.53	3.641456727	11/1/1984 21:20	0.006
11.67	700	0.013	7.90	2203.83	0.0132	0.0326	0.0458	0.0000	522.97	0.00	522.97	7.90161	11/1/1984 21:30	0.013
11.83	710	0.027	16.02	2219.84	0.0267	0.0191	0.0458	0.0000	511.53	0.00	511.53	16.01685421	11/1/1984 21:40	0.027
12.00	720	0.020	12.03	2231.88	0.0201	0.0257	0.0458	0.0000	496.11	0.00	496.11	12.03414452	11/1/1984 21:50	0.020
12.17	730	0.018	10.71	2242.59	0.0179	0.0279	0.0458	0.0000	479.36	0.00	479.36	10.71388771	11/1/1984 22:00	0.018
12.33	740	0.017	10.27	2252.87	0.0171	0.0286	0.0458	0.0000	462.18	0.00	462.18	10.27380211	11/1/1984 22:10	0.017
12.50	750	0.006	3.42	2256.29	0.0057	0.0401	0.0458	0.0000	438.14	0.00	438.14	3.424600704	11/1/1984 22:20	0.006
12.67	760	0.002	1.14	2257.43	0.0019	0.0439	0.0458	0.0000	411.82	0.00	411.82	1.141533568	11/1/1984 22:30	0.002
12.83	770	0.001	0.38	2257.81	0.0006	0.0451	0.0458	0.0000	384.75	0.00	384.75	0.380511189	11/1/1984 22:40	0.001
13.00	780	0.000	0.13	2257.94	0.0002	0.0456	0.0458	0.0000	357.41	0.00	357.41	0.126837063	11/1/1984 22:50	0.000
13.17	790	0.000	0.04	2257.98	0.0001	0.0457	0.0458	0.0000	330.00	0.00	330.00	0.042279021	11/1/1984 23:00	0.000
13.33	800	0.011	6.72	2264.71	0.0112	0.0346	0.0458	0.0000	309.26	0.00	309.26	6.723824864	11/1/1984 23:10	0.011
13.50	810	0.026	15.67	2280.37	0.0261	0.0197	0.0458	0.0000	297.47	0.00	297.47	15.66787833	11/1/1984 23:20	0.026
13.67	820	0.031	18.66	2299.04	0.0311	0.0147	0.0458	0.0000	288.68	0.00	288.68	18.66342426	11/1/1984 23:30	0.031
13.83	830	0.022	12.95	2311.98	0.0216	0.0242	0.0458	0.0000	274.16	0.00	274.16	12.94506805	11/1/1984 23:40	0.022
14.00	840	0.007	4.32	2316.30	0.0072	0.0386	0.0458	0.0000	251.02	0.00	251.02	4.315022683	11/1/1984 23:50	0.007
14.17	850	0.002	1.44	2317.74	0.0024	0.0434	0.0458	0.0000	225.00	0.00	225.00	1.438340894	11/2/1984 0:00	0.002
14.33	860	0.001	0.48	2318.21	0.0008	0.0450	0.0458	0.0000	198.02	0.00	198.02	0.479446965	11/2/1984 0:10	0.001
14.50	870	0.000	0.16	2318.37	0.0003	0.0455	0.0458	0.0000	170.72	0.00	170.72	0.159815655	11/2/1984 0:20	0.000
14.67	880	0.000	0.05	2318.43	0.0001	0.0457	0.0458	0.0000	143.32	0.00	143.32	0.053271885	11/2/1984 0:30	0.000
14.83	890	0.011	6.75	2325.18	0.0112	0.0345	0.0458	0.0000	122.61	0.00	122.61	6.748655864	11/2/1984 0:40	0.011
15.00	900	0.026	15.72	2340.89	0.0262	0.0196	0.0458	0.0000	110.87	0.00	110.87	15.71823923	11/2/1984 0:50	0.026
15.17	910	0.031	18.72	2359.62	0.0312	0.0146	0.0458	0.0000	102.13	0.00	102.13	18.72180016	11/2/1984 1:00	0.031
15.33	920	0.022	12.99	2372.60	0.0216	0.0241	0.0458	0.0000	87.65	0.00	87.65	12.98519843	11/2/1984 1:10	0.022
15.50	930	0.018	11.08	2383.68	0.0185	0.0273	0.0458	0.0000	71.28	0.00	71.28	11.07972836	11/2/1984 1:20	0.018
15.67	940	0.029	17.20	2400.88	0.0287	0.0171	0.0458	0.0000	61.02	0.00	61.02	17.20255319	11/2/1984 1:30	0.029
15.83	950	0.021	12.49	2413.38	0.0208	0.0249	0.0458	0.0000	46.05	0.00	46.05	12.49216591	11/2/1984 1:40	0.021
16.00	960	0.007	4.16	2417.54	0.0069	0.0388	0.0458	0.0000	22.76	0.00	22.76	4.164055302	11/2/1984 1:50	0.007
16.17	970	0.002	1.39	2418.93	0.0023	0.0435	0.0458	0.0000	-3.31	0.00	0.00	1.388018434	11/2/1984 2:00	0.002
16.33	980	0.001	0.46	2419.39	0.0008	0.0000	0.0008	0.0000	0.00	0.00	0.00	0.462672811	11/2/1984 2:10	0.001
16.50	990	0.000	0.15	2419.55	0.0003	0.0000	0.0003	0.0000	0.00	0.00	0.00	0.15422427	11/2/1984 2:20	0.000
16.67	1000	0.011	6.82	2426.36	0.0114	0.0000	0.0114	0.0000	0.00	0.00	0.00	6.81596559	11/2/1984 2:30	0.011
16.83	1010	0.015	9.04	2435.40	0.0151	0.0000	0.0151	0.0000	0.00	0.00	0.00	9.03654603	11/2/1984 2:40	0.015
17.00	1020	0.005	3.01	2438.41	0.0050	0.0000	0.0050	0.0000	0.00	0.00	0.00	3.01218201	11/2/1984 2:50	0.005
17.17	1030	0.036	21.34	2459.75	0.0356	0.0000	0.0356	0.0000	0.00	0.00	0.00	21.33644097	11/2/1984 3:00	0.036
17.33	1040	0.057	34.23	2493.98	0.0458	0.0000	0.0458	0.0113	6.78	0.00	6.78	34.2346465	11/2/1984 3:10	0.057
17.50	1050	0.064	38.61	2532.59	0.0458	0.0000	0.0458	0.0186	17.93	0.00	17.93	38.60901216	11/2/1984 3:20	0.064
17.67	1060	0.090	53.74	2586.33	0.0458	0.0000	0.0458	0.0438	44.21	0.00	44.21	53.73840931	11/2/1984 3:30	0.090
17.83	1070	0.087	52.04	2638.37	0.0458	0.0000	0.0458	0.0410	68.79	0.00	68.79	52.04427864	11/2/1984 3:40	0.087
18.00	1080	0.086	51.57	2689.94	0.0458	0.0000	0.0458	0.0402	92.90	0.00	92.90	51.56576199	11/2/1984 3:50	0.086
18.17	1090	0.086	51.46	2741.40	0.0458	0.0000	0.0458	0.0400	116.90	0.00	116.90	51.46217019	11/2/1984 4:00	0.086
18.33	1100	0.063	37.75	2779.15	0.0458	0.0000	0.0458	0.0172	127.19	0.00	127.19	37.75115306	11/2/1984 4:10	0.063
18.50	1110	0.032	19.45	2798.61	0.0324	0.0133	0.0458	0.0000	119.19	0.00	119.19	19.4548192	11/2/1984 4:20	0.032
18.67	1120	0.011	6.48	2805.09	0.0108	0.0350	0.0458	0.0000	98.22	0.00	98.22	6.484939734	11/2/1984 4:30	0.011
18.83	1130	0.015	9.04	2814.13	0.0151	0.0307	0.0458	0.0000	79.80	0.00	79.80	9.038074298	11/2/1984 4:40	0.015
19.00	1140	0.016	9.89	2824.02	0.0165	0.0293	0.0458	0.0000	62.23	0.00	62.23	9.889119152	11/2/1984	



19.83	1190	0.067	39.95	2995.34	0.0458	0.0000	0.0458	0.0208	96.26	0.00	96.26	39.95024716	11/2/1984 5:40	0.067	
20.00	1200	0.022	13.32	3008.66	0.0222	0.0236	0.0458	0.0000	82.12	0.00	82.12	13.31674905	11/2/1984 5:50	0.022	
20.17	1210	0.007	4.44	3013.10	0.0074	0.0384	0.0458	0.0000	59.10	0.00	59.10	4.438916352	11/2/1984 6:00	0.007	
20.33	1220	0.026	15.34	3028.44	0.0256	0.0202	0.0458	0.0000	46.98	0.00	46.98	15.33782866	11/2/1984 6:10	0.026	
20.50	1230	0.066	39.79	3068.23	0.0458	0.0000	0.0458	0.0206	59.31	0.00	59.31	39.79322295	11/2/1984 6:20	0.066	
20.67	1240	0.068	41.04	3109.27	0.0458	0.0000	0.0458	0.0226	72.89	0.00	72.89	41.03682138	11/2/1984 6:30	0.068	
20.83	1250	0.034	20.63	3129.90	0.0344	0.0114	0.0458	0.0000	66.06	0.00	66.06	20.62893067	11/2/1984 6:40	0.034	
21.00	1260	0.023	13.83	3143.73	0.0231	0.0227	0.0458	0.0000	52.43	0.00	52.43	13.83081518	11/2/1984 6:50	0.023	
21.17	1270	0.031	18.52	3162.25	0.0309	0.0149	0.0458	0.0000	43.50	0.00	43.50	18.52375145	11/2/1984 7:00	0.031	
21.33	1280	0.068	41.01	3203.26	0.0458	0.0000	0.0458	0.0226	57.05	0.00	57.05	41.01327857	11/2/1984 7:10	0.068	
21.50	1290	0.116	69.50	3272.76	0.0458	0.0000	0.0458	0.0701	99.09	0.00	99.09	69.49861027	11/2/1984 7:20	0.116	
21.67	1300	0.132	79.13	3351.89	0.0458	0.0000	0.0458	0.0861	150.76	0.00	150.76	79.12727626	11/2/1984 7:30	0.132	
21.83	1310	0.114	68.42	3420.31	0.0458	0.0000	0.0458	0.0683	191.72	0.00	191.72	68.41945057	11/2/1984 7:40	0.114	
22.00	1320	0.061	36.84	3457.15	0.0458	0.0000	0.0458	0.0156	201.10	0.00	201.10	36.83689993	11/2/1984 7:50	0.061	
22.17	1330	0.032	19.30	3476.45	0.0322	0.0136	0.0458	0.0000	192.94	0.00	192.94	19.29998862	11/2/1984 8:00	0.032	
22.33	1340	0.022	13.45	3489.90	0.0224	0.0233	0.0458	0.0000	178.93	0.00	178.93	13.45435151	11/2/1984 8:10	0.022	
22.50	1350	0.007	4.48	3494.39	0.0075	0.0383	0.0458	0.0000	155.96	0.00	155.96	4.484783837	11/2/1984 8:20	0.007	
22.67	1360	0.002	1.49	3495.88	0.0025	0.0433	0.0458	0.0000	130.00	0.00	130.00	1.494927946	11/2/1984 8:30	0.002	
22.83	1370	0.001	0.50	3496.38	0.0008	0.0449	0.0458	0.0000	103.04	0.00	103.04	0.498309315	11/2/1984 8:40	0.001	
23.00	1380	0.024	14.22	3510.60	0.0237	0.0221	0.0458	0.0000	89.80	0.00	89.80	14.21959294	11/2/1984 8:50	0.024	
23.17	1390	0.043	25.83	3536.42	0.0430	0.0027	0.0458	0.0000	88.16	0.00	88.16	25.82575075	11/2/1984 9:00	0.043	
23.33	1400	0.026	15.64	3552.06	0.0261	0.0197	0.0458	0.0000	76.35	0.00	76.35	15.64098018	11/2/1984 9:10	0.026	
23.50	1410	0.232	139.50	3691.56	0.0458	0.0000	0.0458	0.1867	188.39	0.00	188.39	139.4988459	11/2/1984 9:20	0.232	0.149998759
23.67	1420	0.349	209.21	3900.77	0.0458	0.0000	0.0458	0.3029	370.13	0.00	370.13	209.2062202	11/2/1984 9:30	0.349	0.224952925
23.83	1430	0.247	148.01	4048.78	0.0458	0.0000	0.0458	0.2009	490.68	0.00	490.68	148.0098299	11/2/1984 9:40	0.247	0.159150355
24.00	1440	0.177	106.32	4155.10	0.0458	0.0000	0.0458	0.1314	569.55	0.00	569.55	106.3230673	11/2/1984 9:50	0.177	
24.17	1450	0.000	0.00	4155.10	0.0000	0.0458	0.0458	0.0000	542.09	0.00	542.09	0	11/2/1984 10:00	0.000	
24.33	1460	0.000	0.00	4155.10	0.0000	0.0458	0.0458	0.0000	514.63	0.00	514.63	0	11/2/1984 10:10	0.000	
24.50	1470	0.000	0.00	4155.10	0.0000	0.0458	0.0458	0.0000	487.17	0.00	487.17	0	11/2/1984 10:20	0.000	
24.67	1480	0.000	0.00	4155.10	0.0000	0.0458	0.0458	0.0000	459.71	0.00	459.71	0	11/2/1984 10:30	0.000	
24.83	1490	0.000	0.00	4155.10	0.0000	0.0458	0.0458	0.0000	432.26	0.00	432.26	0	11/2/1984 10:40	0.000	
25.00	1500	0.000	0.00	4155.10	0.0000	0.0458	0.0458	0.0000	404.80	0.00	404.80	0	11/2/1984 10:50	0.000	
25.17	1510	0.000	0.00	4155.10	0.0000	0.0458	0.0458	0.0000	377.34	0.00	377.34	0	11/2/1984 11:00	0.000	
25.33	1520	0.000	0.00	4155.10	0.0000	0.0458	0.0458	0.0000	349.88	0.00	349.88	0	11/2/1984 11:10	0.000	
25.50	1530	0.000	0.00	4155.10	0.0000	0.0458	0.0458	0.0000	322.42	0.00	322.42	0	11/2/1984 11:20	0.000	
25.67	1540	0.000	0.00	4155.10	0.0000	0.0458	0.0458	0.0000	294.96	0.00	294.96	0	11/2/1984 11:30	0.000	
25.83	1550	0.000	0.00	4155.10	0.0000	0.0458	0.0458	0.0000	267.50	0.00	267.50	0	11/2/1984 11:40	0.000	
26.00	1560	0.000	0.00	4155.10	0.0000	0.0458	0.0458	0.0000	240.04	0.00	240.04	0	11/2/1984 11:50	0.000	
26.17	1570	0.000	0.00	4155.10	0.0000	0.0458	0.0458	0.0000	212.59	0.00	212.59	0	11/2/1984 12:00	0.000	
26.33	1580	0.000	0.00	4155.10	0.0000	0.0458	0.0458	0.0000	185.13	0.00	185.13	0	11/2/1984 12:10	0.000	
26.50	1590	0.000	0.00	4155.10	0.0000	0.0458	0.0458	0.0000	157.67	0.00	157.67	0	11/2/1984 12:20	0.000	
26.67	1600	0.000	0.00	4155.10	0.0000	0.0458	0.0458	0.0000	130.21	0.00	130.21	0	11/2/1984 12:30	0.000	
26.83	1610	0.000	0.00	4155.10	0.0000	0.0458	0.0458	0.0000	102.75	0.00	102.75	0	11/2/1984 12:40	0.000	
27.00	1620	0.000	0.00	4155.10	0.0000	0.0458	0.0458	0.0000	75.29	0.00	75.29	0	11/2/1984 12:50	0.000	
27.17	1630	0.000	0.00	4155.10	0.0000	0.0458	0.0458	0.0000	47.83	0.00	47.83	0	11/2/1984 13:00	0.000	
27.33	1640	0.000	0.00	4155.10	0.0000	0.0458	0.0458	0.0000	20.37	0.00	20.37	0	11/2/1984 13:10	0.000	
27.50	1650	0.000	0.00	4155.10	0.0000	0.0458	0.0458	0.0000	-7.08	0.00	0.00	0	11/2/1984 13:20	0.000	
27.67	1660	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 13:30	0.000	
27.83	1670	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 13:40	0.000	
28.00	1680	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 13:50	0.000	
28.17	1690	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 14:00	0.000	
28.33	1700	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 14:10	0.000	
28.50	1710	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 14:20	0.000	
28.67	1720	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 14:30	0.000	
28.83	1730	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 14:40	0.000	
29.00	1740	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 14:50	0.000	
29.17	1750	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 15:00	0.000	
29.33	1760	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 15:10	0.000	
29.50	1770	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 15:20	0.000	
29.67	1780	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 15:30	0.000	
29.83	1790	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 15:40	0.000	
30.00	1800	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 15:50	0.000	
30.17	1810	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 16:00	0.000	
30.33	1820	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 16:10	0.000	
30.50	1830	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 16:20	0.000	
30.67	1840	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 16:30	0.000	











Modeling Results for

Section 3a

With ROW and Private Parcel Tributary Area

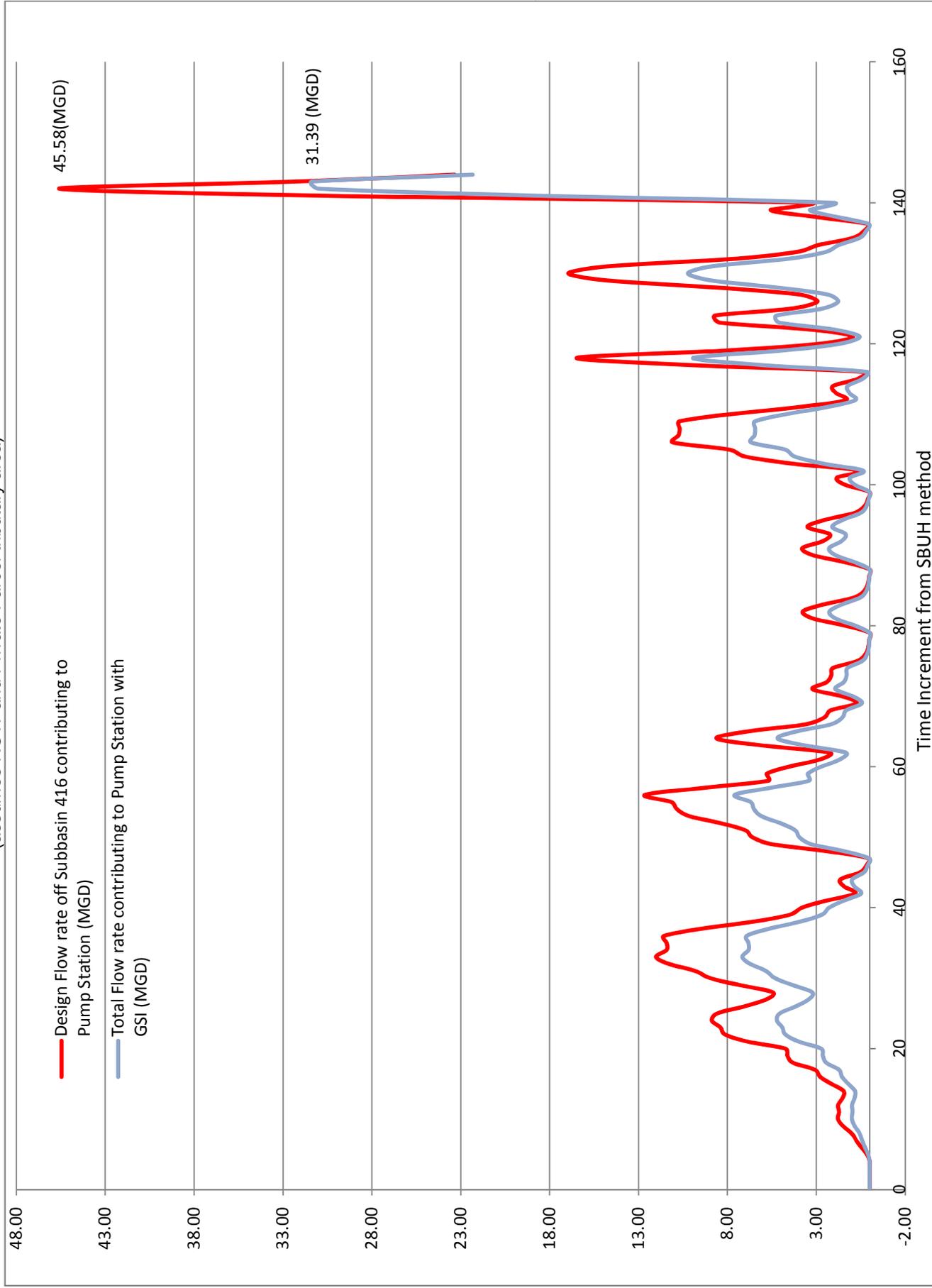


SvR Modeled Subbasin 416 Design Flow Rate to Pump Station

SECTION 3a

during 1984 Storm

(assumes ROW and Private Parcel tributary area)







**King County CSO**  
**Barton Basin Subbasin 416 GSI Analysis**  
 SvR Project No. 06053  
 Date: 05/11/2010

**Santa Barbara Urban Hydrograph Method (SBUH)**

red text is user entered  
 Rainfall data provided by King County  
 conversion from sf to acre 43560 sf/acre  
 assume that both sides of a street have the same planter width  
 alleys are assumed to be negligible  
 a time increment of 9999 indicates that the rain event (provided by King County) has finished  
 corners at roadway intersections are counted as impervious in the N/S ROW areas  
 assumes crowned roadway

**Typical One Block Characteristics**

Block (N/S) per GIS (lf)	601	
Block (E/W) per GIS (lf)	276	
Private Parcel Area (sf)	165,876	3.81 (ac)
Roof Area of Private Parcels per Block per GIS (sf)	41,451	0.95 (ac)
Non Roof Impervious Area of Private Parcels per Block per GIS (sf)	55,937	1.28 (ac)
Pervious Area of Private Parcels per Block including alleys (sf)	68,488	1.57 (ac)
ROW width (N/S) (lf)	60	
Planter Width (N/S) (lf)	10	
Width of Impervious in ROW (N/S) (lf)	40	
ROW width (E/W) (lf)	60	
Planter Width (E/W) (lf)	10	
Width of Impervious in ROW (E/W) (lf)	40	
ROW Impervious Area (N/S) (sf)	26440	0.61 (ac)
ROW Pervious Area (N/S) (sf)	12020	0.28 (ac)
ROW Impervious Area (E/W) (sf)	11040	0.25 (ac)
ROW Pervious Area (E/W) (sf)	5520	0.13 (ac)

	Percentage to RG	Effective Area to RG	CN	Impervious to RG (ac)	Pervious to RG (ac)	Percentage Impervious	Percentage Pervious
<b>PRIVATE PARCEL CHARACTERISTICS</b>							
Block Area to RG (ac)	50%						
Total Roof Area per One Block (ac)	100%						
Roof Area disconnected	60%	0.29	86	0.00	0.29	0.00%	11.26%
Total Non-Roof Impervious Area Per One Block (ac)							
Non-Roof Impervious Area to RG (ac)	50%	0.32	86	0.00	0.32	0.00%	12.66%
Total Pervious Area per One Block (ac)							
Pervious Area to RG (ac)	50%	0.39	86	0.00	0.39	0.00%	15.50%
<b>N/S ROADWAY CHARACTERISTICS</b>							
One N/S ROW to RG per One Block	50%						
Total ROW Impervious Area (N/S) fronting a Block (ac)							
ROW Impervious Area (N/S) to RG (ac)		0.30	98	0.30	0	11.97%	0.00%
Total ROW Pervious Area (N/S) fronting a Block (ac)							
ROW Pervious Area (N/S) to RG (ac)		0.14	86	0	0.14	0.00%	5.44%
<b>E/W ROADWAY CHARACTERISTICS</b>							
One E/W ROW to RG per One Block	50%						
Total ROW Impervious Area (E/W) fronting One Block(ac)							
ROW Impervious Area (E/W) to RG (ac)		0.13	98	0.13	0	5.00%	0.00%
Total ROW Pervious Area (E/W) fronting One Block(ac)							
ROW Pervious Area (E/W) to RG (ac)		0.06	86	0	0.06	0.00%	2.50%
				Impervious to RG (ac)	Pervious to RG (ac)	16.97%	47.36%

Total Areas (ac)	0.43	1.20	Total Area contributing flow to rain garden (ac)	1.63	Total Foot Print Area of Half Block (ac)	2.54
CN	98	86				

**Rainfall Distribution: 1984 Storm** this field needs to be year of storm followed a space then "Storm". Example "1984 Storm"

Max Time Increment 144  
 Pt = 2.39 inches Tc = 10 minutes w = 0.33  
 Sp = 1.63 dt = 10 minutes  
 Si = 0.20

Time Increment	Time	Rainfall Distribution	Incremental Rainfall	Accumulated Rainfall	Pervious Accumulated Runoff	Pervious Area Increment Runoff	Impervious Accumulated Runoff	Impervious Area Incr. Runoff	Total Runoff	Peak Instant Flow rate	Design Flow rate	Difference Between Instant and Design Flow
	(minutes)	(fraction)	(inches)	(inches)	(inches)	(inches)	(inches)	(inches)	(inches)	(cfs)	(cfs)	
0	0	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
1	10	0.0042	0.0100	0.010	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
2	20	0.0042	0.0100	0.020	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
3	30	0.0042	0.0100	0.030	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
4	40	0.0042	0.0100	0.040	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
5	50	0.0126	0.0300	0.070	0.000	0.000	0.004	0.004	0.001	0.01	0.003	0.01
6	60	0.0084	0.0200	0.090	0.000	0.000	0.010	0.006	0.002	0.02	0.009	0.01
7	70	0.0084	0.0200	0.110	0.000	0.000	0.018	0.008	0.002	0.02	0.015	0.01
8	80	0.0084	0.0200	0.130	0.000	0.000	0.027	0.010	0.003	0.03	0.020	0.00
9	90	0.0126	0.0300	0.160	0.000	0.000	0.044	0.017	0.004	0.04	0.030	0.01
10	100	0.0084	0.0200	0.180	0.000	0.000	0.056	0.012	0.003	0.03	0.035	0.00
11	110	0.0084	0.0200	0.200	0.000	0.000	0.070	0.013	0.004	0.03	0.034	0.00
12	120	0.0084	0.0200	0.220	0.000	0.000	0.084	0.014	0.004	0.04	0.035	0.00
13	130	0.0042	0.0100	0.230	0.000	0.000	0.091	0.007	0.002	0.02	0.030	-0.01
14	140	0.0084	0.0200	0.250	0.000	0.000	0.106	0.015	0.004	0.04	0.029	0.01
15	150	0.0126	0.0300	0.280	0.000	0.000	0.129	0.023	0.006	0.06	0.043	0.02
16	160	0.0126	0.0300	0.310	0.000	0.000	0.153	0.024	0.006	0.06	0.055	0.01
17	170	0.0126	0.0300	0.340	0.000	0.000	0.178	0.025	0.007	0.07	0.061	0.00
18	180	0.0209	0.0500	0.390	0.002	0.002	0.220	0.043	0.013	0.13	0.085	0.04
19	190	0.0084	0.0200	0.410	0.004	0.002	0.238	0.017	0.006	0.06	0.090	-0.03
20	200	0.0167	0.0400	0.450	0.009	0.005	0.273	0.035	0.013	0.13	0.091	0.03
21	210	0.0209	0.0500	0.500	0.017	0.008	0.318	0.045	0.018	0.18	0.131	0.04
22	220	0.0167	0.0400	0.540	0.025	0.008	0.354	0.036	0.016	0.15	0.153	0.00
23	230	0.0167	0.0400	0.580	0.034	0.009	0.391	0.037	0.017	0.16	0.157	0.01
24	240	0.0167	0.0400	0.620	0.045	0.011	0.428	0.037	0.018	0.17	0.165	0.01
25	250	0.0126	0.0300	0.650	0.054	0.009	0.456	0.028	0.014	0.14	0.159	-0.02
26	260	0.0084	0.0200	0.670	0.060	0.006	0.475	0.019	0.010	0.09	0.130	-0.04
27	270	0.0084	0.0200	0.690	0.067	0.007	0.494	0.019	0.010	0.10	0.107	-0.01
28	280	0.0084	0.0200	0.710	0.073	0.007	0.513	0.019	0.010	0.10	0.101	0.00
29	290	0.0167	0.0400	0.750	0.088	0.014	0.551	0.038	0.021	0.20	0.134	0.07
30	300	0.0126	0.0300	0.780	0.099	0.011	0.579	0.029	0.016	0.16	0.165	-0.01
31	310	0.0167	0.0400	0.820	0.115	0.016	0.617	0.038	0.022	0.22	0.179	0.04
32	320	0.0167	0.0400	0.860	0.132	0.017	0.656	0.038	0.023	0.22	0.206	0.02
33	330	0.0167	0.0400	0.900	0.150	0.018	0.694	0.038	0.023	0.23	0.219	0.01
34	340	0.0126	0.0300	0.930	0.164	0.014	0.723	0.029	0.018	0.18	0.208	-0.03
35	350	0.0167	0.0400	0.970	0.183	0.019	0.762	0.039	0.024	0.24	0.208	0.03
36	360	0.0126	0.0300	1.000	0.198	0.015	0.791	0.029	0.019	0.18	0.210	-0.03
37	370	0.0084	0.0200	1.020	0.208	0.010	0.810	0.019	0.013	0.12	0.172	-0.05
38	380	0.0042	0.0100	1.030	0.213	0.005	0.820	0.010	0.006	0.06	0.119	-0.06
39	390	0.0042	0.0100	1.040	0.218	0.005	0.830	0.010	0.006	0.06	0.082	-0.02
40	400	0.0042	0.0100	1.050	0.223	0.005	0.839	0.010	0.006	0.06	0.069	-0.01
41	410	0.0000	0.0000	1.050	0.223	0.000	0.839	0.000	0.000	0.00	0.044	-0.04
42	420	0.0000	0.0000	1.050	0.223	0.000	0.839	0.000	0.000	0.00	0.015	-0.01
43	430	0.0042	0.0100	1.060	0.228	0.005	0.849	0.010	0.006	0.06	0.026	0.04
44	440	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	0.030	-0.03
45	450	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	0.010	-0.01
46	460	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	0.003	0.00
47	470	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	0.001	0.00
48	480	0.0084	0.0200	1.080	0.239	0.011	0.869	0.019	0.013	0.13	0.043	0.08
49	490	0.0084	0.0200	1.100	0.250	0.011	0.888	0.019	0.013	0.13	0.100	0.03
50	500	0.0084	0.0200	1.120	0.261	0.011	0.908	0.019	0.013	0.13	0.119	0.01
51	510	0.0084	0.0200	1.140	0.272	0.011	0.927	0.020	0.013	0.13	0.127	0.00
52	520	0.0126	0.0300	1.170	0.288	0.017	0.956	0.029	0.020	0.20	0.152	0.05
53	530	0.0126	0.0300	1.200	0.306	0.017	0.986	0.029	0.020	0.20	0.184	0.02
54	540	0.0126	0.0300	1.230	0.323	0.017	1.015	0.029	0.021	0.20	0.196	0.01
55	550	0.0126	0.0300	1.260	0.341	0.018	1.044	0.029	0.021	0.21	0.202	0.00
56	560	0.0167	0.0400	1.300	0.365	0.024	1.084	0.039	0.028	0.28	0.228	0.05
57	570	0.0000	0.0000	1.300	0.365	0.000	1.084	0.000	0.000	0.00	0.168	-0.17













**King County CSO**  
**Barton Basin Subbasin 416 - GSI Option**  
 SvR Project No. 06053  
 DATE: 05/11/2010

RAIN GARDEN SYSTEM COMPONENTS			
	Infiltration Rate into Native Subgrade (in/hr)		<b>0.50</b>
<b>SECTION 01 RG</b>	1.5	16.67	3.00% (biosoil depth/lf/slope)
	Number of Section 1 Rain Gardens for Basin (ea)		<b>0</b>
	Total Infiltration Area for Section 1 Rain Gardens (sf)*		0
	Storage Capacity for a single Section 1 Rain Garden (cf)		59
	Total Storage Capacity for Section 1 Rain Gardens (cf)		0
<b>SECTION 02 RG</b>	1.5	42	2.00% (biosoil depth/lf/slope)
	Number of Section 2 Rain Gardens for Basin (ea)		<b>0</b>
	Total Infiltration Area for Section 2 Rain Gardens (sf)*		0
	Storage Capacity for a single Section 2 Rain Garden (cf)		232
	Total Storage Capacity for Section 2 Rain Gardens (cf)		0
<b>SECTION 03 RG</b>	1.5	28	3.00% (biosoil depth/lf/slope)
	Number of Section 3 Rain Gardens for Basin (ea)		<b>13</b>
	Total Infiltration Area for Section 3 Rain Gardens (sf)*		3954
	Storage Capacity for a single Section 3 Rain Garden (cf)		301
	Total Storage Capacity for Section 3 Rain Gardens (cf)		3907

**CONVERSION FACTORS**

conversion factor from cfs to MGD: 0.6452  
 conversion factor from cfs to cf/per time step: 600

**Routing Flow through Rain Garden to Estimate Flow Reduction by Half Block**

**Results Summary**

Total Volume of Runoff Removed of entire storm event duration (cf) 7,620 (per GSI half block)  
 Total Volume of Runoff Removed of entire storm event duration (gal) 56997.23 (per GSI half block)  
 Total volume of runoff removed from 8:50 to 9:50 of the 1984 storm 6771.928987 (gal per GSI half block)  
 232468.435 (gal)

Rainfall Distribution: 1984 Storm

**RAIN GARDEN SYSTEM SUMMARY**

Total Infiltration Flow (cfs) 0.0458  
 Total Swale Storage Capacity (cf) 3907.2

Flow reduction from subbasin 416 (MGD) **14.6** per John Phillips  
 Flow reduction from assumed half block at peak flow(MGD) 0.425305755

**Number of half blocks needed to get total flow reduction out of subbasin 416 34**

Time (hours)	Time (minutes)	Design Flow Rate from Rain Event (cfs)	Inflow Water Volume (cf)	Inflow Cumm. Volume (cf)	Check if inflow infiltrates	Check if storage infiltrates	Initial Exfiltration to Native Subgrade of Inflow (cfs)	Infiltration into Native Subgrade of Stored Water (cfs)	Total Infiltration into Native Subgrade (cfs)	Inflow to Swale After Infiltration into Native Subgrade (cfs)	Swale Storage before Overflow Volume (cf)	Overtop Flow to Pump Station (cfs)	Runoff Stored in Swale Storage Volume (cf)	Volume of Runoff Removed From Pump Station (cf)	Date & Time	Amount Flow Reduced to Pump Station (cfs)	Amount Flow Reduced to Pump Station (MGD)
0	0	0.000	0.00	0.00			0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0			
0.17	10	0.000	0.00	0.00			0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:00	0.000	
0.33	20	0.000	0.00	0.00			0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:10	0.000	
0.50	30	0.000	0.00	0.00			0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:20	0.000	
0.67	40	0.000	0.00	0.00			0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:30	0.000	
0.83	50	0.003	1.90	1.90			0.0032	0.0000	0.0032	0.0000	0.00	0.00	0.00	1.900626807	11/1/1984 10:40	0.003	
1.00	60	0.009	5.61	7.51			0.0093	0.0000	0.0093	0.0000	0.00	0.00	0.00	5.605567335	11/1/1984 10:50	0.009	
1.17	70	0.015	9.09	16.59			0.0151	0.0000	0.0151	0.0000	0.00	0.00	0.00	9.085690673	11/1/1984 11:00	0.015	
1.33	80	0.020	12.17	28.77			0.0203	0.0000	0.0203	0.0000	0.00	0.00	0.00	12.17466638	11/1/1984 11:10	0.020	
1.50	90	0.030	17.81	46.58			0.0297	0.0000	0.0297	0.0000	0.00	0.00	0.00	17.8143958	11/1/1984 11:20	0.030	
1.67	100	0.035	21.20	67.78			0.0353	0.0000	0.0353	0.0000	0.00	0.00	0.00	21.19743158	11/1/1984 11:30	0.035	
1.83	110	0.034	20.50	88.28			0.0342	0.0000	0.0342	0.0000	0.00	0.00	0.00	20.50300898	11/1/1984 11:40	0.034	
2.00	120	0.035	21.06	109.35			0.0351	0.0000	0.0351	0.0000	0.00	0.00	0.00	21.06473615	11/1/1984 11:50	0.035	
2.17	130	0.030	18.09	127.43			0.0301	0.0000	0.0301	0.0000	0.00	0.00	0.00	18.08536098	11/1/1984 12:00	0.030	
2.33	140	0.029	17.54	144.97			0.0292	0.0000	0.0292	0.0000	0.00	0.00	0.00	17.53865912	11/1/1984 12:10	0.029	
2.50	150	0.043	25.66	170.63			0.0428	0.0000	0.0428	0.0000	0.00	0.00	0.00	25.6553555	11/1/1984 12:20	0.043	
2.67	160	0.055	33.13	203.76			0.0458	0.0000	0.0458	0.0095	5.68	0.00	5.68	33.13403255	11/1/1984 12:30	0.055	
2.83	170	0.061	36.63	240.39			0.0458	0.0000	0.0458	0.0153	14.85	0.00	14.85	36.63065266	11/1/1984 12:40	0.061	
3.00	180	0.085	50.79	291.18			0.0458	0.0000	0.0458	0.0389	38.18	0.00	38.18	50.79371058	11/1/1984 12:50	0.085	
3.17	190	0.090	53.97	345.16			0.0458	0.0000	0.0458	0.0442	64.70	0.00	64.70	53.97339262	11/1/1984 13:00	0.090	
3.33	200	0.091	54.66	399.82			0.0458	0.0000	0.0458	0.0453	91.90	0.00	91.90	54.66401283	11/1/1984 13:10	0.091	
3.50	210	0.131	78.42	478.24			0.0458	0.0000	0.0458	0.0849	142.86	0.00	142.86	78.41902389	11/1/1984 13:20	0.131	
3.67	220	0.153	91.89	570.13			0.0458	0.0000	0.0458	0.1074	207.29	0.00	207.29	91.89092043	11/1/1984 13:30	0.153	
3.83	230	0.157	94.20	664.33			0.0458	0.0000	0.0458	0.1112	274.03	0.00	274.03	94.19797599	11/1/1984 13:40	0.157	
4.00	240	0.165	99.16	763.49			0.0458	0.0000	0.0458	0.1195	345.73	0.00	345.73	99.15660697	11/1/1984 13:50	0.165	
4.17	250	0.159	95.35	858.83			0.0458	0.0000	0.0458	0.1131	413.62	0.00	413.62	95.34640582	11/1/1984 14:00	0.159	
4.33	260	0.130	78.02	936.85			0.0458	0.0000	0.0458	0.0843	464.18	0.00	464.18	78.02086674	11/1/1984 14:10	0.130	
4.50	270	0.107	64.10	1000.96			0.0458	0.0000	0.0458	0.0611	500.83	0.00	500.83	64.10279216	11/1/1984 14:20	0.107	
4.67	280	0.101	60.31	1061.27			0.0458	0.0000	0.0458	0.0548	533.68	0.00	533.68	60.31251706	11/1/1984 14:30	0.101	
4.83	290	0.134	80.35	1141.62			0.0458	0.0000	0.0458	0.0881	586.57	0.00	586.57	80.34751225	11/1/1984 14:40	0.134	
5.00	300	0.165	98.77	1240.38			0.0458	0.0000	0.0458	0.1188	657.88	0.00	657.88	98.76706303	11/1/1984 14:50	0.165	
5.17	310	0.179	107.50	1347.88			0.0458	0.0000	0.0458	0.1334	737.92	0.00	737.92	107.5018434	11/1/1984 15:00	0.179	
5.33	320	0.206	123.51	1471.40			0.0458	0.0000	0.0458	0.1601	833.97	0.00	833.97	123.5106495	11/1/1984 15:10	0.206	
5.50	330	0.219	131.49	1602.89			0.0458	0.0000	0.0458	0.1734	938.01	0.00	938.01	131.4936174	11/1/1984 15:20	0.219	
5.67	340	0.208	124.79	1727.68			0.0458	0.0000	0.0458	0.1622	1035.33	0.00	1035.33	124.7867403	11/1/1984 15:30	0.208	
5.83	350	0.208	124.63	1852.30			0.0458	0.0000	0.0458	0.1619	1132.50	0.00	1132.50	124.6276671	11/1/1984 15:40	0.208	
6.00	360	0.210	126.06	1978.36			0.0458	0.0000	0.0458	0.1643	1231.10	0.00	1231.10	126.0571051	11/1/1984 15:50	0.210	
6.17	370	0.172	103.41	2081.77			0.0458	0.0000	0.0458	0.1266	1307.05	0.00	1307.05	103.4069694	11/1/1984 16:00	0.172	
6.33	380	0.119	71.70	2153.46			0.0458	0.0000	0.0458	0.0737	1351.29	0.00	1351.29	71.69611608	11/1/1984 16:10	0.119	
6.50	390	0.082	48.91	2202.37			0.0458	0.0000	0.0458	0.0358	1372.74	0.00	1372.74	48.90884629	11/1/1984 16:20	0.082	
6.67	400	0.069	41.44	2243.81			0.0458	0.0000	0.0458	0.0233	1386.72	0.00	1386.72	41.43876698	11/1/1984 16:30	0.069	
6.83	410	0.044	26.41	2270.22			0.0440	0.0017	0.0458	0.0000	1385.67	0.00	1385.67	26.41204143	11/1/1984 16:40	0.044	
7.00	420	0.015	8.80	2279.03			0.0147	0.0311	0.0458	0.0000	1367.02	0.00	1367.02	8.80401381	11/1/1984 16:50	0.015	
7.17	430	0.026	15.60	2294.62			0.0260	0.0198	0.0458	0.0000	1355.15	0.00	1355.15	15.59538824	11/1/1984 17:00	0.026	



7.33	440	0.030	17.86	2312.48	0.0298	0.0160	0.0458	0.0000	1345.55	0.00	1345.55	17.85917971	11/1/1984 17:10	0.030
7.50	450	0.010	5.95	2318.43	0.0099	0.0358	0.0458	0.0000	1324.05	0.00	1324.05	5.953059904	11/1/1984 17:20	0.010
7.67	460	0.003	1.98	2320.42	0.0033	0.0425	0.0458	0.0000	1298.57	0.00	1298.57	1.984353301	11/1/1984 17:30	0.003
7.83	470	0.001	0.66	2321.08	0.0011	0.0447	0.0458	0.0000	1271.78	0.00	1271.78	0.6614511	11/1/1984 17:40	0.001
8.00	480	0.043	25.72	2346.80	0.0429	0.0029	0.0458	0.0000	1270.04	0.00	1270.04	25.72349642	11/1/1984 17:50	0.043
8.17	490	0.100	59.82	2406.62	0.0458	0.0000	0.0458	0.0539	1302.40	0.00	1302.40	59.81741393	11/1/1984 18:00	0.100
8.33	500	0.119	71.65	2478.27	0.0458	0.0000	0.0458	0.0737	1346.59	0.00	1346.59	71.6497663	11/1/1984 18:10	0.119
8.50	510	0.127	76.05	2554.32	0.0458	0.0000	0.0458	0.0810	1395.18	0.00	1395.18	76.04967545	11/1/1984 18:20	0.127
8.67	520	0.152	91.25	2645.57	0.0458	0.0000	0.0458	0.1063	1458.97	0.00	1458.97	91.24862698	11/1/1984 18:30	0.152
8.83	530	0.184	110.30	2755.87	0.0458	0.0000	0.0458	0.1381	1541.81	0.00	1541.81	110.2975133	11/1/1984 18:40	0.184
9.00	540	0.196	117.58	2873.45	0.0458	0.0000	0.0458	0.1502	1631.93	0.00	1631.93	117.5802183	11/1/1984 18:50	0.196
9.17	550	0.202	120.91	2994.35	0.0458	0.0000	0.0458	0.1557	1725.38	0.00	1725.38	120.9069794	11/1/1984 19:00	0.202
9.33	560	0.228	136.81	3131.16	0.0458	0.0000	0.0458	0.1823	1834.73	0.00	1834.73	136.8091982	11/1/1984 19:10	0.228
9.50	570	0.168	101.03	3232.20	0.0458	0.0000	0.0458	0.1226	1908.30	0.00	1908.30	101.0324817	11/1/1984 19:20	0.168
9.67	580	0.103	61.66	3293.86	0.0458	0.0000	0.0458	0.0570	1942.51	0.00	1942.51	61.66489707	11/1/1984 19:30	0.103
9.83	590	0.104	62.60	3356.46	0.0458	0.0000	0.0458	0.0586	1977.65	0.00	1977.65	62.60238865	11/1/1984 19:40	0.104
10.00	600	0.082	49.03	3405.49	0.0458	0.0000	0.0458	0.0360	1999.23	0.00	1999.23	49.03102999	11/1/1984 19:50	0.082
10.17	610	0.051	30.45	3435.94	0.0458	0.0000	0.0458	0.0050	2002.21	0.00	2002.21	30.44722397	11/1/1984 20:00	0.051
10.33	620	0.040	24.30	3460.24	0.0405	0.0053	0.0458	0.0000	1999.05	0.00	1999.05	24.29564605	11/1/1984 20:10	0.040
10.50	630	0.108	64.94	3525.18	0.0458	0.0000	0.0458	0.0625	2036.53	0.00	2036.53	64.93806144	11/1/1984 20:20	0.108
10.67	640	0.155	93.01	3618.18	0.0458	0.0000	0.0458	0.1092	2102.08	0.00	2102.08	93.00716016	11/1/1984 20:30	0.155
10.83	650	0.123	74.07	3692.25	0.0458	0.0000	0.0458	0.0777	2148.69	0.00	2148.69	74.06515819	11/1/1984 20:40	0.123
11.00	660	0.065	39.08	3731.33	0.0458	0.0000	0.0458	0.0194	2160.31	0.00	2160.31	39.08295923	11/1/1984 20:50	0.065
11.17	670	0.046	27.46	3758.79	0.0458	0.0000	0.0458	0.0000	2160.31	0.00	2160.31	27.4619378	11/1/1984 21:00	0.046
11.33	680	0.039	23.59	3782.38	0.0393	0.0065	0.0458	0.0000	2156.44	0.00	2156.44	23.588264	11/1/1984 21:10	0.039
11.50	690	0.013	7.86	3790.24	0.0131	0.0327	0.0458	0.0000	2136.85	0.00	2136.85	7.862754665	11/1/1984 21:20	0.013
11.67	700	0.028	17.09	3807.34	0.0285	0.0173	0.0458	0.0000	2126.48	0.00	2126.48	17.09446975	11/1/1984 21:30	0.028
11.83	710	0.058	34.68	3842.02	0.0458	0.0000	0.0458	0.0120	2133.71	0.00	2133.71	34.68408837	11/1/1984 21:40	0.058
12.00	720	0.043	26.07	3868.10	0.0435	0.0023	0.0458	0.0000	2132.32	0.00	2132.32	26.07374306	11/1/1984 21:50	0.043
12.17	730	0.039	23.24	3891.34	0.0387	0.0070	0.0458	0.0000	2128.11	0.00	2128.11	23.24202522	11/1/1984 22:00	0.039
12.33	740	0.037	22.30	3913.64	0.0372	0.0086	0.0458	0.0000	2122.95	0.00	2122.95	22.29811927	11/1/1984 22:10	0.037
12.50	750	0.012	7.43	3921.07	0.0124	0.0334	0.0458	0.0000	2102.92	0.00	2102.92	7.432706422	11/1/1984 22:20	0.012
12.67	760	0.004	2.48	3923.55	0.0041	0.0416	0.0458	0.0000	2077.94	0.00	2077.94	2.477568807	11/1/1984 22:30	0.004
12.83	770	0.001	0.83	3924.37	0.0014	0.0444	0.0458	0.0000	2051.31	0.00	2051.31	0.825856269	11/1/1984 22:40	0.001
13.00	780	0.000	0.28	3924.65	0.0005	0.0453	0.0458	0.0000	2024.12	0.00	2024.12	0.275285423	11/1/1984 22:50	0.000
13.17	790	0.000	0.09	3924.74	0.0002	0.0456	0.0458	0.0000	1996.76	0.00	1996.76	0.091761808	11/1/1984 23:00	0.000
13.33	800	0.024	14.62	3939.36	0.0244	0.0214	0.0458	0.0000	1983.92	0.00	1983.92	14.61933703	11/1/1984 23:10	0.024
13.50	810	0.057	34.09	3973.45	0.0458	0.0000	0.0458	0.0110	1990.55	0.00	1990.55	34.0881654	11/1/1984 23:20	0.057
13.67	820	0.068	40.65	4014.10	0.0458	0.0000	0.0458	0.0220	2003.74	0.00	2003.74	40.65246943	11/1/1984 23:30	0.068
13.83	830	0.047	28.21	4042.31	0.0458	0.0000	0.0458	0.0013	2004.49	0.00	2004.49	28.21426748	11/1/1984 23:40	0.047
14.00	840	0.016	9.40	4051.72	0.0157	0.0301	0.0458	0.0000	1986.44	0.00	1986.44	9.404755826	11/1/1984 23:50	0.016
14.17	850	0.005	3.13	4054.85	0.0052	0.0405	0.0458	0.0000	1962.12	0.00	1962.12	3.134918609	11/2/1984 0:00	0.005
14.33	860	0.002	1.04	4055.90	0.0017	0.0440	0.0458	0.0000	1935.70	0.00	1935.70	1.04497287	11/2/1984 0:10	0.002
14.50	870	0.001	0.35	4056.25	0.0006	0.0452	0.0458	0.0000	1908.59	0.00	1908.59	0.34832429	11/2/1984 0:20	0.001
14.67	880	0.000	0.12	4056.36	0.0002	0.0456	0.0458	0.0000	1881.25	0.00	1881.25	0.116108097	11/2/1984 0:30	0.000
14.83	890	0.025	14.74	4071.10	0.0246	0.0212	0.0458	0.0000	1868.53	0.00	1868.53	14.73888167	11/2/1984 0:40	0.025
15.00	900	0.057	34.35	4105.45	0.0458	0.0000	0.0458	0.0115	1875.42	0.00	1875.42	34.34965272	11/2/1984 0:50	0.057
15.17	910	0.068	40.96	4146.41	0.0458	0.0000	0.0458	0.0225	1888.92	0.00	1888.92	40.95885028	11/2/1984 1:00	0.068
15.33	920	0.047	28.43	4174.84	0.0458	0.0000	0.0458	0.0016	1889.89	0.00	1889.89	28.42540294	11/2/1984 1:10	0.047
15.50	930	0.040	24.28	4199.12	0.0405	0.0053	0.0458	0.0000	1886.71	0.00	1886.71	24.28313802	11/2/1984 1:20	0.040
15.67	940	0.063	37.75	4236.86	0.0458	0.0000	0.0458	0.0171	1897.00	0.00	1897.00	37.74555447	11/2/1984 1:30	0.063
15.83	950	0.046	27.43	4264.29	0.0457	0.0001	0.0458	0.0000	1896.97	0.00	1896.97	27.4250229	11/2/1984 1:40	0.046
16.00	960	0.015	9.14	4273.43	0.0152	0.0305	0.0458	0.0000	1878.65	0.00	1878.65	9.141674302	11/2/1984 1:50	0.015
16.17	970	0.005	3.05	4276.48	0.0051	0.0407	0.0458	0.0000	1854.24	0.00	1854.24	3.047224767	11/2/1984 2:00	0.005
16.33	980	0.002	1.02	4277.49	0.0017	0.0441	0.0458	0.0000	1827.79	0.00	1827.79	1.015741589	11/2/1984 2:10	0.002
16.50	990	0.001	0.34	4277.83	0.0006	0.0452	0.0458	0.0000	1800.67	0.00	1800.67	0.33858053	11/2/1984 2:20	0.001
16.67	1000	0.025	14.99	4292.82	0.0250	0.0208	0.0458	0.0000	1788.21	0.00	1788.21	14.9908217	11/2/1984 2:30	0.025
16.83	1010	0.033	19.87	4312.70	0.0331	0.0126	0.0458	0.0000	1780.62	0.00	1780.62	19.87490209	11/2/1984 2:40	0.033
17.00	1020	0.011	6.62	4319.32	0.0110	0.0347	0.0458	0.0000	1759.79	0.00	1759.79	6.624967362	11/2/1984 2:50	0.011
17.17	1030	0.078	47.05	4366.37	0.0458	0.0000	0.0458	0.0326	1779.38	0.00	1779.38	47.04725269	11/2/1984 3:00	0.078
17.33	1040	0.126	75.53	4441.91	0.0458	0.0000	0.0458	0.0801	1827.45	0.00	1827.45	75.53480112	11/2/1984 3:10	0.126
17.50	1050	0.142	85.43	4527.33	0.0458	0.0000	0.0458	0.0966	1885.42	0.00	1885.42	85.42859048	11/2/1984 3:20	0.142
17.67	1060	0.199	119.24	4646.57	0.0458	0.0000	0.0458	0.1530	1977.20	0.00	1977.20	119.2375802	11/2/1984 3:30	0.199
17.83	1070	0.193	115.78	4762.35	0.0458	0.0000	0.0458	0.1472	2065.52	0.00	2065.52	115.7754693	11/2/1984 3:40	0.193
18.00	1080	0.192	115.08	4877.43	0.0458	0.0000	0.0458	0.1460	2153.14	0.00	2153.14	115.0813695	11/2/1984 3:50	0.192
18.17	1090	0.192	115.15	4992.58	0.0458	0.0000	0.0458	0.1462	2240.83	0.00	2240.83	115.1488475	11/2/1984 4:00	0.192
18.33	1100	0.141	84.63	5077.21	0.0458	0.0000	0.0458	0.0953	2298.01	0.00	2298.01	84.63226049	11/2/1984 4:10	0.141
18.50	1110	0.073	43.66	5120.87	0.0458	0.0000	0.0458	0.0270	2314.20	0.00	2314.20	43.65612424	11/2/1984 4:20	0.073
18.67	1120	0.024	14.55	5135.42	0.0243	0.0215	0.0458	0.0000	2301.30	0.00	2301.30	14.55204141	11/2/1984 4:30	0.024
18.83	1130	0.034	20.32	5155.74	0.0339	0.0119	0.0458	0.0000	2294.16	0.00				



19.83	1190	0.151	90.46	5565.40	0.0458	0.0000	0.0458	0.1050	2539.07	0.00	2539.07	90.45847505	11/2/1984 5:40	0.151
20.00	1200	0.050	30.15	5595.55	0.0458	0.0000	0.0458	0.0045	2541.76	0.00	2541.76	30.15282502	11/2/1984 5:50	0.050
20.17	1210	0.017	10.05	5605.60	0.0168	0.0290	0.0458	0.0000	2524.35	0.00	2524.35	10.05094167	11/2/1984 6:00	0.017
20.33	1220	0.058	34.86	5640.47	0.0458	0.0000	0.0458	0.0123	2531.76	0.00	2531.76	34.86452382	11/2/1984 6:10	0.058
20.50	1230	0.151	90.60	5731.06	0.0458	0.0000	0.0458	0.1052	2594.90	0.00	2594.90	90.59664165	11/2/1984 6:20	0.151
20.67	1240	0.156	93.53	5824.59	0.0458	0.0000	0.0458	0.1101	2660.97	0.00	2660.97	93.52971004	11/2/1984 6:30	0.156
20.83	1250	0.078	47.05	5871.64	0.0458	0.0000	0.0458	0.0326	2680.55	0.00	2680.55	47.04647572	11/2/1984 6:40	0.078
21.00	1260	0.053	31.58	5903.22	0.0458	0.0000	0.0458	0.0069	2684.67	0.00	2684.67	31.57647023	11/2/1984 6:50	0.053
21.17	1270	0.071	42.34	5945.55	0.0458	0.0000	0.0458	0.0248	2699.55	0.00	2699.55	42.33828806	11/2/1984 7:00	0.071
21.33	1280	0.157	93.94	6039.50	0.0458	0.0000	0.0458	0.1108	2766.04	0.00	2766.04	93.94241736	11/2/1984 7:10	0.157
21.50	1290	0.266	159.51	6199.00	0.0458	0.0000	0.0458	0.2201	2898.08	0.00	2898.08	159.5055119	11/2/1984 7:20	0.266
21.67	1300	0.303	182.08	6381.09	0.0458	0.0000	0.0458	0.2577	3052.71	0.00	3052.71	182.0844789	11/2/1984 7:30	0.303
21.83	1310	0.263	157.78	6538.86	0.0458	0.0000	0.0458	0.2172	3183.03	0.00	3183.03	157.7777892	11/2/1984 7:40	0.263
22.00	1320	0.142	85.04	6623.90	0.0458	0.0000	0.0458	0.0960	3240.61	0.00	3240.61	85.03978877	11/2/1984 7:50	0.142
22.17	1330	0.074	44.60	6668.51	0.0458	0.0000	0.0458	0.0286	3257.75	0.00	3257.75	44.60183741	11/2/1984 8:00	0.074
22.33	1340	0.052	31.12	6699.63	0.0458	0.0000	0.0458	0.0061	3261.41	0.00	3261.41	31.12252028	11/2/1984 8:10	0.052
22.50	1350	0.017	10.37	6710.00	0.0173	0.0285	0.0458	0.0000	3244.33	0.00	3244.33	10.37417343	11/2/1984 8:20	0.017
22.67	1360	0.006	3.46	6713.46	0.0058	0.0400	0.0458	0.0000	3220.33	0.00	3220.33	3.458057809	11/2/1984 8:30	0.006
22.83	1370	0.002	1.15	6714.61	0.0019	0.0438	0.0458	0.0000	3194.02	0.00	3194.02	1.152685936	11/2/1984 8:40	0.002
23.00	1380	0.055	32.96	6747.57	0.0458	0.0000	0.0458	0.0092	3199.52	0.00	3199.52	32.95705328	11/2/1984 8:50	0.055
23.17	1390	0.100	59.88	6807.45	0.0458	0.0000	0.0458	0.0540	3231.94	0.00	3231.94	59.87572031	11/2/1984 9:00	0.100
23.33	1400	0.060	36.28	6843.72	0.0458	0.0000	0.0458	0.0147	3240.76	0.00	3240.76	36.2757847	11/2/1984 9:10	0.060
23.50	1410	0.543	325.78	7169.50	0.0458	0.0000	0.0458	0.4972	3539.07	0.00	3539.07	325.777746	11/2/1984 9:20	0.543
23.67	1420	<b>0.815</b>	<b>489.14</b>	<b>7658.64</b>	0.0458	0.0000	0.0458	0.7695	4000.76	0.16	3907.15	395.5343519	11/2/1984 9:30	0.659
23.83	1430	0.579	347.56	8006.21	0.0458	0.0000	0.0458	0.5335	4227.26	0.53	3907.15	27.45872188	11/2/1984 9:40	0.046
24.00	1440	0.417	250.37	8256.58	0.0458	0.0000	0.0458	0.3715	4130.07	0.37	3907.15	27.45872188	11/2/1984 9:50	0.046
24.17	1450	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3879.69	0.00	3879.69	0	11/2/1984 10:00	0.000
24.33	1460	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3852.23	0.00	3852.23	0	11/2/1984 10:10	0.000
24.50	1470	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3824.77	0.00	3824.77	0	11/2/1984 10:20	0.000
24.67	1480	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3797.32	0.00	3797.32	0	11/2/1984 10:30	0.000
24.83	1490	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3769.86	0.00	3769.86	0	11/2/1984 10:40	0.000
25.00	1500	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3742.40	0.00	3742.40	0	11/2/1984 10:50	0.000
25.17	1510	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3714.94	0.00	3714.94	0	11/2/1984 11:00	0.000
25.33	1520	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3687.48	0.00	3687.48	0	11/2/1984 11:10	0.000
25.50	1530	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3660.02	0.00	3660.02	0	11/2/1984 11:20	0.000
25.67	1540	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3632.56	0.00	3632.56	0	11/2/1984 11:30	0.000
25.83	1550	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3605.10	0.00	3605.10	0	11/2/1984 11:40	0.000
26.00	1560	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3577.65	0.00	3577.65	0	11/2/1984 11:50	0.000
26.17	1570	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3550.19	0.00	3550.19	0	11/2/1984 12:00	0.000
26.33	1580	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3522.73	0.00	3522.73	0	11/2/1984 12:10	0.000
26.50	1590	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3495.27	0.00	3495.27	0	11/2/1984 12:20	0.000
26.67	1600	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3467.81	0.00	3467.81	0	11/2/1984 12:30	0.000
26.83	1610	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3440.35	0.00	3440.35	0	11/2/1984 12:40	0.000
27.00	1620	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3412.89	0.00	3412.89	0	11/2/1984 12:50	0.000
27.17	1630	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3385.43	0.00	3385.43	0	11/2/1984 13:00	0.000
27.33	1640	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3357.98	0.00	3357.98	0	11/2/1984 13:10	0.000
27.50	1650	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3330.52	0.00	3330.52	0	11/2/1984 13:20	0.000
27.67	1660	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3303.06	0.00	3303.06	0	11/2/1984 13:30	0.000
27.83	1670	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3275.60	0.00	3275.60	0	11/2/1984 13:40	0.000
28.00	1680	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3248.14	0.00	3248.14	0	11/2/1984 13:50	0.000
28.17	1690	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3220.68	0.00	3220.68	0	11/2/1984 14:00	0.000
28.33	1700	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3193.22	0.00	3193.22	0	11/2/1984 14:10	0.000
28.50	1710	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3165.77	0.00	3165.77	0	11/2/1984 14:20	0.000
28.67	1720	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3138.31	0.00	3138.31	0	11/2/1984 14:30	0.000
28.83	1730	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3110.85	0.00	3110.85	0	11/2/1984 14:40	0.000
29.00	1740	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3083.39	0.00	3083.39	0	11/2/1984 14:50	0.000
29.17	1750	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3055.93	0.00	3055.93	0	11/2/1984 15:00	0.000
29.33	1760	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3028.47	0.00	3028.47	0	11/2/1984 15:10	0.000
29.50	1770	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3001.01	0.00	3001.01	0	11/2/1984 15:20	0.000
29.67	1780	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2973.55	0.00	2973.55	0	11/2/1984 15:30	0.000
29.83	1790	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2946.10	0.00	2946.10	0	11/2/1984 15:40	0.000
30.00	1800	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2918.64	0.00	2918.64	0	11/2/1984 15:50	0.000
30.17	1810	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2891.18	0.00	2891.18	0	11/2/1984 16:00	0.000
30.33	1820	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2863.72	0.00	2863.72	0	11/2/1984 16:10	0.000
30.50	1830	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2836.26	0.00	2836.26	0	11/2/1984 16:20	0.000
30.67	1840	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2808.80	0.00	2808.80	0	11/2/1984 16:30	0.000



30.83	1850	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2781.34	0.00	2781.34	0	11/2/1984 16:40	0.000
31.00	1860	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2753.88	0.00	2753.88	0	11/2/1984 16:50	0.000
31.17	1870	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2726.43	0.00	2726.43	0	11/2/1984 17:00	0.000
31.33	1880	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2698.97	0.00	2698.97	0	11/2/1984 17:10	0.000
31.50	1890	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2671.51	0.00	2671.51	0	11/2/1984 17:20	0.000
31.67	1900	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2644.05	0.00	2644.05	0	11/2/1984 17:30	0.000
31.83	1910	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2616.59	0.00	2616.59	0	11/2/1984 17:40	0.000
32.00	1920	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2589.13	0.00	2589.13	0	11/2/1984 17:50	0.000
32.17	1930	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2561.67	0.00	2561.67	0	11/2/1984 18:00	0.000
32.33	1940	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2534.21	0.00	2534.21	0	11/2/1984 18:10	0.000
32.50	1950	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2506.76	0.00	2506.76	0	11/2/1984 18:20	0.000
32.67	1960	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2479.30	0.00	2479.30	0	11/2/1984 18:30	0.000
32.83	1970	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2451.84	0.00	2451.84	0	11/2/1984 18:40	0.000
33.00	1980	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2424.38	0.00	2424.38	0	11/2/1984 18:50	0.000
33.17	1990	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2396.92	0.00	2396.92	0	11/2/1984 19:00	0.000
33.33	2000	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2369.46	0.00	2369.46	0	11/2/1984 19:10	0.000
33.50	2010	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2342.00	0.00	2342.00	0	11/2/1984 19:20	0.000
33.67	2020	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2314.54	0.00	2314.54	0	11/2/1984 19:30	0.000
33.83	2030	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2287.09	0.00	2287.09	0	11/2/1984 19:40	0.000
34.00	2040	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2259.63	0.00	2259.63	0	11/2/1984 19:50	0.000
34.17	2050	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2232.17	0.00	2232.17	0	11/2/1984 20:00	0.000
34.33	2060	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2204.71	0.00	2204.71	0	11/2/1984 20:10	0.000
34.50	2070	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2177.25	0.00	2177.25	0	11/2/1984 20:20	0.000
34.67	2080	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2149.79	0.00	2149.79	0	11/2/1984 20:30	0.000
34.83	2090	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2122.33	0.00	2122.33	0	11/2/1984 20:40	0.000
35.00	2100	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2094.87	0.00	2094.87	0	11/2/1984 20:50	0.000
35.17	2110	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2067.42	0.00	2067.42	0	11/2/1984 21:00	0.000
35.33	2120	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2039.96	0.00	2039.96	0	11/2/1984 21:10	0.000
35.50	2130	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2012.50	0.00	2012.50	0	11/2/1984 21:20	0.000
35.67	2140	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1985.04	0.00	1985.04	0	11/2/1984 21:30	0.000
35.83	2150	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1957.58	0.00	1957.58	0	11/2/1984 21:40	0.000
36.00	2160	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1930.12	0.00	1930.12	0	11/2/1984 21:50	0.000
36.17	2170	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1902.66	0.00	1902.66	0	11/2/1984 22:00	0.000
36.33	2180	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1875.21	0.00	1875.21	0	11/2/1984 22:10	0.000
36.50	2190	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1847.75	0.00	1847.75	0	11/2/1984 22:20	0.000
36.67	2200	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1820.29	0.00	1820.29	0	11/2/1984 22:30	0.000
36.83	2210	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1792.83	0.00	1792.83	0	11/2/1984 22:40	0.000
37.00	2220	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1765.37	0.00	1765.37	0	11/2/1984 22:50	0.000
37.17	2230	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1737.91	0.00	1737.91	0	11/2/1984 23:00	0.000
37.33	2240	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1710.45	0.00	1710.45	0	11/2/1984 23:10	0.000
37.50	2250	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1682.99	0.00	1682.99	0	11/2/1984 23:20	0.000
37.67	2260	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1655.54	0.00	1655.54	0	11/2/1984 23:30	0.000
37.83	2270	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1628.08	0.00	1628.08	0	11/2/1984 23:40	0.000
38.00	2280	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1600.62	0.00	1600.62	0	11/2/1984 23:50	0.000
38.17	2290	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1573.16	0.00	1573.16	0	1/0/1900 0:00	0.000
38.33	2300	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1545.70	0.00	1545.70	0	1/0/1900 0:00	0.000
38.50	2310	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1518.24	0.00	1518.24	0	1/0/1900 0:00	0.000
38.67	2320	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1490.78	0.00	1490.78	0	1/0/1900 0:00	0.000
38.83	2330	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1463.32	0.00	1463.32	0	1/0/1900 0:00	0.000
39.00	2340	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1435.87	0.00	1435.87	0	1/0/1900 0:00	0.000
39.17	2350	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1408.41	0.00	1408.41	0	1/0/1900 0:00	0.000
39.33	2360	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1380.95	0.00	1380.95	0	1/0/1900 0:00	0.000
39.50	2370	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1353.49	0.00	1353.49	0	1/0/1900 0:00	0.000
39.67	2380	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1326.03	0.00	1326.03	0	1/0/1900 0:00	0.000
39.83	2390	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1298.57	0.00	1298.57	0	1/0/1900 0:00	0.000
40.00	2400	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1271.11	0.00	1271.11	0	1/0/1900 0:00	0.000
40.17	2410	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1243.65	0.00	1243.65	0	1/0/1900 0:00	0.000
40.33	2420	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1216.20	0.00	1216.20	0	1/0/1900 0:00	0.000
40.50	2430	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1188.74	0.00	1188.74	0	1/0/1900 0:00	0.000
40.67	2440	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1161.28	0.00	1161.28	0	1/0/1900 0:00	0.000
40.83	2450	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1133.82	0.00	1133.82	0	1/0/1900 0:00	0.000
41.00	2460	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1106.36	0.00	1106.36	0	1/0/1900 0:00	0.000
41.17	2470	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1078.90	0.00	1078.90	0	1/0/1900 0:00	0.000
41.33	2480	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1051.44	0.00	1051.44	0	1/0/1900 0:00	0.000
41.50	2490	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1023.98	0.00	1023.98	0	1/0/1900 0:00	0.000
41.67	2500	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	996.53	0.00	996.53	0	1/0/1900 0:00	0.000
41.83	2510	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	969.07	0.00	969.07	0	1/0/1900 0:00	0.000
42.00	2520	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	941.61	0.00	941.61	0	1/0/1900 0:00	0.000
42.16	2530	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	914.15	0.00	914.15	0	1/0/1900 0:00	0.000
42.33	2540	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	886.69	0.00	886.69	0	1/0/1900 0:00	0.000
42.50	2550	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	859.23	0.00	859.23	0	1/0/1900 0:00	0.000
42.66	2560	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	831.77	0.00	831.77	0	1/0/1900 0:00	0.000
42.83	2570	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	804.31	0.00	804.31	0	1/0/1900 0:00	0.000
43.00	2580	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	776.86	0.00	776.86	0	1/0/1900 0:00	0.000</



43.33	2600	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	721.94	0.00	721.94	0	1/0/1900 0:00	0.000
43.50	2610	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	694.48	0.00	694.48	0	1/0/1900 0:00	0.000
43.66	2620	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	667.02	0.00	667.02	0	1/0/1900 0:00	0.000
43.83	2630	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	639.56	0.00	639.56	0	1/0/1900 0:00	0.000
44.00	2640	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	612.10	0.00	612.10	0	1/0/1900 0:00	0.000
44.16	2650	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	584.65	0.00	584.65	0	1/0/1900 0:00	0.000
44.33	2660	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	557.19	0.00	557.19	0	1/0/1900 0:00	0.000
44.50	2670	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	529.73	0.00	529.73	0	1/0/1900 0:00	0.000
44.66	2680	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	502.27	0.00	502.27	0	1/0/1900 0:00	0.000
44.83	2690	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	474.81	0.00	474.81	0	1/0/1900 0:00	0.000
45.00	2700	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	447.35	0.00	447.35	0	1/0/1900 0:00	0.000
45.16	2710	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	419.89	0.00	419.89	0	1/0/1900 0:00	0.000
45.33	2720	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	392.43	0.00	392.43	0	1/0/1900 0:00	0.000
45.50	2730	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	364.98	0.00	364.98	0	1/0/1900 0:00	0.000
45.66	2740	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	337.52	0.00	337.52	0	1/0/1900 0:00	0.000
45.83	2750	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	310.06	0.00	310.06	0	1/0/1900 0:00	0.000
46.00	2760	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	282.60	0.00	282.60	0	1/0/1900 0:00	0.000
46.16	2770	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	255.14	0.00	255.14	0	1/0/1900 0:00	0.000
46.33	2780	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	227.68	0.00	227.68	0	1/0/1900 0:00	0.000
46.50	2790	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	200.22	0.00	200.22	0	1/0/1900 0:00	0.000
46.66	2800	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	172.76	0.00	172.76	0	1/0/1900 0:00	0.000
46.83	2810	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	145.31	0.00	145.31	0	1/0/1900 0:00	0.000
47.00	2820	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	117.85	0.00	117.85	0	1/0/1900 0:00	0.000
47.16	2830	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	90.39	0.00	90.39	0	1/0/1900 0:00	0.000
47.33	2840	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	62.93	0.00	62.93	0	1/0/1900 0:00	0.000
47.50	2850	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	35.47	0.00	35.47	0	1/0/1900 0:00	0.000
47.66	2860	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	8.01	0.00	8.01	0	1/0/1900 0:00	0.000
47.83	2870	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	-19.45	0.00	0.00	0	1/0/1900 0:00	0.000
48.00	2880	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.16	2890	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.33	2900	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.50	2910	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.66	2920	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.83	2930	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.00	2940	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.16	2950	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.33	2960	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.50	2970	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.66	2980	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.83	2990	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.00	3000	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.16	3010	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.33	3020	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.50	3030	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.66	3040	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.83	3050	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
51.00	3060	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
51.16	3070	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000



Modeling Results for  
Section 3b  
With Only ROW Tributary Area

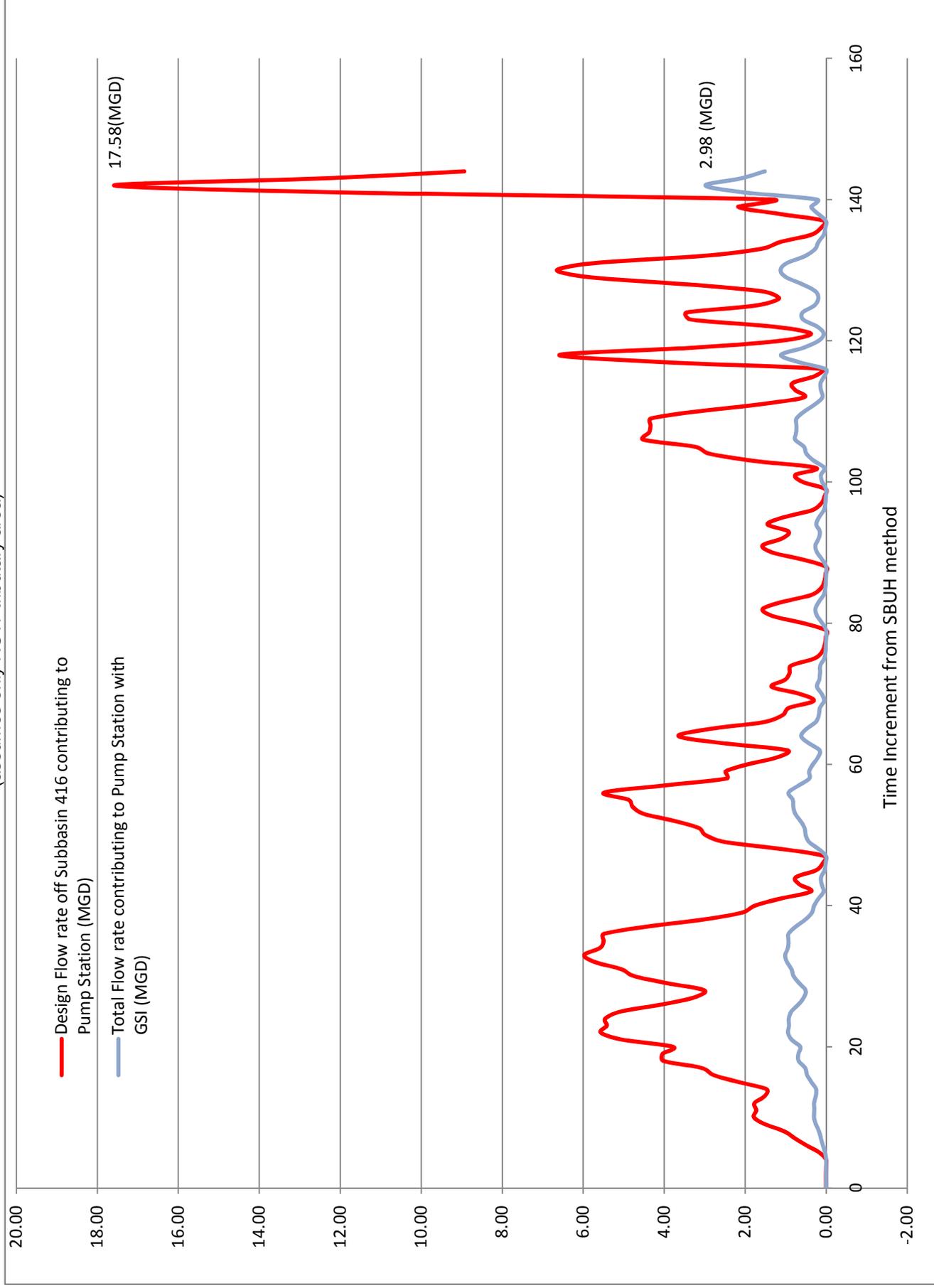


SvR Modeled Subbasin 416 Design Flow Rate to Pump Station

SECTION 3b

during 1984 Storm

(assumes only ROW tributary area)







**King County CSO**  
**Barton Basin Subbasin 416 GSI Analysis**  
 SvR Project No. 06053  
 Date: 05/11/2010

**Santa Barbara Urban Hydrograph Method (SBUH)**

red text is user entered  
 Rainfall data provided by King County  
 conversion from sf to acre 43560 sf/acre  
 assume that both sides of a street have the same planter width  
 alleys are assumed to be negligible  
 a time increment of 9999 indicates that the rain event (provided by King County) has finished  
 corners at roadway intersections are counted as impervious in the N/S ROW areas  
 assumes crowned roadway

Typical One Block Characteristics			
Block (N/S) per GIS (lf)	601		
Block (E/W) per GIS (lf)	276		
Private Parcel Area (sf)	165,876	3.81 (ac)	
Roof Area of Private Parcels per Block per GIS (sf)	41,451	0.95 (ac)	
Non Roof Impervious Area of Private Parcels per Block per GIS (sf)	55,937	1.28 (ac)	
Pervious Area of Private Parcels per Block including alleys (sf)	68,488	1.57 (ac)	
ROW width (N/S) (lf)	60		
Planter Width (N/S) (lf)	10		
Width of Impervious in ROW (N/S) (lf)	40		
ROW width (E/W) (lf)	60		
Planter Width (E/W) (lf)	10		
Width of Impervious in ROW (E/W) (lf)	40		
ROW Impervious Area (N/S) (sf)	26440	0.61 (ac)	
ROW Pervious Area (N/S) (sf)	12020	0.28 (ac)	
ROW Impervious Area (E/W) (sf)	11040	0.25 (ac)	
ROW Pervious Area (E/W) (sf)	5520	0.13 (ac)	

	Percentage to RG	Effective Area to RG	CN	Impervious to RG (ac)	Pervious to RG (ac)	Percentage Impervious	Percentage Pervious
<b>PRIVATE PARCEL CHARACTERISTICS</b>							
Block Area to RG (ac)	0%						
Total Roof Area per One Block (ac)	0.95	100%					
Roof Area disconnected		60%	86	0.00	0.00	0.00%	0.00%
Total Non-Roof Impervious Area Per One Block (ac)	1.28						
Non-Roof Impervious Area to RG (ac)		50%	86	0.00	0.00	0.00%	0.00%
Total Pervious Area per One Block (ac)	1.57						
Pervious Area to RG (ac)		50%	86	0.00	0.00	0.00%	0.00%
<b>N/S ROADWAY CHARACTERISTICS</b>							
One N/S ROW to RG per One Block		50%					
Total ROW Impervious Area (N/S) fronting a Block (ac)	0.61						
ROW Impervious Area (N/S) to RG (ac)			98	0.30	0	11.97%	0.00%
Total ROW Pervious Area (N/S) fronting a Block (ac)	0.28						
ROW Pervious Area (N/S) to RG (ac)			86	0	0.14	0.00%	5.44%
<b>E/W ROADWAY CHARACTERISTICS</b>							
One E/W ROW to RG per One Block		50%					
Total ROW Impervious Area (E/W) fronting One Block(ac)	0.25						
ROW Impervious Area (E/W) to RG (ac)			98	0.13	0	5.00%	0.00%
Total ROW Pervious Area (E/W) fronting One Block(ac)	0.13						
ROW Pervious Area (E/W) to RG (ac)			86	0	0.06	0.00%	2.50%

Impervious to RG (ac) Pervious to RG (ac)

Total Areas (ac)	0.43	0.20	Total Area contributing flow to rain garden (ac)	0.63	Total Foot Print Area of Half Block (ac)	2.54
CN	98	86				

**Rainfall Distribution: 1984 Storm** this field needs to be year of storm followed a space then "Storm". Example "1984 Storm"

Max Time Increment 144  
 Pt = 2.39 inches Tc = 10 minutes w = 0.33  
 Sp = 1.63 dt = 10 minutes  
 Si = 0.20

Time Increment	Time	Rainfall Distribution	Incremental Rainfall	Accumulated Rainfall	Pervious Accumulated Runoff	Pervious Area Increment Runoff	Impervious Accumulated Runoff	Impervious Area Incr. Runoff	Total Runoff	Instant Flow rate	Design Flow rate	Difference Between Instant and Design Flow
	(minutes)	(fraction)	(inches)	(inches)	(inches)	(inches)	(inches)	(inches)	(inches)	(cfs)	(cfs)	
0	0	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
1	10	0.0042	0.0100	0.010	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
2	20	0.0042	0.0100	0.020	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
3	30	0.0042	0.0100	0.030	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
4	40	0.0042	0.0100	0.040	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
5	50	0.0126	0.0300	0.070	0.000	0.000	0.004	0.004	0.002	0.01	0.003	0.01
6	60	0.0084	0.0200	0.090	0.000	0.000	0.010	0.006	0.004	0.02	0.009	0.01
7	70	0.0084	0.0200	0.110	0.000	0.000	0.018	0.008	0.005	0.02	0.015	0.01
8	80	0.0084	0.0200	0.130	0.000	0.000	0.027	0.010	0.007	0.03	0.020	0.00
9	90	0.0126	0.0300	0.160	0.000	0.000	0.044	0.017	0.011	0.04	0.030	0.01
10	100	0.0084	0.0200	0.180	0.000	0.000	0.056	0.012	0.009	0.03	0.035	0.00
11	110	0.0084	0.0200	0.200	0.000	0.000	0.070	0.013	0.009	0.03	0.034	0.00
12	120	0.0084	0.0200	0.220	0.000	0.000	0.084	0.014	0.010	0.04	0.035	0.00
13	130	0.0042	0.0100	0.230	0.000	0.000	0.091	0.007	0.005	0.02	0.030	-0.01
14	140	0.0084	0.0200	0.250	0.000	0.000	0.106	0.015	0.010	0.04	0.029	0.01
15	150	0.0126	0.0300	0.280	0.000	0.000	0.129	0.023	0.016	0.06	0.043	0.02
16	160	0.0126	0.0300	0.310	0.000	0.000	0.153	0.024	0.016	0.06	0.055	0.01
17	170	0.0126	0.0300	0.340	0.000	0.000	0.178	0.025	0.017	0.06	0.061	0.00
18	180	0.0209	0.0500	0.390	0.002	0.002	0.220	0.043	0.030	0.11	0.080	0.03
19	190	0.0084	0.0200	0.410	0.004	0.002	0.238	0.017	0.012	0.05	0.080	-0.03
20	200	0.0167	0.0400	0.450	0.009	0.005	0.273	0.035	0.026	0.10	0.075	0.02
21	210	0.0209	0.0500	0.500	0.017	0.008	0.318	0.045	0.033	0.13	0.100	0.03
22	220	0.0167	0.0400	0.540	0.025	0.008	0.354	0.036	0.027	0.10	0.110	-0.01
23	230	0.0167	0.0400	0.580	0.034	0.009	0.391	0.037	0.028	0.11	0.107	0.00
24	240	0.0167	0.0400	0.620	0.045	0.011	0.428	0.037	0.029	0.11	0.108	0.00
25	250	0.0126	0.0300	0.650	0.054	0.009	0.456	0.028	0.022	0.08	0.101	-0.02
26	260	0.0084	0.0200	0.670	0.060	0.006	0.475	0.019	0.015	0.06	0.080	-0.02
27	270	0.0084	0.0200	0.690	0.067	0.007	0.494	0.019	0.015	0.06	0.065	-0.01
28	280	0.0084	0.0200	0.710	0.073	0.007	0.513	0.019	0.015	0.06	0.060	0.00
29	290	0.0167	0.0400	0.750	0.088	0.014	0.551	0.038	0.030	0.12	0.078	0.04
30	300	0.0126	0.0300	0.780	0.099	0.011	0.579	0.029	0.023	0.09	0.094	-0.01
31	310	0.0167	0.0400	0.820	0.115	0.016	0.617	0.038	0.031	0.12	0.100	0.02
32	320	0.0167	0.0400	0.860	0.132	0.017	0.656	0.038	0.032	0.12	0.113	0.01
33	330	0.0167	0.0400	0.900	0.150	0.018	0.694	0.038	0.032	0.12	0.118	0.00
34	340	0.0126	0.0300	0.930	0.164	0.014	0.723	0.029	0.024	0.09	0.111	-0.02
35	350	0.0167	0.0400	0.970	0.183	0.019	0.762	0.039	0.032	0.12	0.109	0.01
36	360	0.0126	0.0300	1.000	0.198	0.015	0.791	0.029	0.025	0.09	0.109	-0.02
37	370	0.0084	0.0200	1.020	0.208	0.010	0.810	0.019	0.016	0.06	0.088	-0.03
38	380	0.0042	0.0100	1.030	0.213	0.005	0.820	0.010	0.008	0.03	0.061	-0.03
39	390	0.0042	0.0100	1.040	0.218	0.005	0.830	0.010	0.008	0.03	0.041	-0.01
40	400	0.0042	0.0100	1.050	0.223	0.005	0.839	0.010	0.008	0.03	0.035	0.00
41	410	0.0000	0.0000	1.050	0.223	0.000	0.839	0.000	0.000	0.00	0.022	-0.02
42	420	0.0000	0.0000	1.050	0.223	0.000	0.839	0.000	0.000	0.00	0.007	-0.01
43	430	0.0042	0.0100	1.060	0.228	0.005	0.849	0.010	0.008	0.03	0.013	0.02
44	440	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	0.015	-0.01
45	450	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	0.005	0.00
46	460	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	0.002	0.00
47	470	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	0.001	0.00
48	480	0.0084	0.0200	1.080	0.239	0.011	0.869	0.019	0.017	0.06	0.021	0.04
49	490	0.0084	0.0200	1.100	0.250	0.011	0.888	0.019	0.017	0.06	0.050	0.01
50	500	0.0084	0.0200	1.120	0.261	0.011	0.908	0.019	0.017	0.06	0.059	0.00
51	510	0.0084	0.0200	1.140	0.272	0.011	0.927	0.020	0.017	0.06	0.062	0.00
52	520	0.0126	0.0300	1.170	0.288	0.017	0.956	0.029	0.025	0.10	0.074	0.02
53	530	0.0126	0.0300	1.200	0.306	0.017	0.986	0.029	0.025	0.10	0.089	0.01
54	540	0.0126	0.0300	1.230	0.323	0.017	1.015	0.029	0.026	0.10	0.095	0.00
55	550	0.0126	0.0300	1.260	0.341	0.018	1.044	0.029	0.026	0.10	0.097	0.00
56	560	0.0167	0.0400	1.300	0.365	0.024	1.084	0.039	0.034	0.13	0.109	0.02
57	570	0.0000	0.0000	1.300	0.365	0.000	1.084	0.000	0.000	0.00	0.080	-0.08
58	580	0.0084	0.0200	1.320	0.377	0.012	1.103	0.020	0.017	0.07	0.049	0.02













**King County CSO**  
**Barton Basin Subbasin 416 - GSI Option**  
 SvR Project No. 06053  
 DATE: 05/11/2010

RAIN GARDEN SYSTEM COMPONENTS			
	Infiltration Rate into Native Subgrade (in/hr)		<b>0.50</b>
<b>SECTION 01 RG</b>	1.5	25.00	2.00% (biosoil depth/lf/slope)
	Number of Section 1 Rain Gardens for Basin (ea)		<b>0</b>
	Total Infiltration Area for Section 1 Rain Gardens (sf)*		0
	Storage Capacity for a single Section 1 Rain Garden (cf)		88
	Total Storage Capacity for Section 1 Rain Gardens (cf)		0
<b>SECTION 02 RG</b>	1.5	42	2.00% (biosoil depth/lf/slope)
	Number of Section 2 Rain Gardens for Basin (ea)		<b>0</b>
	Total Infiltration Area for Section 2 Rain Gardens (sf)*		0
	Storage Capacity for a single Section 2 Rain Garden (cf)		232
	Total Storage Capacity for Section 2 Rain Gardens (cf)		0
<b>SECTION 03 RG</b>	1.5	42	2.00% (biosoil depth/lf/slope)
	Number of Section 3 Rain Gardens for Basin (ea)		<b>9</b>
	Total Infiltration Area for Section 3 Rain Gardens (sf)*		4106
	Storage Capacity for a single Section 3 Rain Garden (cf)		451
	Total Storage Capacity for Section 3 Rain Gardens (cf)		4057

**CONVERSION FACTORS**

conversion factor from cfs to MGD: 0.6452  
 conversion factor from cfs to cf/per time step: 600

Routing Flow through Rain Garden to Estimate Flow Reduction by Half Block

**Results Summary**

Total Volume of Runoff Removed of entire storm event duration (cf) 4,155 (per GSI half block)  
 Total Volume of Runoff Removed of entire storm event duration (gal) 31080.17 (per GSI half block)  
 Total volume of runoff removed from 8:50 to 9:50 of the 1984 storm 4927.257668 (gal per GSI half block)  
 319791.1828 (gal)

**Rainfall Distribution: 1984 Storm**

**RAIN GARDEN SYSTEM SUMMARY**

Total Infiltration Flow (cfs) 0.0475  
 Total Swale Storage Capacity (cf) 4057.5

Flow reduction from subbasin 416 (MGD) **14.6** per John Phillips  
 Flow reduction from assumed half block at peak flow(MGD) 0.224952925

**Number of half blocks needed to get total flow reduction out of subbasin 416 65**

Time (hours)	Time (minutes)	Design Flow Rate from Rain Event (cfs)	Inflow Water Volume (cf)	Inflow Cumm. Volume (cf)	Check if inflow infiltrates	Check if storage infiltrates	Initial Exfiltration to Native Subgrade of Inflow (cfs)	Infiltration into Native Subgrade of Stored Water (cfs)	Total Infiltration into Native Subgrade (cfs)	Inflow to Swale After Infiltration into Native Subgrade (cfs)	Swale Storage before Overflow Volume (cf)	Overtop Flow to Pump Station (cfs)	Runoff Stored in Swale Storage Volume (cf)	Volume of Runoff Removed From Pump Station (cf)	Date & Time	Amount Flow Reduced to Pump Station (cfs)	Amount Flow Reduced to Pump Station (MGD)
0	0	0.000	0.00	0.00			0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0			
0.17	10	0.000	0.00	0.00			0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:00	0.000	
0.33	20	0.000	0.00	0.00			0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:10	0.000	
0.50	30	0.000	0.00	0.00			0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:20	0.000	
0.67	40	0.000	0.00	0.00			0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:30	0.000	
0.83	50	0.003	1.90	1.90			0.0032	0.0000	0.0032	0.0000	0.00	0.00	0.00	1.900626807	11/1/1984 10:40	0.003	
1.00	60	0.009	5.61	7.51			0.0093	0.0000	0.0093	0.0000	0.00	0.00	0.00	5.605567335	11/1/1984 10:50	0.009	
1.17	70	0.015	9.09	16.59			0.0151	0.0000	0.0151	0.0000	0.00	0.00	0.00	9.085690673	11/1/1984 11:00	0.015	
1.33	80	0.020	12.17	28.77			0.0203	0.0000	0.0203	0.0000	0.00	0.00	0.00	12.17466638	11/1/1984 11:10	0.020	
1.50	90	0.030	17.81	46.58			0.0297	0.0000	0.0297	0.0000	0.00	0.00	0.00	17.8143958	11/1/1984 11:20	0.030	
1.67	100	0.035	21.20	67.78			0.0353	0.0000	0.0353	0.0000	0.00	0.00	0.00	21.19743158	11/1/1984 11:30	0.035	
1.83	110	0.034	20.50	88.28			0.0342	0.0000	0.0342	0.0000	0.00	0.00	0.00	20.50300898	11/1/1984 11:40	0.034	
2.00	120	0.035	21.06	109.35			0.0351	0.0000	0.0351	0.0000	0.00	0.00	0.00	21.06473615	11/1/1984 11:50	0.035	
2.17	130	0.030	18.09	127.43			0.0301	0.0000	0.0301	0.0000	0.00	0.00	0.00	18.08536098	11/1/1984 12:00	0.030	
2.33	140	0.029	17.54	144.97			0.0292	0.0000	0.0292	0.0000	0.00	0.00	0.00	17.53865912	11/1/1984 12:10	0.029	
2.50	150	0.043	25.66	170.63			0.0428	0.0000	0.0428	0.0000	0.00	0.00	0.00	25.6553555	11/1/1984 12:20	0.043	
2.67	160	0.055	33.13	203.76			0.0475	0.0000	0.0475	0.0077	4.62	0.00	4.62	33.13403255	11/1/1984 12:30	0.055	
2.83	170	0.061	36.48	240.24			0.0475	0.0000	0.0475	0.0133	12.58	0.00	12.58	36.47754794	11/1/1984 12:40	0.061	
3.00	180	0.080	47.78	288.01			0.0475	0.0000	0.0475	0.0321	31.84	0.00	31.84	47.77688775	11/1/1984 12:50	0.080	
3.17	190	0.080	48.09	336.10			0.0475	0.0000	0.0475	0.0326	51.41	0.00	51.41	48.08714279	11/1/1984 13:00	0.080	
3.33	200	0.075	44.98	381.08			0.0475	0.0000	0.0475	0.0274	67.88	0.00	67.88	44.98314287	11/1/1984 13:10	0.075	
3.50	210	0.100	59.81	440.89			0.0475	0.0000	0.0475	0.0522	99.18	0.00	99.18	59.81060881	11/1/1984 13:20	0.100	
3.67	220	0.110	66.19	507.08			0.0475	0.0000	0.0475	0.0628	136.85	0.00	136.85	66.18986175	11/1/1984 13:30	0.110	
3.83	230	0.107	64.45	571.54			0.0475	0.0000	0.0475	0.0599	172.79	0.00	172.79	64.45468198	11/1/1984 13:40	0.107	
4.00	240	0.108	64.89	636.43			0.0475	0.0000	0.0475	0.0606	209.16	0.00	209.16	64.88628415	11/1/1984 13:50	0.108	
4.17	250	0.101	60.31	696.74			0.0475	0.0000	0.0475	0.0530	240.96	0.00	240.96	60.31248582	11/1/1984 14:00	0.101	
4.33	260	0.080	48.14	744.88			0.0475	0.0000	0.0475	0.0327	260.58	0.00	260.58	48.13781342	11/1/1984 14:10	0.080	
4.50	270	0.065	38.72	783.60			0.0475	0.0000	0.0475	0.0170	270.79	0.00	270.79	38.72385189	11/1/1984 14:20	0.065	
4.67	280	0.060	35.78	819.38			0.0475	0.0000	0.0475	0.0121	278.05	0.00	278.05	35.77643213	11/1/1984 14:30	0.060	
4.83	290	0.078	46.63	866.01			0.0475	0.0000	0.0475	0.0302	296.17	0.00	296.17	46.63284372	11/1/1984 14:40	0.078	
5.00	300	0.094	56.41	922.42			0.0475	0.0000	0.0475	0.0465	324.06	0.00	324.06	56.40882598	11/1/1984 14:50	0.094	
5.17	310	0.100	60.23	982.65			0.0475	0.0000	0.0475	0.0529	355.78	0.00	355.78	60.22934692	11/1/1984 15:00	0.100	
5.33	320	0.113	67.94	1050.59			0.0475	0.0000	0.0475	0.0657	395.21	0.00	395.21	67.94245789	11/1/1984 15:10	0.113	
5.50	330	0.118	71.07	1121.66			0.0475	0.0000	0.0475	0.0709	437.76	0.00	437.76	71.07203902	11/1/1984 15:20	0.118	
5.67	340	0.111	66.46	1188.13			0.0475	0.0000	0.0475	0.0632	475.71	0.00	475.71	66.46357161	11/1/1984 15:30	0.111	
5.83	350	0.109	65.36	1253.48			0.0475	0.0000	0.0475	0.0614	512.55	0.00	512.55	65.35638515	11/1/1984 15:40	0.109	
6.00	360	0.109	65.29	1318.77			0.0475	0.0000	0.0475	0.0613	549.33	0.00	549.33	65.2909189	11/1/1984 15:50	0.109	
6.17	370	0.088	53.05	1371.82			0.0475	0.0000	0.0475	0.0409	573.86	0.00	573.86	53.04664664	11/1/1984 16:00	0.088	
6.33	380	0.061	36.53	1408.35			0.0475	0.0000	0.0475	0.0134	581.88	0.00	581.88	36.53184299	11/1/1984 16:10	0.061	
6.50	390	0.041	24.78	1433.13			0.0413	0.0062	0.0475	0.0000	578.14	0.00	578.14	24.7824167	11/1/1984 16:20	0.041	
6.67	400	0.035	20.89	1454.02			0.0348	0.0127	0.0475	0.0000	570.52	0.00	570.52	20.89120721	11/1/1984 16:30	0.035	
6.83	410	0.022	13.29	1467.31			0.0221	0.0254	0.0475	0.0000	555.29	0.00	555.29	13.28520482	11/1/1984 16:40	0.022	
7.00	420	0.007	4.43	1471.74			0.0074	0.0401	0.0475	0.0000	531.20	0.00	531.20	4.428401606	11/1/1984 16:50	0.007	
7.17	430	0.013	7.81	1479.55			0.0130	0.0345	0.0475	0.0000	510.50	0.00	510.50	7.809950826	11/1/1984 17:00	0.013	



7.33	440	0.015	8.94	1488.49	0.0149	0.0326	0.0475	0.0000	490.92	0.00	490.92	8.9371339	11/1/1984 17:10	0.015
7.50	450	0.005	2.98	1491.46	0.0050	0.0426	0.0475	0.0000	465.38	0.00	465.38	2.979044633	11/1/1984 17:20	0.005
7.67	460	0.002	0.99	1492.46	0.0017	0.0459	0.0475	0.0000	437.86	0.00	437.86	0.993014878	11/1/1984 17:30	0.002
7.83	470	0.001	0.33	1492.79	0.0006	0.0470	0.0475	0.0000	409.68	0.00	409.68	0.331004959	11/1/1984 17:40	0.001
8.00	480	0.021	12.81	1505.60	0.0214	0.0262	0.0475	0.0000	393.98	0.00	393.98	12.81427851	11/1/1984 17:50	0.021
8.17	490	0.050	29.73	1535.33	0.0475	0.0000	0.0475	0.0020	395.19	0.00	395.19	29.72654198	11/1/1984 18:00	0.050
8.33	500	0.059	35.46	1570.79	0.0475	0.0000	0.0475	0.0116	402.13	0.00	402.13	35.45705237	11/1/1984 18:10	0.059
8.50	510	0.062	37.46	1608.24	0.0475	0.0000	0.0475	0.0149	411.07	0.00	411.07	37.45763197	11/1/1984 18:20	0.062
8.67	520	0.074	44.67	1652.91	0.0475	0.0000	0.0475	0.0269	427.23	0.00	427.23	44.67062384	11/1/1984 18:30	0.074
8.83	530	0.089	53.67	1706.58	0.0475	0.0000	0.0475	0.0419	452.38	0.00	452.38	53.66992088	11/1/1984 18:40	0.089
9.00	540	0.095	56.85	1763.44	0.0475	0.0000	0.0475	0.0472	480.72	0.00	480.72	56.85265588	11/1/1984 18:50	0.095
9.17	550	0.097	58.09	1821.53	0.0475	0.0000	0.0475	0.0493	510.29	0.00	510.29	58.08915945	11/1/1984 19:00	0.097
9.33	560	0.109	65.25	1886.78	0.0475	0.0000	0.0475	0.0612	547.03	0.00	547.03	65.25268773	11/1/1984 19:10	0.109
9.50	570	0.080	48.03	1934.81	0.0475	0.0000	0.0475	0.0325	566.54	0.00	566.54	48.0283904	11/1/1984 19:20	0.080
9.67	580	0.049	29.20	1964.01	0.0475	0.0000	0.0475	0.0011	567.23	0.00	567.23	29.20093819	11/1/1984 19:30	0.049
9.83	590	0.049	29.53	1993.54	0.0475	0.0000	0.0475	0.0017	568.25	0.00	568.25	29.53364677	11/1/1984 19:40	0.049
10.00	600	0.038	23.07	2016.61	0.0384	0.0091	0.0475	0.0000	562.80	0.00	562.80	23.06998223	11/1/1984 19:50	0.038
10.17	610	0.024	14.31	2030.92	0.0238	0.0237	0.0475	0.0000	548.60	0.00	548.60	14.3069014	11/1/1984 20:00	0.024
10.33	620	0.019	11.39	2042.31	0.0190	0.0285	0.0475	0.0000	531.47	0.00	531.47	11.3941499	11/1/1984 20:10	0.019
10.50	630	0.051	30.35	2072.66	0.0475	0.0000	0.0475	0.0031	533.31	0.00	533.31	30.34740281	11/1/1984 20:20	0.051
10.67	640	0.072	43.36	2116.02	0.0475	0.0000	0.0475	0.0247	548.15	0.00	548.15	43.36226966	11/1/1984 20:30	0.072
10.83	650	0.057	34.45	2150.47	0.0475	0.0000	0.0475	0.0099	554.09	0.00	554.09	34.44910265	11/1/1984 20:40	0.057
11.00	660	0.030	18.16	2168.63	0.0303	0.0173	0.0475	0.0000	543.73	0.00	543.73	18.15574833	11/1/1984 20:50	0.030
11.17	670	0.021	12.73	2181.36	0.0212	0.0263	0.0475	0.0000	527.95	0.00	527.95	12.73221472	11/1/1984 21:00	0.021
11.33	680	0.018	10.92	2192.28	0.0182	0.0293	0.0475	0.0000	510.35	0.00	510.35	10.92437018	11/1/1984 21:10	0.018
11.50	690	0.006	3.64	2195.93	0.0061	0.0415	0.0475	0.0000	485.48	0.00	485.48	3.641456727	11/1/1984 21:20	0.006
11.67	700	0.013	7.90	2203.83	0.0132	0.0344	0.0475	0.0000	464.87	0.00	464.87	7.90161	11/1/1984 21:30	0.013
11.83	710	0.027	16.02	2219.84	0.0267	0.0208	0.0475	0.0000	452.37	0.00	452.37	16.01685421	11/1/1984 21:40	0.027
12.00	720	0.020	12.03	2231.88	0.0201	0.0275	0.0475	0.0000	435.89	0.00	435.89	12.03414452	11/1/1984 21:50	0.020
12.17	730	0.018	10.71	2242.59	0.0179	0.0297	0.0475	0.0000	418.09	0.00	418.09	10.71388771	11/1/1984 22:00	0.018
12.33	740	0.017	10.27	2252.87	0.0171	0.0304	0.0475	0.0000	399.85	0.00	399.85	10.27380211	11/1/1984 22:10	0.017
12.50	750	0.006	3.42	2256.29	0.0057	0.0418	0.0475	0.0000	374.75	0.00	374.75	3.424600704	11/1/1984 22:20	0.006
12.67	760	0.002	1.14	2257.43	0.0019	0.0456	0.0475	0.0000	347.38	0.00	347.38	1.141533568	11/1/1984 22:30	0.002
12.83	770	0.001	0.38	2257.81	0.0006	0.0469	0.0475	0.0000	319.25	0.00	319.25	0.380511189	11/1/1984 22:40	0.001
13.00	780	0.000	0.13	2257.94	0.0002	0.0473	0.0475	0.0000	290.86	0.00	290.86	0.126837063	11/1/1984 22:50	0.000
13.17	790	0.000	0.04	2257.98	0.0001	0.0475	0.0475	0.0000	262.39	0.00	262.39	0.042279021	11/1/1984 23:00	0.000
13.33	800	0.011	6.72	2264.71	0.0112	0.0363	0.0475	0.0000	240.59	0.00	240.59	6.723824864	11/1/1984 23:10	0.011
13.50	810	0.026	15.67	2280.37	0.0261	0.0214	0.0475	0.0000	227.75	0.00	227.75	15.66787833	11/1/1984 23:20	0.026
13.67	820	0.031	18.66	2299.04	0.0311	0.0164	0.0475	0.0000	217.90	0.00	217.90	18.66342426	11/1/1984 23:30	0.031
13.83	830	0.022	12.95	2311.98	0.0216	0.0260	0.0475	0.0000	202.32	0.00	202.32	12.94506805	11/1/1984 23:40	0.022
14.00	840	0.007	4.32	2316.30	0.0072	0.0403	0.0475	0.0000	178.12	0.00	178.12	4.315022683	11/1/1984 23:50	0.007
14.17	850	0.002	1.44	2317.74	0.0024	0.0451	0.0475	0.0000	151.05	0.00	151.05	1.438340894	11/2/1984 0:00	0.002
14.33	860	0.001	0.48	2318.21	0.0008	0.0467	0.0475	0.0000	123.01	0.00	123.01	0.479446965	11/2/1984 0:10	0.001
14.50	870	0.000	0.16	2318.37	0.0003	0.0473	0.0475	0.0000	94.66	0.00	94.66	0.159815655	11/2/1984 0:20	0.000
14.67	880	0.000	0.05	2318.43	0.0001	0.0474	0.0475	0.0000	66.19	0.00	66.19	0.053271885	11/2/1984 0:30	0.000
14.83	890	0.011	6.75	2325.18	0.0112	0.0363	0.0475	0.0000	44.43	0.00	44.43	6.748655864	11/2/1984 0:40	0.011
15.00	900	0.026	15.72	2340.89	0.0262	0.0213	0.0475	0.0000	31.63	0.00	31.63	15.71823923	11/2/1984 0:50	0.026
15.17	910	0.031	18.72	2359.62	0.0312	0.0163	0.0475	0.0000	21.84	0.00	21.84	18.72180016	11/2/1984 1:00	0.031
15.33	920	0.022	12.99	2372.60	0.0216	0.0259	0.0475	0.0000	6.31	0.00	6.31	12.98519843	11/2/1984 1:10	0.022
15.50	930	0.018	11.08	2383.68	0.0185	0.0291	0.0475	0.0000	-11.13	0.00	0.00	11.07972836	11/2/1984 1:20	0.018
15.67	940	0.029	17.20	2400.88	0.0287	0.0000	0.0287	0.0000	0.00	0.00	0.00	17.20255319	11/2/1984 1:30	0.029
15.83	950	0.021	12.49	2413.38	0.0208	0.0000	0.0208	0.0000	0.00	0.00	0.00	12.49216591	11/2/1984 1:40	0.021
16.00	960	0.007	4.16	2417.54	0.0069	0.0000	0.0069	0.0000	0.00	0.00	0.00	4.164055302	11/2/1984 1:50	0.007
16.17	970	0.002	1.39	2418.93	0.0023	0.0000	0.0023	0.0000	0.00	0.00	0.00	1.388018434	11/2/1984 2:00	0.002
16.33	980	0.001	0.46	2419.39	0.0008	0.0000	0.0008	0.0000	0.00	0.00	0.00	0.462672811	11/2/1984 2:10	0.001
16.50	990	0.000	0.15	2419.55	0.0003	0.0000	0.0003	0.0000	0.00	0.00	0.00	0.15422427	11/2/1984 2:20	0.000
16.67	1000	0.011	6.82	2426.36	0.0114	0.0000	0.0114	0.0000	0.00	0.00	0.00	6.81596559	11/2/1984 2:30	0.011
16.83	1010	0.015	9.04	2435.40	0.0151	0.0000	0.0151	0.0000	0.00	0.00	0.00	9.03654603	11/2/1984 2:40	0.015
17.00	1020	0.005	3.01	2438.41	0.0050	0.0000	0.0050	0.0000	0.00	0.00	0.00	3.01218201	11/2/1984 2:50	0.005
17.17	1030	0.036	21.34	2459.75	0.0356	0.0000	0.0356	0.0000	0.00	0.00	0.00	21.33644097	11/2/1984 3:00	0.036
17.33	1040	0.057	34.23	2493.98	0.0475	0.0000	0.0475	0.0095	5.72	0.00	5.72	34.2346465	11/2/1984 3:10	0.057
17.50	1050	0.064	38.61	2532.59	0.0475	0.0000	0.0475	0.0168	15.81	0.00	15.81	38.60901216	11/2/1984 3:20	0.064
17.67	1060	0.090	53.74	2586.33	0.0475	0.0000	0.0475	0.0420	41.04	0.00	41.04	53.73840931	11/2/1984 3:30	0.090
17.83	1070	0.087	52.04	2638.37	0.0475	0.0000	0.0475	0.0392	64.57	0.00	64.57	52.04427864	11/2/1984 3:40	0.087
18.00	1080	0.086	51.57	2689.94	0.0475	0.0000	0.0475	0.0384	87.62	0.00	87.62	51.56576199	11/2/1984 3:50	0.086
18.17	1090	0.086	51.46	2741.40	0.0475	0.0000	0.0475	0.0382	110.56	0.00	110.56	51.46217019	11/2/1984 4:00	0.086
18.33	1100	0.063	37.75	2779.15	0.0475	0.0000	0.0475	0.0154	119.80	0.00	119.80	37.75115306	11/2/1984 4:10	0.063
18.50	1110	0.032	19.45	2798.61	0.0324	0.0151	0.0475	0.0000	110.74	0.00	110.74	19.4548192	11/2/1984 4:20	0.032
18.67	1120	0.011	6.48	2805.09	0.0108	0.0367	0.0475	0.0000	88.71	0.00	88.71	6.484939734	11/2/1984 4:30	0.011
18.83	1130	0.015	9.04	2814.13	0.0151	0.0325	0.0475	0.0000	69.23	0.00	69.23	9.038074298	11/2/1984 4:40	0.015
19.00	1140	0.016	9.89	2824.02	0.0165	0.0310	0.0475	0.0000	50.61	0.00	50.61	9.889119152	11/2/1984 4:50	0.016



19.83	1190	0.067	39.95	2995.34	0.0475	0.0000	0.0475	0.0191	81.38	0.00	81.38	39.95024716	11/2/1984 5:40	0.067	
20.00	1200	0.022	13.32	3008.66	0.0222	0.0253	0.0475	0.0000	66.19	0.00	66.19	13.31674905	11/2/1984 5:50	0.022	
20.17	1210	0.007	4.44	3013.10	0.0074	0.0401	0.0475	0.0000	42.11	0.00	42.11	4.438916352	11/2/1984 6:00	0.007	
20.33	1220	0.026	15.34	3028.44	0.0256	0.0220	0.0475	0.0000	28.93	0.00	28.93	15.33782866	11/2/1984 6:10	0.026	
20.50	1230	0.066	39.79	3068.23	0.0475	0.0000	0.0475	0.0188	40.21	0.00	40.21	39.79322295	11/2/1984 6:20	0.066	
20.67	1240	0.068	41.04	3109.27	0.0475	0.0000	0.0475	0.0209	52.73	0.00	52.73	41.03682138	11/2/1984 6:30	0.068	
20.83	1250	0.034	20.63	3129.90	0.0344	0.0131	0.0475	0.0000	44.85	0.00	44.85	20.62893067	11/2/1984 6:40	0.034	
21.00	1260	0.023	13.83	3143.73	0.0231	0.0245	0.0475	0.0000	30.16	0.00	30.16	13.83081518	11/2/1984 6:50	0.023	
21.17	1270	0.031	18.52	3162.25	0.0309	0.0167	0.0475	0.0000	20.17	0.00	20.17	18.52375145	11/2/1984 7:00	0.031	
21.33	1280	0.068	41.01	3203.26	0.0475	0.0000	0.0475	0.0208	32.67	0.00	32.67	41.01327857	11/2/1984 7:10	0.068	
21.50	1290	0.116	69.50	3272.76	0.0475	0.0000	0.0475	0.0683	73.65	0.00	73.65	69.49861027	11/2/1984 7:20	0.116	
21.67	1300	0.132	79.13	3351.89	0.0475	0.0000	0.0475	0.0844	124.26	0.00	124.26	79.12727626	11/2/1984 7:30	0.132	
21.83	1310	0.114	68.42	3420.31	0.0475	0.0000	0.0475	0.0665	164.17	0.00	164.17	68.41945057	11/2/1984 7:40	0.114	
22.00	1320	0.061	36.84	3457.15	0.0475	0.0000	0.0475	0.0139	172.49	0.00	172.49	36.83689993	11/2/1984 7:50	0.061	
22.17	1330	0.032	19.30	3476.45	0.0322	0.0154	0.0475	0.0000	163.27	0.00	163.27	19.29998862	11/2/1984 8:00	0.032	
22.33	1340	0.022	13.45	3489.90	0.0224	0.0251	0.0475	0.0000	148.21	0.00	148.21	13.45435151	11/2/1984 8:10	0.022	
22.50	1350	0.007	4.48	3494.39	0.0075	0.0401	0.0475	0.0000	124.18	0.00	124.18	4.484783837	11/2/1984 8:20	0.007	
22.67	1360	0.002	1.49	3495.88	0.0025	0.0450	0.0475	0.0000	97.16	0.00	97.16	1.494927946	11/2/1984 8:30	0.002	
22.83	1370	0.001	0.50	3496.38	0.0008	0.0467	0.0475	0.0000	69.15	0.00	69.15	0.498309315	11/2/1984 8:40	0.001	
23.00	1380	0.024	14.22	3510.60	0.0237	0.0238	0.0475	0.0000	54.85	0.00	54.85	14.21959294	11/2/1984 8:50	0.024	
23.17	1390	0.043	25.83	3536.42	0.0430	0.0045	0.0475	0.0000	52.16	0.00	52.16	25.82575075	11/2/1984 9:00	0.043	
23.33	1400	0.026	15.64	3552.06	0.0261	0.0215	0.0475	0.0000	39.29	0.00	39.29	15.64098018	11/2/1984 9:10	0.026	
23.50	1410	0.232	139.50	3691.56	0.0475	0.0000	0.0475	0.1850	150.27	0.00	150.27	139.4988459	11/2/1984 9:20	0.232	0.149998759
23.67	1420	0.349	209.21	3900.77	0.0475	0.0000	0.0475	0.3012	330.96	0.00	330.96	209.2062202	11/2/1984 9:30	0.349	0.224952925
23.83	1430	0.247	148.01	4048.78	0.0475	0.0000	0.0475	0.1992	450.46	0.00	450.46	148.0098299	11/2/1984 9:40	0.247	0.159150355
24.00	1440	0.177	106.32	4155.10	0.0475	0.0000	0.0475	0.1297	528.26	0.00	528.26	106.3230673	11/2/1984 9:50	0.177	
24.17	1450	0.000	0.00	4155.10	0.0000	0.0475	0.0475	0.0000	499.75	0.00	499.75	0	11/2/1984 10:00	0.000	
24.33	1460	0.000	0.00	4155.10	0.0000	0.0475	0.0475	0.0000	471.23	0.00	471.23	0	11/2/1984 10:10	0.000	
24.50	1470	0.000	0.00	4155.10	0.0000	0.0475	0.0475	0.0000	442.72	0.00	442.72	0	11/2/1984 10:20	0.000	
24.67	1480	0.000	0.00	4155.10	0.0000	0.0475	0.0475	0.0000	414.20	0.00	414.20	0	11/2/1984 10:30	0.000	
24.83	1490	0.000	0.00	4155.10	0.0000	0.0475	0.0475	0.0000	385.69	0.00	385.69	0	11/2/1984 10:40	0.000	
25.00	1500	0.000	0.00	4155.10	0.0000	0.0475	0.0475	0.0000	357.17	0.00	357.17	0	11/2/1984 10:50	0.000	
25.17	1510	0.000	0.00	4155.10	0.0000	0.0475	0.0475	0.0000	328.66	0.00	328.66	0	11/2/1984 11:00	0.000	
25.33	1520	0.000	0.00	4155.10	0.0000	0.0475	0.0475	0.0000	300.14	0.00	300.14	0	11/2/1984 11:10	0.000	
25.50	1530	0.000	0.00	4155.10	0.0000	0.0475	0.0475	0.0000	271.63	0.00	271.63	0	11/2/1984 11:20	0.000	
25.67	1540	0.000	0.00	4155.10	0.0000	0.0475	0.0475	0.0000	243.11	0.00	243.11	0	11/2/1984 11:30	0.000	
25.83	1550	0.000	0.00	4155.10	0.0000	0.0475	0.0475	0.0000	214.60	0.00	214.60	0	11/2/1984 11:40	0.000	
26.00	1560	0.000	0.00	4155.10	0.0000	0.0475	0.0475	0.0000	186.08	0.00	186.08	0	11/2/1984 11:50	0.000	
26.17	1570	0.000	0.00	4155.10	0.0000	0.0475	0.0475	0.0000	157.57	0.00	157.57	0	11/2/1984 12:00	0.000	
26.33	1580	0.000	0.00	4155.10	0.0000	0.0475	0.0475	0.0000	129.05	0.00	129.05	0	11/2/1984 12:10	0.000	
26.50	1590	0.000	0.00	4155.10	0.0000	0.0475	0.0475	0.0000	100.54	0.00	100.54	0	11/2/1984 12:20	0.000	
26.67	1600	0.000	0.00	4155.10	0.0000	0.0475	0.0475	0.0000	72.02	0.00	72.02	0	11/2/1984 12:30	0.000	
26.83	1610	0.000	0.00	4155.10	0.0000	0.0475	0.0475	0.0000	43.51	0.00	43.51	0	11/2/1984 12:40	0.000	
27.00	1620	0.000	0.00	4155.10	0.0000	0.0475	0.0475	0.0000	14.99	0.00	14.99	0	11/2/1984 12:50	0.000	
27.17	1630	0.000	0.00	4155.10	0.0000	0.0475	0.0475	0.0000	-13.52	0.00	0.00	0	11/2/1984 13:00	0.000	
27.33	1640	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 13:10	0.000	
27.50	1650	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 13:20	0.000	
27.67	1660	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 13:30	0.000	
27.83	1670	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 13:40	0.000	
28.00	1680	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 13:50	0.000	
28.17	1690	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 14:00	0.000	
28.33	1700	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 14:10	0.000	
28.50	1710	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 14:20	0.000	
28.67	1720	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 14:30	0.000	
28.83	1730	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 14:40	0.000	
29.00	1740	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 14:50	0.000	
29.17	1750	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 15:00	0.000	
29.33	1760	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 15:10	0.000	
29.50	1770	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 15:20	0.000	
29.67	1780	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 15:30	0.000	
29.83	1790	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 15:40	0.000	
30.00	1800	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 15:50	0.000	
30.17	1810	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 16:00	0.000	
30.33	1820	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 16:10	0.000	
30.50	1830	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 16:20	0.000	
30.67	1840	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 16:30	0.000	











Modeling Results for

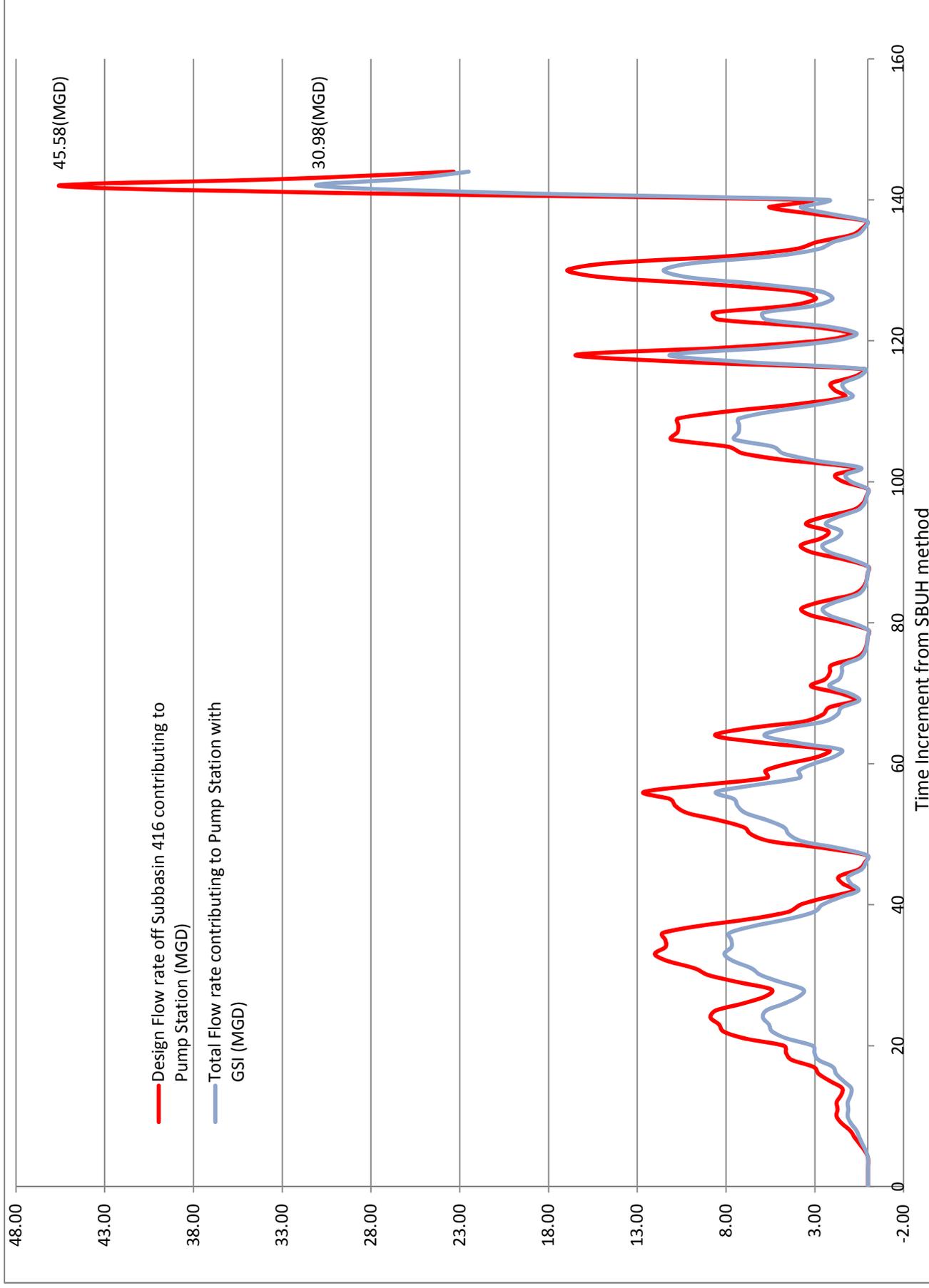
Section 3b

With ROW and Private Parcel Tributary Area



SvR Modeled Subbasin 416 Design Flow Rate to Pump Station during 1984 Storm (assumes ROW and Private Parcel tributary area)

SECTION 3b







**King County CSO**  
**Barton Basin Subbasin 416 GSI Analysis**  
 SvR Project No. 06053  
 Date: 05/11/2010

**Santa Barbara Urban Hydrograph Method (SBUH)**

red text is user entered

Rainfall data provided by King County

conversion from sf to acre

assume that both sides of a street have the same planter width

alleys are assumed to be negligible

a time increment of 9999 indicates that the rain event (provided by King County) has finished

corners at roadway intersections are counted as impervious in the N/S ROW areas

assumes crowned roadway

Typical One Block Characteristics			
Block (N/S) per GIS (lf)	601		
Block (E/W) per GIS (lf)	276		
Private Parcel Area (sf)	165,876	3.81 (ac)	
Roof Area of Private Parcels per Block per GIS (sf)	41,451	0.95 (ac)	
Non Roof Impervious Area of Private Parcels per Block per GIS (sf)	55,937	1.28 (ac)	
Pervious Area of Private Parcels per Block including alleys (sf)	68,488	1.57 (ac)	
ROW width (N/S) (lf)	60		
Planter Width (N/S) (lf)	10		
Width of Impervious in ROW (N/S) (lf)	40		
ROW width (E/W) (lf)	60		
Planter Width (E/W) (lf)	10		
Width of Impervious in ROW (E/W) (lf)	40		
ROW Impervious Area (N/S) (sf)	26440	0.61 (ac)	
ROW Pervious Area (N/S) (sf)	12020	0.28 (ac)	
ROW Impervious Area (E/W) (sf)	11040	0.25 (ac)	
ROW Pervious Area (E/W) (sf)	5520	0.13 (ac)	

	Percentage to RG	Effective Area to RG	CN	Impervious to RG (ac)	Pervious to RG (ac)	Percentage Impervious	Percentage Pervious
<b>PRIVATE PARCEL CHARACTERISTICS</b>							
Block Area to RG (ac)	50%						
Total Roof Area per One Block (ac)	100%						
Roof Area disconnected	60%	0.29	86	0.00	0.29	0.00%	11.26%
Total Non-Roof Impervious Area Per One Block (ac)							
Non-Roof Impervious Area to RG (ac)	50%	0.32	86	0.00	0.32	0.00%	12.66%
Total Pervious Area per One Block (ac)							
Pervious Area to RG (ac)	50%	0.39	86	0.00	0.39	0.00%	15.50%
<b>N/S ROADWAY CHARACTERISTICS</b>							
One N/S ROW to RG per One Block	50%						
Total ROW Impervious Area (N/S) fronting a Block (ac)							
ROW Impervious Area (N/S) to RG (ac)		0.30	98	0.30	0	11.97%	0.00%
Total ROW Pervious Area (N/S) fronting a Block (ac)							
ROW Pervious Area (N/S) to RG (ac)		0.14	86	0	0.14	0.00%	5.44%
<b>E/W ROADWAY CHARACTERISTICS</b>							
One E/W ROW to RG per One Block	50%						
Total ROW Impervious Area (E/W) fronting One Block(ac)							
ROW Impervious Area (E/W) to RG (ac)		0.13	98	0.13	0	5.00%	0.00%
Total ROW Pervious Area (E/W) fronting One Block(ac)							
ROW Pervious Area (E/W) to RG (ac)		0.06	86	0	0.06	0.00%	2.50%
				Impervious to RG (ac)	Pervious to RG (ac)	16.97%	47.36%

Total Areas (ac)	0.43	1.20	Total Area contributing flow to rain garden (ac)	1.63	Total Foot Print Area of Half Block (ac)	2.54
CN	98	86				

**Rainfall Distribution: 1984 Storm** this field needs to be year of storm followed a space then "Storm". Example "1984 Storm"

Max Time Increment 144  
 Pt = 2.39 inches Tc = 10 minutes w = 0.33  
 Sp = 1.63 dt = 10 minutes  
 Si = 0.20

Time Increment	Time	Rainfall Distribution	Incremental Rainfall	Accumulated Rainfall	Pervious Accumulated Runoff	Pervious Area Increment Runoff	Impervious Accumulated Runoff	Impervious Area Incr. Runoff	Total Runoff	Peak Instant Flow rate	Design Flow rate	Difference Between Instant and Design Flow
	(minutes)	(fraction)	(inches)	(inches)	(inches)	(inches)	(inches)	(inches)	(inches)	(cfs)	(cfs)	
0	0	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
1	10	0.0042	0.0100	0.010	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
2	20	0.0042	0.0100	0.020	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
3	30	0.0042	0.0100	0.030	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
4	40	0.0042	0.0100	0.040	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
5	50	0.0126	0.0300	0.070	0.000	0.000	0.004	0.004	0.001	0.01	0.003	0.01
6	60	0.0084	0.0200	0.090	0.000	0.000	0.010	0.006	0.002	0.02	0.009	0.01
7	70	0.0084	0.0200	0.110	0.000	0.000	0.018	0.008	0.002	0.02	0.015	0.01
8	80	0.0084	0.0200	0.130	0.000	0.000	0.027	0.010	0.003	0.03	0.020	0.00
9	90	0.0126	0.0300	0.160	0.000	0.000	0.044	0.017	0.004	0.04	0.030	0.01
10	100	0.0084	0.0200	0.180	0.000	0.000	0.056	0.012	0.003	0.03	0.035	0.00
11	110	0.0084	0.0200	0.200	0.000	0.000	0.070	0.013	0.004	0.03	0.034	0.00
12	120	0.0084	0.0200	0.220	0.000	0.000	0.084	0.014	0.004	0.04	0.035	0.00
13	130	0.0042	0.0100	0.230	0.000	0.000	0.091	0.007	0.002	0.02	0.030	-0.01
14	140	0.0084	0.0200	0.250	0.000	0.000	0.106	0.015	0.004	0.04	0.029	0.01
15	150	0.0126	0.0300	0.280	0.000	0.000	0.129	0.023	0.006	0.06	0.043	0.02
16	160	0.0126	0.0300	0.310	0.000	0.000	0.153	0.024	0.006	0.06	0.055	0.01
17	170	0.0126	0.0300	0.340	0.000	0.000	0.178	0.025	0.007	0.07	0.061	0.00
18	180	0.0209	0.0500	0.390	0.002	0.002	0.220	0.043	0.013	0.13	0.085	0.04
19	190	0.0084	0.0200	0.410	0.004	0.002	0.238	0.017	0.006	0.06	0.090	-0.03
20	200	0.0167	0.0400	0.450	0.009	0.005	0.273	0.035	0.013	0.13	0.091	0.03
21	210	0.0209	0.0500	0.500	0.017	0.008	0.318	0.045	0.018	0.18	0.131	0.04
22	220	0.0167	0.0400	0.540	0.025	0.008	0.354	0.036	0.016	0.15	0.153	0.00
23	230	0.0167	0.0400	0.580	0.034	0.009	0.391	0.037	0.017	0.16	0.157	0.01
24	240	0.0167	0.0400	0.620	0.045	0.011	0.428	0.037	0.018	0.17	0.165	0.01
25	250	0.0126	0.0300	0.650	0.054	0.009	0.456	0.028	0.014	0.14	0.159	-0.02
26	260	0.0084	0.0200	0.670	0.060	0.006	0.475	0.019	0.010	0.09	0.130	-0.04
27	270	0.0084	0.0200	0.690	0.067	0.007	0.494	0.019	0.010	0.10	0.107	-0.01
28	280	0.0084	0.0200	0.710	0.073	0.007	0.513	0.019	0.010	0.10	0.101	0.00
29	290	0.0167	0.0400	0.750	0.088	0.014	0.551	0.038	0.021	0.20	0.134	0.07
30	300	0.0126	0.0300	0.780	0.099	0.011	0.579	0.029	0.016	0.16	0.165	-0.01
31	310	0.0167	0.0400	0.820	0.115	0.016	0.617	0.038	0.022	0.22	0.179	0.04
32	320	0.0167	0.0400	0.860	0.132	0.017	0.656	0.038	0.023	0.22	0.206	0.02
33	330	0.0167	0.0400	0.900	0.150	0.018	0.694	0.038	0.023	0.23	0.219	0.01
34	340	0.0126	0.0300	0.930	0.164	0.014	0.723	0.029	0.018	0.18	0.208	-0.03
35	350	0.0167	0.0400	0.970	0.183	0.019	0.762	0.039	0.024	0.24	0.208	0.03
36	360	0.0126	0.0300	1.000	0.198	0.015	0.791	0.029	0.019	0.18	0.210	-0.03
37	370	0.0084	0.0200	1.020	0.208	0.010	0.810	0.019	0.013	0.12	0.172	-0.05
38	380	0.0042	0.0100	1.030	0.213	0.005	0.820	0.010	0.006	0.06	0.119	-0.06
39	390	0.0042	0.0100	1.040	0.218	0.005	0.830	0.010	0.006	0.06	0.082	-0.02
40	400	0.0042	0.0100	1.050	0.223	0.005	0.839	0.010	0.006	0.06	0.069	-0.01
41	410	0.0000	0.0000	1.050	0.223	0.000	0.839	0.000	0.000	0.00	0.044	-0.04
42	420	0.0000	0.0000	1.050	0.223	0.000	0.839	0.000	0.000	0.00	0.015	-0.01
43	430	0.0042	0.0100	1.060	0.228	0.005	0.849	0.010	0.006	0.06	0.026	0.04
44	440	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	0.030	-0.03
45	450	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	0.010	-0.01
46	460	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	0.003	0.00
47	470	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	0.001	0.00
48	480	0.0084	0.0200	1.080	0.239	0.011	0.869	0.019	0.013	0.13	0.043	0.08
49	490	0.0084	0.0200	1.100	0.250	0.011	0.888	0.019	0.013	0.13	0.100	0.03
50	500	0.0084	0.0200	1.120	0.261	0.011	0.908	0.019	0.013	0.13	0.119	0.01
51	510	0.0084	0.0200	1.140	0.272	0.011	0.927	0.020	0.013	0.13	0.127	0.00
52	520	0.0126	0.0300	1.170	0.288	0.017	0.956	0.029	0.020	0.20	0.152	0.05
53	530	0.0126	0.0300	1.200	0.306	0.017	0.986	0.029	0.020	0.20	0.184	0.02
54	540	0.0126	0.0300	1.230	0.323	0.017	1.015	0.029	0.021	0.20	0.196	0.01
55	550	0.0126	0.0300	1.260	0.341	0.018	1.044	0.029	0.021	0.21	0.202	0.00
56	560	0.0167	0.0400	1.300	0.365	0.024	1.084	0.039	0.028	0.28	0.228	0.05
57	570	0.0000	0.0000	1.300	0.365	0.000	1.084	0.000	0.000	0.00	0.168	-0.17













**King County CSO**  
**Barton Basin Subbasin 416 - GSI Option**  
 SvR Project No. 06053  
 DATE: 05/11/2010

RAIN GARDEN SYSTEM COMPONENTS			
	Infiltration Rate into Native Subgrade (in/hr)		<b>0.50</b>
<b>SECTION 01 RG</b>	1.5	16.67	3.00% (biosoil depth/lf/slope)
	Number of Section 1 Rain Gardens for Basin (ea)		<b>0</b>
	Total Infiltration Area for Section 1 Rain Gardens (sf)*		0
	Storage Capacity for a single Section 1 Rain Garden (cf)		59
	Total Storage Capacity for Section 1 Rain Gardens (cf)		0
<b>SECTION 02 RG</b>	1.5	42	2.00% (biosoil depth/lf/slope)
	Number of Section 2 Rain Gardens for Basin (ea)		<b>0</b>
	Total Infiltration Area for Section 2 Rain Gardens (sf)*		0
	Storage Capacity for a single Section 2 Rain Garden (cf)		232
	Total Storage Capacity for Section 2 Rain Gardens (cf)		0
<b>SECTION 03 RG</b>	1.5	42	2.00% (biosoil depth/lf/slope)
	Number of Section 3 Rain Gardens for Basin (ea)		<b>9</b>
	Total Infiltration Area for Section 3 Rain Gardens (sf)*		4106
	Storage Capacity for a single Section 3 Rain Garden (cf)		451
	Total Storage Capacity for Section 3 Rain Gardens (cf)		4057

**CONVERSION FACTORS**

conversion factor from cfs to MGD: 0.6452  
 conversion factor from cfs to cf/per time step: 600

**Routing Flow through Rain Garden to Estimate Flow Reduction by Half Block**

**Results Summary**

Total Volume of Runoff Removed of entire storm event duration (cf) 7,907 (per GSI half block)  
 Total Volume of Runoff Removed of entire storm event duration (gal) 59141.60 (per GSI half block)  
 Total volume of runoff removed from 8:50 to 9:50 of the 1984 storm 8916.294175 (gal per GSI half block)  
 247504.7162 (gal)

**Rainfall Distribution: 1984 Storm**

**RAIN GARDEN SYSTEM SUMMARY**

Total Infiltration Flow (cfs) 0.0475  
 Total Swale Storage Capacity (cf) 4057.5

Flow reduction from subbasin 416 (MGD) **14.6** per John Phillips  
 Flow reduction from assumed half block at peak flow(MGD) 0.52596127

**Number of half blocks needed to get total flow reduction out of subbasin 416 27.8**

Time (hours)	Time (minutes)	Design Flow Rate from Rain Event (cfs)	Inflow Water Volume (cf)	Inflow Cumm. Volume (cf)	Check if inflow infiltrates	Initial Exfiltration to Native Subgrade of Inflow (cfs)	Check if storage infiltrates	Infiltration into Native Subgrade of Stored Water (cfs)	Total Infiltration into Native Subgrade (cfs)	Inflow to Swale After Infiltration into Native Subgrade (cfs)	Swale Storage before Overflow Volume (cf)	Overtop Flow to Pump Station (cfs)	Runoff Stored in Swale Storage Volume (cf)	Volume of Runoff Removed From Pump Station (cf)	Date & Time	Amount Flow Reduced to Pump Station (cfs)	Amount Flow Reduced to Pump Station (MGD)
0	0	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0			
0.17	10	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:00	0.000	
0.33	20	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:10	0.000	
0.50	30	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:20	0.000	
0.67	40	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:30	0.000	
0.83	50	0.003	1.90	1.90	0.0032	0.0000	0.0000	0.0032	0.0032	0.0000	0.00	0.00	0.00	1.900626807	11/1/1984 10:40	0.003	
1.00	60	0.009	5.61	7.51	0.0093	0.0000	0.0000	0.0093	0.0093	0.0000	0.00	0.00	0.00	5.605567335	11/1/1984 10:50	0.009	
1.17	70	0.015	9.09	16.59	0.0151	0.0000	0.0000	0.0151	0.0151	0.0000	0.00	0.00	0.00	9.085690673	11/1/1984 11:00	0.015	
1.33	80	0.020	12.17	28.77	0.0203	0.0000	0.0000	0.0203	0.0203	0.0000	0.00	0.00	0.00	12.17466638	11/1/1984 11:10	0.020	
1.50	90	0.030	17.81	46.58	0.0297	0.0000	0.0000	0.0297	0.0297	0.0000	0.00	0.00	0.00	17.8143958	11/1/1984 11:20	0.030	
1.67	100	0.035	21.20	67.78	0.0353	0.0000	0.0000	0.0353	0.0353	0.0000	0.00	0.00	0.00	21.19743158	11/1/1984 11:30	0.035	
1.83	110	0.034	20.50	88.28	0.0342	0.0000	0.0000	0.0342	0.0342	0.0000	0.00	0.00	0.00	20.50300898	11/1/1984 11:40	0.034	
2.00	120	0.035	21.06	109.35	0.0351	0.0000	0.0000	0.0351	0.0351	0.0000	0.00	0.00	0.00	21.06473615	11/1/1984 11:50	0.035	
2.17	130	0.030	18.09	127.43	0.0301	0.0000	0.0000	0.0301	0.0301	0.0000	0.00	0.00	0.00	18.08536098	11/1/1984 12:00	0.030	
2.33	140	0.029	17.54	144.97	0.0292	0.0000	0.0000	0.0292	0.0292	0.0000	0.00	0.00	0.00	17.53865912	11/1/1984 12:10	0.029	
2.50	150	0.043	25.66	170.63	0.0428	0.0000	0.0000	0.0428	0.0428	0.0000	0.00	0.00	0.00	25.6553555	11/1/1984 12:20	0.043	
2.67	160	0.055	33.13	203.76	0.0475	0.0000	0.0000	0.0475	0.0077	4.62	4.62	0.00	4.62	33.13403255	11/1/1984 12:30	0.055	
2.83	170	0.061	36.63	240.39	0.0475	0.0000	0.0000	0.0475	0.0135	12.73	12.73	0.00	12.73	36.63065266	11/1/1984 12:40	0.061	
3.00	180	0.085	50.79	291.18	0.0475	0.0000	0.0000	0.0475	0.0371	35.01	35.01	0.00	35.01	50.79371058	11/1/1984 12:50	0.085	
3.17	190	0.090	53.97	345.16	0.0475	0.0000	0.0000	0.0475	0.0424	60.47	60.47	0.00	60.47	53.97339262	11/1/1984 13:00	0.090	
3.33	200	0.091	54.66	399.82	0.0475	0.0000	0.0000	0.0475	0.0436	86.62	86.62	0.00	86.62	54.66401283	11/1/1984 13:10	0.091	
3.50	210	0.131	78.42	478.24	0.0475	0.0000	0.0000	0.0475	0.0832	136.52	136.52	0.00	136.52	78.41902389	11/1/1984 13:20	0.131	
3.67	220	0.153	91.89	570.13	0.0475	0.0000	0.0000	0.0475	0.1056	199.90	199.90	0.00	199.90	91.89092043	11/1/1984 13:30	0.153	
3.83	230	0.157	94.20	664.33	0.0475	0.0000	0.0000	0.0475	0.1095	265.58	265.58	0.00	265.58	94.19797599	11/1/1984 13:40	0.157	
4.00	240	0.165	99.16	763.49	0.0475	0.0000	0.0000	0.0475	0.1177	336.22	336.22	0.00	336.22	99.15660697	11/1/1984 13:50	0.165	
4.17	250	0.159	95.35	858.83	0.0475	0.0000	0.0000	0.0475	0.1114	403.05	403.05	0.00	403.05	95.34640582	11/1/1984 14:00	0.159	
4.33	260	0.130	78.02	936.85	0.0475	0.0000	0.0000	0.0475	0.0825	452.56	452.56	0.00	452.56	78.02086674	11/1/1984 14:10	0.130	
4.50	270	0.107	64.10	1000.96	0.0475	0.0000	0.0000	0.0475	0.0593	488.14	488.14	0.00	488.14	64.10279216	11/1/1984 14:20	0.107	
4.67	280	0.101	60.31	1061.27	0.0475	0.0000	0.0000	0.0475	0.0530	519.94	519.94	0.00	519.94	60.31251706	11/1/1984 14:30	0.101	
4.83	290	0.134	80.35	1141.62	0.0475	0.0000	0.0000	0.0475	0.0864	571.77	571.77	0.00	571.77	80.34751225	11/1/1984 14:40	0.134	
5.00	300	0.165	98.77	1240.38	0.0475	0.0000	0.0000	0.0475	0.1171	642.02	642.02	0.00	642.02	98.76706303	11/1/1984 14:50	0.165	
5.17	310	0.179	107.50	1347.88	0.0475	0.0000	0.0000	0.0475	0.1316	721.01	721.01	0.00	721.01	107.5018434	11/1/1984 15:00	0.179	
5.33	320	0.206	123.51	1471.40	0.0475	0.0000	0.0000	0.0475	0.1583	816.01	816.01	0.00	816.01	123.5106495	11/1/1984 15:10	0.206	
5.50	330	0.219	131.49	1602.89	0.0475	0.0000	0.0000	0.0475	0.1716	918.98	918.98	0.00	918.98	131.4936174	11/1/1984 15:20	0.219	
5.67	340	0.208	124.79	1727.68	0.0475	0.0000	0.0000	0.0475	0.1605	1015.25	1015.25	0.00	1015.25	124.7867403	11/1/1984 15:30	0.208	
5.83	350	0.208	124.63	1852.30	0.0475	0.0000	0.0000	0.0475	0.1602	1111.37	1111.37	0.00	1111.37	124.6276671	11/1/1984 15:40	0.208	
6.00	360	0.210	126.06	1978.36	0.0475	0.0000	0.0000	0.0475	0.1626	1208.91	1208.91	0.00	1208.91	126.0571051	11/1/1984 15:50	0.210	
6.17	370	0.172	103.41	2081.77	0.0475	0.0000	0.0000	0.0475	0.1248	1283.80	1283.80	0.00	1283.80	103.4069694	11/1/1984 16:00	0.172	
6.33	380	0.119	71.70	2153.46	0.0475	0.0000	0.0000	0.0475	0.0720	1326.98	1326.98	0.00	1326.98	71.69611608	11/1/1984 16:10	0.119	
6.50	390	0.082	48.91	2202.37	0.0475	0.0000	0.0000	0.0475	0.0340	1347.37	1347.37	0.00	1347.37	48.90884629	11/1/1984 16:20	0.082	
6.67	400	0.069	41.44	2243.81	0.0475	0.0000	0.0000	0.0475	0.0215	1360.30	1360.30	0.00	1360.30	41.43876698	11/1/1984 16:30	0.069	
6.83	410	0.044	26.41	2270.22	0.0440	0.0035	0.0000	0.0475	0.0000	1358.19	1358.19	0.00	1358.19	26.41204143	11/1/1984 16:40	0.044	
7.00	420	0.015	8.80	2279.03	0.0147	0.0329	0.0000	0.0475	0.0000	1338.48	1338.48	0.00	1338.48	8.80401381	11/1/1984 16:50	0.015	
7.17	430	0.026	15.60	2294.62	0.0260	0.0215	0.0000	0.0475	0.0000	1325.56	1325.56	0.00	1325.56	15.59538824	11/1/1984 17:00	0.026	



7.33	440	0.030	17.86	2312.48	0.0298	0.0178	0.0475	0.0000	1314.90	0.00	1314.90	17.85917971	11/1/1984 17:10	0.030
7.50	450	0.010	5.95	2318.43	0.0099	0.0376	0.0475	0.0000	1292.34	0.00	1292.34	5.953059904	11/1/1984 17:20	0.010
7.67	460	0.003	1.98	2320.42	0.0033	0.0442	0.0475	0.0000	1265.81	0.00	1265.81	1.984353301	11/1/1984 17:30	0.003
7.83	470	0.001	0.66	2321.08	0.0011	0.0464	0.0475	0.0000	1237.96	0.00	1237.96	0.6614511	11/1/1984 17:40	0.001
8.00	480	0.043	25.72	2346.80	0.0429	0.0047	0.0475	0.0000	1235.16	0.00	1235.16	25.72349642	11/1/1984 17:50	0.043
8.17	490	0.100	59.82	2406.62	0.0475	0.0000	0.0475	0.0522	1266.47	0.00	1266.47	59.81741393	11/1/1984 18:00	0.100
8.33	500	0.119	71.65	2478.27	0.0475	0.0000	0.0475	0.0719	1309.60	0.00	1309.60	71.6497663	11/1/1984 18:10	0.119
8.50	510	0.127	76.05	2554.32	0.0475	0.0000	0.0475	0.0792	1357.13	0.00	1357.13	76.04967545	11/1/1984 18:20	0.127
8.67	520	0.152	91.25	2645.57	0.0475	0.0000	0.0475	0.1046	1419.87	0.00	1419.87	91.24862698	11/1/1984 18:30	0.152
8.83	530	0.184	110.30	2755.87	0.0475	0.0000	0.0475	0.1363	1501.65	0.00	1501.65	110.2975133	11/1/1984 18:40	0.184
9.00	540	0.196	117.58	2873.45	0.0475	0.0000	0.0475	0.1484	1590.71	0.00	1590.71	117.5802183	11/1/1984 18:50	0.196
9.17	550	0.202	120.91	2994.35	0.0475	0.0000	0.0475	0.1540	1683.11	0.00	1683.11	120.9069794	11/1/1984 19:00	0.202
9.33	560	0.228	136.81	3131.16	0.0475	0.0000	0.0475	0.1805	1791.40	0.00	1791.40	136.8091982	11/1/1984 19:10	0.228
9.50	570	0.168	101.03	3232.20	0.0475	0.0000	0.0475	0.1209	1863.92	0.00	1863.92	101.0324817	11/1/1984 19:20	0.168
9.67	580	0.103	61.66	3293.86	0.0475	0.0000	0.0475	0.0552	1897.07	0.00	1897.07	61.66489707	11/1/1984 19:30	0.103
9.83	590	0.104	62.60	3356.46	0.0475	0.0000	0.0475	0.0568	1931.15	0.00	1931.15	62.60238865	11/1/1984 19:40	0.104
10.00	600	0.082	49.03	3405.49	0.0475	0.0000	0.0475	0.0342	1951.67	0.00	1951.67	49.03102999	11/1/1984 19:50	0.082
10.17	610	0.051	30.45	3435.94	0.0475	0.0000	0.0475	0.0032	1953.60	0.00	1953.60	30.44722397	11/1/1984 20:00	0.051
10.33	620	0.040	24.30	3460.24	0.0405	0.0070	0.0475	0.0000	1949.38	0.00	1949.38	24.29564605	11/1/1984 20:10	0.040
10.50	630	0.108	64.94	3525.18	0.0475	0.0000	0.0475	0.0607	1985.80	0.00	1985.80	64.93806144	11/1/1984 20:20	0.108
10.67	640	0.155	93.01	3618.18	0.0475	0.0000	0.0475	0.1075	2050.29	0.00	2050.29	93.00716016	11/1/1984 20:30	0.155
10.83	650	0.123	74.07	3692.25	0.0475	0.0000	0.0475	0.0759	2095.84	0.00	2095.84	74.06515819	11/1/1984 20:40	0.123
11.00	660	0.065	39.08	3731.33	0.0475	0.0000	0.0475	0.0176	2106.41	0.00	2106.41	39.08295923	11/1/1984 20:50	0.065
11.17	670	0.046	27.46	3758.79	0.0458	0.0018	0.0475	0.0000	2105.36	0.00	2105.36	27.4619378	11/1/1984 21:00	0.046
11.33	680	0.039	23.59	3782.38	0.0393	0.0082	0.0475	0.0000	2100.43	0.00	2100.43	23.588264	11/1/1984 21:10	0.039
11.50	690	0.013	7.86	3790.24	0.0131	0.0344	0.0475	0.0000	2079.78	0.00	2079.78	7.862754665	11/1/1984 21:20	0.013
11.67	700	0.028	17.09	3807.34	0.0285	0.0190	0.0475	0.0000	2068.36	0.00	2068.36	17.09446975	11/1/1984 21:30	0.028
11.83	710	0.058	34.68	3842.02	0.0475	0.0000	0.0475	0.0103	2074.52	0.00	2074.52	34.68408837	11/1/1984 21:40	0.058
12.00	720	0.043	26.07	3868.10	0.0435	0.0041	0.0475	0.0000	2072.08	0.00	2072.08	26.07374306	11/1/1984 21:50	0.043
12.17	730	0.039	23.24	3891.34	0.0387	0.0088	0.0475	0.0000	2066.81	0.00	2066.81	23.24202522	11/1/1984 22:00	0.039
12.33	740	0.037	22.30	3913.64	0.0372	0.0104	0.0475	0.0000	2060.59	0.00	2060.59	22.29811927	11/1/1984 22:10	0.037
12.50	750	0.012	7.43	3921.07	0.0124	0.0351	0.0475	0.0000	2039.51	0.00	2039.51	7.432706422	11/1/1984 22:20	0.012
12.67	760	0.004	2.48	3923.55	0.0041	0.0434	0.0475	0.0000	2013.47	0.00	2013.47	2.477568807	11/1/1984 22:30	0.004
12.83	770	0.001	0.83	3924.37	0.0014	0.0461	0.0475	0.0000	1985.78	0.00	1985.78	0.825856269	11/1/1984 22:40	0.001
13.00	780	0.000	0.28	3924.65	0.0005	0.0471	0.0475	0.0000	1957.54	0.00	1957.54	0.275285423	11/1/1984 22:50	0.000
13.17	790	0.000	0.09	3924.74	0.0002	0.0474	0.0475	0.0000	1929.12	0.00	1929.12	0.091761808	11/1/1984 23:00	0.000
13.33	800	0.024	14.62	3939.36	0.0244	0.0232	0.0475	0.0000	1915.22	0.00	1915.22	14.61933703	11/1/1984 23:10	0.024
13.50	810	0.057	34.09	3973.45	0.0475	0.0000	0.0475	0.0093	1920.79	0.00	1920.79	34.0881654	11/1/1984 23:20	0.057
13.67	820	0.068	40.65	4014.10	0.0475	0.0000	0.0475	0.0202	1932.93	0.00	1932.93	40.65246943	11/1/1984 23:30	0.068
13.83	830	0.047	28.21	4042.31	0.0470	0.0005	0.0475	0.0000	1932.63	0.00	1932.63	28.21426748	11/1/1984 23:40	0.047
14.00	840	0.016	9.40	4051.72	0.0157	0.0319	0.0475	0.0000	1913.52	0.00	1913.52	9.404755826	11/1/1984 23:50	0.016
14.17	850	0.005	3.13	4054.85	0.0052	0.0423	0.0475	0.0000	1888.14	0.00	1888.14	3.134918609	11/2/1984 0:00	0.005
14.33	860	0.002	1.04	4055.90	0.0017	0.0458	0.0475	0.0000	1860.67	0.00	1860.67	1.04497287	11/2/1984 0:10	0.002
14.50	870	0.001	0.35	4056.25	0.0006	0.0469	0.0475	0.0000	1832.50	0.00	1832.50	0.34832429	11/2/1984 0:20	0.001
14.67	880	0.000	0.12	4056.36	0.0002	0.0473	0.0475	0.0000	1804.10	0.00	1804.10	0.116108097	11/2/1984 0:30	0.000
14.83	890	0.025	14.74	4071.10	0.0246	0.0230	0.0475	0.0000	1790.32	0.00	1790.32	14.73888167	11/2/1984 0:40	0.025
15.00	900	0.057	34.35	4105.45	0.0475	0.0000	0.0475	0.0097	1796.16	0.00	1796.16	34.34965272	11/2/1984 0:50	0.057
15.17	910	0.068	40.96	4146.41	0.0475	0.0000	0.0475	0.0207	1808.60	0.00	1808.60	40.95885028	11/2/1984 1:00	0.068
15.33	920	0.047	28.43	4174.84	0.0474	0.0002	0.0475	0.0000	1808.51	0.00	1808.51	28.42540294	11/2/1984 1:10	0.047
15.50	930	0.040	24.28	4199.12	0.0405	0.0071	0.0475	0.0000	1804.28	0.00	1804.28	24.28313802	11/2/1984 1:20	0.040
15.67	940	0.063	37.75	4236.86	0.0475	0.0000	0.0475	0.0154	1813.51	0.00	1813.51	37.74555447	11/2/1984 1:30	0.063
15.83	950	0.046	27.43	4264.29	0.0457	0.0018	0.0475	0.0000	1812.42	0.00	1812.42	27.4250229	11/2/1984 1:40	0.046
16.00	960	0.015	9.14	4273.43	0.0152	0.0323	0.0475	0.0000	1793.04	0.00	1793.04	9.141674302	11/2/1984 1:50	0.015
16.17	970	0.005	3.05	4276.48	0.0051	0.0424	0.0475	0.0000	1767.57	0.00	1767.57	3.047224767	11/2/1984 2:00	0.005
16.33	980	0.002	1.02	4277.49	0.0017	0.0458	0.0475	0.0000	1740.08	0.00	1740.08	1.015741589	11/2/1984 2:10	0.002
16.50	990	0.001	0.34	4277.83	0.0006	0.0470	0.0475	0.0000	1711.90	0.00	1711.90	0.33858053	11/2/1984 2:20	0.001
16.67	1000	0.025	14.99	4292.82	0.0250	0.0225	0.0475	0.0000	1698.37	0.00	1698.37	14.9908217	11/2/1984 2:30	0.025
16.83	1010	0.033	19.87	4312.70	0.0331	0.0144	0.0475	0.0000	1689.73	0.00	1689.73	19.87490209	11/2/1984 2:40	0.033
17.00	1020	0.011	6.62	4319.32	0.0110	0.0365	0.0475	0.0000	1667.84	0.00	1667.84	6.624967362	11/2/1984 2:50	0.011
17.17	1030	0.078	47.05	4366.37	0.0475	0.0000	0.0475	0.0309	1686.37	0.00	1686.37	47.04725269	11/2/1984 3:00	0.078
17.33	1040	0.126	75.53	4441.91	0.0475	0.0000	0.0475	0.0784	1733.39	0.00	1733.39	75.53480112	11/2/1984 3:10	0.126
17.50	1050	0.142	85.43	4527.33	0.0475	0.0000	0.0475	0.0949	1790.31	0.00	1790.31	85.42859048	11/2/1984 3:20	0.142
17.67	1060	0.199	119.24	4646.57	0.0475	0.0000	0.0475	0.1512	1881.03	0.00	1881.03	119.2375802	11/2/1984 3:30	0.199
17.83	1070	0.193	115.78	4762.35	0.0475	0.0000	0.0475	0.1454	1968.29	0.00	1968.29	115.7754693	11/2/1984 3:40	0.193
18.00	1080	0.192	115.08	4877.43	0.0475	0.0000	0.0475	0.1443	2054.85	0.00	2054.85	115.0813695	11/2/1984 3:50	0.192
18.17	1090	0.192	115.15	4992.58	0.0475	0.0000	0.0475	0.1444	2141.49	0.00	2141.49	115.1488475	11/2/1984 4:00	0.192
18.33	1100	0.141	84.63	5077.21	0.0475	0.0000	0.0475	0.0935	2197.60	0.00	2197.60	84.63226049	11/2/1984 4:10	0.141
18.50	1110	0.073	43.66	5120.87	0.0475	0.0000	0.0475	0.0252	2212.74	0.00	2212.74	43.65612424	11/2/1984 4:20	0.073
18.67	1120	0.024	14.55	5135.42	0.0243	0.0233	0.0475	0.0000	2198.78	0.00	2198.78	14.55204141	11/2/1984 4:30	0.024
18.83	1130	0.034	20.32	5155.74	0.0339	0.0137	0.0475	0.0000	2190.59	0.00				



19.83	1190	0.151	90.46	5565.40	0.0475	0.0000	0.0475	0.1032	2429.15	0.00	2429.15	90.45847505	11/2/1984 5:40	0.151
20.00	1200	0.050	30.15	5595.55	0.0475	0.0000	0.0475	0.0027	2430.79	0.00	2430.79	30.15282502	11/2/1984 5:50	0.050
20.17	1210	0.017	10.05	5605.60	0.0168	0.0308	0.0475	0.0000	2412.32	0.00	2412.32	10.05094167	11/2/1984 6:00	0.017
20.33	1220	0.058	34.86	5640.47	0.0475	0.0000	0.0475	0.0106	2418.67	0.00	2418.67	34.86452382	11/2/1984 6:10	0.058
20.50	1230	0.151	90.60	5731.06	0.0475	0.0000	0.0475	0.1035	2480.75	0.00	2480.75	90.59664165	11/2/1984 6:20	0.151
20.67	1240	0.156	93.53	5824.59	0.0475	0.0000	0.0475	0.1084	2545.77	0.00	2545.77	93.52971004	11/2/1984 6:30	0.156
20.83	1250	0.078	47.05	5871.64	0.0475	0.0000	0.0475	0.0309	2564.30	0.00	2564.30	47.04647572	11/2/1984 6:40	0.078
21.00	1260	0.053	31.58	5903.22	0.0475	0.0000	0.0475	0.0051	2567.36	0.00	2567.36	31.57647023	11/2/1984 6:50	0.053
21.17	1270	0.071	42.34	5945.55	0.0475	0.0000	0.0475	0.0230	2581.18	0.00	2581.18	42.33828806	11/2/1984 7:00	0.071
21.33	1280	0.157	93.94	6039.50	0.0475	0.0000	0.0475	0.1090	2646.61	0.00	2646.61	93.94241736	11/2/1984 7:10	0.157
21.50	1290	0.266	159.51	6199.00	0.0475	0.0000	0.0475	0.2183	2777.60	0.00	2777.60	159.5055119	11/2/1984 7:20	0.266
21.67	1300	0.303	182.08	6381.09	0.0475	0.0000	0.0475	0.2559	2931.17	0.00	2931.17	182.0844789	11/2/1984 7:30	0.303
21.83	1310	0.263	157.78	6538.86	0.0475	0.0000	0.0475	0.2154	3060.43	0.00	3060.43	157.7777892	11/2/1984 7:40	0.263
22.00	1320	0.142	85.04	6623.90	0.0475	0.0000	0.0475	0.0942	3116.96	0.00	3116.96	85.03978877	11/2/1984 7:50	0.142
22.17	1330	0.074	44.60	6668.51	0.0475	0.0000	0.0475	0.0268	3133.04	0.00	3133.04	44.60183741	11/2/1984 8:00	0.074
22.33	1340	0.052	31.12	6699.63	0.0475	0.0000	0.0475	0.0043	3135.65	0.00	3135.65	31.12252028	11/2/1984 8:10	0.052
22.50	1350	0.017	10.37	6710.00	0.0173	0.0302	0.0475	0.0000	3117.51	0.00	3117.51	10.37417343	11/2/1984 8:20	0.017
22.67	1360	0.006	3.46	6713.46	0.0058	0.0418	0.0475	0.0000	3092.45	0.00	3092.45	3.458057809	11/2/1984 8:30	0.006
22.83	1370	0.002	1.15	6714.61	0.0019	0.0456	0.0475	0.0000	3065.09	0.00	3065.09	1.152685936	11/2/1984 8:40	0.002
23.00	1380	0.055	32.96	6747.57	0.0475	0.0000	0.0475	0.0074	3069.53	0.00	3069.53	32.95705328	11/2/1984 8:50	0.055
23.17	1390	0.100	59.88	6807.45	0.0475	0.0000	0.0475	0.0523	3100.89	0.00	3100.89	59.87572031	11/2/1984 9:00	0.100
23.33	1400	0.060	36.28	6843.72	0.0475	0.0000	0.0475	0.0129	3108.65	0.00	3108.65	36.2757847	11/2/1984 9:10	0.060
23.50	1410	0.543	325.78	7169.50	0.0475	0.0000	0.0475	0.4954	3405.91	0.00	3405.91	325.777746	11/2/1984 9:20	0.543
23.67	1420	<b>0.815</b>	<b>489.14</b>	<b>7658.64</b>	<b>0.0475</b>	<b>0.0000</b>	<b>0.0475</b>	<b>0.7677</b>	<b>3866.54</b>	<b>0.00</b>	<b>3866.54</b>	<b>489.1439814</b>	<b>11/2/1984 9:30</b>	<b>0.815</b>
23.83	1430	0.579	347.56	8006.21	0.0475	0.0000	0.0475	0.5317	4185.59	0.21	4057.50	219.4720728	11/2/1984 9:40	0.366
24.00	1440	0.417	250.37	8256.58	0.0475	0.0000	0.0475	0.3698	4279.36	0.37	4057.50	28.51557938	11/2/1984 9:50	0.048
24.17	1450	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	4028.98	0.00	4028.98	0	11/2/1984 10:00	0.000
24.33	1460	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	4000.46	0.00	4000.46	0	11/2/1984 10:10	0.000
24.50	1470	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3971.95	0.00	3971.95	0	11/2/1984 10:20	0.000
24.67	1480	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3943.43	0.00	3943.43	0	11/2/1984 10:30	0.000
24.83	1490	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3914.92	0.00	3914.92	0	11/2/1984 10:40	0.000
25.00	1500	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3886.40	0.00	3886.40	0	11/2/1984 10:50	0.000
25.17	1510	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3857.89	0.00	3857.89	0	11/2/1984 11:00	0.000
25.33	1520	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3829.37	0.00	3829.37	0	11/2/1984 11:10	0.000
25.50	1530	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3800.86	0.00	3800.86	0	11/2/1984 11:20	0.000
25.67	1540	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3772.34	0.00	3772.34	0	11/2/1984 11:30	0.000
25.83	1550	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3743.82	0.00	3743.82	0	11/2/1984 11:40	0.000
26.00	1560	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3715.31	0.00	3715.31	0	11/2/1984 11:50	0.000
26.17	1570	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3686.79	0.00	3686.79	0	11/2/1984 12:00	0.000
26.33	1580	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3658.28	0.00	3658.28	0	11/2/1984 12:10	0.000
26.50	1590	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3629.76	0.00	3629.76	0	11/2/1984 12:20	0.000
26.67	1600	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3601.25	0.00	3601.25	0	11/2/1984 12:30	0.000
26.83	1610	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3572.73	0.00	3572.73	0	11/2/1984 12:40	0.000
27.00	1620	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3544.22	0.00	3544.22	0	11/2/1984 12:50	0.000
27.17	1630	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3515.70	0.00	3515.70	0	11/2/1984 13:00	0.000
27.33	1640	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3487.18	0.00	3487.18	0	11/2/1984 13:10	0.000
27.50	1650	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3458.67	0.00	3458.67	0	11/2/1984 13:20	0.000
27.67	1660	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3430.15	0.00	3430.15	0	11/2/1984 13:30	0.000
27.83	1670	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3401.64	0.00	3401.64	0	11/2/1984 13:40	0.000
28.00	1680	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3373.12	0.00	3373.12	0	11/2/1984 13:50	0.000
28.17	1690	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3344.61	0.00	3344.61	0	11/2/1984 14:00	0.000
28.33	1700	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3316.09	0.00	3316.09	0	11/2/1984 14:10	0.000
28.50	1710	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3287.58	0.00	3287.58	0	11/2/1984 14:20	0.000
28.67	1720	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3259.06	0.00	3259.06	0	11/2/1984 14:30	0.000
28.83	1730	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3230.54	0.00	3230.54	0	11/2/1984 14:40	0.000
29.00	1740	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3202.03	0.00	3202.03	0	11/2/1984 14:50	0.000
29.17	1750	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3173.51	0.00	3173.51	0	11/2/1984 15:00	0.000
29.33	1760	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3145.00	0.00	3145.00	0	11/2/1984 15:10	0.000
29.50	1770	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3116.48	0.00	3116.48	0	11/2/1984 15:20	0.000
29.67	1780	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3087.97	0.00	3087.97	0	11/2/1984 15:30	0.000
29.83	1790	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3059.45	0.00	3059.45	0	11/2/1984 15:40	0.000
30.00	1800	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3030.93	0.00	3030.93	0	11/2/1984 15:50	0.000
30.17	1810	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3002.42	0.00	3002.42	0	11/2/1984 16:00	0.000
30.33	1820	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2973.90	0.00	2973.90	0	11/2/1984 16:10	0.000
30.50	1830	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2945.39	0.00	2945.39	0	11/2/1984 16:20	0.000
30.67	1840	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2916.87	0.00	2916.87	0	11/2/1984 16:30	0.000



30.83	1850	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2888.36	0.00	2888.36	0	11/2/1984 16:40	0.000
31.00	1860	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2859.84	0.00	2859.84	0	11/2/1984 16:50	0.000
31.17	1870	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2831.33	0.00	2831.33	0	11/2/1984 17:00	0.000
31.33	1880	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2802.81	0.00	2802.81	0	11/2/1984 17:10	0.000
31.50	1890	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2774.29	0.00	2774.29	0	11/2/1984 17:20	0.000
31.67	1900	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2745.78	0.00	2745.78	0	11/2/1984 17:30	0.000
31.83	1910	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2717.26	0.00	2717.26	0	11/2/1984 17:40	0.000
32.00	1920	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2688.75	0.00	2688.75	0	11/2/1984 17:50	0.000
32.17	1930	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2660.23	0.00	2660.23	0	11/2/1984 18:00	0.000
32.33	1940	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2631.72	0.00	2631.72	0	11/2/1984 18:10	0.000
32.50	1950	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2603.20	0.00	2603.20	0	11/2/1984 18:20	0.000
32.67	1960	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2574.69	0.00	2574.69	0	11/2/1984 18:30	0.000
32.83	1970	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2546.17	0.00	2546.17	0	11/2/1984 18:40	0.000
33.00	1980	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2517.65	0.00	2517.65	0	11/2/1984 18:50	0.000
33.17	1990	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2489.14	0.00	2489.14	0	11/2/1984 19:00	0.000
33.33	2000	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2460.62	0.00	2460.62	0	11/2/1984 19:10	0.000
33.50	2010	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2432.11	0.00	2432.11	0	11/2/1984 19:20	0.000
33.67	2020	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2403.59	0.00	2403.59	0	11/2/1984 19:30	0.000
33.83	2030	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2375.08	0.00	2375.08	0	11/2/1984 19:40	0.000
34.00	2040	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2346.56	0.00	2346.56	0	11/2/1984 19:50	0.000
34.17	2050	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2318.05	0.00	2318.05	0	11/2/1984 20:00	0.000
34.33	2060	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2289.53	0.00	2289.53	0	11/2/1984 20:10	0.000
34.50	2070	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2261.01	0.00	2261.01	0	11/2/1984 20:20	0.000
34.67	2080	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2232.50	0.00	2232.50	0	11/2/1984 20:30	0.000
34.83	2090	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2203.98	0.00	2203.98	0	11/2/1984 20:40	0.000
35.00	2100	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2175.47	0.00	2175.47	0	11/2/1984 20:50	0.000
35.17	2110	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2146.95	0.00	2146.95	0	11/2/1984 21:00	0.000
35.33	2120	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2118.44	0.00	2118.44	0	11/2/1984 21:10	0.000
35.50	2130	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2089.92	0.00	2089.92	0	11/2/1984 21:20	0.000
35.67	2140	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2061.41	0.00	2061.41	0	11/2/1984 21:30	0.000
35.83	2150	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2032.89	0.00	2032.89	0	11/2/1984 21:40	0.000
36.00	2160	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2004.37	0.00	2004.37	0	11/2/1984 21:50	0.000
36.17	2170	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1975.86	0.00	1975.86	0	11/2/1984 22:00	0.000
36.33	2180	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1947.34	0.00	1947.34	0	11/2/1984 22:10	0.000
36.50	2190	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1918.83	0.00	1918.83	0	11/2/1984 22:20	0.000
36.67	2200	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1890.31	0.00	1890.31	0	11/2/1984 22:30	0.000
36.83	2210	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1861.80	0.00	1861.80	0	11/2/1984 22:40	0.000
37.00	2220	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1833.28	0.00	1833.28	0	11/2/1984 22:50	0.000
37.17	2230	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1804.76	0.00	1804.76	0	11/2/1984 23:00	0.000
37.33	2240	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1776.25	0.00	1776.25	0	11/2/1984 23:10	0.000
37.50	2250	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1747.73	0.00	1747.73	0	11/2/1984 23:20	0.000
37.67	2260	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1719.22	0.00	1719.22	0	11/2/1984 23:30	0.000
37.83	2270	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1690.70	0.00	1690.70	0	11/2/1984 23:40	0.000
38.00	2280	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1662.19	0.00	1662.19	0	11/2/1984 23:50	0.000
38.17	2290	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1633.67	0.00	1633.67	0	1/0/1900 0:00	0.000
38.33	2300	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1605.16	0.00	1605.16	0	1/0/1900 0:00	0.000
38.50	2310	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1576.64	0.00	1576.64	0	1/0/1900 0:00	0.000
38.67	2320	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1548.12	0.00	1548.12	0	1/0/1900 0:00	0.000
38.83	2330	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1519.61	0.00	1519.61	0	1/0/1900 0:00	0.000
39.00	2340	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1491.09	0.00	1491.09	0	1/0/1900 0:00	0.000
39.17	2350	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1462.58	0.00	1462.58	0	1/0/1900 0:00	0.000
39.33	2360	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1434.06	0.00	1434.06	0	1/0/1900 0:00	0.000
39.50	2370	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1405.55	0.00	1405.55	0	1/0/1900 0:00	0.000
39.67	2380	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1377.03	0.00	1377.03	0	1/0/1900 0:00	0.000
39.83	2390	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1348.52	0.00	1348.52	0	1/0/1900 0:00	0.000
40.00	2400	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1320.00	0.00	1320.00	0	1/0/1900 0:00	0.000
40.17	2410	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1291.48	0.00	1291.48	0	1/0/1900 0:00	0.000
40.33	2420	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1262.97	0.00	1262.97	0	1/0/1900 0:00	0.000
40.50	2430	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1234.45	0.00	1234.45	0	1/0/1900 0:00	0.000
40.67	2440	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1205.94	0.00	1205.94	0	1/0/1900 0:00	0.000
40.83	2450	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1177.42	0.00	1177.42	0	1/0/1900 0:00	0.000
41.00	2460	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1148.91	0.00	1148.91	0	1/0/1900 0:00	0.000
41.17	2470	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1120.39	0.00	1120.39	0	1/0/1900 0:00	0.000
41.33	2480	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1091.88	0.00	1091.88	0	1/0/1900 0:00	0.000
41.50	2490	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1063.36	0.00	1063.36	0	1/0/1900 0:00	0.000
41.67	2500	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1034.84	0.00	1034.84	0	1/0/1900 0:00	0.000
41.83	2510	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1006.33	0.00	1006.33	0	1/0/1900 0:00	0.000
42.00	2520	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	977.81	0.00	977.81	0	1/0/1900 0:00	0.000
42.16	2530	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	949.30	0.00	949.30	0	1/0/1900 0:00	0.000
42.33	2540	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	920.78	0.00	920.78	0	1/0/1900 0:00	0.000
42.50	2550	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	892.27	0.00	892.27	0	1/0/1900 0:00	0.000
42.66	2560	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	863.75	0.00	863.75	0	1/0/1900 0:00	0.000
42.83	2570	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	835.24	0.00	835.24	0	1/0/1900 0:00	0.000
43.00	2580	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	806.72	0.00	806.72	0	1/0/1900 0:00	



43.33	2600	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	749.69	0.00	749.69	0	1/0/1900 0:00	0.000
43.50	2610	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	721.17	0.00	721.17	0	1/0/1900 0:00	0.000
43.66	2620	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	692.66	0.00	692.66	0	1/0/1900 0:00	0.000
43.83	2630	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	664.14	0.00	664.14	0	1/0/1900 0:00	0.000
44.00	2640	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	635.63	0.00	635.63	0	1/0/1900 0:00	0.000
44.16	2650	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	607.11	0.00	607.11	0	1/0/1900 0:00	0.000
44.33	2660	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	578.60	0.00	578.60	0	1/0/1900 0:00	0.000
44.50	2670	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	550.08	0.00	550.08	0	1/0/1900 0:00	0.000
44.66	2680	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	521.56	0.00	521.56	0	1/0/1900 0:00	0.000
44.83	2690	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	493.05	0.00	493.05	0	1/0/1900 0:00	0.000
45.00	2700	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	464.53	0.00	464.53	0	1/0/1900 0:00	0.000
45.16	2710	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	436.02	0.00	436.02	0	1/0/1900 0:00	0.000
45.33	2720	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	407.50	0.00	407.50	0	1/0/1900 0:00	0.000
45.50	2730	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	378.99	0.00	378.99	0	1/0/1900 0:00	0.000
45.66	2740	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	350.47	0.00	350.47	0	1/0/1900 0:00	0.000
45.83	2750	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	321.95	0.00	321.95	0	1/0/1900 0:00	0.000
46.00	2760	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	293.44	0.00	293.44	0	1/0/1900 0:00	0.000
46.16	2770	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	264.92	0.00	264.92	0	1/0/1900 0:00	0.000
46.33	2780	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	236.41	0.00	236.41	0	1/0/1900 0:00	0.000
46.50	2790	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	207.89	0.00	207.89	0	1/0/1900 0:00	0.000
46.66	2800	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	179.38	0.00	179.38	0	1/0/1900 0:00	0.000
46.83	2810	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	150.86	0.00	150.86	0	1/0/1900 0:00	0.000
47.00	2820	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	122.35	0.00	122.35	0	1/0/1900 0:00	0.000
47.16	2830	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	93.83	0.00	93.83	0	1/0/1900 0:00	0.000
47.33	2840	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	65.31	0.00	65.31	0	1/0/1900 0:00	0.000
47.50	2850	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	36.80	0.00	36.80	0	1/0/1900 0:00	0.000
47.66	2860	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	8.28	0.00	8.28	0	1/0/1900 0:00	0.000
47.83	2870	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	-20.23	0.00	0.00	0	1/0/1900 0:00	0.000
48.00	2880	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.16	2890	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.33	2900	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.50	2910	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.66	2920	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.83	2930	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.00	2940	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.16	2950	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.33	2960	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.50	2970	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.66	2980	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.83	2990	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.00	3000	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.16	3010	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.33	3020	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.50	3030	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.66	3040	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.83	3050	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
51.00	3060	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
51.16	3070	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000



**KC CSO – Barton GSI Project Study Area**
**TM 600.6 Appendix- Planning Construction Cost Estimate Notes**

SvR#06053

Cost Assumptions Include: General Conditions Allowance; Mobilization; and Allowances for Management & Layout, Stripping/Clearing, Common Excavation, Landscape Bioretention Soil, Curb cuts, landscaping, new street trees, removal of existing curb/pavement when applicable for curb bulbs, new curb for curb bulbs, removal and replacement of ADA ramps where applicable for curb bulbs, irrigation for plant establishment, utility service relocation allowance. **30%** construction contingency included. Taxes, design, permitting fees, construction permitting/agency inspection fees not included. Cross Section based off Figure 4 in report.

**Table A1 – Planning Construction Costs per half block for each Rain Garden Section**

Section #	Cost per half block	Require SDOT variance
1a	\$191,200	No
1b	\$186,900	No
2a	\$182,100	Yes
2b	\$183,000	Yes
3a	\$337,000	Yes
3b	\$304,000	Yes

Table A2 summarizes the planning costs for each section given the modeling approach and assumptions.

**Table A2– Planning Costs for GSI Based on Modeling Approach and Assumptions**

Planning Costs for GSI (M=Million)		
Section #	SBUH Model	
	ROW only/# of half blocks***	ROW + Parcel / # of half blocks***
2b	\$11.9M/65	n/a*
3a	n/a**	\$11.8M/35
3b	n/a**	\$8.5M/28
Average 3a & 3b	n/a **	\$10.2M/32

\*Not feasible since number of half blocks required not available in study area for GSI

\*\*Not shown for planning level since smaller section 2b is feasible for the analysis as compared to larger sections (3a&3b)

\*\*\*Half block is equivalent to one half block north/south and one half block east/west. Half block is half of the public right-of-way.



**SENSITIVITY ANALYSIS FOR GSI ALTERNATIVE  
MODELING**





## Addendum to Technical Memorandum 600.6

DATE: May 27, 2010

TO: Allen deSteiguer, PE, Carrollo Engineers

FROM: Kathryn Gwilym, PE  
Amalia Leighton, PE  
Sarah Shoup, PE  
Greg Giraldo, PE

RE: Sensitivity Analysis for GSI alternative modeling  
**King County CSO, Barton Basin GSI Alternative**  
SvR Project No. 06053

Allen,

In follow-up to SvR Technical Memorandum 600.6 (TM 600.6), we have completed a sensitivity review for the modeling of the Green Stormwater Infrastructure (GSI) alternative for the Barton Basin. For this analysis, we reviewed the following items:

1. **Basin 416 runoff:** The total peak flow out of Barton subbasin 416 draining to CSS using the two tributary area land cover assumptions (right-of-way+parcel and right-of-way only) outlined in TM 600.6 for the 1984 Storm Event using SBUH. SvR compared the peak flows assuming time of concentration of 10 minutes versus adjustment of 53 minutes which accounts for time lag from overflow at rain garden to downstream end of subbasin 416. This analysis was to compare the peak flows to the King County model. See Appendix for calculations and assumptions.
2. **Basin 416 minus 26 Acres:** Same land cover assumptions as Item 1 above, minus 26 acres of impervious area. This analysis was to compare the peak flows to the King County modeled estimate of reduction of 14.6MGD.
3. **Additional Storm Events:** King County provided additional design storm events (1987 and 1988). SvR analyzed how the rain gardens would function using same land cover assumptions and rain garden cross section 3b outlined in TM 600.6.

The following is a summary of our findings from the sensitivity analysis at this planning stage.

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**Subbasin 416 Analysis – Time of Concentration Sensitivity**

The following table summarizes the results/assumptions of Items 1 and 2 above. This analysis considers only the stormwater runoff that contributes to the combined sewer system (CSS) within Basin 416. Time of concentration was calculated using GIS data and Stormshed software. The effect of the time of concentration was analyzed using the same modified SBUH model as described in TM 600.6.

**Table I: Comparison of Tc, Peak Flows and Delta Peak Flows**

1984 Design Storm				
Tributary Area	Tc (minutes)	Peak Flow (MGD) off Subbasin 416 to CSS w/o GSI	Peak Flow (MGD) off Subbasin 416 to CSS minus 26ac of impervious	Difference in Peak Flow (MGD)
ROW only *	53.3	7.0	3.0	4.0
ROW + Parcel*	53.3	18.2	14.2	4.0
ROW only*	10	17.5	7.6	9.9
ROW+Parcel*	10	45.4	35.5	9.9
King County Mouse Model**	n/a	22.1	7.5	14.6

Tc = Time of Concentration

\*SBUH modeling used to estimate peak flow runoff for 1984 Storm Event

\*\*Results provided by King County

As expected, with the increase in time of concentration (Tc), based on the modeling assumptions, the peak flow decreased as the Tc increased. For example, the peak flow from the right-of-way only area changed from 7.0 MGD to 17.5 MGD when revising the Tc from 53.3 minutes to 10 minutes, respectively. The difference in peak flow reduction remained the same for each set of Tc. For example for Tc=10 minutes the change was 9.9 MGD, whereas for Tc=53.3 minutes the change was 4.0 MGD.

The King County model estimated that during the 1984 storm event the peak flow out of the Barton Basin before applying GSI was 47.8 (MGD) (see Draft TM 600.3). Tetra Tech noted that based on their recent rainfall monitoring of the basin they estimated that 46.2% of the peak flow from Barton basin comes from the subbasin 416 draining to the CSS. As a result, the peak flow runoff estimated for the 1984 Storm Event for the King County model was 22.1 MGD w/o GSI. In comparison, column 3 in Table I shows the differing peak flow rates out of Subbasin 416 w/o GSI when using the SBUH model and differing Tc and tributary area assumptions.

Depending upon which model is used and assumptions for the model, differing results can emerge. Both of the modeling approaches are simplified versions for planning purposes. SvR recommends that during design, a more detailed modeling network accounting for the various Barton subbasins and times of concentration within subbasin 416 be conducted such as using the EPA’s SUSTAIN program or other model that allows for a network approach. SvR also recommends additional flow monitoring be conducted for areas where GSI is proposed in subbasin 416 and



in the lower portions of the Barton basin in order to better calibrate the models to monitored flow data.

**Additional Design Storms Sensitivity Analysis**

Two additional design storms were reviewed as part of the sensitivity analysis for the modeling. For this analysis we looked at the runoff from the tributary area of parcel plus right-of-way using the same assumptions described in TM 600.6.

SvR received rainfall data from King County on March 16, 2010 for storms in 1988, 1987, 1984 and 1979. See Appendix for a description of those storms rainfall data and duration. King County Technical Memorandum 600.3 discusses the 1984, 1987, and 1988 storm events. SvR did not receive data for the pump station flows for the 1979 storm event. For these reasons we analyzed the 1984, 1987, and 1988 storms and did not review the 1979 storm. Modeling for the 1984 storm event is presented in TM 600.6. This Addendum covers 1987 and 1988 storm only (see calculations and assumptions in Appendix).

Using the same half block assumptions and rain garden cross section 3b as discussed in TM 600.6, a tributary area that consists of flow from right-of-way and private parcel, and rain gardens constructed with rain garden cross section 3b, the impact of GSI was analyzed to provide a peak flow reduction to the peak flow rate leaving subbasin 416 that would control a CSO. Pump station data was included in files received from King County on March 24, 2010. For the 1984 storm, SvR was tasked to provide a flow reduction of 14.6 MGD to the peak flow rate. To identify the flow reduction needed to control a CSO for the other two storm events, the difference between the estimated peak flow rate at the pump station and the pump capacity (33 MGD) was calculated. Table II summarizes the results for the 1984, 1987, and 1988 storms using SBUH.

**Table II: GSI Half Block Analysis (ROW+Parcel) Summary**

<b>Storm Event</b>	<b>Barton Pump Station Peak Flow (KC)* (MGD)</b>	<b>Peak Flow Reduction (KC)** (MGD)</b>	<b># of GSI Half Blocks to control CSO (Section 3b) (SBUH)</b>	<b>Peak at downstream of Subbasin 416 w/oGSI (SBUH) (MGD)***</b>	<b>Estimated Peak Flow off Subbasin 416 w/o GSI (KC) (MGD)****</b>
1984	47.81	14.6	28	45.58	22.1
1987	40.68	7.7	251	39.42	18.8
1988	42.58	9.6	33	24.98	19.7

KC = King County Mouse model, SBUH=Santa Barbara Urban Hydrograph model

\* Peak flow calculated in King County Mouse model

\*\*Peak Flow reduction required at the pump based on King County model-pump capacity of approximately 33MGD

\*\*\* Tc = 10 minutes, SBUH modeled flows

\*\*\*\*Estimated at 46.2% of the total Barton peak flow per email from Tetra Tech.

As shown in Table II, based on the modeling assumptions, the 1987 storm would require more half blocks (251) to be modified with GSI than is available within the



current project study area. In addition, as noted earlier, the peak flows out of subbasin 416 without GSI differed depending upon the model used. See last two columns in Table II which list peak flows based on SBUH model vs King County mouse model.

Table III compares the characteristics of the storm events and illustrates that the 1987 produces more volume of runoff prior to the peak than the other storm events.

**Table III: Storm Event Characteristics (ROW+Parcel Tributary Area)**

<b>Storm Event</b>	<b>Time from Start of Storm to Design Peak Flow (minutes)</b>	<b>Cumulative Runoff Volume from Start of Storm to Time of Peak per Half Block (gallons)</b>	<b>Total Precipitation for the Design Storm (inches)</b>	<b>Overflow from Rain Gardens Occur at Peak Flow?</b>
1984	1420	57,300	2.39	Yes
1987	2150	68,800	3.22	Yes
1988	470	13,200	1.45	No

Based on the modeling assumptions, during the 1988 storm event, there is no overflow out of the rain garden during the peak and stormwater is infiltrated through the rain garden. During the 1987 storm, which had similar duration to the 1988 storm but more than twice the rainfall, there was more overflow out of the rain garden and more cumulative water flowing through the rain garden prior to the peak of the storm. As a result, with this analysis, by the time the storm reached the peak, more storage would be needed since the rain gardens were already full.

In summary, as shown in Table II, this analysis further demonstrates that depending upon model used, how that model is calibrated, and tributary area assumptions, differing flow data is generated. SvR recommends that additional monitoring be installed within the subbasin 416 and greater Barton basin for areas flowing to the pump station in order to better calibrate the models to actual conditions for sizing and designing the rain gardens for the design phase.

**Enclosure: Appendix**

**King County CSO**  
**Barton Subbasin 416 to CSS – GSI Alternative**  
SvR #06053, By: SS Ck'd By AL

**Input Summary for Determining Time of Concentration (Tc)**

StormShed release 6.1.6.8 was utilized to calculate the time of concentration for subbasin 416. The time of concentration was analyzed for runoff leaving subbasin 416, not the time it takes to reach the pump station. The travel path of the storm water to the downstream end of subbasin 416 consists of sheetflow off private parcels into the right-of-way and then entering and flowing through the combined sewer system. GIS layers provided by King County were used to determine path lengths and slope for the piped system. The sheetflow portion of the travel path (Figure 1) includes a length of 150-feet across a private parcel (measured in GIS from the center line of the alley to the face of the private parcel) and 300-feet of curb before entering a catch basin. Then for the piped portion of the travel path, a length of 8,500-feet was measured in GIS and using surface contours a slope of 1-percent was assumed.

Total time of concentration based on above assumptions = 53.3 minutes from upstream end to outlet from Subbasin 416. See following pages for calculations and assumptions used for the Tc sensitivity analysis.

**Additional Design Storms**

For the analysis on the additional design storms, SvR received rainfall data from King County on March 16, 2010 and below is a summary of the rainfall data time period and duration of the storm that was provided.

1. 1984 Storm
  - a. Overall Rainfall Data: November 1, 1984 0:00 to November 2, 1984 23:50
  - b. Storm Duration: November 1, 1984 10:00 to November 2, 1984 9:50
2. 1987 Storm
  - a. Overall Rainfall Data: March 2, 1987 0:00 to March 4, 1984 14:10
  - b. Storm Duration: March 2, 1987 3:10 to March 4, 1987 1:10.
3. 1979 Storm
  - a. Overall Rainfall Data: December 13, 1979 0:06 to December 16, 1979 3:26
  - b. Storm Duration: December 13, 1979 2:06 to December 15, 1979 5:06
4. 1988 Storm
  - a. Overall Rainfall Data: November 21, 1988 0:01 to November 24, 1988 5:41
  - b. Storm Duration: November 22, 1988 3:51 to November 24, 1988 2:01

We used the same half block assumptions described in TM 600.6 for the right-of-way and parcel tributary area and Section 3b (see TM 600.6) for the rain garden modeled section. We did not receive pump station flows for the 1979 storm so this storm was not analyzed. The following pages include outputs from the SBUH model for the 1987 and 1988 storm. See TM 600.6 for the assumptions and calculations for the 1984 storm.

TIME OF CONCENTRATION  
RUNOFF PATH ASSUMPTIONS

King County CSO  
Barton Subbasin 416  
GSI Review  
SvR 06053  
05/26/10

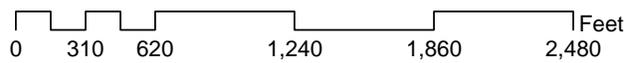


Sheetflow across  
Private Parcel  
150 lf at 2%  
Curb & Gutter Flow  
300 lf at 3%

Begin Piped Flow  
Upstream Elevation:  
462' +/-

Piped flow  
8,500 lf at calculated slope of 1%

Approximate Outlet from  
Subbasin 416 CSS  
Downstream Elevation:  
378' +/-





ROW Only  
Tc = 53.3 minutes  
1984 Storm

SBUH Method			
subbasin 416	Peak =	10.90 cfs	7.03 MGD
w/ 26 imperv acres removed	Peak =	4.71 cfs	3.04 MGD
			Difference
			3.99 MGD

**King County CSO  
Barton Basin Subbasin 416 GSI Analysis**

SvR Project No. 06053  
Santa Barbara Urban Hydrograph Method (SBUH)  
Rainfall data provided by King County

conversion from sf to acre 43560 sf/ac  
conversion factor from cfs to MGD: 0.64516129 MGD/cfs

a time increment of 9999 indicates that the rain event (provided by King County) has finished  
Tc is taken from StormShed analysis.

used percent impervious and pervious from half block analysis to calculate percentages

% impervious row contributing flow to Pump Station **16.9%**  
% pervious row contributing flow to Pump Station **7.9%**  
% impervious roof in half block **0.0%**  
% pervious parcel contributing flow to Pump Station **0.0%**

198.2 (ac) Average acreage footprint contributing flow to pump station (Table D8 in TM 200.7 between Scenario A and B)

	Impervious 16.9%	Pervious 8%									
Total Areas (ac) CN	33.55 98	15.61 86	49.16 (ac) Total surface 416 area contributing flow to Pump Station								
Rainfall Distribution: 1984 Storm this field needs to be year of storm followed a space then "Storm". Example "1984 Storm"											
Max Time Increment	288		Tc = 53.29 minutes		w = 0.09						
Pt =	2.52 inches		dt = 10 minutes								
Sp =	1.63										
Si =	0.20										
Time Increment	Time	Rainfall Distribution	Incremental Rainfall	Accumulated Rainfall	Pervious Accumulated Runoff	Pervious Area Increment Runoff	Impervious Accumulated Runoff	Impervious Area Incr. Runoff	Total Runoff	Instant Flow rate	Design Flow rate
	(minutes)	(fraction)	(inches)	(inches)	(inches)	(inches)	(inches)	(inches)	(inches)	(cfs)	(cfs)
1	2	3	4	5	6	7	8	9	10	11	12,000
0	0	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
1	10	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
2	20	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
3	30	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
4	40	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
5	50	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
6	60	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
7	70	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
8	80	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
9	90	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
10	100	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
11	110	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
12	120	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
13	130	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
14	140	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
15	150	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
16	160	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
17	170	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
18	180	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
19	190	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
20	200	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
21	210	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
22	220	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
23	230	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
24	240	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
25	250	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
26	260	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
27	270	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
28	280	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
29	290	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
30	300	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
31	310	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
32	320	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
33	330	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
34	340	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
35	350	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
36	360	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
37	370	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
38	380	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
39	390	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
40	400	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
41	410	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
42	420	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
43	430	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
44	440	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
45	450	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
46	460	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
47	470	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
48	480	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
49	490	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
50	500	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
51	510	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
52	520	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
53	530	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
54	540	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
55	550	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
56	560	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
57	570	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
58	580	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
59	590	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
60	600	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
61	610	0.0040	0.0100	0.010	0.000	0.000	0.000	0.000	0.000	0.00	0.000
62	620	0.0040	0.0100	0.020	0.000	0.000	0.000	0.000	0.000	0.00	0.000
63	630	0.0040	0.0100	0.030	0.000	0.000	0.000	0.000	0.000	0.00	0.000
64	640	0.0040	0.0100	0.040	0.000	0.000	0.000	0.000	0.000	0.00	0.000
65	650	0.0119	0.0300	0.070	0.000	0.000	0.004	0.004	0.002	0.74	0.064
66	660	0.0079	0.0200	0.090	0.000	0.000	0.010	0.006	0.004	1.20	0.219
67	670	0.0079	0.0200	0.110	0.000	0.000	0.018	0.008	0.005	1.62	0.423
68	680	0.0079	0.0200	0.130	0.000	0.000	0.027	0.010	0.007	1.95	0.656
69	690	0.0119	0.0300	0.160	0.000	0.000	0.044	0.017	0.011	3.41	1.004
70	700	0.0079	0.0200	0.180	0.000	0.000	0.056	0.012	0.009	2.54	1.342
71	710	0.0079	0.0200	0.200	0.000	0.000	0.070	0.013	0.009	2.70	1.561
72	720	0.0079	0.0200	0.220	0.000	0.000	0.084	0.014	0.010	2.85	1.769
73	730	0.0040	0.0100	0.230	0.000	0.000	0.091	0.007	0.005	1.47	1.836
74	740	0.0079	0.0200	0.250	0.000	0.000	0.106	0.015	0.010	3.02	1.906
75	750	0.0119	0.0300	0.280	0.000	0.000	0.129	0.023	0.016	4.71	2.242
76	760	0.0119	0.0300	0.310	0.000	0.000	0.153	0.024	0.016	4.88	2.679
77	770	0.0119	0.0300	0.340	0.000	0.000	0.178	0.025	0.017	5.04	3.070
78	780	0.0198	0.0500	0.390	0.002	0.002	0.220	0.043	0.030	8.85	3.735
79	790	0.0079	0.0200	0.410	0.004	0.002	0.238	0.017	0.012	3.69	4.170
80	800	0.0159	0.0400	0.450	0.009	0.005	0.273	0.035	0.026	7.60	4.423
81	810	0.0198	0.0500	0.500	0.017	0.008	0.318	0.045	0.033	9.87	5.162
82	820	0.0159	0.0400	0.540	0.025	0.008	0.354	0.036	0.027	8.16	5.823
83	830	0.0159	0.0400	0.580	0.034	0.009	0.391	0.037	0.028	8.36	6.241
84	840	0.0159	0.0400	0.620	0.045	0.011	0.428	0.037	0.029	8.55	6.621
85	850	0.0119	0.0300	0.650	0.054	0.009	0.456	0.028	0.022	6.52	6.778
86	860	0.0079	0.0200	0.670	0.060	0.006	0.475	0.019	0.015	4.40	6.553
87	870	0.0079	0.0200	0.690	0.067	0.007	0.494	0.019	0.015	4.44	6.186
88	880	0.0079	0.0200	0.710	0.073	0.007	0.513	0.019	0.015	4.47	5.889
89	890	0.0159	0.0400	0.750	0.088						



108	1080	0.0079	0.0200	1.080	0.239	0.011	0.869	0.019	0.017	4.95	1.888
109	1090	0.0079	0.0200	1.100	0.250	0.011	0.888	0.019	0.017	4.97	2.414
110	1100	0.0079	0.0200	1.120	0.261	0.011	0.908	0.019	0.017	4.98	2.854
111	1110	0.0079	0.0200	1.140	0.272	0.011	0.927	0.020	0.017	5.00	3.221
112	1120	0.0119	0.0300	1.170	0.288	0.017	0.956	0.029	0.025	7.53	3.743
113	1130	0.0119	0.0300	1.200	0.306	0.017	0.986	0.029	0.025	7.57	4.397
114	1140	0.0119	0.0300	1.230	0.323	0.017	1.015	0.029	0.026	7.60	4.944
115	1150	0.0119	0.0300	1.260	0.341	0.018	1.044	0.029	0.026	7.64	5.403
116	1160	0.0159	0.0400	1.300	0.365	0.024	1.084	0.039	0.034	10.23	6.009
117	1170	0.0000	0.0000	1.300	0.365	0.000	1.084	0.000	0.000	0.00	5.856
118	1180	0.0079	0.0200	1.320	0.377	0.012	1.103	0.020	0.017	5.14	5.292
119	1190	0.0040	0.0100	1.330	0.383	0.006	1.113	0.010	0.009	2.57	5.046
120	1200	0.0040	0.0100	1.340	0.389	0.006	1.123	0.010	0.009	2.58	4.622
121	1210	0.0000	0.0000	1.340	0.389	0.000	1.123	0.000	0.000	0.00	4.050
122	1220	0.0040	0.0100	1.350	0.396	0.006	1.133	0.010	0.009	2.58	3.576
123	1230	0.0119	0.0300	1.380	0.414	0.019	1.162	0.029	0.026	7.76	3.850
124	1240	0.0079	0.0200	1.400	0.427	0.013	1.182	0.020	0.017	5.19	4.300
125	1250	0.0040	0.0100	1.410	0.434	0.006	1.192	0.010	0.009	2.60	4.230
126	1260	0.0000	0.0000	1.410	0.434	0.000	1.192	0.000	0.000	0.00	3.727
127	1270	0.0040	0.0100	1.420	0.440	0.006	1.201	0.010	0.009	2.60	3.311
128	1280	0.0000	0.0000	1.420	0.440	0.000	1.201	0.000	0.000	0.00	2.966
129	1290	0.0000	0.0000	1.420	0.440	0.000	1.201	0.000	0.000	0.00	2.457
130	1300	0.0040	0.0100	1.430	0.446	0.006	1.211	0.010	0.009	2.60	2.259
131	1310	0.0040	0.0100	1.440	0.453	0.006	1.221	0.010	0.009	2.61	2.319
132	1320	0.0000	0.0000	1.440	0.453	0.000	1.221	0.000	0.000	0.00	2.144
133	1330	0.0040	0.0100	1.450	0.459	0.006	1.231	0.010	0.009	2.61	2.000
134	1340	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	1.881
135	1350	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	1.558
136	1360	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	1.291
137	1370	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	1.070
138	1380	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.886
139	1390	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.734
140	1400	0.0040	0.0100	1.460	0.466	0.007	1.241	0.010	0.009	2.61	0.832
141	1410	0.0040	0.0100	1.470	0.472	0.007	1.251	0.010	0.009	2.62	1.138
142	1420	0.0040	0.0100	1.480	0.479	0.007	1.260	0.010	0.009	2.62	1.392
143	1430	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	1.378
144	1440	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	1.141
145	1450	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.945
146	1460	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.783
147	1470	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.649
148	1480	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.538
149	1490	0.0040	0.0100	1.490	0.486	0.007	1.270	0.010	0.009	2.62	0.670
150	1500	0.0040	0.0100	1.500	0.492	0.007	1.280	0.010	0.009	2.62	1.005
151	1510	0.0040	0.0100	1.510	0.499	0.007	1.290	0.010	0.009	2.63	1.283
152	1520	0.0000	0.0000	1.510	0.499	0.000	1.290	0.000	0.000	0.00	1.288
153	1530	0.0040	0.0100	1.520	0.505	0.007	1.300	0.010	0.009	2.63	1.293
154	1540	0.0040	0.0100	1.530	0.512	0.007	1.310	0.010	0.009	2.63	1.522
155	1550	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	1.487
156	1560	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	1.232
157	1570	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	1.020
158	1580	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	0.845
159	1590	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	0.700
160	1600	0.0040	0.0100	1.540	0.519	0.007	1.320	0.010	0.009	2.63	0.806
161	1610	0.0000	0.0000	1.540	0.519	0.000	1.320	0.000	0.000	0.00	0.894
162	1620	0.0000	0.0000	1.540	0.519	0.000	1.320	0.000	0.000	0.00	0.740
163	1630	0.0119	0.0300	1.570	0.539	0.020	1.349	0.030	0.027	7.92	1.293
164	1640	0.0040	0.0100	1.580	0.546	0.007	1.359	0.010	0.009	2.64	1.977
165	1650	0.0119	0.0300	1.610	0.566	0.021	1.389	0.030	0.027	7.95	2.546
166	1660	0.0119	0.0300	1.640	0.587	0.021	1.418	0.030	0.027	7.97	3.474
167	1670	0.0079	0.0200	1.660	0.601	0.014	1.438	0.020	0.018	5.32	4.018
168	1680	0.0119	0.0300	1.690	0.622	0.021	1.468	0.030	0.027	8.00	4.472
169	1690	0.0079	0.0200	1.710	0.636	0.014	1.487	0.020	0.018	5.34	4.849
170	1700	0.0040	0.0100	1.720	0.643	0.007	1.497	0.010	0.009	2.68	4.705
171	1710	0.0000	0.0000	1.720	0.643	0.000	1.497	0.000	0.000	0.00	4.128
172	1720	0.0000	0.0000	1.720	0.643	0.000	1.497	0.000	0.000	0.00	3.419
173	1730	0.0040	0.0100	1.730	0.650	0.007	1.507	0.010	0.009	2.68	3.062
174	1740	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	2.767
175	1750	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	2.292
176	1760	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	1.899
177	1770	0.0278	0.0700	1.800	0.701	0.050	1.576	0.069	0.063	18.80	3.186
178	1780	0.0079	0.0200	1.820	0.715	0.015	1.596	0.020	0.018	5.39	4.714
179	1790	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	4.367
180	1800	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	3.618
181	1810	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	2.997
182	1820	0.0079	0.0200	1.840	0.730	0.015	1.616	0.020	0.018	5.40	2.946
183	1830	0.0119	0.0300	1.870	0.752	0.022	1.646	0.030	0.027	8.11	3.599
184	1840	0.0040	0.0100	1.880	0.759	0.007	1.655	0.010	0.009	2.71	3.909
185	1850	0.0000	0.0000	1.880	0.759	0.000	1.655	0.000	0.000	0.00	3.470
186	1860	0.0040	0.0100	1.890	0.767	0.007	1.665	0.010	0.009	2.71	3.107
187	1870	0.0040	0.0100	1.900	0.774	0.007	1.675	0.010	0.009	2.71	3.039
188	1880	0.0159	0.0400	1.940	0.804	0.030	1.715	0.040	0.036	10.85	3.681
189	1890	0.0159	0.0400	1.980	0.834	0.030	1.755	0.040	0.037	10.88	4.914
190	1900	0.0159	0.0400	2.020	0.864	0.030	1.794	0.040	0.037	10.91	5.940
191	1910	0.0079	0.0200	2.040	0.879	0.015	1.814	0.020	0.018	5.46	6.325
192	1920	0.0000	0.0000	2.040	0.879	0.000	1.814	0.000	0.000	0.00	5.708
193	1930	0.0040	0.0100	2.050	0.887	0.008	1.824	0.010	0.009	2.73	4.964
194	1940	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	4.347
195	1950	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	3.601
196	1960	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	2.983
197	1970	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	2.471
198	1980	0.0079	0.0200	2.070	0.902	0.015	1.844	0.020	0.018	5.47	2.517
199	1990	0.0040	0.0100	2.080	0.910	0.008	1.854	0.010	0.009	2.74	2.789
200	2000	0.0000	0.0000	2.080	0.910	0.000	1.854	0.000	0.000	0.00	2.546
201	2010	0.0754	0.1900	2.270	1.058	0.148	2.042	0.189	0.176	52.28	6.593
202	2020	0.0159	0.0400	2.310	1.090	0.032	2.082	0.040	0.037	11.06	10.896
203	2030	0.0278	0.0700	2.380	1.146	0.056	2.151	0.070	0.065	19.41	11.641
204	2040	0.0040	0.0100	2.390	1.154	0.008	2.161	0.010	0.009	2.78	11.547
205	2050	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	9.804
206	2060	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	8.122
207	2070	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000		









**King County CSO**  
**Barton Basin Subbasin 416 GSI Analysis**  
 SvR Project No. 06053  
 SEE SBUH-all TAB FOR ASSUMPTIONS.

Impervious Pervious  
 Total Areas (ac) 7.55 15.61 Total Area (ac) 23.16  
 CN 98 86  
**Rainfall Distribution: 1984 Storm** this field needs to be year of storm followed a space then "Storm". Example "1984 Storm"  
 Max Time Increment 288  
 Pt = 2.52 inches Tc = 53.29 minutes w = 0.09  
 Sp = 1.63 dt = 10 minutes  
 Si = 0.20

Time Increment	Time (minutes)	Rainfall Distribution 1 (fraction)	Incremental Rainfall (inches)	Accumulated Rainfall (inches)	Pervious Accumulated Runoff (inches)	Pervious Area Increment Runoff (inches)	Impervious Accumulated Runoff (inches)	Impervious Area Incr. Runoff (inches)	Total Runoff (inches)	Instant Flow rate (cfs)	Design Flow rate (cfs)
0	0	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
1	10	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
2	20	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
3	30	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
4	40	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
5	50	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
6	60	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
7	70	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
8	80	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
9	90	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
10	100	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
11	110	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
12	120	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
13	130	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
14	140	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
15	150	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
16	160	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
17	170	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
18	180	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
19	190	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
20	200	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
21	210	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
22	220	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
23	230	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
24	240	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
25	250	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
26	260	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
27	270	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
28	280	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
29	290	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
30	300	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
31	310	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
32	320	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
33	330	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
34	340	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
35	350	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
36	360	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
37	370	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
38	380	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
39	390	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
40	400	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
41	410	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
42	420	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
43	430	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
44	440	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
45	450	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
46	460	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
47	470	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
48	480	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
49	490	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
50	500	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
51	510	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
52	520	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
53	530	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
54	540	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
55	550	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
56	560	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
57	570	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
58	580	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
59	590	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
60	600	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
61	610	0.0040	0.0100	0.010	0.000	0.000	0.000	0.000	0.000	0.00	0.000
62	620	0.0040	0.0100	0.020	0.000	0.000	0.000	0.000	0.000	0.00	0.000
63	630	0.0040	0.0100	0.030	0.000	0.000	0.000	0.000	0.000	0.00	0.000
64	640	0.0040	0.0100	0.040	0.000	0.000	0.000	0.000	0.000	0.00	0.000
65	650	0.0119	0.0300	0.070	0.000	0.000	0.004	0.004	0.001	0.17	0.014
66	660	0.0079	0.0200	0.090	0.000	0.000	0.010	0.006	0.002	0.27	0.049
67	670	0.0079	0.0200	0.110	0.000	0.000	0.018	0.008	0.003	0.36	0.095
68	680	0.0079	0.0200	0.130	0.000	0.000	0.027	0.010	0.003	0.44	0.148
69	690	0.0119	0.0300	0.160	0.000	0.000	0.044	0.017	0.005	0.77	0.226
70	700	0.0079	0.0200	0.180	0.000	0.000	0.056	0.012	0.004	0.57	0.302
71	710	0.0079	0.0200	0.200	0.000	0.000	0.070	0.013	0.004	0.61	0.351
72	720	0.0079	0.0200	0.220	0.000	0.000	0.084	0.014	0.005	0.64	0.398
73	730	0.0040	0.0100	0.230	0.000	0.000	0.091	0.007	0.002	0.33	0.413
74	740	0.0079	0.0200	0.250	0.000	0.000	0.106	0.015	0.005	0.68	0.429
75	750	0.0119	0.0300	0.280	0.000	0.000	0.129	0.023	0.008	1.06	0.505
76	760	0.0119	0.0300	0.310	0.000	0.000	0.153	0.024	0.008	1.10	0.603
77	770	0.0119	0.0300	0.340	0.000	0.000	0.178	0.025	0.008	1.14	0.692
78	780	0.0198	0.0500	0.390	0.002	0.002	0.220	0.043	0.015	2.16	0.857
79	790	0.0079	0.0200	0.410	0.004	0.002	0.238	0.017	0.007	0.96	0.977
80	800	0.0159	0.0400	0.450	0.009	0.005	0.273	0.035	0.015	2.05	1.068
81	810	0.0198	0.0500	0.500	0.017	0.008	0.318	0.045	0.020	2.81	1.302
82	820	0.0159	0.0400	0.540	0.025	0.008	0.354	0.036	0.017	2.43	1.528
83	830	0.0159	0.0400	0.580	0.034	0.009	0.391	0.037	0.018	2.57	1.694
84	840	0.0159	0.0400	0.620	0.045	0.011	0.428	0.037	0.019	2.71	1.857
85	850	0.0119	0.0300	0.650	0.054	0.009	0.456	0.028	0.015	2.11	1.952
86	860	0.0079	0.0200	0.670	0.060	0.006	0.475	0.019	0.010	1.45	1.922
87	870	0.0079	0.0200	0.690	0.067	0.007	0.494	0.019	0.011	1.48	1.843
88	880	0.0079	0.0200	0.710	0.073	0.007	0.513	0.019	0.011	1.50	1.782
89	890	0.0159	0.0400	0.750	0.088	0.014	0.551	0.038	0.022	3.09	1.870
90	900	0.0119	0.0300	0.780	0.099	0.011	0.579	0.029	0.017	2.38	2.018
91	910	0.0159	0.0400	0.820	0.115	0.016	0.617	0.038	0.023	3.26	2.156
92	920	0.0159	0.0400	0.860	0.132	0.017	0.656	0.038	0.024	3.35	2.353
93	930	0.0159	0.0400	0.900	0.150	0.018	0.694	0.038	0.025	3.43	2.531
94	940	0.0119	0.0300	0.930	0.164	0.014	0.723	0.029	0.019	2.63	2.616
95	950	0.0159	0.0400	0.970	0.183	0.019	0.762	0.039	0.025	3.57	2.699
96	960	0.0119	0.0300	1.000	0.198	0.015	0.791	0.029	0.019	2.73	2.776
97	970	0.0079	0.0200	1.020	0.208						



116	1160	0.0159	0.0400	1.300	0.365	0.024	1.084	0.039	0.029	4.07	2.344
117	1170	0.0000	0.0000	1.300	0.365	0.000	1.084	0.000	0.000	0.00	2.291
118	1180	0.0079	0.0200	1.320	0.377	0.012	1.103	0.020	0.015	2.05	2.074
119	1190	0.0040	0.0100	1.330	0.383	0.006	1.113	0.010	0.007	1.03	1.982
120	1200	0.0040	0.0100	1.340	0.389	0.006	1.123	0.010	0.007	1.03	1.819
121	1210	0.0000	0.0000	1.340	0.389	0.000	1.123	0.000	0.000	0.00	1.596
122	1220	0.0040	0.0100	1.350	0.396	0.006	1.133	0.010	0.007	1.04	1.411
123	1230	0.0119	0.0300	1.380	0.414	0.019	1.162	0.029	0.022	3.12	1.526
124	1240	0.0079	0.0200	1.400	0.427	0.013	1.182	0.020	0.015	2.10	1.712
125	1250	0.0040	0.0100	1.410	0.434	0.006	1.192	0.010	0.008	1.05	1.688
126	1260	0.0000	0.0000	1.410	0.434	0.000	1.192	0.000	0.000	0.00	1.489
127	1270	0.0040	0.0100	1.420	0.440	0.006	1.201	0.010	0.008	1.05	1.324
128	1280	0.0000	0.0000	1.420	0.440	0.000	1.201	0.000	0.000	0.00	1.187
129	1290	0.0000	0.0000	1.420	0.440	0.000	1.201	0.000	0.000	0.00	0.983
130	1300	0.0040	0.0100	1.430	0.446	0.006	1.211	0.010	0.008	1.06	0.905
131	1310	0.0040	0.0100	1.440	0.453	0.006	1.221	0.010	0.008	1.06	0.932
132	1320	0.0000	0.0000	1.440	0.453	0.000	1.221	0.000	0.000	0.00	0.863
133	1330	0.0040	0.0100	1.450	0.459	0.006	1.231	0.010	0.008	1.06	0.806
134	1340	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.759
135	1350	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.629
136	1360	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.521
137	1370	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.431
138	1380	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.357
139	1390	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.296
140	1400	0.0040	0.0100	1.460	0.466	0.007	1.241	0.010	0.008	1.06	0.337
141	1410	0.0040	0.0100	1.470	0.472	0.007	1.251	0.010	0.008	1.07	0.462
142	1420	0.0040	0.0100	1.480	0.479	0.007	1.260	0.010	0.008	1.07	0.566
143	1430	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.561
144	1440	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.464
145	1450	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.385
146	1460	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.319
147	1470	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.264
148	1480	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.219
149	1490	0.0040	0.0100	1.490	0.486	0.007	1.270	0.010	0.008	1.07	0.273
150	1500	0.0040	0.0100	1.500	0.492	0.007	1.280	0.010	0.008	1.07	0.410
151	1510	0.0040	0.0100	1.510	0.499	0.007	1.290	0.010	0.008	1.08	0.525
152	1520	0.0000	0.0000	1.510	0.499	0.000	1.290	0.000	0.000	0.00	0.527
153	1530	0.0040	0.0100	1.520	0.505	0.007	1.300	0.010	0.008	1.08	0.529
154	1540	0.0040	0.0100	1.530	0.512	0.007	1.310	0.010	0.008	1.08	0.624
155	1550	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	0.609
156	1560	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	0.505
157	1570	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	0.418
158	1580	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	0.347
159	1590	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	0.287
160	1600	0.0040	0.0100	1.540	0.519	0.007	1.320	0.010	0.008	1.08	0.331
161	1610	0.0000	0.0000	1.540	0.519	0.000	1.320	0.000	0.000	0.00	0.367
162	1620	0.0000	0.0000	1.540	0.519	0.000	1.320	0.000	0.000	0.00	0.304
163	1630	0.0119	0.0300	1.570	0.539	0.020	1.349	0.030	0.023	3.26	0.532
164	1640	0.0040	0.0100	1.580	0.546	0.007	1.359	0.010	0.008	1.09	0.814
165	1650	0.0119	0.0300	1.610	0.566	0.021	1.389	0.030	0.023	3.29	1.051
166	1660	0.0119	0.0300	1.640	0.587	0.021	1.418	0.030	0.024	3.31	1.437
167	1670	0.0079	0.0200	1.660	0.601	0.014	1.438	0.020	0.016	2.22	1.664
168	1680	0.0119	0.0300	1.690	0.622	0.021	1.468	0.030	0.024	3.34	1.855
169	1690	0.0079	0.0200	1.710	0.636	0.014	1.487	0.020	0.016	2.24	2.015
170	1700	0.0040	0.0100	1.720	0.643	0.007	1.497	0.010	0.008	1.12	1.958
171	1710	0.0000	0.0000	1.720	0.643	0.000	1.497	0.000	0.000	0.00	1.718
172	1720	0.0000	0.0000	1.720	0.643	0.000	1.497	0.000	0.000	0.00	1.423
173	1730	0.0040	0.0100	1.730	0.650	0.007	1.507	0.010	0.008	1.12	1.275
174	1740	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	1.153
175	1750	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	0.955
176	1760	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	0.791
177	1770	0.0278	0.0700	1.800	0.701	0.050	1.576	0.069	0.056	7.91	1.334
178	1780	0.0079	0.0200	1.820	0.715	0.015	1.596	0.020	0.016	2.28	1.979
179	1790	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	1.835
180	1800	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	1.520
181	1810	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	1.259
182	1820	0.0079	0.0200	1.840	0.730	0.015	1.616	0.020	0.016	2.28	1.239
183	1830	0.0119	0.0300	1.870	0.752	0.022	1.646	0.030	0.025	3.44	1.517
184	1840	0.0040	0.0100	1.880	0.759	0.007	1.655	0.010	0.008	1.15	1.650
185	1850	0.0000	0.0000	1.880	0.759	0.000	1.655	0.000	0.000	0.00	1.466
186	1860	0.0040	0.0100	1.890	0.767	0.007	1.665	0.010	0.008	1.15	1.313
187	1870	0.0040	0.0100	1.900	0.774	0.007	1.675	0.010	0.008	1.15	1.285
188	1880	0.0159	0.0400	1.940	0.804	0.030	1.715	0.040	0.033	4.62	1.560
189	1890	0.0159	0.0400	1.980	0.834	0.030	1.755	0.040	0.033	4.65	2.088
190	1900	0.0159	0.0400	2.020	0.864	0.030	1.794	0.040	0.033	4.67	2.529
191	1910	0.0079	0.0200	2.040	0.879	0.015	1.814	0.020	0.017	2.34	2.697
192	1920	0.0000	0.0000	2.040	0.879	0.000	1.814	0.000	0.000	0.00	2.435
193	1930	0.0040	0.0100	2.050	0.887	0.008	1.824	0.010	0.008	1.17	2.118
194	1940	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	1.855
195	1950	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	1.537
196	1960	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	1.273
197	1970	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	1.055
198	1980	0.0079	0.0200	2.070	0.902	0.015	1.844	0.020	0.017	2.35	1.076
199	1990	0.0040	0.0100	2.080	0.910	0.008	1.854	0.010	0.008	1.18	1.194
200	2000	0.0000	0.0000	2.080	0.910	0.000	1.854	0.000	0.000	0.00	1.090
201	2010	0.0754	0.1900	2.270	1.058	0.148	2.042	0.189	0.161	22.62	2.844
202	2020	0.0159	0.0400	2.310	1.090	0.032	2.082	0.040	0.034	4.82	4.709
203	2030	0.0278	0.0700	2.380	1.146	0.056	2.151	0.070	0.060	8.47	5.041
204	2040	0.0040	0.0100	2.390	1.154	0.008	2.161	0.010	0.009	1.21	5.007
205	2050	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	4.252
206	2060	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	3.523
207	2070	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	2.918
208	2080	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	2.418
209	2090	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	2.003
210	2100	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	1.659
211	2110	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	1.375
212	2120	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	1.139
213	2130	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	0.943
214	2140	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	0.782
215	2150	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.0		









**King County CSO  
Barton Basin Subbasin 416 GSI Analysis**

SvR Project No. 06053  
Santa Barbara Urban Hydrograph Method (SBUH)  
Rainfall data provided by King County

conversion from sf to acre 43560 sf/acre  
conversion factor from cfs to MGD: 0.64516129 MGD/cfs  
a time increment of 9999 indicates that the rain event (provided by King County) has finished  
Tc is taken from StormShed analysis.

SBUH Method			
subbasin 416	Peak =	28.20 cfs	18.2 MGD
w/ 26 imperv acres removed	Peak =	22.02 cfs	14.2 MGD
			Difference
			3.99 MGD

used percent impervious and pervious from half block analysis to calculate percentages

% impervious row contributing flow to Pump Station **16.9%**  
% pervious row contributing flow to Pump Station **7.9%**  
% impervious roof in half block **18.7%**  
% pervious parcel contributing flow to Pump Station **28.1%**

198.2 (ac) Average acreage footprint contributing flow to pump station (Table D8 in TM 200.7 between Scenario A and B)

		Impervious 16.9%	Pervious 55%								
Total Areas (ac)		33.55	108.37	141.92 (ac) Total surface 416 area contributing flow to Pump Station							
CN		98	86								
Rainfall Distribution: 1984 Storm this field needs to be year of storm followed a space then "Storm". Example "1984 Storm"											
Max Time Increment		288									
Pt =		2.52 inches		Tc =		53.29 minutes		w =		0.09	
Sp =		1.63		dt =		10 minutes					
Si =		0.20									
Time Increment	Time	Rainfall Distribution	Incremental Rainfall	Accumulated Rainfall	Pervious Accumulated Runoff	Pervious Area Increment Runoff	Impervious Accumulated Runoff	Impervious Area Incr. Runoff	Total Runoff	Instant Flow rate	Design Flow rate
	(minutes)	(fraction)	(inches)	(inches)	(inches)	(inches)	(inches)	(inches)	(inches)	(cfs)	(cfs)
1	2	3	4	5	6	7	8	9	10	11	12.000
0	0	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
1	10	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
2	20	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
3	30	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
4	40	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
5	50	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
6	60	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
7	70	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
8	80	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
9	90	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
10	100	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
11	110	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
12	120	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
13	130	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
14	140	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
15	150	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
16	160	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
17	170	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
18	180	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
19	190	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
20	200	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
21	210	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
22	220	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
23	230	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
24	240	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
25	250	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
26	260	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
27	270	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
28	280	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
29	290	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
30	300	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
31	310	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
32	320	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
33	330	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
34	340	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
35	350	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
36	360	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
37	370	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
38	380	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
39	390	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
40	400	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
41	410	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
42	420	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
43	430	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
44	440	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
45	450	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
46	460	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
47	470	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
48	480	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
49	490	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
50	500	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
51	510	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
52	520	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
53	530	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
54	540	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
55	550	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
56	560	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
57	570	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
58	580	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
59	590	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
60	600	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
61	610	0.0040	0.0100	0.010	0.000	0.000	0.000	0.000	0.000	0.00	0.000
62	620	0.0040	0.0100	0.020	0.000	0.000	0.000	0.000	0.000	0.00	0.000
63	630	0.0040	0.0100	0.030	0.000	0.000	0.000	0.000	0.000	0.00	0.000
64	640	0.0040	0.0100	0.040	0.000	0.000	0.000	0.000	0.000	0.00	0.000
65	650	0.0119	0.0300	0.070	0.000	0.000	0.004	0.004	0.001	0.74	0.064
66	660	0.0079	0.0200	0.090	0.000	0.000	0.010	0.006	0.001	1.20	0.219
67	670	0.0079	0.0200	0.110	0.000	0.000	0.018	0.008	0.002	1.62	0.423
68	680	0.0079	0.0200	0.130	0.000	0.000	0.027	0.010	0.002	1.95	0.656
69	690	0.0119	0.0300	0.160	0.000	0.000	0.044	0.017	0.004	3.41	1.004
70	700	0.0079	0.0200	0.180	0.000	0.000	0.056	0.012	0.003	2.54	1.342
71	710	0.0079	0.0200	0.200	0.000	0.000	0.070	0.013	0.003	2.70	1.561
72	720	0.0079	0.0200	0.220	0.000	0.000	0.084	0.014	0.003	2.85	1.769
73	730	0.0040	0.0100	0.230	0.000	0.000	0.091	0.007	0.002	1.47	1.836
74	740	0.0079	0.0200	0.250	0.000	0.000	0.106	0.015	0.004	3.02	1.906
75	750	0.0119	0.0300	0.280	0.000	0.000	0.129	0.023	0.005	4.71	2.242
76	760	0.0119	0.0300	0.310	0.000	0.000	0.153	0.024	0.006	4.88	2.679
77	770	0.0119	0.0300	0.340	0.000	0.000	0.178	0.025	0.006	5.11	3.077
78	780	0.0198	0.0500	0.390	0.002	0.002	0.220	0.043	0.012	10.16	3.858
79	790	0.0079	0.0200	0.410	0.004	0.002	0.238	0.017	0.005	4.65	4



ROW and Private Parcel  
Tc = 53.3 minutes  
1984 Storm

108	1080	0.0079	0.0200	1.080	0.239	0.011	0.869	0.019	0.013	10.89	3.944
109	1090	0.0079	0.0200	1.100	0.250	0.011	0.888	0.019	0.013	10.99	5.144
110	1100	0.0079	0.0200	1.120	0.261	0.011	0.908	0.019	0.013	11.10	6.157
111	1110	0.0079	0.0200	1.140	0.272	0.011	0.927	0.020	0.013	11.20	7.013
112	1120	0.0119	0.0300	1.170	0.288	0.017	0.956	0.029	0.020	16.98	8.227
113	1130	0.0119	0.0300	1.200	0.306	0.017	0.986	0.029	0.020	17.19	9.747
114	1140	0.0119	0.0300	1.230	0.323	0.017	1.015	0.029	0.020	17.40	11.042
115	1150	0.0119	0.0300	1.260	0.341	0.018	1.044	0.029	0.020	17.60	12.150
116	1160	0.0159	0.0400	1.300	0.365	0.024	1.084	0.039	0.028	23.76	13.613
117	1170	0.0000	0.0000	1.300	0.365	0.000	1.084	0.000	0.000	0.00	13.315
118	1180	0.0079	0.0200	1.320	0.377	0.012	1.103	0.020	0.014	12.00	12.061
119	1190	0.0040	0.0100	1.330	0.383	0.006	1.113	0.010	0.007	6.03	11.538
120	1200	0.0040	0.0100	1.340	0.389	0.006	1.123	0.010	0.007	6.05	10.595
121	1210	0.0000	0.0000	1.340	0.389	0.000	1.123	0.000	0.000	0.00	9.297
122	1220	0.0040	0.0100	1.350	0.396	0.006	1.133	0.010	0.007	6.07	8.222
123	1230	0.0119	0.0300	1.380	0.414	0.019	1.162	0.029	0.021	18.32	8.904
124	1240	0.0079	0.0200	1.400	0.427	0.013	1.182	0.020	0.014	12.31	10.004
125	1250	0.0040	0.0100	1.410	0.434	0.006	1.192	0.010	0.007	6.18	9.874
126	1260	0.0000	0.0000	1.410	0.434	0.000	1.192	0.000	0.000	0.00	8.710
127	1270	0.0040	0.0100	1.420	0.440	0.006	1.201	0.010	0.007	6.20	7.748
128	1280	0.0000	0.0000	1.420	0.440	0.000	1.201	0.000	0.000	0.00	6.950
129	1290	0.0000	0.0000	1.420	0.440	0.000	1.201	0.000	0.000	0.00	5.758
130	1300	0.0040	0.0100	1.430	0.446	0.006	1.211	0.010	0.007	6.22	5.303
131	1310	0.0040	0.0100	1.440	0.453	0.006	1.221	0.010	0.007	6.23	5.462
132	1320	0.0000	0.0000	1.440	0.453	0.000	1.221	0.000	0.000	0.00	5.059
133	1330	0.0040	0.0100	1.450	0.459	0.006	1.231	0.010	0.007	6.25	4.728
134	1340	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	4.453
135	1350	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	3.689
136	1360	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	3.056
137	1370	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	2.532
138	1380	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	2.097
139	1390	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	1.738
140	1400	0.0040	0.0100	1.460	0.466	0.007	1.241	0.010	0.007	6.27	1.977
141	1410	0.0040	0.0100	1.470	0.472	0.007	1.251	0.010	0.007	6.29	2.715
142	1420	0.0040	0.0100	1.480	0.479	0.007	1.260	0.010	0.007	6.30	3.329
143	1430	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	3.298
144	1440	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	2.733
145	1450	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	2.264
146	1460	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	1.875
147	1470	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	1.554
148	1480	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	1.287
149	1490	0.0040	0.0100	1.490	0.486	0.007	1.270	0.010	0.007	6.32	1.608
150	1500	0.0040	0.0100	1.500	0.492	0.007	1.280	0.010	0.007	6.34	2.418
151	1510	0.0040	0.0100	1.510	0.499	0.007	1.290	0.010	0.007	6.35	3.091
152	1520	0.0000	0.0000	1.510	0.499	0.000	1.290	0.000	0.000	0.00	3.106
153	1530	0.0040	0.0100	1.520	0.505	0.007	1.300	0.010	0.007	6.37	3.119
154	1540	0.0040	0.0100	1.530	0.512	0.007	1.310	0.010	0.007	6.38	3.678
155	1550	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	3.594
156	1560	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	2.978
157	1570	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	2.467
158	1580	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	2.044
159	1590	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	1.693
160	1600	0.0040	0.0100	1.540	0.519	0.007	1.320	0.010	0.007	6.40	1.951
161	1610	0.0000	0.0000	1.540	0.519	0.000	1.320	0.000	0.000	0.00	2.165
162	1620	0.0000	0.0000	1.540	0.519	0.000	1.320	0.000	0.000	0.00	1.794
163	1630	0.0119	0.0300	1.570	0.539	0.020	1.349	0.030	0.022	19.29	3.141
164	1640	0.0040	0.0100	1.580	0.546	0.007	1.359	0.010	0.008	6.46	4.810
165	1650	0.0119	0.0300	1.610	0.566	0.021	1.389	0.030	0.023	19.47	6.209
166	1660	0.0119	0.0300	1.640	0.587	0.021	1.418	0.030	0.023	19.60	8.495
167	1670	0.0079	0.0200	1.660	0.601	0.014	1.438	0.020	0.015	13.13	9.845
168	1680	0.0119	0.0300	1.690	0.622	0.021	1.468	0.030	0.023	19.80	10.981
169	1690	0.0079	0.0200	1.710	0.636	0.014	1.487	0.020	0.015	13.27	11.934
170	1700	0.0040	0.0100	1.720	0.643	0.007	1.497	0.010	0.008	6.65	11.596
171	1710	0.0000	0.0000	1.720	0.643	0.000	1.497	0.000	0.000	0.00	10.177
172	1720	0.0000	0.0000	1.720	0.643	0.000	1.497	0.000	0.000	0.00	8.431
173	1730	0.0040	0.0100	1.730	0.650	0.007	1.507	0.010	0.008	6.67	7.557
174	1740	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	6.832
175	1750	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	5.660
176	1760	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	4.689
177	1770	0.0278	0.0700	1.800	0.701	0.050	1.576	0.069	0.055	47.02	7.917
178	1780	0.0079	0.0200	1.820	0.715	0.015	1.596	0.020	0.016	13.54	11.754
179	1790	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	10.899
180	1800	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	9.029
181	1810	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	7.480
182	1820	0.0079	0.0200	1.840	0.730	0.015	1.616	0.020	0.016	13.59	7.362
183	1830	0.0119	0.0300	1.870	0.752	0.022	1.646	0.030	0.024	20.47	9.020
184	1840	0.0040	0.0100	1.880	0.759	0.007	1.655	0.010	0.008	6.84	9.816
185	1850	0.0000	0.0000	1.880	0.759	0.000	1.655	0.000	0.000	0.00	8.719
186	1860	0.0040	0.0100	1.890	0.767	0.007	1.665	0.010	0.008	6.86	7.811
187	1870	0.0040	0.0100	1.900	0.774	0.007	1.675	0.010	0.008	6.87	7.648
188	1880	0.0159	0.0400	1.940	0.804	0.030	1.715	0.040	0.032	27.57	9.290
189	1890	0.0159	0.0400	1.980	0.834	0.030	1.755	0.040	0.032	27.74	12.441
190	1900	0.0159	0.0400	2.020	0.864	0.030	1.794	0.040	0.032	27.90	15.079
191	1910	0.0079	0.0200	2.040	0.879	0.015	1.814	0.020	0.016	14.01	16.087
192	1920	0.0000	0.0000	2.040	0.879	0.000	1.814	0.000	0.000	0.00	14.529
193	1930	0.0040	0.0100	2.050	0.887	0.008	1.824	0.010	0.008	7.02	12.638
194	1940	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	11.072
195	1950	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	9.173
196	1960	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	7.599
197	1970	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	6.295
198	1980	0.0079	0.0200	2.070	0.902	0.015	1.844	0.020	0.016	14.06	6.422
199	1990	0.0040	0.0100	2.080	0.910	0.008	1.854	0.010	0.008	7.05	7.131
200	2000	0.0000	0.0000	2.080	0.910	0.000	1.854	0.000	0.000	0.00	6.512
201	2010	0.0754	0.1900	2.270	1.058	0.148	2.042	0.189	0.158	135.52	17.019
202	2020	0.0159	0.0400	2.310	1.090	0.032	2.082	0.040	0.034	28.90	28.294
203	2030	0.0278	0.0700	2.380	1.146	0.056	2.151	0.070	0.059	50.87	30.207
204	2040	0.0040	0.0100	2.390	1.154	0.008	2.161	0.010	0.008	7.30	30.014
205	2050	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	25.491
206	2060	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	21.118
207	2070	0.0000	0.0000	2.390	1.						









**King County CSO**  
**Barton Basin Subbasin 416 GSI Analysis**  
 SvR Project No. 06053  
 SEE SBUH-all TAB FOR ASSUMPTIONS.

Impervious Pervious  
 Total Areas (ac) 7.55 108.37 Total Area (ac) 115.92  
 CN 98 86  
**Rainfall Distribution: 1984 Storm** this field needs to be year of storm followed a space then "Storm". Example "1984 Storm"  
 Max Time Increment 288  
 Pt = 2.52 inches Tc = 53.29 minutes w = 0.09  
 Sp = 1.63 dt = 10 minutes  
 Si = 0.20

Time Increment	Time (minutes)	Rainfall Distribution 1 (fraction)	Incremental Rainfall (inches)	Accumulated Rainfall (inches)	Pervious Accumulated Runoff (inches)	Pervious Area Increment Runoff (inches)	Impervious Accumulated Runoff (inches)	Impervious Area Incr. Runoff (inches)	Total Runoff (inches)	Instant Flow rate (cfs)	Design Flow rate (cfs)
0	0	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
1	10	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
2	20	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
3	30	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
4	40	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
5	50	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
6	60	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
7	70	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
8	80	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
9	90	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
10	100	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
11	110	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
12	120	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
13	130	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
14	140	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
15	150	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
16	160	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
17	170	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
18	180	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
19	190	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
20	200	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
21	210	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
22	220	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
23	230	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
24	240	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
25	250	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
26	260	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
27	270	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
28	280	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
29	290	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
30	300	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
31	310	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
32	320	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
33	330	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
34	340	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
35	350	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
36	360	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
37	370	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
38	380	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
39	390	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
40	400	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
41	410	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
42	420	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
43	430	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
44	440	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
45	450	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
46	460	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
47	470	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
48	480	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
49	490	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
50	500	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
51	510	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
52	520	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
53	530	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
54	540	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
55	550	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
56	560	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
57	570	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
58	580	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
59	590	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
60	600	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
61	610	0.0040	0.0100	0.010	0.000	0.000	0.000	0.000	0.000	0.00	0.000
62	620	0.0040	0.0100	0.020	0.000	0.000	0.000	0.000	0.000	0.00	0.000
63	630	0.0040	0.0100	0.030	0.000	0.000	0.000	0.000	0.000	0.00	0.000
64	640	0.0040	0.0100	0.040	0.000	0.000	0.000	0.000	0.000	0.00	0.000
65	650	0.0119	0.0300	0.070	0.000	0.000	0.004	0.004	0.000	0.17	0.014
66	660	0.0079	0.0200	0.090	0.000	0.000	0.010	0.006	0.000	0.27	0.049
67	670	0.0079	0.0200	0.110	0.000	0.000	0.018	0.008	0.001	0.36	0.095
68	680	0.0079	0.0200	0.130	0.000	0.000	0.027	0.010	0.001	0.44	0.148
69	690	0.0119	0.0300	0.160	0.000	0.000	0.044	0.017	0.001	0.77	0.226
70	700	0.0079	0.0200	0.180	0.000	0.000	0.056	0.012	0.001	0.57	0.302
71	710	0.0079	0.0200	0.200	0.000	0.000	0.070	0.013	0.001	0.61	0.351
72	720	0.0079	0.0200	0.220	0.000	0.000	0.084	0.014	0.001	0.64	0.398
73	730	0.0040	0.0100	0.230	0.000	0.000	0.091	0.007	0.000	0.33	0.413
74	740	0.0079	0.0200	0.250	0.000	0.000	0.106	0.015	0.001	0.68	0.429
75	750	0.0119	0.0300	0.280	0.000	0.000	0.129	0.023	0.002	1.06	0.505
76	760	0.0119	0.0300	0.310	0.000	0.000	0.153	0.024	0.002	1.10	0.603
77	770	0.0119	0.0300	0.340	0.000	0.000	0.178	0.025	0.002	1.21	0.698
78	780	0.0198	0.0500	0.390	0.002	0.002	0.220	0.043	0.005	3.47	0.980
79	790	0.0079	0.0200	0.410	0.004	0.002	0.238	0.017	0.003	1.91	1.274
80	800	0.0159	0.0400	0.450	0.009	0.005	0.273	0.035	0.007	4.67	1.620
81	810	0.0198	0.0500	0.500	0.017	0.008	0.318	0.045	0.010	7.33	2.372
82	820	0.0159	0.0400	0.540	0.025	0.008	0.354	0.036	0.010	6.96	3.190
83	830	0.0159	0.0400	0.580	0.034	0.009	0.391	0.037	0.011	7.87	3.915
84	840	0.0159	0.0400	0.620	0.045	0.011	0.428	0.037	0.012	8.72	4.665
85	850	0.0119	0.0300	0.650	0.054	0.009	0.456	0.028	0.010	7.06	5.218
86	860	0.0079	0.0200	0.670	0.060	0.006	0.475	0.019	0.007	4.95	5.353
87	870	0.0079	0.0200	0.690	0.067	0.007	0.494	0.019	0.007	5.13	5.299
88	880	0.0079	0.0200	0.710	0.073	0.007	0.513	0.019	0.008	5.31	5.285
89	890	0.0159	0.0400	0.750	0.088	0.014	0.551	0.038	0.016	11.13	5.788
90	900	0.0119	0.0300	0.780	0.099	0.011	0.579	0.029	0.013	8.78	6.503
91	910	0.0159	0.0400	0.820	0.115	0.016	0.617	0.038	0.017	12.24	7.190
92	920	0.0159	0.0400	0.860	0.132	0.017	0.656	0.038	0.018	12.83	8.108
93	930	0.0159	0.0400	0.900	0.150	0.018	0.694	0.038	0.019	13.39	8.966
94	940	0.0119	0.0300	0.930	0.164	0.014	0.723	0.029	0.015	10.39	9.468
95	950	0.0159	0.0400	0.970	0.183	0.019	0.762	0.039	0.020	14.29	9.960
96	960	0.0119	0.0300	1.000	0.198	0.015	0.791	0.029	0.016	11.03	10.424
97	970	0.0079	0.0200	1.020							



116	1160	0.0159	0.0400	1.300	0.365	0.024	1.084	0.039	0.025	17.59	9.948
117	1170	0.0000	0.0000	1.300	0.365	0.000	1.084	0.000	0.000	0.00	9.750
118	1180	0.0079	0.0200	1.320	0.377	0.012	1.103	0.020	0.013	8.92	8.842
119	1190	0.0040	0.0100	1.330	0.383	0.006	1.113	0.010	0.006	4.49	8.475
120	1200	0.0040	0.0100	1.340	0.389	0.006	1.123	0.010	0.006	4.51	7.793
121	1210	0.0000	0.0000	1.340	0.389	0.000	1.123	0.000	0.000	0.00	6.842
122	1220	0.0040	0.0100	1.350	0.396	0.006	1.133	0.010	0.006	4.53	6.057
123	1230	0.0119	0.0300	1.380	0.414	0.019	1.162	0.029	0.020	13.69	6.580
124	1240	0.0079	0.0200	1.400	0.427	0.013	1.182	0.020	0.013	9.22	7.416
125	1250	0.0040	0.0100	1.410	0.434	0.006	1.192	0.010	0.007	4.63	7.332
126	1260	0.0000	0.0000	1.410	0.434	0.000	1.192	0.000	0.000	0.00	6.472
127	1270	0.0040	0.0100	1.420	0.440	0.006	1.201	0.010	0.007	4.65	5.760
128	1280	0.0000	0.0000	1.420	0.440	0.000	1.201	0.000	0.000	0.00	5.171
129	1290	0.0000	0.0000	1.420	0.440	0.000	1.201	0.000	0.000	0.00	4.284
130	1300	0.0040	0.0100	1.430	0.446	0.006	1.211	0.010	0.007	4.67	3.950
131	1310	0.0040	0.0100	1.440	0.453	0.006	1.221	0.010	0.007	4.69	4.075
132	1320	0.0000	0.0000	1.440	0.453	0.000	1.221	0.000	0.000	0.00	3.778
133	1330	0.0040	0.0100	1.450	0.459	0.006	1.231	0.010	0.007	4.70	3.533
134	1340	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	3.330
135	1350	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	2.759
136	1360	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	2.286
137	1370	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	1.894
138	1380	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	1.569
139	1390	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	1.300
140	1400	0.0040	0.0100	1.460	0.466	0.007	1.241	0.010	0.007	4.72	1.482
141	1410	0.0040	0.0100	1.470	0.472	0.007	1.251	0.010	0.007	4.74	2.039
142	1420	0.0040	0.0100	1.480	0.479	0.007	1.260	0.010	0.007	4.75	2.503
143	1430	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	2.481
144	1440	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	2.056
145	1450	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	1.703
146	1460	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	1.411
147	1470	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	1.169
148	1480	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.968
149	1490	0.0040	0.0100	1.490	0.486	0.007	1.270	0.010	0.007	4.77	1.211
150	1500	0.0040	0.0100	1.500	0.492	0.007	1.280	0.010	0.007	4.79	1.823
151	1510	0.0040	0.0100	1.510	0.499	0.007	1.290	0.010	0.007	4.80	2.333
152	1520	0.0000	0.0000	1.510	0.499	0.000	1.290	0.000	0.000	0.00	2.344
153	1530	0.0040	0.0100	1.520	0.505	0.007	1.300	0.010	0.007	4.82	2.355
154	1540	0.0040	0.0100	1.530	0.512	0.007	1.310	0.010	0.007	4.83	2.779
155	1550	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	2.717
156	1560	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	2.251
157	1570	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	1.865
158	1580	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	1.545
159	1590	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	1.280
160	1600	0.0040	0.0100	1.540	0.519	0.007	1.320	0.010	0.007	4.85	1.476
161	1610	0.0000	0.0000	1.540	0.519	0.000	1.320	0.000	0.000	0.00	1.639
162	1620	0.0000	0.0000	1.540	0.519	0.000	1.320	0.000	0.000	0.00	1.358
163	1630	0.0119	0.0300	1.570	0.539	0.020	1.349	0.030	0.021	14.64	2.380
164	1640	0.0040	0.0100	1.580	0.546	0.007	1.359	0.010	0.007	4.91	3.648
165	1650	0.0119	0.0300	1.610	0.566	0.021	1.389	0.030	0.021	14.81	4.714
166	1660	0.0119	0.0300	1.640	0.587	0.021	1.418	0.030	0.021	14.94	6.457
167	1670	0.0079	0.0200	1.660	0.601	0.014	1.438	0.020	0.014	10.03	7.491
168	1680	0.0119	0.0300	1.690	0.622	0.021	1.468	0.030	0.022	15.14	8.365
169	1690	0.0079	0.0200	1.710	0.636	0.014	1.487	0.020	0.014	10.16	9.100
170	1700	0.0040	0.0100	1.720	0.643	0.007	1.497	0.010	0.007	5.10	8.848
171	1710	0.0000	0.0000	1.720	0.643	0.000	1.497	0.000	0.000	0.00	7.767
172	1720	0.0000	0.0000	1.720	0.643	0.000	1.497	0.000	0.000	0.00	6.435
173	1730	0.0040	0.0100	1.730	0.650	0.007	1.507	0.010	0.007	5.11	5.769
174	1740	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	5.218
175	1750	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	4.323
176	1760	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	3.581
177	1770	0.0278	0.0700	1.800	0.701	0.050	1.576	0.069	0.052	36.13	6.066
178	1780	0.0079	0.0200	1.820	0.715	0.015	1.596	0.020	0.015	10.43	9.019
179	1790	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	8.366
180	1800	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	6.931
181	1810	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	5.742
182	1820	0.0079	0.0200	1.840	0.730	0.015	1.616	0.020	0.015	10.47	5.655
183	1830	0.0119	0.0300	1.870	0.752	0.022	1.646	0.030	0.023	15.80	6.939
184	1840	0.0040	0.0100	1.880	0.759	0.007	1.655	0.010	0.008	5.29	7.557
185	1850	0.0000	0.0000	1.880	0.759	0.000	1.655	0.000	0.000	0.00	6.714
186	1860	0.0040	0.0100	1.890	0.767	0.007	1.665	0.010	0.008	5.30	6.017
187	1870	0.0040	0.0100	1.900	0.774	0.007	1.675	0.010	0.008	5.31	5.894
188	1880	0.0159	0.0400	1.940	0.804	0.030	1.715	0.040	0.030	21.34	7.169
189	1890	0.0159	0.0400	1.980	0.834	0.030	1.755	0.040	0.031	21.51	9.615
190	1900	0.0159	0.0400	2.020	0.864	0.030	1.794	0.040	0.031	21.66	11.668
191	1910	0.0079	0.0200	2.040	0.879	0.015	1.814	0.020	0.016	10.89	12.459
192	1920	0.0000	0.0000	2.040	0.879	0.000	1.814	0.000	0.000	0.00	11.255
193	1930	0.0040	0.0100	2.050	0.887	0.008	1.824	0.010	0.008	5.46	9.793
194	1940	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	8.581
195	1950	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	7.109
196	1960	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	5.889
197	1970	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	4.879
198	1980	0.0079	0.0200	2.070	0.902	0.015	1.844	0.020	0.016	10.94	4.981
199	1990	0.0040	0.0100	2.080	0.910	0.008	1.854	0.010	0.008	5.49	5.536
200	2000	0.0000	0.0000	2.080	0.910	0.000	1.854	0.000	0.000	0.00	5.057
201	2010	0.0754	0.1900	2.270	1.058	0.148	2.042	0.189	0.151	105.86	13.270
202	2020	0.0159	0.0400	2.310	1.090	0.032	2.082	0.040	0.032	22.85	22.017
203	2030	0.0278	0.0700	2.380	1.146	0.056	2.151	0.070	0.057	39.93	23.608
204	2040	0.0040	0.0100	2.390	1.154	0.008	2.161	0.010	0.008	5.73	23.475
205	2050	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	19.939
206	2060	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	16.518
207	2070	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	13.685
208	2080	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	11.337
209	2090	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	9.392
210	2100	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	7.781
211	2110	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	6.446
212	2120	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	5.340
213	2130	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	4.424
214	2140	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	3.665
215	2150	0.0000	0.0000	2.390	1.154						









**King County CSO  
Barton Basin Subbasin 416 GSI Analysis**

SvR Project No. 06053  
Santa Barbara Urban Hydrograph Method (SBUH)  
Rainfall data provided by King County  
conversion from sf to acre 43560 sf/acre  
conversion factor from cfs to MGD: 0.64516129 MGD/cfs  
a time increment of 9999 indicates that the rain event (provided by King County) has finished  
Tc is taken from StormShed analysis.

SBUH Method				
subbasin 416	Peak =	27.15 cfs	17.52 MGD	
w/ 26 imperv acres removed	Peak =	11.76 cfs	7.58 MGD	
			Difference	9.93 MGD

used percent impervious and pervious from half block analysis to calculate percentages

% impervious row contributing flow to Pump Station **16.9%**  
% pervious row contributing flow to Pump Station **7.9%**  
% impervious roof in half block **0.0%**  
% pervious parcel contributing flow to Pump Station **0.0%**

198.2 (ac) Average acreage footprint contributing flow to pump station (Table D8 in TM 200.7 between Scenario A and B)

		Impervious 16.9%	Pervious 8%									
Total Areas (ac)		33.55	15.61	49.16 (ac) Total surface 416 area contributing flow to Pump Station								
CN		98	86									
Rainfall Distribution: 1984 Storm this field needs to be year of storm followed a space then "Storm". Example "1984 Storm"												
Max Time Increment		288		Tc =		10 minutes		w =		0.33		
Pt =		2.52 inches		dt =		10 minutes						
Sp =		1.63										
Si =		0.20										
Time Increment	Time	Rainfall Distribution	Incremental Rainfall	Accumulated Rainfall	Pervious Accumulated Runoff	Pervious Area Increment	Impervious Accumulated Runoff	Impervious Area Incr.	Total Runoff	Instant Flow rate	Design Flow rate	
	(minutes)	(fraction)	(inches)	(inches)	(inches)	(inches)	(inches)	(inches)	(inches)	(cfs)	(cfs)	
1	2	3	4	5	6	7	8	9	10	11	12.000	
0	0	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
1	10	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
2	20	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
3	30	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
4	40	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
5	50	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
6	60	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
7	70	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
8	80	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
9	90	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
10	100	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
11	110	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
12	120	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
13	130	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
14	140	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
15	150	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
16	160	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
17	170	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
18	180	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
19	190	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
20	200	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
21	210	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
22	220	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
23	230	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
24	240	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
25	250	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
26	260	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
27	270	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
28	280	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
29	290	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
30	300	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
31	310	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
32	320	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
33	330	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
34	340	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
35	350	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
36	360	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
37	370	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
38	380	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
39	390	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
40	400	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
41	410	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
42	420	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
43	430	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
44	440	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
45	450	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
46	460	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
47	470	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
48	480	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
49	490	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
50	500	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
51	510	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
52	520	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
53	530	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
54	540	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
55	550	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
56	560	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
57	570	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
58	580	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
59	590	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
60	600	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
61	610	0.0040	0.0100	0.010	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
62	620	0.0040	0.0100	0.020	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
63	630	0.0040	0.0100	0.030	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
64	640	0.0040	0.0100	0.040	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
65	650	0.0119	0.0300	0.070	0.000	0.000	0.004	0.004	0.002	0.74	0.247	
66	660	0.0079	0.0200	0.090	0.000	0.000	0.010	0.006	0.004	1.20	0.729	
67	670	0.0079	0.0200	0.110	0.000	0.000	0.018	0.008	0.005	1.62	1.181	
68	680	0.0079	0.0200	0.130	0.000	0.000	0.027	0.010	0.007	1.95	1.583	
69	690	0.0119	0.0300	0.160	0.000	0.000	0.044	0.017	0.011	3.41	2.316	
70	700	0.0079	0.0200	0.180	0.000	0.000	0.056	0.012	0.009	2.54	2.755	
71	710	0.0079	0.0200	0.200	0.000	0.000	0.070	0.013	0.009	2.70	2.665	
72	720	0.0079	0.0200	0.220	0.000	0.000	0.084	0.014	0.010	2.85	2.738	
73	730	0.0040	0.0100	0.230	0.000	0.000	0.091	0.007	0.005	1.47	2.351	
74	740	0.0079	0.0200	0.250	0.000	0.000	0.106	0.015	0.010	3.02	2.280	
75	750	0.0119	0.0300	0.280	0.000	0.000	0.129	0.023	0.016	4.71	3.335	
76	760	0.0119	0.0300	0.310	0.000	0.000	0.153	0.024	0.016	4.88	4.307	
77	770	0.0119	0.0300	0.340	0.000	0.000	0.178	0.025	0.017	5.04	4.742	
78	780	0.0198	0.0500	0.390	0.002	0.002	0.220	0.043	0.030	8.85	6.210	
79	790	0.0079	0.0200	0.410	0.004	0.002	0.238	0.017	0.012	3.69	6.250	
80	800	0.0159	0.0400	0.450	0.009	0.005	0.273	0.035	0.026	7.60	5.846	
81	810	0.0198	0.0500	0.500	0.017	0.008	0.318	0.045	0.033	9.87	7.772	
82	820	0.0159	0.0400	0.540	0.025	0.008	0.354	0.036	0.027	8.16	8.600	
83	830	0.0159	0.0400	0.580	0.034	0.009	0.391	0.037	0.028	8.36	8.374	
84	840	0.0159	0.0400	0.620	0.045	0.011	0.428	0.037	0.029	8.55	8.429	
85	850	0.0119	0.0300	0.650	0.054	0.009	0.456	0.028	0.022	6.52	7.834	
86	860	0.0079	0.0200	0.670	0.060	0.006	0.475	0.019	0.015	4.40	6.253	
87	870	0.0079	0.0200	0.690	0.067	0.007	0.494	0.019	0.015	4.44	5.030	
88	880	0.0079	0.0200	0.710	0.073	0.007	0.513	0.019	0.015	4.47	4.647	
89	890	0.0159	0.0400	0.750	0.088	0.014						



104	1040	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	1.160
105	1050	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	0.387
106	1060	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	0.129
107	1070	0.0000	0.0000	1.060	0.228	0.000	0.849	0.000	0.000	0.00	0.043
108	1080	0.0079	0.0200	1.080	0.239	0.011	0.869	0.019	0.017	4.95	1.664
109	1090	0.0079	0.0200	1.100	0.250	0.011	0.888	0.019	0.017	4.97	3.859
110	1100	0.0079	0.0200	1.120	0.261	0.011	0.908	0.019	0.017	4.98	4.603
111	1110	0.0079	0.0200	1.140	0.272	0.011	0.927	0.020	0.017	5.00	4.863
112	1120	0.0119	0.0300	1.170	0.288	0.017	0.956	0.029	0.025	7.53	5.799
113	1130	0.0119	0.0300	1.200	0.306	0.017	0.986	0.029	0.025	7.57	6.967
114	1140	0.0119	0.0300	1.230	0.323	0.017	1.015	0.029	0.026	7.60	7.380
115	1150	0.0119	0.0300	1.260	0.341	0.018	1.044	0.029	0.026	7.64	7.541
116	1160	0.0159	0.0400	1.300	0.365	0.024	1.084	0.039	0.034	10.23	8.471
117	1170	0.0000	0.0000	1.300	0.365	0.000	1.084	0.000	0.000	0.00	6.235
118	1180	0.0079	0.0200	1.320	0.377	0.012	1.103	0.020	0.017	5.14	3.791
119	1190	0.0040	0.0100	1.330	0.383	0.006	1.113	0.010	0.009	2.57	3.834
120	1200	0.0040	0.0100	1.340	0.389	0.006	1.123	0.010	0.009	2.58	2.995
121	1210	0.0000	0.0000	1.340	0.389	0.000	1.123	0.000	0.000	0.00	1.857
122	1220	0.0040	0.0100	1.350	0.396	0.006	1.133	0.010	0.009	2.58	1.479
123	1230	0.0119	0.0300	1.380	0.414	0.019	1.162	0.029	0.026	7.76	3.939
124	1240	0.0079	0.0200	1.400	0.427	0.013	1.182	0.020	0.017	5.19	5.629
125	1250	0.0040	0.0100	1.410	0.434	0.006	1.192	0.010	0.009	2.60	4.472
126	1260	0.0000	0.0000	1.410	0.434	0.000	1.192	0.000	0.000	0.00	2.357
127	1270	0.0040	0.0100	1.420	0.440	0.006	1.201	0.010	0.009	2.60	1.653
128	1280	0.0000	0.0000	1.420	0.440	0.000	1.201	0.000	0.000	0.00	1.418
129	1290	0.0000	0.0000	1.420	0.440	0.000	1.201	0.000	0.000	0.00	0.473
130	1300	0.0040	0.0100	1.430	0.446	0.006	1.211	0.010	0.009	2.60	1.026
131	1310	0.0040	0.0100	1.440	0.453	0.006	1.221	0.010	0.009	2.61	2.079
132	1320	0.0000	0.0000	1.440	0.453	0.000	1.221	0.000	0.000	0.00	1.562
133	1330	0.0040	0.0100	1.450	0.459	0.006	1.231	0.010	0.009	2.61	1.391
134	1340	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	1.334
135	1350	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.445
136	1360	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.148
137	1370	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.049
138	1380	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.016
139	1390	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.005
140	1400	0.0040	0.0100	1.460	0.466	0.007	1.241	0.010	0.009	2.61	0.873
141	1410	0.0040	0.0100	1.470	0.472	0.007	1.251	0.010	0.009	2.62	2.034
142	1420	0.0040	0.0100	1.480	0.479	0.007	1.260	0.010	0.009	2.62	2.423
143	1430	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	1.680
144	1440	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.560
145	1450	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.187
146	1460	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.062
147	1470	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.021
148	1480	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.007
149	1490	0.0040	0.0100	1.490	0.486	0.007	1.270	0.010	0.009	2.62	0.876
150	1500	0.0040	0.0100	1.500	0.492	0.007	1.280	0.010	0.009	2.62	2.040
151	1510	0.0040	0.0100	1.510	0.499	0.007	1.290	0.010	0.009	2.63	2.430
152	1520	0.0000	0.0000	1.510	0.499	0.000	1.290	0.000	0.000	0.00	1.685
153	1530	0.0040	0.0100	1.520	0.505	0.007	1.300	0.010	0.009	2.63	1.438
154	1540	0.0040	0.0100	1.530	0.512	0.007	1.310	0.010	0.009	2.63	2.233
155	1550	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	1.621
156	1560	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	0.540
157	1570	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	0.180
158	1580	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	0.060
159	1590	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	0.020
160	1600	0.0040	0.0100	1.540	0.519	0.007	1.320	0.010	0.009	2.63	0.885
161	1610	0.0000	0.0000	1.540	0.519	0.000	1.320	0.000	0.000	0.00	1.173
162	1620	0.0000	0.0000	1.540	0.519	0.000	1.320	0.000	0.000	0.00	0.391
163	1630	0.0119	0.0300	1.570	0.539	0.020	1.349	0.030	0.027	7.92	2.769
164	1640	0.0040	0.0100	1.580	0.546	0.007	1.359	0.010	0.009	2.64	4.443
165	1650	0.0119	0.0300	1.610	0.566	0.021	1.389	0.030	0.027	7.95	5.011
166	1660	0.0119	0.0300	1.640	0.587	0.021	1.418	0.030	0.027	7.97	6.975
167	1670	0.0079	0.0200	1.660	0.601	0.014	1.438	0.020	0.018	5.32	6.755
168	1680	0.0119	0.0300	1.690	0.622	0.021	1.468	0.030	0.027	8.00	6.693
169	1690	0.0079	0.0200	1.710	0.636	0.014	1.487	0.020	0.018	5.34	6.679
170	1700	0.0040	0.0100	1.720	0.643	0.007	1.497	0.010	0.009	2.68	4.900
171	1710	0.0000	0.0000	1.720	0.643	0.000	1.497	0.000	0.000	0.00	2.525
172	1720	0.0000	0.0000	1.720	0.643	0.000	1.497	0.000	0.000	0.00	0.842
173	1730	0.0040	0.0100	1.730	0.650	0.007	1.507	0.010	0.009	2.68	1.173
174	1740	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	1.283
175	1750	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	0.428
176	1760	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	0.143
177	1770	0.0278	0.0700	1.800	0.701	0.050	1.576	0.069	0.063	18.80	6.314
178	1780	0.0079	0.0200	1.820	0.715	0.015	1.596	0.020	0.018	5.39	10.167
179	1790	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	5.185
180	1800	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	1.728
181	1810	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	0.576
182	1820	0.0079	0.0200	1.840	0.730	0.015	1.616	0.020	0.018	5.40	1.991
183	1830	0.0119	0.0300	1.870	0.752	0.022	1.646	0.030	0.027	8.11	5.165
184	1840	0.0040	0.0100	1.880	0.759	0.007	1.655	0.010	0.009	2.71	5.326
185	1850	0.0000	0.0000	1.880	0.759	0.000	1.655	0.000	0.000	0.00	2.677
186	1860	0.0040	0.0100	1.890	0.767	0.007	1.665	0.010	0.009	2.71	1.795
187	1870	0.0040	0.0100	1.900	0.774	0.007	1.675	0.010	0.009	2.71	2.404
188	1880	0.0159	0.0400	1.940	0.804	0.030	1.715	0.040	0.036	10.85	5.323
189	1890	0.0159	0.0400	1.980	0.834	0.030	1.755	0.040	0.037	10.88	9.020
190	1900	0.0159	0.0400	2.020	0.864	0.030	1.794	0.040	0.037	10.91	10.269
191	1910	0.0079	0.0200	2.040	0.879	0.015	1.814	0.020	0.018	5.46	8.879
192	1920	0.0000	0.0000	2.040	0.879	0.000	1.814	0.000	0.000	0.00	4.781
193	1930	0.0040	0.0100	2.050	0.887	0.008	1.824	0.010	0.009	2.73	2.505
194	1940	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	1.746
195	1950	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	0.582
196	1960	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	0.194
197	1970	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	0.065
198	1980	0.0079	0.0200	2.070	0.902	0.015	1.844	0.020	0.018	5.47	1.845
199	1990	0.0040	0.0100	2.080	0.910	0.008	1.854	0.010	0.009	2.74	3.352
200	2000	0.0000	0.0000	2.080	0.910	0.000	1.854	0.000	0.000	0.00	2.030
201	2010	0.0754	0.1900	2.270	1.058	0.148	2.042	0.189	0.176	52.28	18.103
202	2020	0.0159	0.0400	2.310	1.090	0.032	2.082	0.040	0.037	11.06	27.150
203	2030	0.0278	0.0700	2.380	1.146	0.056	2.151	0.070	0.065	19	









King County CSO  
 Barton Basin Subbasin 416 GSI Analysis  
 SvR Project No. 06053

SEE SBUH-all TAB FOR ASSUMPTIONS.

Impervious Pervious  
 Total Areas (ac) 7.55 15.61 Total Area (ac) 23.16  
 CN 98 86  
**Rainfall Distribution: 1984 Storm** this field needs to be year of storm followed a space then "Storm". Example "1984 Storm"  
 Max Time Increment 288  
 Pt = 2.52 inches Tc = 10 minutes w = 0.33  
 Sp = 1.63 dt = 10 minutes  
 Si = 0.20

Time Increment	Time (minutes)	Rainfall Distribution 1 (fraction)	Incremental Rainfall (inches)	Accumulated Rainfall (inches)	Pervious Accumulated Runoff (inches)	Pervious Area Increment Runoff (inches)	Impervious Accumulated Runoff (inches)	Impervious Area Incr. Runoff (inches)	Total Runoff (inches)	Instant Flow rate (cfs)	Design Flow rate (cfs)
0	0	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
1	10	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
2	20	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
3	30	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
4	40	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
5	50	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
6	60	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
7	70	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
8	80	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
9	90	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
10	100	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
11	110	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
12	120	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
13	130	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
14	140	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
15	150	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
16	160	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
17	170	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
18	180	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
19	190	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
20	200	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
21	210	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
22	220	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
23	230	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
24	240	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
25	250	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
26	260	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
27	270	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
28	280	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
29	290	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
30	300	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
31	310	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
32	320	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
33	330	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
34	340	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
35	350	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
36	360	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
37	370	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
38	380	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
39	390	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
40	400	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
41	410	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
42	420	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
43	430	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
44	440	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
45	450	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
46	460	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
47	470	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
48	480	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
49	490	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
50	500	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
51	510	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
52	520	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
53	530	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
54	540	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
55	550	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
56	560	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
57	570	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
58	580	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
59	590	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
60	600	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
61	610	0.0040	0.0100	0.010	0.000	0.000	0.000	0.000	0.000	0.00	0.000
62	620	0.0040	0.0100	0.020	0.000	0.000	0.000	0.000	0.000	0.00	0.000
63	630	0.0040	0.0100	0.030	0.000	0.000	0.000	0.000	0.000	0.00	0.000
64	640	0.0040	0.0100	0.040	0.000	0.000	0.000	0.000	0.000	0.00	0.000
65	650	0.0119	0.0300	0.070	0.000	0.000	0.004	0.004	0.001	0.17	0.056
66	660	0.0079	0.0200	0.090	0.000	0.000	0.010	0.006	0.002	0.27	0.164
67	670	0.0079	0.0200	0.110	0.000	0.000	0.018	0.008	0.003	0.36	0.266
68	680	0.0079	0.0200	0.130	0.000	0.000	0.027	0.010	0.003	0.44	0.356
69	690	0.0119	0.0300	0.160	0.000	0.000	0.044	0.017	0.005	0.77	0.521
70	700	0.0079	0.0200	0.180	0.000	0.000	0.056	0.012	0.004	0.57	0.620
71	710	0.0079	0.0200	0.200	0.000	0.000	0.070	0.013	0.004	0.61	0.600
72	720	0.0079	0.0200	0.220	0.000	0.000	0.084	0.014	0.005	0.64	0.616
73	730	0.0040	0.0100	0.230	0.000	0.000	0.091	0.007	0.002	0.33	0.529
74	740	0.0079	0.0200	0.250	0.000	0.000	0.106	0.015	0.005	0.68	0.513
75	750	0.0119	0.0300	0.280	0.000	0.000	0.129	0.023	0.008	1.06	0.751
76	760	0.0119	0.0300	0.310	0.000	0.000	0.153	0.024	0.008	1.10	0.970
77	770	0.0119	0.0300	0.340	0.000	0.000	0.178	0.025	0.008	1.14	1.071
78	780	0.0198	0.0500	0.390	0.002	0.002	0.220	0.043	0.015	2.16	1.459
79	790	0.0079	0.0200	0.410	0.004	0.002	0.238	0.017	0.007	0.96	1.526
80	800	0.0159	0.0400	0.450	0.009	0.005	0.273	0.035	0.015	2.05	1.511
81	810	0.0198	0.0500	0.500	0.017	0.008	0.318	0.045	0.020	2.81	2.125
82	820	0.0159	0.0400	0.540	0.025	0.008	0.354	0.036	0.017	2.43	2.454
83	830	0.0159	0.0400	0.580	0.034	0.009	0.391	0.037	0.018	2.57	2.485
84	840	0.0159	0.0400	0.620	0.045	0.011	0.428	0.037	0.019	2.71	2.589
85	850	0.0119	0.0300	0.650	0.054	0.009	0.456	0.028	0.015	2.11	2.470
86	860	0.0079	0.0200	0.670	0.060	0.006	0.475	0.019	0.010	1.45	2.010
87	870	0.0079	0.0200	0.690	0.067	0.007	0.494	0.019	0.011	1.48	1.644
88	880	0.0079	0.0200	0.710	0.073	0.007	0.513	0.019	0.011	1.50	1.541
89	890	0.0159	0.0400	0.750	0.088	0.014	0.551	0.038	0.022	3.09	2.043
90	900	0.0119	0.0300	0.780	0.099	0.011	0.579	0.029	0.017	2.38	2.503
91	910	0.0159	0.0400	0.820	0.115	0.016	0.617	0.038	0.023	3.26	2.714
92	920	0.0159	0.0400	0.860	0.132	0.017	0.656	0.038	0.024	3.35	3.107
93	930	0.0159	0.0400	0.900	0.150	0.018	0.694	0.038	0.025	3.43	3.296
94	940	0.0119	0.0300	0.930	0.164	0.014	0.723	0.029	0.019	2.63	3.119
95	950	0.0159	0.0400	0.970	0.183	0.019	0.762	0.039	0.025	3.57	3.106
96	960	0.0119	0.0300	1.000	0.198	0.015	0.791	0.029	0.019	2.73	3.134
97	970	0.0079	0.0200								



114	1140	0.0119	0.0300	1.230	0.323	0.017	1.015	0.029	0.021	2.99	2.886
115	1150	0.0119	0.0300	1.260	0.341	0.018	1.044	0.029	0.022	3.02	2.964
116	1160	0.0159	0.0400	1.300	0.365	0.024	1.084	0.039	0.029	4.07	3.350
117	1170	0.0000	0.0000	1.300	0.365	0.000	1.084	0.000	0.000	0.00	2.472
118	1180	0.0079	0.0200	1.320	0.377	0.012	1.103	0.020	0.015	2.05	1.508
119	1190	0.0040	0.0100	1.330	0.383	0.006	1.113	0.010	0.007	1.03	1.530
120	1200	0.0040	0.0100	1.340	0.389	0.006	1.123	0.010	0.007	1.03	1.198
121	1210	0.0000	0.0000	1.340	0.389	0.000	1.123	0.000	0.000	0.00	0.744
122	1220	0.0040	0.0100	1.350	0.396	0.006	1.133	0.010	0.007	1.04	0.593
123	1230	0.0119	0.0300	1.380	0.414	0.019	1.162	0.029	0.022	3.12	1.584
124	1240	0.0079	0.0200	1.400	0.427	0.013	1.182	0.020	0.015	2.10	2.268
125	1250	0.0040	0.0100	1.410	0.434	0.006	1.192	0.010	0.008	1.05	1.805
126	1260	0.0000	0.0000	1.410	0.434	0.000	1.192	0.000	0.000	0.00	0.953
127	1270	0.0040	0.0100	1.420	0.440	0.006	1.201	0.010	0.008	1.05	0.669
128	1280	0.0000	0.0000	1.420	0.440	0.000	1.201	0.000	0.000	0.00	0.575
129	1290	0.0000	0.0000	1.420	0.440	0.000	1.201	0.000	0.000	0.00	0.192
130	1300	0.0040	0.0100	1.430	0.446	0.006	1.211	0.010	0.008	1.06	0.416
131	1310	0.0040	0.0100	1.440	0.453	0.006	1.221	0.010	0.008	1.06	0.844
132	1320	0.0000	0.0000	1.440	0.453	0.000	1.221	0.000	0.000	0.00	0.635
133	1330	0.0040	0.0100	1.450	0.459	0.006	1.231	0.010	0.008	1.06	0.566
134	1340	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.543
135	1350	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.181
136	1360	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.060
137	1370	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.020
138	1380	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.007
139	1390	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.002
140	1400	0.0040	0.0100	1.460	0.466	0.007	1.241	0.010	0.008	1.06	0.356
141	1410	0.0040	0.0100	1.470	0.472	0.007	1.251	0.010	0.008	1.07	0.829
142	1420	0.0040	0.0100	1.480	0.479	0.007	1.260	0.010	0.008	1.07	0.989
143	1430	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.686
144	1440	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.229
145	1450	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.076
146	1460	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.025
147	1470	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.008
148	1480	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.003
149	1490	0.0040	0.0100	1.490	0.486	0.007	1.270	0.010	0.008	1.07	0.358
150	1500	0.0040	0.0100	1.500	0.492	0.007	1.280	0.010	0.008	1.07	0.835
151	1510	0.0040	0.0100	1.510	0.499	0.007	1.290	0.010	0.008	1.08	0.995
152	1520	0.0000	0.0000	1.510	0.499	0.000	1.290	0.000	0.000	0.00	0.691
153	1530	0.0040	0.0100	1.520	0.505	0.007	1.300	0.010	0.008	1.08	0.590
154	1540	0.0040	0.0100	1.530	0.512	0.007	1.310	0.010	0.008	1.08	0.917
155	1550	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	0.666
156	1560	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	0.222
157	1570	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	0.074
158	1580	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	0.025
159	1590	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	0.008
160	1600	0.0040	0.0100	1.540	0.519	0.007	1.320	0.010	0.008	1.08	0.364
161	1610	0.0000	0.0000	1.540	0.519	0.000	1.320	0.000	0.000	0.00	0.483
162	1620	0.0000	0.0000	1.540	0.519	0.000	1.320	0.000	0.000	0.00	0.161
163	1630	0.0119	0.0300	1.570	0.539	0.020	1.349	0.030	0.023	3.26	1.142
164	1640	0.0040	0.0100	1.580	0.546	0.007	1.359	0.010	0.008	1.09	1.833
165	1650	0.0119	0.0300	1.610	0.566	0.021	1.389	0.030	0.023	3.29	2.072
166	1660	0.0119	0.0300	1.640	0.587	0.021	1.418	0.030	0.024	3.31	2.891
167	1670	0.0079	0.0200	1.660	0.601	0.014	1.438	0.020	0.016	2.22	2.806
168	1680	0.0119	0.0300	1.690	0.622	0.021	1.468	0.030	0.024	3.34	2.787
169	1690	0.0079	0.0200	1.710	0.636	0.014	1.487	0.020	0.016	2.24	2.788
170	1700	0.0040	0.0100	1.720	0.643	0.007	1.497	0.010	0.008	1.12	2.048
171	1710	0.0000	0.0000	1.720	0.643	0.000	1.497	0.000	0.000	0.00	1.056
172	1720	0.0000	0.0000	1.720	0.643	0.000	1.497	0.000	0.000	0.00	0.352
173	1730	0.0040	0.0100	1.730	0.650	0.007	1.507	0.010	0.008	1.12	0.492
174	1740	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	0.538
175	1750	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	0.179
176	1760	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	0.060
177	1770	0.0278	0.0700	1.800	0.701	0.050	1.576	0.069	0.056	7.91	2.657
178	1780	0.0079	0.0200	1.820	0.715	0.015	1.596	0.020	0.016	2.28	4.281
179	1790	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	2.186
180	1800	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	0.729
181	1810	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	0.243
182	1820	0.0079	0.0200	1.840	0.730	0.015	1.616	0.020	0.016	2.28	0.842
183	1830	0.0119	0.0300	1.870	0.752	0.022	1.646	0.030	0.025	3.44	2.187
184	1840	0.0040	0.0100	1.880	0.759	0.007	1.655	0.010	0.008	1.15	2.257
185	1850	0.0000	0.0000	1.880	0.759	0.000	1.655	0.000	0.000	0.00	1.135
186	1860	0.0040	0.0100	1.890	0.767	0.007	1.665	0.010	0.008	1.15	0.762
187	1870	0.0040	0.0100	1.900	0.774	0.007	1.675	0.010	0.008	1.15	1.021
188	1880	0.0159	0.0400	1.940	0.804	0.030	1.715	0.040	0.033	4.62	2.265
189	1890	0.0159	0.0400	1.980	0.834	0.030	1.755	0.040	0.033	4.65	3.845
190	1900	0.0159	0.0400	2.020	0.864	0.030	1.794	0.040	0.033	4.67	4.388
191	1910	0.0079	0.0200	2.040	0.879	0.015	1.814	0.020	0.017	2.34	3.801
192	1920	0.0000	0.0000	2.040	0.879	0.000	1.814	0.000	0.000	0.00	2.048
193	1930	0.0040	0.0100	2.050	0.887	0.008	1.824	0.010	0.008	1.17	1.074
194	1940	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	0.749
195	1950	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	0.250
196	1960	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	0.083
197	1970	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	0.028
198	1980	0.0079	0.0200	2.070	0.902	0.015	1.844	0.020	0.017	2.35	0.793
199	1990	0.0040	0.0100	2.080	0.910	0.008	1.854	0.010	0.008	1.18	1.441
200	2000	0.0000	0.0000	2.080	0.910	0.000	1.854	0.000	0.000	0.00	0.873
201	2010	0.0754	0.1900	2.270	1.058	0.148	2.042	0.189	0.161	22.62	7.831
202	2020	0.0159	0.0400	2.310	1.090	0.032	2.082	0.040	0.034	4.82	11.756
203	2030	0.0278	0.0700	2.380	1.146	0.056	2.151	0.070	0.060	8.47	8.348
204	2040	0.0040	0.0100	2.390	1.154	0.008	2.161	0.010	0.009	1.21	6.011
205	2050	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	2.408
206	2060	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	0.803
207	2070	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	0.268
208	2080	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	0.089
209	2090	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	0.030
210	2100	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	0.010
211	2110	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	0.003
212	2120	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	0.001
213	2130	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.00		









**King County CSO**  
**Barton Basin Subbasin 416 GSI Analysis**

SvR Project No. 06053  
Santa Barbara Urban Hydrograph Method (SBUH)

Rainfall data provided by King County  
conversion from sf to acre

43560 sf/acre  
conversion factor from cfs to MGD: 0.64516129 MGD/cfs  
a time increment of 9999 indicates that the rain event (provided by King County) has finished  
Tc is taken from StormShed analysis.

used percent impervious and pervious from half block analysis to calculate percentages

- % impervious row contributing flow to Pump Station **16.9%**
- % pervious row contributing flow to Pump Station **7.9%**
- % impervious roof in half block **18.7%**
- % pervious parcel contributing flow to Pump Station **28.1%**

198.2 (ac) Average acreage footprint contributing flow to pump station (Table D8 in TM 200.7 between Scenario A and B)

SBUH Method			
subbasin 416	Peak =	70.45 cfs	45.4 MGD
w/ 26 imperv acres removed	Peak =	55.05 cfs	35.5 MGD
	Difference		9.93 MGD

Total Areas (ac)		Impervious	Pervious									
CN		16.9%	55%	141.92 (ac) Total surface 416 area contributing flow to Pump Station								
33.55		33.55	108.37									
98		98	86									
Rainfall Distribution: <b>1984 Storm</b> this field needs to be year of storm followed a space then "Storm". Example "1984 Storm" Max Time Increment: 288 Pt = 2.52 inches      Tc = 10 minutes      w = 0.33 Sp = 1.63              dt = 10 minutes Si = 0.20												
Time Increment	Time	Rainfall Distribution	Incremental Rainfall	Accumulated Rainfall	Pervious Accumulated Runoff	Pervious Area Increment Runoff	Impervious Accumulated Runoff	Impervious Area Increment Runoff	Total Runoff	Instant Flow rate	Design Flow rate	
	(minutes)	(fraction)	(inches)	(inches)	(inches)	(inches)	(inches)	(inches)	(inches)	(cfs)	(cfs)	
1	2	3	4	5	6	7	8	9	10	11	12.000	
0	0	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
1	10	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
2	20	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
3	30	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
4	40	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
5	50	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
6	60	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
7	70	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
8	80	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
9	90	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
10	100	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
11	110	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
12	120	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
13	130	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
14	140	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
15	150	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
16	160	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
17	170	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
18	180	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
19	190	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
20	200	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
21	210	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
22	220	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
23	230	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
24	240	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
25	250	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
26	260	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
27	270	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
28	280	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
29	290	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
30	300	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
31	310	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
32	320	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
33	330	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
34	340	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
35	350	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
36	360	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
37	370	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
38	380	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
39	390	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
40	400	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
41	410	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
42	420	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
43	430	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
44	440	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
45	450	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
46	460	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
47	470	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
48	480	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
49	490	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
50	500	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
51	510	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
52	520	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
53	530	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
54	540	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
55	550	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
56	560	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
57	570	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
58	580	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
59	590	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
60	600	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
61	610	0.0040	0.0100	0.010	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
62	620	0.0040	0.0100	0.020	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
63	630	0.0040	0.0100	0.030	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
64	640	0.0040	0.0100	0.040	0.000	0.000	0.000	0.000	0.000	0.00	0.000	
65	650	0.0119	0.0300	0.070	0.000	0.000	0.004	0.004	0.004	0.74	0.247	
66	660	0.0079	0.0200	0.090	0.000	0.000	0.010	0.006	0.010	1.20	0.729	
67	670	0.0079	0.0200	0.110	0.000	0.000	0.018	0.008	0.026	1.62	1.181	
68	680	0.0079	0.0200	0.130	0.000	0.000	0.027	0.010	0.037	1.95	1.583	
69	690	0.0119	0.0300	0.160	0.000	0.000	0.044	0.017	0.061	3.41	2.316	
70	700	0.0079	0.0200	0.180	0.000	0.000	0.056	0.012	0.073	2.54	2.755	
71	710	0.0079	0.0200	0.200	0.000	0.000	0.070	0.013	0.086	2.70	2.665	
72	720	0.0079	0.0200	0.220	0.000	0.000	0.084	0.014	0.099	2.85	2.738	
73	730	0.0040	0.0100	0.230	0.000	0.000	0.091	0.007	0.106	1.47	2.351	
74	740	0.0079	0.0200	0.250	0.000	0.000	0.106	0.015	0.121	3.02	2.280	
75	750	0.0119	0.0300	0.280	0.000	0.000	0.129	0.023	0.152	4.71	3.335	
76	760	0.0119	0.0300	0.310	0.000	0.000	0.153	0.024	0.177	4.88	4.307	
77	770	0.0119	0.0300	0.340	0.000	0.000	0.178	0.025	0.203	5.11	4.765	
78	780	0.0198	0.0500	0.390	0.002	0.002	0.220	0.043	0.263	10.16	6.677	
79	790	0.0079	0.0200	0.410	0.004	0.002	0.238	0.017	0.255	4.65	7.160	
80	800	0.0159	0.0400									



109	1090	0.0079	0.0200	1.100	0.250	0.011	0.888	0.019	0.013	10.99	8.513
110	1100	0.0079	0.0200	1.120	0.261	0.011	0.908	0.019	0.013	11.10	10.201
111	1110	0.0079	0.0200	1.140	0.272	0.011	0.927	0.020	0.013	11.20	10.832
112	1120	0.0119	0.0300	1.170	0.288	0.017	0.956	0.029	0.020	16.98	13.003
113	1130	0.0119	0.0300	1.200	0.306	0.017	0.986	0.029	0.020	17.19	15.726
114	1140	0.0119	0.0300	1.230	0.323	0.017	1.015	0.029	0.020	17.40	16.773
115	1150	0.0119	0.0300	1.260	0.341	0.018	1.044	0.029	0.020	17.60	17.257
116	1160	0.0159	0.0400	1.300	0.365	0.024	1.084	0.039	0.028	23.76	19.538
117	1170	0.0000	0.0000	1.300	0.365	0.000	1.084	0.000	0.000	0.00	14.432
118	1180	0.0079	0.0200	1.320	0.377	0.012	1.103	0.020	0.014	12.00	8.812
119	1190	0.0040	0.0100	1.330	0.383	0.006	1.113	0.010	0.007	6.03	8.948
120	1200	0.0040	0.0100	1.340	0.389	0.006	1.123	0.010	0.007	6.05	7.010
121	1210	0.0000	0.0000	1.340	0.389	0.000	1.123	0.000	0.000	0.00	4.353
122	1220	0.0040	0.0100	1.350	0.396	0.006	1.133	0.010	0.007	6.07	3.474
123	1230	0.0119	0.0300	1.380	0.414	0.019	1.162	0.029	0.021	18.32	9.289
124	1240	0.0079	0.0200	1.400	0.427	0.013	1.182	0.020	0.014	12.31	13.307
125	1250	0.0040	0.0100	1.410	0.434	0.006	1.192	0.010	0.007	6.18	10.599
126	1260	0.0000	0.0000	1.410	0.434	0.000	1.192	0.000	0.000	0.00	5.593
127	1270	0.0040	0.0100	1.420	0.440	0.006	1.201	0.010	0.007	6.20	3.931
128	1280	0.0000	0.0000	1.420	0.440	0.000	1.201	0.000	0.000	0.00	3.377
129	1290	0.0000	0.0000	1.420	0.440	0.000	1.201	0.000	0.000	0.00	1.126
130	1300	0.0040	0.0100	1.430	0.446	0.006	1.211	0.010	0.007	6.22	2.447
131	1310	0.0040	0.0100	1.440	0.453	0.006	1.221	0.010	0.007	6.23	4.966
132	1320	0.0000	0.0000	1.440	0.453	0.000	1.221	0.000	0.000	0.00	3.733
133	1330	0.0040	0.0100	1.450	0.459	0.006	1.231	0.010	0.007	6.25	3.328
134	1340	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	3.193
135	1350	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	1.064
136	1360	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.355
137	1370	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.118
138	1380	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.039
139	1390	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.013
140	1400	0.0040	0.0100	1.460	0.466	0.007	1.241	0.010	0.007	6.27	2.094
141	1410	0.0040	0.0100	1.470	0.472	0.007	1.251	0.010	0.007	6.29	4.883
142	1420	0.0040	0.0100	1.480	0.479	0.007	1.260	0.010	0.007	6.30	5.823
143	1430	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	4.042
144	1440	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	1.347
145	1450	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.449
146	1460	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.150
147	1470	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.050
148	1480	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.017
149	1490	0.0040	0.0100	1.490	0.486	0.007	1.270	0.010	0.007	6.32	2.112
150	1500	0.0040	0.0100	1.500	0.492	0.007	1.280	0.010	0.007	6.34	4.922
151	1510	0.0040	0.0100	1.510	0.499	0.007	1.290	0.010	0.007	6.35	5.869
152	1520	0.0000	0.0000	1.510	0.499	0.000	1.290	0.000	0.000	0.00	4.073
153	1530	0.0040	0.0100	1.520	0.505	0.007	1.300	0.010	0.007	6.37	3.480
154	1540	0.0040	0.0100	1.530	0.512	0.007	1.310	0.010	0.007	6.38	5.410
155	1550	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	3.931
156	1560	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	1.310
157	1570	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	0.437
158	1580	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	0.146
159	1590	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	0.049
160	1600	0.0040	0.0100	1.540	0.519	0.007	1.320	0.010	0.007	6.40	2.149
161	1610	0.0000	0.0000	1.540	0.519	0.000	1.320	0.000	0.000	0.00	2.849
162	1620	0.0000	0.0000	1.540	0.519	0.000	1.320	0.000	0.000	0.00	0.950
163	1630	0.0119	0.0300	1.570	0.539	0.020	1.349	0.030	0.022	19.29	6.746
164	1640	0.0040	0.0100	1.580	0.546	0.007	1.359	0.010	0.008	6.46	10.831
165	1650	0.0119	0.0300	1.610	0.566	0.021	1.389	0.030	0.023	19.47	12.253
166	1660	0.0119	0.0300	1.640	0.587	0.021	1.418	0.030	0.023	19.60	17.105
167	1670	0.0079	0.0200	1.660	0.601	0.014	1.438	0.020	0.015	13.13	16.612
168	1680	0.0119	0.0300	1.690	0.622	0.021	1.468	0.030	0.023	19.80	16.516
169	1690	0.0079	0.0200	1.710	0.636	0.014	1.487	0.020	0.015	13.27	16.529
170	1700	0.0040	0.0100	1.720	0.643	0.007	1.497	0.010	0.008	6.65	12.151
171	1710	0.0000	0.0000	1.720	0.643	0.000	1.497	0.000	0.000	0.00	6.268
172	1720	0.0000	0.0000	1.720	0.643	0.000	1.497	0.000	0.000	0.00	2.089
173	1730	0.0040	0.0100	1.730	0.650	0.007	1.507	0.010	0.008	6.67	2.919
174	1740	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	3.195
175	1750	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	1.065
176	1760	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	0.355
177	1770	0.0278	0.0700	1.800	0.701	0.050	1.576	0.069	0.055	47.02	15.790
178	1780	0.0079	0.0200	1.820	0.715	0.015	1.596	0.020	0.016	13.54	25.449
179	1790	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	12.997
180	1800	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	4.332
181	1810	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	1.444
182	1820	0.0079	0.0200	1.840	0.730	0.015	1.616	0.020	0.016	13.59	5.011
183	1830	0.0119	0.0300	1.870	0.752	0.022	1.646	0.030	0.024	20.47	13.022
184	1840	0.0040	0.0100	1.880	0.759	0.007	1.655	0.010	0.008	6.84	13.445
185	1850	0.0000	0.0000	1.880	0.759	0.000	1.655	0.000	0.000	0.00	6.763
186	1860	0.0040	0.0100	1.890	0.767	0.007	1.665	0.010	0.008	6.86	4.540
187	1870	0.0040	0.0100	1.900	0.774	0.007	1.675	0.010	0.008	6.87	6.087
188	1880	0.0159	0.0400	1.940	0.804	0.030	1.715	0.040	0.032	27.57	13.509
189	1890	0.0159	0.0400	1.980	0.834	0.030	1.755	0.040	0.032	27.74	22.940
190	1900	0.0159	0.0400	2.020	0.864	0.030	1.794	0.040	0.032	27.90	26.193
191	1910	0.0079	0.0200	2.040	0.879	0.015	1.814	0.020	0.016	14.01	22.700
192	1920	0.0000	0.0000	2.040	0.879	0.000	1.814	0.000	0.000	0.00	12.236
193	1930	0.0040	0.0100	2.050	0.887	0.008	1.824	0.010	0.008	7.02	6.418
194	1940	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	4.479
195	1950	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	1.493
196	1960	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	0.498
197	1970	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	0.166
198	1980	0.0079	0.0200	2.070	0.902	0.015	1.844	0.020	0.016	14.06	4.743
199	1990	0.0040	0.0100	2.080	0.910	0.008	1.854	0.010	0.008	7.05	8.618
200	2000	0.0000	0.0000	2.080	0.910	0.000	1.854	0.000	0.000	0.00	5.221
201	2010	0.0754	0.1900	2.270	1.058	0.148	2.042	0.189	0.158	135.52	46.914
202	2020	0.0159	0.0400	2.310	1.090	0.032	2.082	0.040	0.034	28.90	70.446
203	2030	0.0278	0.0700	2.380	1.146	0.056	2.151	0.070	0.059	50.87	50.071
204	2040	0.0040	0.0100	2.390	1.154	0.008	2.161	0.010	0.008	7.30	36.077
205	2050	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	14.458
206	2060	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	4.819
207	2070	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	1.606
208	2080	0.0000	0.0000	2.390							









King County CSO  
 Barton Basin Subbasin 416 GSI Analysis  
 SvR Project No. 06053  
 SEE SBUH-all TAB FOR ASSUMPTIONS.

Impervious Pervious  
 Total Areas (ac) 7.55 108.37 Total Area (ac) 115.92  
 CN 98 86  
**Rainfall Distribution: 1984 Storm** this field needs to be year of storm followed a space then "Storm". Example "1984 Storm"  
 Max Time Increment 288  
 Pt = 2.52 inches Tc = 10 minutes w = 0.33  
 Sp = 1.63 dt = 10 minutes  
 Si = 0.20

Time Increment	Time (minutes)	Rainfall Distribution 1 (fraction)	Incremental Rainfall (inches)	Accumulated Rainfall (inches)	Pervious Accumulated Runoff (inches)	Pervious Area Increment Runoff (inches)	Impervious Accumulated Runoff (inches)	Impervious Area Incr. Runoff (inches)	Total Runoff (inches)	Instant Flow rate (cfs)	Design Flow rate (cfs)
1	2	3	4	5	6	7	8	9	10	11	12.000
0	0	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
1	10	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
2	20	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
3	30	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
4	40	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
5	50	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
6	60	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
7	70	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
8	80	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
9	90	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
10	100	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
11	110	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
12	120	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
13	130	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
14	140	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
15	150	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
16	160	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
17	170	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
18	180	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
19	190	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
20	200	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
21	210	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
22	220	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
23	230	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
24	240	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
25	250	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
26	260	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
27	270	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
28	280	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
29	290	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
30	300	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
31	310	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
32	320	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
33	330	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
34	340	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
35	350	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
36	360	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
37	370	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
38	380	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
39	390	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
40	400	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
41	410	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
42	420	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
43	430	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
44	440	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
45	450	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
46	460	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
47	470	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
48	480	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
49	490	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
50	500	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
51	510	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
52	520	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
53	530	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
54	540	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
55	550	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
56	560	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
57	570	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
58	580	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
59	590	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
60	600	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000
61	610	0.0040	0.0100	0.010	0.000	0.000	0.000	0.000	0.000	0.00	0.000
62	620	0.0040	0.0100	0.020	0.000	0.000	0.000	0.000	0.000	0.00	0.000
63	630	0.0040	0.0100	0.030	0.000	0.000	0.000	0.000	0.000	0.00	0.000
64	640	0.0040	0.0100	0.040	0.000	0.000	0.000	0.000	0.000	0.00	0.000
65	650	0.0119	0.0300	0.070	0.000	0.000	0.004	0.004	0.000	0.17	0.056
66	660	0.0079	0.0200	0.090	0.000	0.000	0.010	0.006	0.000	0.27	0.164
67	670	0.0079	0.0200	0.110	0.000	0.000	0.018	0.008	0.001	0.36	0.266
68	680	0.0079	0.0200	0.130	0.000	0.000	0.027	0.010	0.001	0.44	0.356
69	690	0.0119	0.0300	0.160	0.000	0.000	0.044	0.017	0.001	0.77	0.521
70	700	0.0079	0.0200	0.180	0.000	0.000	0.056	0.012	0.001	0.57	0.620
71	710	0.0079	0.0200	0.200	0.000	0.000	0.070	0.013	0.001	0.61	0.600
72	720	0.0079	0.0200	0.220	0.000	0.000	0.084	0.014	0.001	0.64	0.616
73	730	0.0040	0.0100	0.230	0.000	0.000	0.091	0.007	0.000	0.33	0.529
74	740	0.0079	0.0200	0.250	0.000	0.000	0.106	0.015	0.001	0.68	0.513
75	750	0.0119	0.0300	0.280	0.000	0.000	0.129	0.023	0.002	1.06	0.751
76	760	0.0119	0.0300	0.310	0.000	0.000	0.153	0.024	0.002	1.10	0.970
77	770	0.0119	0.0300	0.340	0.000	0.000	0.178	0.025	0.002	1.21	1.094
78	780	0.0198	0.0500	0.390	0.002	0.002	0.220	0.043	0.005	3.47	1.925
79	790	0.0079	0.0200	0.410	0.004	0.002	0.238	0.017	0.003	1.91	2.436
80	800	0.0159	0.0400	0.450	0.009	0.005	0.273	0.035	0.007	4.67	3.008
81	810	0.0198	0.0500	0.500	0.017	0.008	0.318	0.045	0.010	7.33	5.003
82	820	0.0159	0.0400	0.540	0.025	0.008	0.354	0.036	0.010	6.96	6.429
83	830	0.0159	0.0400	0.580	0.034	0.009	0.391	0.037	0.011	7.87	7.085
84	840	0.0159	0.0400	0.620	0.045	0.011	0.428	0.037	0.012	8.72	7.889
85	850	0.0119	0.0300	0.650	0.054	0.009	0.456	0.028	0.010	7.06	7.889
86	860	0.0079	0.0200	0.670	0.060	0.006	0.475	0.019	0.007	4.95	6.632
87	870	0.0079	0.0200	0.690	0.067	0.007	0.494	0.019	0.007	5.13	5.569
88	880	0.0079	0.0200	0.710	0.073	0.007	0.513	0.019	0.008	5.31	5.336
89	890	0.0159	0.0400	0.750	0.088	0.014	0.551	0.038	0.016	11.13	7.258
90	900	0.0119	0.0300	0.780	0.099	0.011	0.579	0.029	0.013	8.78	9.055
91	910	0.0159	0.0400	0.820	0.115	0.016	0.617	0.038	0.017	12.24	10.025
92	920	0.0159	0.0400	0.860	0.132	0.017	0.656	0.038	0.018	12.83	11.701
93	930	0.0159	0.0400	0.900	0.150	0.018	0.694	0.038	0.019	13.39	12.641
94	940	0.0119	0.0300	0.930	0.164	0.014	0.723	0.029	0.015	10.39	12.139
95	950	0.0159	0.0400	0.970	0.183	0.019	0.762	0.039	0.020	14.29	12.273
96	960	0.0119	0.0300	1.000	0.198	0.015	0.791				



116	1160	0.0159	0.0400	1.300	0.365	0.024	1.084	0.039	0.025	17.59	14.417
117	1170	0.0000	0.0000	1.300	0.365	0.000	1.084	0.000	0.000	0.00	10.670
118	1180	0.0079	0.0200	1.320	0.377	0.012	1.103	0.020	0.013	8.92	6.529
119	1190	0.0040	0.0100	1.330	0.383	0.006	1.113	0.010	0.006	4.49	6.644
120	1200	0.0040	0.0100	1.340	0.389	0.006	1.123	0.010	0.006	4.51	5.213
121	1210	0.0000	0.0000	1.340	0.389	0.000	1.123	0.000	0.000	0.00	3.240
122	1220	0.0040	0.0100	1.350	0.396	0.006	1.133	0.010	0.006	4.53	2.588
123	1230	0.0119	0.0300	1.380	0.414	0.019	1.162	0.029	0.020	13.69	6.934
124	1240	0.0079	0.0200	1.400	0.427	0.013	1.182	0.020	0.013	9.22	9.946
125	1250	0.0040	0.0100	1.410	0.434	0.006	1.192	0.010	0.007	4.63	7.933
126	1260	0.0000	0.0000	1.410	0.434	0.000	1.192	0.000	0.000	0.00	4.189
127	1270	0.0040	0.0100	1.420	0.440	0.006	1.201	0.010	0.007	4.65	2.947
128	1280	0.0000	0.0000	1.420	0.440	0.000	1.201	0.000	0.000	0.00	2.533
129	1290	0.0000	0.0000	1.420	0.440	0.000	1.201	0.000	0.000	0.00	0.844
130	1300	0.0040	0.0100	1.430	0.446	0.006	1.211	0.010	0.007	4.67	1.838
131	1310	0.0040	0.0100	1.440	0.453	0.006	1.221	0.010	0.007	4.69	3.732
132	1320	0.0000	0.0000	1.440	0.453	0.000	1.221	0.000	0.000	0.00	2.806
133	1330	0.0040	0.0100	1.450	0.459	0.006	1.231	0.010	0.007	4.70	2.503
134	1340	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	2.402
135	1350	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.801
136	1360	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.267
137	1370	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.089
138	1380	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.030
139	1390	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.010
140	1400	0.0040	0.0100	1.460	0.466	0.007	1.241	0.010	0.007	4.72	1.577
141	1410	0.0040	0.0100	1.470	0.472	0.007	1.251	0.010	0.007	4.74	3.678
142	1420	0.0040	0.0100	1.480	0.479	0.007	1.260	0.010	0.007	4.75	4.390
143	1430	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	3.048
144	1440	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	1.016
145	1450	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.339
146	1460	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.113
147	1470	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.038
148	1480	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.013
149	1490	0.0040	0.0100	1.490	0.486	0.007	1.270	0.010	0.007	4.77	1.594
150	1500	0.0040	0.0100	1.500	0.492	0.007	1.280	0.010	0.007	4.79	3.717
151	1510	0.0040	0.0100	1.510	0.499	0.007	1.290	0.010	0.007	4.80	4.435
152	1520	0.0000	0.0000	1.510	0.499	0.000	1.290	0.000	0.000	0.00	3.079
153	1530	0.0040	0.0100	1.520	0.505	0.007	1.300	0.010	0.007	4.82	2.632
154	1540	0.0040	0.0100	1.530	0.512	0.007	1.310	0.010	0.007	4.83	4.094
155	1550	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	2.976
156	1560	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	0.992
157	1570	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	0.331
158	1580	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	0.110
159	1590	0.0000	0.0000	1.530	0.512	0.000	1.310	0.000	0.000	0.00	0.037
160	1600	0.0040	0.0100	1.540	0.519	0.007	1.320	0.010	0.007	4.85	1.628
161	1610	0.0000	0.0000	1.540	0.519	0.000	1.320	0.000	0.000	0.00	2.159
162	1620	0.0000	0.0000	1.540	0.519	0.000	1.320	0.000	0.000	0.00	0.720
163	1630	0.0119	0.0300	1.570	0.539	0.020	1.349	0.030	0.021	14.64	5.118
164	1640	0.0040	0.0100	1.580	0.546	0.007	1.359	0.010	0.007	4.91	8.221
165	1650	0.0119	0.0300	1.610	0.566	0.021	1.389	0.030	0.021	14.81	9.313
166	1660	0.0119	0.0300	1.640	0.587	0.021	1.418	0.030	0.021	14.94	13.021
167	1670	0.0079	0.0200	1.660	0.601	0.014	1.438	0.020	0.014	10.03	12.663
168	1680	0.0119	0.0300	1.690	0.622	0.021	1.468	0.030	0.022	15.14	12.611
169	1690	0.0079	0.0200	1.710	0.636	0.014	1.487	0.020	0.014	10.16	12.638
170	1700	0.0040	0.0100	1.720	0.643	0.007	1.497	0.010	0.007	5.10	9.299
171	1710	0.0000	0.0000	1.720	0.643	0.000	1.497	0.000	0.000	0.00	4.799
172	1720	0.0000	0.0000	1.720	0.643	0.000	1.497	0.000	0.000	0.00	1.600
173	1730	0.0040	0.0100	1.730	0.650	0.007	1.507	0.010	0.007	5.11	2.237
174	1740	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	2.450
175	1750	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	0.817
176	1760	0.0000	0.0000	1.730	0.650	0.000	1.507	0.000	0.000	0.00	0.272
177	1770	0.0278	0.0700	1.800	0.701	0.050	1.576	0.069	0.052	36.13	12.133
178	1780	0.0079	0.0200	1.820	0.715	0.015	1.596	0.020	0.015	10.43	19.563
179	1790	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	9.997
180	1800	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	3.332
181	1810	0.0000	0.0000	1.820	0.715	0.000	1.596	0.000	0.000	0.00	1.111
182	1820	0.0079	0.0200	1.840	0.730	0.015	1.616	0.020	0.015	10.47	3.862
183	1830	0.0119	0.0300	1.870	0.752	0.022	1.646	0.030	0.023	15.80	10.044
184	1840	0.0040	0.0100	1.880	0.759	0.007	1.655	0.010	0.008	5.29	10.376
185	1850	0.0000	0.0000	1.880	0.759	0.000	1.655	0.000	0.000	0.00	5.221
186	1860	0.0040	0.0100	1.890	0.767	0.007	1.665	0.010	0.008	5.30	3.507
187	1870	0.0040	0.0100	1.900	0.774	0.007	1.675	0.010	0.008	5.31	4.705
188	1880	0.0159	0.0400	1.940	0.804	0.030	1.715	0.040	0.030	21.34	10.452
189	1890	0.0159	0.0400	1.980	0.834	0.030	1.755	0.040	0.031	21.51	17.766
190	1900	0.0159	0.0400	2.020	0.864	0.030	1.794	0.040	0.031	21.66	20.312
191	1910	0.0079	0.0200	2.040	0.879	0.015	1.814	0.020	0.016	10.89	17.621
192	1920	0.0000	0.0000	2.040	0.879	0.000	1.814	0.000	0.000	0.00	9.503
193	1930	0.0040	0.0100	2.050	0.887	0.008	1.824	0.010	0.008	5.46	4.987
194	1940	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	3.482
195	1950	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	1.161
196	1960	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	0.387
197	1970	0.0000	0.0000	2.050	0.887	0.000	1.824	0.000	0.000	0.00	0.129
198	1980	0.0079	0.0200	2.070	0.902	0.015	1.844	0.020	0.016	10.94	3.691
199	1990	0.0040	0.0100	2.080	0.910	0.008	1.854	0.010	0.008	5.49	6.707
200	2000	0.0000	0.0000	2.080	0.910	0.000	1.854	0.000	0.000	0.00	4.064
201	2010	0.0754	0.1900	2.270	1.058	0.148	2.042	0.189	0.151	105.86	36.642
202	2020	0.0159	0.0400	2.310	1.090	0.032	2.082	0.040	0.032	22.85	55.053
203	2030	0.0278	0.0700	2.380	1.146	0.056	2.151	0.070	0.057	39.93	39.211
204	2040	0.0040	0.0100	2.390	1.154	0.008	2.161	0.010	0.008	5.73	28.290
205	2050	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	11.341
206	2060	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	3.780
207	2070	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	1.260
208	2080	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	0.420
209	2090	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	0.140
210	2100	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	0.047
211	2110	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	0.016
212	2120	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	0.005
213	2130	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	0.002
214	2140	0.0000	0.0000	2.390	1.154	0.000	2.161	0.000	0.000	0.00	0.001
215	2150	0.0000	0.0000	2.390	1.15						

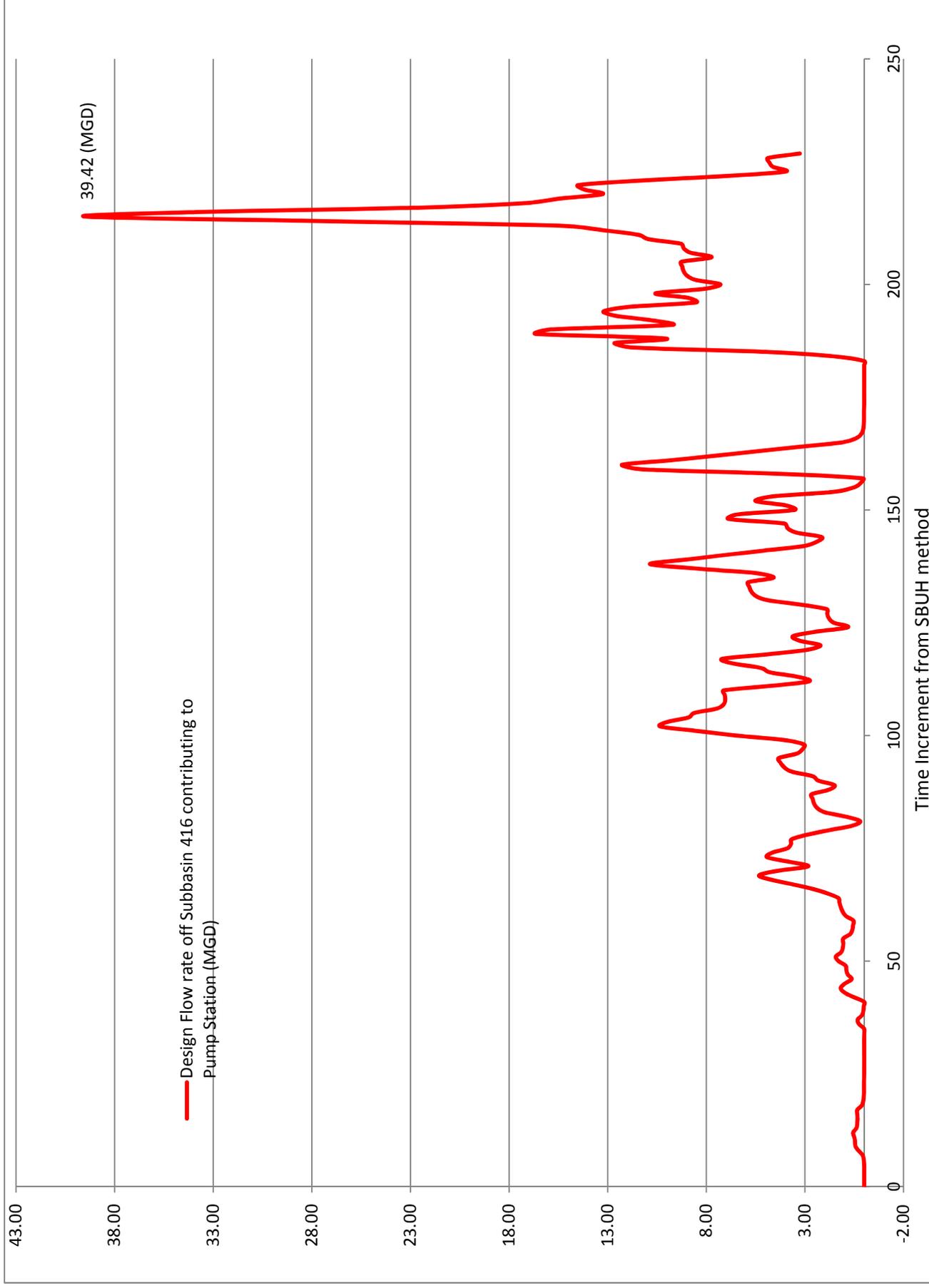






SvR Modeled Subbasin 416 Design Flow Rate to Pump Station during 1987 Storm (assumes ROW and Private Parcel tributary area)

SECTION 3b







**King County CSO**  
**Barton Basin Subbasin 416 GSI Analysis**  
SVR Project No. 06053  
Date: 05/26/2010

**Santa Barbara Urban Hydrograph Method (SBUH)**

red text is user entered

Rainfall data provided by King County

conversion from sf to acre

assume that both sides of a street have the same planter width

alleys are assumed to be negligible

a time increment of 9999 indicates that the rain event (provided by King County) has finished

corners at roadway intersections are counted as impervious in the N/S ROW areas

assumes crowned roadway

Typical One Block Characteristics			
Block (N/S) per GIS (lf)	601		
Block (E/W) per GIS (lf)	276		
Private Parcel Area (sf)	165,876	3.81 (ac)	
Roof Area of Private Parcels per Block per GIS (sf)	41,451	0.95 (ac)	
Non Roof Impervious Area of Private Parcels per Block per GIS (sf)	55,937	1.28 (ac)	
Pervious Area of Private Parcels per Block including alleys (sf)	68,488	1.57 (ac)	
ROW width (N/S) (lf)	60		
Planter Width (N/S) (lf)	10		
Width of Impervious in ROW (N/S) (lf)	40		
ROW width (E/W) (lf)	60		
Planter Width (E/W) (lf)	10		
Width of Impervious in ROW (E/W) (lf)	40		
ROW Impervious Area (N/S) (sf)	26440	0.61 (ac)	
ROW Pervious Area (N/S) (sf)	12020	0.28 (ac)	
ROW Impervious Area (E/W) (sf)	11040	0.25 (ac)	
ROW Pervious Area (E/W) (sf)	5520	0.13 (ac)	

	Percentage to RG	Effective Area to RG	CN	Impervious to RG (ac)	Pervious to RG (ac)	Percentage Impervious	Percentage Pervious
<b>PRIVATE PARCEL CHARACTERISTICS</b>							
Block Area to RG (ac)	50%						
Total Roof Area per One Block (ac)	0.95	100%					
Roof Area disconnected		60%	0.29	86	0.00	0.00%	11.26%
Total Non-Roof Impervious Area Per One Block (ac)	1.28						
Non-Roof Impervious Area to RG (ac)		50%	0.32	86	0.00	0.00%	12.66%
Total Pervious Area per One Block (ac)	1.57						
Pervious Area to RG (ac)		50%	0.39	86	0.00	0.00%	15.50%
<b>N/S ROADWAY CHARACTERISTICS</b>							
One N/S ROW to RG per One Block		50%					
Total ROW Impervious Area (N/S) fronting a Block (ac)	0.61						
ROW Impervious Area (N/S) to RG (ac)			0.30	98	0.30	11.97%	0.00%
Total ROW Pervious Area (N/S) fronting a Block (ac)	0.28						
ROW Pervious Area (N/S) to RG (ac)			0.14	86	0	0.00%	5.44%
<b>E/W ROADWAY CHARACTERISTICS</b>							
One E/W ROW to RG per One Block		50%					
Total ROW Impervious Area (E/W) fronting One Block(ac)	0.25						
ROW Impervious Area (E/W) to RG (ac)			0.13	98	0.13	5.00%	0.00%
Total ROW Pervious Area (E/W) fronting One Block(ac)	0.13						
ROW Pervious Area (E/W) to RG (ac)			0.06	86	0	0.00%	2.50%

	Impervious to RG (ac)	Pervious to RG (ac)	Total Area contributing flow to rain garden (ac)		Total Foot Print Area of Half Block (ac)
	0.43	1.20	1.63		2.54
	CN 98	86			

**Rainfall Distribution: 1987 Storm** this field needs to be year of storm followed a space then "Storm". Example "1984 Storm"

Max Time Increment 277

Pt = 3.22 inches

Tc = 10 minutes

w = 0.33

Sp = 1.63

dt = 10 minutes

Si = 0.20

Time Increment	Time	Rainfall Distribution	Incremental Rainfall	Accumulated Rainfall	Pervious Accumulated Runoff	Pervious Area Increment Runoff	Impervious Accumulated Runoff	Impervious Area Incr. Runoff	Total Runoff	Instant Flow rate	Design Flow rate	Difference Between Instant and Design Flow
	(minutes)	(fraction)	(inches)	(inches)	(inches)	(inches)	(inches)	(inches)	(inches)	(cfs)	(cfs)	
0	0	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
1	10	0.0031	0.0100	0.010	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
2	20	0.0031	0.0100	0.020	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
3	30	0.0000	0.0000	0.020	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
4	40	0.0031	0.0100	0.030	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
5	50	0.0031	0.0100	0.040	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
6	60	0.0031	0.0100	0.050	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
7	70	0.0031	0.0100	0.060	0.000	0.000	0.002	0.001	0.000	0.00	0.002	0.00
8	80	0.0062	0.0200	0.080	0.000	0.000	0.006	0.005	0.001	0.01	0.006	0.01
9	90	0.0031	0.0100	0.090	0.000	0.000	0.010	0.003	0.001	0.01	0.009	0.00
10	100	0.0031	0.0100	0.100	0.000	0.000	0.013	0.004	0.001	0.01	0.009	0.00
11	110	0.0031	0.0100	0.110	0.000	0.000	0.018	0.004	0.001	0.01	0.010	0.00
12	120	0.0031	0.0100	0.120	0.000	0.000	0.022	0.005	0.001	0.01	0.011	0.00
13	130	0.0000	0.0000	0.120	0.000	0.000	0.022	0.000	0.000	0.00	0.008	-0.01
14	140	0.0031	0.0100	0.130	0.000	0.000	0.027	0.005	0.001	0.01	0.007	0.01
15	150	0.0000	0.0000	0.130	0.000	0.000	0.027	0.000	0.000	0.00	0.007	-0.01
16	160	0.0031	0.0100	0.140	0.000	0.000	0.032	0.005	0.001	0.01	0.007	0.01
17	170	0.0000	0.0000	0.140	0.000	0.000	0.032	0.000	0.000	0.00	0.007	-0.01
18	180	0.0000	0.0000	0.140	0.000	0.000	0.032	0.000	0.000	0.00	0.002	0.00
19	190	0.0000	0.0000	0.140	0.000	0.000	0.032	0.000	0.000	0.00	0.001	0.00
20	200	0.0000	0.0000	0.140	0.000	0.000	0.032	0.000	0.000	0.00	0.000	0.00
21	210	0.0000	0.0000	0.140	0.000	0.000	0.032	0.000	0.000	0.00	0.000	0.00
22	220	0.0000	0.0000	0.140	0.000	0.000	0.032	0.000	0.000	0.00	0.000	0.00
23	230	0.0000	0.0000	0.140	0.000	0.000	0.032	0.000	0.000	0.00	0.000	0.00
24	240	0.0000	0.0000	0.140	0.000	0.000	0.032	0.000	0.000	0.00	0.000	0.00
25	250	0.0000	0.0000	0.140	0.000	0.000	0.032	0.000	0.000	0.00	0.000	0.00
26	260	0.0000	0.0000	0.140	0.000	0.000	0.032	0.000	0.000	0.00	0.000	0.00
27	270	0.0000	0.0000	0.140	0.000	0.000	0.032	0.000	0.000	0.00	0.000	0.00
28	280	0.0000	0.0000	0.140	0.000	0.000	0.032	0.000	0.000	0.00	0.000	0.00
29	290	0.0000	0.0000	0.140	0.000	0.000	0.032	0.000	0.000	0.00	0.000	0.00
30	300	0.0000	0.0000	0.140	0.000	0.000	0.032	0.000	0.000	0.00	0.000	0.00
31	310	0.0000	0.0000	0.140	0.000	0.000	0.032	0.000	0.000	0.00	0.000	0.00
32	320	0.0000	0.0000	0.140	0.000	0.000	0.032	0.000	0.000	0.00	0.000	0.00
33	330	0.0000	0.0000	0.140	0.000	0.000	0.032	0.000	0.000	0.00	0.000	0.00
34	340	0.0000	0.0000	0.140	0.000	0.000	0.032	0.000	0.000	0.00	0.000	0.00
35	350	0.0000	0.0000	0.140	0.000	0.000	0.032	0.000	0.000	0.00	0.000	0.00
36	360	0.0031	0.0100	0.150	0.000	0.000	0.038	0.006	0.001	0.01	0.005	0.01
37	370	0.0000	0.0000	0.150	0.000	0.000	0.038	0.000	0.000	0.00	0.006	-0.01
38	380	0.0000	0.0000	0.150	0.000	0.000	0.038	0.000	0.000	0.00	0.002	0.00
39	390	0.0000	0.0000	0.150	0.000	0.000	0.038	0.000	0.000	0.00	0.001	0.00
40	400	0.0000	0.0000	0.150	0.000	0.000	0.038	0.000	0.000	0.00	0.000	0.00
41	410	0.0000	0.0000	0.150	0.000	0.000	0.038	0.000	0.000	0.00	0.000	0.00
42	420	0.0062	0.0200	0.170	0.000	0.000	0.050	0.012	0.003	0.03	0.010	0.02
43	430	0.0031	0.0100	0.180	0.000	0.000	0.056	0.006	0.002	0.02	0.019	0.00
44	440	0.0062	0.0200	0.200	0.000	0.000	0.070	0.013	0.004	0.03	0.024	0.01
45	450	0.0000	0.0000	0.200	0.000	0.000	0.070	0.000	0.000	0.00	0.019	-0.02
46	460	0.0031	0.0100	0.210	0.000	0.000	0.077	0.007	0.002	0.02	0.012	0.01
47	470	0.0031	0.0100	0.220	0.000	0.000	0.084	0.007	0.002	0.02	0.016	0.00
48	480	0.0031	0.0100	0.230	0.000	0.000	0.091	0.007	0.002	0.02	0.018	0.00
49	490	0.0031	0.0100	0.240	0.000	0.000	0.098	0.007	0.002	0.02	0.019	0.00
50	500	0.0062	0.0200	0.260	0.000	0.000	0.114	0.015	0.004	0.04	0.026	0.01
51	510	0.0031	0.0100	0.270	0.000	0.000	0.121	0.008	0.002	0.02	0.028	-0.01
52	520	0.0031	0.0100	0.280	0.000	0.000	0.129	0.008	0.002	0.02	0.023	0.00
53	530	0.0031	0.0100	0.290	0.000	0.000	0.137	0.008	0.002	0.02	0.021	0.00
54	540	0.0031	0.0100	0.300	0.000	0.000	0.145	0.008	0.002	0.02	0.021	0.00
55	550	0.0031	0.0100	0.310	0.000	0.000	0.153	0.008	0.002	0.02	0.021	0.00
56	560	0.0000	0.0000	0.310	0.000	0.000	0.153	0.000	0.000	0.00	0.014	-0.01
57	570	0.0031	0.0100	0.320	0.000	0.000	0.161	0.008	0.002	0.02	0.012	0.01
58	580	0.0000	0.0000	0.320	0.000	0.000	0.161	0.000	0.000	0.00	0.011	-0.01



1987 Storm  
Section 3b  
Estimate of Flows to  
Rain Garden

59	590	0.0031	0.0100	0.330	0.000	0.000	0.170	0.008	0.002	0.02	0.011	0.01
60	600	0.0031	0.0100	0.340	0.000	0.000	0.178	0.008	0.002	0.02	0.018	0.00
61	610	0.0031	0.0100	0.350	0.000	0.000	0.186	0.008	0.002	0.02	0.021	0.00
62	620	0.0031	0.0100	0.360	0.001	0.000	0.195	0.008	0.002	0.02	0.023	0.00
63	630	0.0031	0.0100	0.370	0.001	0.000	0.203	0.009	0.003	0.03	0.024	0.00
64	640	0.0031	0.0100	0.380	0.002	0.001	0.212	0.009	0.003	0.03	0.025	0.00
65	650	0.0062	0.0200	0.400	0.003	0.001	0.229	0.017	0.006	0.06	0.036	0.02
66	660	0.0062	0.0200	0.420	0.005	0.002	0.247	0.017	0.006	0.06	0.050	0.01
67	670	0.0093	0.0300	0.450	0.009	0.004	0.273	0.027	0.010	0.10	0.068	0.03
68	680	0.0093	0.0300	0.480	0.013	0.005	0.300	0.027	0.010	0.10	0.089	0.01
69	690	0.0093	0.0300	0.510	0.019	0.005	0.327	0.027	0.011	0.11	0.101	0.01
70	700	0.0031	0.0100	0.520	0.021	0.002	0.336	0.009	0.004	0.04	0.083	-0.04
71	710	0.0031	0.0100	0.530	0.023	0.002	0.345	0.009	0.004	0.04	0.053	-0.01
72	720	0.0093	0.0300	0.560	0.030	0.007	0.373	0.028	0.012	0.12	0.071	0.05
73	730	0.0062	0.0200	0.580	0.034	0.005	0.391	0.018	0.008	0.08	0.092	-0.01
74	740	0.0062	0.0200	0.600	0.040	0.005	0.410	0.019	0.009	0.09	0.087	0.00
75	750	0.0031	0.0100	0.610	0.042	0.003	0.419	0.009	0.004	0.04	0.072	-0.03
76	760	0.0062	0.0200	0.630	0.048	0.006	0.438	0.019	0.009	0.09	0.069	0.02
77	770	0.0031	0.0100	0.640	0.051	0.003	0.447	0.009	0.005	0.05	0.068	-0.02
78	780	0.0031	0.0100	0.650	0.054	0.003	0.456	0.009	0.005	0.05	0.053	-0.01
79	790	0.0000	0.0000	0.650	0.054	0.000	0.456	0.000	0.000	0.00	0.033	-0.03
80	800	0.0000	0.0000	0.650	0.054	0.000	0.456	0.000	0.000	0.00	0.011	-0.01
81	810	0.0000	0.0000	0.650	0.054	0.000	0.456	0.000	0.000	0.00	0.004	0.00
82	820	0.0031	0.0100	0.660	0.057	0.003	0.466	0.009	0.005	0.05	0.017	0.03
83	830	0.0031	0.0100	0.670	0.060	0.003	0.475	0.009	0.005	0.05	0.037	0.01
84	840	0.0031	0.0100	0.680	0.063	0.003	0.484	0.009	0.005	0.05	0.044	0.00
85	850	0.0031	0.0100	0.690	0.067	0.003	0.494	0.009	0.005	0.05	0.047	0.00
86	860	0.0031	0.0100	0.700	0.070	0.003	0.503	0.009	0.005	0.05	0.048	0.00
87	870	0.0031	0.0100	0.710	0.073	0.003	0.513	0.009	0.005	0.05	0.049	0.00
88	880	0.0000	0.0000	0.710	0.073	0.000	0.513	0.000	0.000	0.00	0.033	-0.03
89	890	0.0031	0.0100	0.720	0.077	0.003	0.522	0.009	0.005	0.05	0.028	0.02
90	900	0.0031	0.0100	0.730	0.080	0.004	0.532	0.009	0.005	0.05	0.043	0.01
91	910	0.0031	0.0100	0.740	0.084	0.004	0.541	0.009	0.005	0.05	0.048	0.00
92	920	0.0062	0.0200	0.760	0.092	0.007	0.560	0.019	0.010	0.10	0.067	0.04
93	930	0.0031	0.0100	0.770	0.095	0.004	0.570	0.010	0.005	0.05	0.074	-0.02
94	940	0.0062	0.0200	0.790	0.103	0.008	0.589	0.019	0.011	0.11	0.078	0.03
95	950	0.0031	0.0100	0.800	0.107	0.004	0.598	0.010	0.005	0.05	0.079	-0.03
96	960	0.0031	0.0100	0.810	0.111	0.004	0.608	0.010	0.005	0.05	0.062	-0.01
97	970	0.0031	0.0100	0.820	0.115	0.004	0.617	0.010	0.006	0.05	0.057	0.00
98	980	0.0031	0.0100	0.830	0.119	0.004	0.627	0.010	0.006	0.06	0.056	0.00
99	990	0.0062	0.0200	0.850	0.128	0.008	0.646	0.019	0.011	0.11	0.074	0.04
100	1000	0.0093	0.0300	0.880	0.141	0.013	0.675	0.029	0.017	0.17	0.118	0.05
101	1010	0.0093	0.0300	0.910	0.154	0.014	0.704	0.029	0.018	0.17	0.154	0.02
102	1020	0.0124	0.0400	0.950	0.173	0.019	0.743	0.039	0.024	0.24	0.188	0.05
103	1030	0.0062	0.0200	0.970	0.183	0.010	0.762	0.019	0.012	0.12	0.182	-0.06
104	1040	0.0093	0.0300	1.000	0.198	0.015	0.791	0.029	0.019	0.18	0.162	0.02
105	1050	0.0062	0.0200	1.020	0.208	0.010	0.810	0.019	0.013	0.12	0.156	-0.03
106	1060	0.0062	0.0200	1.040	0.218	0.010	0.830	0.019	0.013	0.13	0.135	-0.01
107	1070	0.0062	0.0200	1.060	0.228	0.010	0.849	0.019	0.013	0.13	0.129	0.00
108	1080	0.0062	0.0200	1.080	0.239	0.011	0.869	0.019	0.013	0.13	0.128	0.00
109	1090	0.0062	0.0200	1.100	0.250	0.011	0.888	0.019	0.013	0.13	0.128	0.00
110	1100	0.0062	0.0200	1.120	0.261	0.011	0.908	0.019	0.013	0.13	0.129	0.00
111	1110	0.0000	0.0000	1.120	0.261	0.000	0.908	0.000	0.000	0.00	0.086	-0.09
112	1120	0.0031	0.0100	1.130	0.266	0.006	0.917	0.010	0.007	0.07	0.051	0.01
113	1130	0.0031	0.0100	1.140	0.272	0.006	0.927	0.010	0.007	0.07	0.061	0.01
114	1140	0.0062	0.0200	1.160	0.283	0.011	0.947	0.020	0.013	0.13	0.086	0.05
115	1150	0.0031	0.0100	1.170	0.288	0.006	0.956	0.010	0.007	0.07	0.095	-0.03
116	1160	0.0093	0.0300	1.200	0.306	0.017	0.986	0.029	0.020	0.20	0.121	0.08
117	1170	0.0031	0.0100	1.210	0.311	0.006	0.995	0.010	0.007	0.07	0.130	-0.06
118	1180	0.0031	0.0100	1.220	0.317	0.006	1.005	0.010	0.007	0.07	0.088	-0.02
119	1190	0.0000	0.0000	1.220	0.317	0.000	1.005	0.000	0.000	0.00	0.052	-0.05
120	1200	0.0031	0.0100	1.230	0.323	0.006	1.015	0.010	0.007	0.07	0.040	0.03
121	1210	0.0031	0.0100	1.240	0.329	0.006	1.025	0.010	0.007	0.07	0.059	0.01
122	1220	0.0031	0.0100	1.250	0.335	0.006	1.035	0.010	0.007	0.07	0.065	0.00
123	1230	0.0000	0.0000	1.250	0.335	0.000	1.035	0.000	0.000	0.00	0.045	-0.04
124	1240	0.0000	0.0000	1.250	0.335	0.000	1.035	0.000	0.000	0.00	0.015	-0.01
125	1250	0.0031	0.0100	1.260	0.341	0.006	1.044	0.010	0.007	0.07	0.028	0.04
126	1260	0.0000	0.0000	1.260	0.341	0.000	1.044	0.000	0.000	0.00	0.032	-0.03
127	1270	0.0031	0.0100	1.270	0.347	0.006	1.054	0.010	0.007	0.07	0.034	0.04
128	1280	0.0000	0.0000	1.270	0.347	0.000	1.054	0.000	0.000	0.00	0.034	-0.03
129	1290	0.0062	0.0200	1.290	0.359	0.012	1.074	0.020	0.014	0.14	0.058	0.08
130	1300	0.0031	0.0100	1.300	0.365	0.006	1.084	0.010	0.007	0.07	0.089	-0.02
131	1310	0.0062	0.0200	1.320	0.377	0.012	1.103	0.020	0.014	0.14	0.099	0.04
132	1320	0.0031	0.0100	1.330	0.383	0.006	1.113	0.010	0.007	0.07	0.103	-0.03
133	1330	0.0062	0.0200	1.350	0.396	0.012	1.133	0.020	0.014	0.14	0.105	0.04
134	1340	0.0031	0.0100	1.360	0.402	0.006	1.142	0.010	0.007	0.07	0.106	-0.03
135	1350	0.0031	0.0100	1.370	0.408	0.006	1.152	0.010	0.007	0.07	0.083	-0.01
136	1360	0.0062	0.0200	1.390	0.421	0.013	1.172	0.020	0.014	0.14	0.099	0.04
137	1370	0.0093	0.0300	1.420	0.440	0.019	1.201	0.029	0.022	0.22	0.153	0.06
138	1380	0.0093	0.0300	1.450	0.459	0.019	1.231	0.030	0.022	0.22	0.195	0.02
139	1390	0.0031	0.0100	1.460	0.466	0.007	1.241	0.010	0.007	0.07	0.162	-0.09
140	1400	0.0062	0.0200	1.480	0.479	0.013	1.260	0.020	0.015	0.15	0.127	0.02
141	1410	0.0000	0.0000	1.480	0.479	0.000	1.260	0.000	0.000	0.00	0.091	-0.09
142	1420	0.0031	0.0100	1.490	0.486	0.007	1.270	0.010	0.007	0.07	0.055	0.02
143	1430	0.0000	0.0000	1.490	0.486	0.000	1.270	0.000	0.000	0.00	0.043	-0.04
144	1440	0.0031	0.0100	1.500	0.492	0.007	1.280	0.010	0.007	0.07	0.039	0.03
145	1450	0.0031	0.0100	1.510	0.499	0.007	1.290	0.010	0.007	0.07	0.062	0.01
146	1460	0.0031	0.0100	1.520	0.505	0.007	1.300	0.010	0.008	0.07	0.070	0.00
147	1470	0.0031	0.0100	1.530	0.512	0.007	1.310	0.010	0.008	0.07	0.073	0.00
148	1480	0.0093	0.0300	1.560	0.532	0.020	1.339	0.030	0.023	0.22	0.124	0.10
149	1490	0.0000	0.0000	1.560	0.532	0.000	1.339	0.000	0.000	0.00	0.116	-0.12
150	1500	0.0031	0.0100	1.570	0.539	0.007	1.349	0.010	0.008	0.07	0.064	0.01
151	1510	0.0031	0.0100	1.580	0.546	0.007	1.359	0.010	0.008	0.08	0.071	0.00
152	1520	0.0062	0.0200	1.600	0.560	0.014	1.379	0.020				









King County CSO  
Barton Basin Subbasin 416 - GSI Option  
SvR Project No. 06053  
DATE: 05/26/2010

RAIN GARDEN SYSTEM COMPONENTS			
	Infiltration Rate into Native Subgrade (in/hr)		0.50
<b>SECTION 01 RG</b>	1.5	16.67	3.00% (biosoil depth/lf/slope)
	Number of Section 1 Rain Gardens for Basin (ea)		0
	Total Infiltration Area for Section 1 Rain Gardens (sf)*		0
	Storage Capacity for a single Section 1 Rain Garden (cf)		59
	Total Storage Capacity for Section 1 Rain Gardens (cf)		0
<b>SECTION 02 RG</b>	1.5	42	2.00% (biosoil depth/lf/slope)
	Number of Section 2 Rain Gardens for Basin (ea)		0
	Total Infiltration Area for Section 2 Rain Gardens (sf)*		0
	Storage Capacity for a single Section 2 Rain Garden (cf)		232
	Total Storage Capacity for Section 2 Rain Gardens (cf)		0
<b>SECTION 03 RG</b>	1.5	42	2.00% (biosoil depth/lf/slope)
	Number of Section 3 Rain Gardens for Basin (ea)		9
	Total Infiltration Area for Section 3 Rain Gardens (sf)*		4106
	Storage Capacity for a single Section 3 Rain Garden (cf)		451
	Total Storage Capacity for Section 3 Rain Gardens (cf)		4057

CONVERSION FACTORS	
conversion factor from cfs to MGD:	0.6452
conversion factor from cfs to cf/per time step:	600

Results Summary		
Total Volume of Runoff Removed of entire storm event duration (cf)	10,096	(per GSI half block)
Total Volume of Runoff Removed of entire storm event duration (gal)	75517.23	(per GSI half block)
Total volume of runoff removed from 8:50 to 9:50 of the 1984 storm	3196.594123	(gal per GSI half block)
	802747.5162	(gal)

Rainfall Distribution: 1987 Storm		RAIN GARDEN SYSTEM SUMMARY	
	Total Infiltration Flow (cfs)		0.0475
	Total Swale Storage Capacity (cf)		4057.5

Flow reduction from subbasin 416 (MGD)	7.7	Calculated from Pump Station Data received 03/24/2010
Flow reduction from assumed half block at peak flow (MGD)	0.030661913	
<b>Number of half blocks needed to get total flow reduction out of subbasin 416</b>	<b>251.1</b>	

Time (hours)	Time (minutes)	Design Flow Rate from Rain Event (cfs)	Inflow Water Volume (cf)	Inflow Cumm. Volume (cf)	Check if inflow infiltrates to Native Subgrade of Inflow (cfs)	Check if storage infiltrates Infiltration into Native Subgrade of Stored Water (cfs)	Total Infiltration into Native Subgrade (cfs)	Inflow to Swale After Infiltration into Native Subgrade (cfs)	Swale Storage before Overflow Volume (cf)	Overtop Flow to Pump Station (cfs)	Runoff Stored in Swale Storage Volume (cf)	Volume of Runoff Removed From Pump Station (cf)	Date & Time	Amount Flow Reduced to Pump Station (cfs)	Amount Flow Reduced to Pump Station (MGD)
0	0	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0			
0.17	10	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	3/2/1987 3:10	0.000	
0.33	20	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	3/2/1987 3:20	0.000	
0.50	30	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	3/2/1987 3:30	0.000	
0.67	40	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	3/2/1987 3:40	0.000	
0.83	50	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	3/2/1987 3:50	0.000	
1.00	60	0.000	0.21	0.21	0.0003	0.0000	0.0003	0.0000	0.00	0.00	0.00	0.205863685	3/2/1987 4:00	0.000	
1.17	70	0.002	0.93	1.13	0.0015	0.0000	0.0015	0.0000	0.00	0.00	0.00	0.926664897	3/2/1987 4:10	0.002	
1.33	80	0.006	3.39	4.52	0.0056	0.0000	0.0056	0.0000	0.00	0.00	0.00	3.388492358	3/2/1987 4:20	0.006	
1.50	90	0.009	5.24	9.76	0.0087	0.0000	0.0087	0.0000	0.00	0.00	0.00	5.24347885	3/2/1987 4:30	0.009	
1.67	100	0.009	5.39	15.15	0.0090	0.0000	0.0090	0.0000	0.00	0.00	0.00	5.388275676	3/2/1987 4:40	0.009	
1.83	110	0.010	5.94	21.09	0.0099	0.0000	0.0099	0.0000	0.00	0.00	0.00	5.941861861	3/2/1987 4:50	0.010	
2.00	120	0.011	6.58	27.67	0.0110	0.0000	0.0110	0.0000	0.00	0.00	0.00	6.577157691	3/2/1987 5:00	0.011	
2.17	130	0.008	4.60	32.27	0.0077	0.0000	0.0077	0.0000	0.00	0.00	0.00	4.59704507	3/2/1987 5:10	0.008	
2.33	140	0.007	4.13	36.40	0.0069	0.0000	0.0069	0.0000	0.00	0.00	0.00	4.128022036	3/2/1987 5:20	0.007	
2.50	150	0.007	3.97	40.37	0.0066	0.0000	0.0066	0.0000	0.00	0.00	0.00	3.971681025	3/2/1987 5:30	0.007	
2.67	160	0.007	4.09	44.46	0.0068	0.0000	0.0068	0.0000	0.00	0.00	0.00	4.091686078	3/2/1987 5:40	0.007	
2.83	170	0.007	4.13	48.59	0.0069	0.0000	0.0069	0.0000	0.00	0.00	0.00	4.131687763	3/2/1987 5:50	0.007	
3.00	180	0.002	1.38	49.97	0.0023	0.0000	0.0023	0.0000	0.00	0.00	0.00	1.377229254	3/2/1987 6:00	0.002	
3.17	190	0.001	0.46	50.43	0.0008	0.0000	0.0008	0.0000	0.00	0.00	0.00	0.459076418	3/2/1987 6:10	0.001	
3.33	200	0.000	0.15	50.58	0.0003	0.0000	0.0003	0.0000	0.00	0.00	0.00	0.153025473	3/2/1987 6:20	0.000	
3.50	210	0.000	0.05	50.63	0.0001	0.0000	0.0001	0.0000	0.00	0.00	0.00	0.051008491	3/2/1987 6:30	0.000	
3.67	220	0.000	0.02	50.65	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.01700283	3/2/1987 6:40	0.000	
3.83	230	0.000	0.01	50.65	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00566761	3/2/1987 6:50	0.000	
4.00	240	0.000	0.00	50.66	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.001889203	3/2/1987 7:00	0.000	
4.17	250	0.000	0.00	50.66	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.000629734	3/2/1987 7:10	0.000	
4.33	260	0.000	0.00	50.66	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.000209911	3/2/1987 7:20	0.000	
4.50	270	0.000	0.00	50.66	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	6.99705E-05	3/2/1987 7:30	0.000	
4.67	280	0.000	0.00	50.66	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	2.33235E-05	3/2/1987 7:40	0.000	
4.83	290	0.000	0.00	50.66	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	7.7745E-06	3/2/1987 7:50	0.000	
5.00	300	0.000	0.00	50.66	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	2.5915E-06	3/2/1987 8:00	0.000	
5.17	310	0.000	0.00	50.66	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	8.63833E-07	3/2/1987 8:10	0.000	
5.33	320	0.000	0.00	50.66	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	2.87944E-07	3/2/1987 8:20	0.000	
5.50	330	0.000	0.00	50.66	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	9.59815E-08	3/2/1987 8:30	0.000	
5.67	340	0.000	0.00	50.66	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	3.19938E-08	3/2/1987 8:40	0.000	
5.83	350	0.000	0.00	50.66	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.06646E-08	3/2/1987 8:50	0.000	
6.00	360	0.005	2.92	53.58	0.0049	0.0000	0.0049	0.0000	0.00	0.00	0.00	2.9234281	3/2/1987 9:00	0.005	
6.17	370	0.006	3.90	57.48	0.0065	0.0000	0.0065	0.0000	0.00	0.00	0.00	3.89790413	3/2/1987 9:10	0.006	
6.33	380	0.002	1.30	58.78	0.0022	0.0000	0.0022	0.0000	0.00	0.00	0.00	1.299301377	3/2/1987 9:20	0.002	
6.50	390	0.001	0.43	59.21	0.0007	0.0000	0.0007	0.0000	0.00	0.00	0.00	0.433100459	3/2/1987 9:30	0.001	
6.67	400	0.000	0.14	59.36	0.0002	0.0000	0.0002	0.0000	0.00	0.00	0.00	0.14436682	3/2/1987 9:40	0.000	
6.83	410	0.000	0.05	59.40	0.0001	0.0000	0.0001	0.0000	0.00	0.00	0.00	0.048122273	3/2/1987 9:50	0.000	



7.00	420	0.010	6.27	65.68	0.0105	0.0000	0.0105	0.0000	0.00	0.00	0.00	6.273763744	3/2/1987 10:00	0.010
7.17	430	0.019	11.66	77.34	0.0194	0.0000	0.0194	0.0000	0.00	0.00	0.00	11.65933373	3/2/1987 10:10	0.019
7.33	440	0.024	14.13	91.47	0.0236	0.0000	0.0236	0.0000	0.00	0.00	0.00	14.13054037	3/2/1987 10:20	0.024
7.50	450	0.019	11.64	103.11	0.0194	0.0000	0.0194	0.0000	0.00	0.00	0.00	11.64391975	3/2/1987 10:30	0.019
7.67	460	0.012	7.49	110.60	0.0125	0.0000	0.0125	0.0000	0.00	0.00	0.00	7.487917683	3/2/1987 10:40	0.012
7.83	470	0.016	9.79	120.39	0.0163	0.0000	0.0163	0.0000	0.00	0.00	0.00	9.792632753	3/2/1987 10:50	0.016
8.00	480	0.018	10.72	131.11	0.0179	0.0000	0.0179	0.0000	0.00	0.00	0.00	10.72138209	3/2/1987 11:00	0.018
8.17	490	0.019	11.18	142.29	0.0186	0.0000	0.0186	0.0000	0.00	0.00	0.00	11.17937749	3/2/1987 11:10	0.019
8.33	500	0.026	15.44	157.73	0.0257	0.0000	0.0257	0.0000	0.00	0.00	0.00	15.43563584	3/2/1987 11:20	0.026
8.50	510	0.028	17.04	174.77	0.0284	0.0000	0.0284	0.0000	0.00	0.00	0.00	17.03923547	3/2/1987 11:30	0.028
8.67	520	0.023	13.78	188.55	0.0230	0.0000	0.0230	0.0000	0.00	0.00	0.00	13.77970427	3/2/1987 11:40	0.023
8.83	530	0.021	12.80	201.34	0.0213	0.0000	0.0213	0.0000	0.00	0.00	0.00	12.79634862	3/2/1987 11:50	0.021
9.00	540	0.021	12.56	213.91	0.0209	0.0000	0.0209	0.0000	0.00	0.00	0.00	12.56496187	3/2/1987 12:00	0.021
9.17	550	0.021	12.58	226.49	0.0210	0.0000	0.0210	0.0000	0.00	0.00	0.00	12.57805262	3/2/1987 12:10	0.021
9.33	560	0.014	8.41	234.90	0.0140	0.0000	0.0140	0.0000	0.00	0.00	0.00	8.409366851	3/2/1987 12:20	0.014
9.50	570	0.012	7.06	241.96	0.0118	0.0000	0.0118	0.0000	0.00	0.00	0.00	7.060729567	3/2/1987 12:30	0.012
9.67	580	0.011	6.61	248.57	0.0110	0.0000	0.0110	0.0000	0.00	0.00	0.00	6.611183806	3/2/1987 12:40	0.011
9.83	590	0.011	6.52	255.09	0.0109	0.0000	0.0109	0.0000	0.00	0.00	0.00	6.517151208	3/2/1987 12:50	0.011
10.00	600	0.018	10.98	266.07	0.0183	0.0000	0.0183	0.0000	0.00	0.00	0.00	10.98455662	3/2/1987 13:00	0.018
10.17	610	0.021	12.87	278.94	0.0214	0.0000	0.0214	0.0000	0.00	0.00	0.00	12.86691912	3/2/1987 13:10	0.021
10.33	620	0.023	13.91	292.84	0.0232	0.0000	0.0232	0.0000	0.00	0.00	0.00	13.90508637	3/2/1987 13:20	0.023
10.50	630	0.024	14.65	307.49	0.0244	0.0000	0.0244	0.0000	0.00	0.00	0.00	14.65189872	3/2/1987 13:30	0.024
10.67	640	0.025	15.29	322.79	0.0255	0.0000	0.0255	0.0000	0.00	0.00	0.00	15.29206341	3/2/1987 13:40	0.025
10.83	650	0.036	21.56	344.35	0.0359	0.0000	0.0359	0.0000	0.00	0.00	0.00	21.56156999	3/2/1987 13:50	0.036
11.00	660	0.050	30.24	374.58	0.0475	0.0000	0.0475	0.0029	1.72	0.00	1.72	30.23598356	3/2/1987 14:00	0.050
11.17	670	0.068	41.08	415.66	0.0475	0.0000	0.0475	0.0209	14.28	0.00	14.28	41.07751992	3/2/1987 14:10	0.068
11.33	680	0.089	53.38	469.04	0.0475	0.0000	0.0475	0.0414	39.14	0.00	39.14	53.37786965	3/2/1987 14:20	0.089
11.50	690	0.101	60.31	529.35	0.0475	0.0000	0.0475	0.0530	70.94	0.00	70.94	60.3076862	3/2/1987 14:30	0.101
11.67	700	0.083	49.65	579.00	0.0475	0.0000	0.0475	0.0352	92.07	0.00	92.07	49.65126655	3/2/1987 14:40	0.083
11.83	710	0.053	31.90	610.90	0.0475	0.0000	0.0475	0.0056	95.46	0.00	95.46	31.90211436	3/2/1987 14:50	0.053
12.00	720	0.071	42.44	653.34	0.0475	0.0000	0.0475	0.0232	109.38	0.00	109.38	42.43819848	3/2/1987 15:00	0.071
12.17	730	0.092	54.90	708.24	0.0475	0.0000	0.0475	0.0440	135.77	0.00	135.77	54.90022741	3/2/1987 15:10	0.092
12.33	740	0.087	52.20	760.44	0.0475	0.0000	0.0475	0.0395	159.45	0.00	159.45	52.1968709	3/2/1987 15:20	0.087
12.50	750	0.072	43.38	803.82	0.0475	0.0000	0.0475	0.0248	174.32	0.00	174.32	43.38326487	3/2/1987 15:30	0.072
12.67	760	0.069	41.17	844.99	0.0475	0.0000	0.0475	0.0211	186.97	0.00	186.97	41.16893315	3/2/1987 15:40	0.069
12.83	770	0.068	40.78	885.77	0.0475	0.0000	0.0475	0.0204	199.24	0.00	199.24	40.78321488	3/2/1987 15:50	0.068
13.00	780	0.053	31.98	917.75	0.0475	0.0000	0.0475	0.0058	202.70	0.00	202.70	31.98024781	3/2/1987 16:00	0.053
13.17	790	0.033	19.91	937.66	0.0332	0.0143	0.0475	0.0000	194.10	0.00	194.10	19.90974103	3/2/1987 16:10	0.033
13.33	800	0.011	6.64	944.30	0.0111	0.0365	0.0475	0.0000	172.22	0.00	172.22	6.636580344	3/2/1987 16:20	0.011
13.50	810	0.004	2.21	946.51	0.0037	0.0438	0.0475	0.0000	145.91	0.00	145.91	2.212193448	3/2/1987 16:30	0.004
13.67	820	0.017	10.10	956.61	0.0168	0.0307	0.0475	0.0000	127.50	0.00	127.50	10.09861848	3/2/1987 16:40	0.017
13.83	830	0.037	22.20	978.81	0.0370	0.0105	0.0475	0.0000	121.18	0.00	121.18	22.19834517	3/2/1987 16:50	0.037
14.00	840	0.044	26.45	1005.26	0.0441	0.0034	0.0475	0.0000	119.11	0.00	119.11	26.44916373	3/2/1987 17:00	0.044
14.17	850	0.047	28.08	1033.34	0.0468	0.0007	0.0475	0.0000	118.68	0.00	118.68	28.08008549	3/2/1987 17:10	0.047
14.33	860	0.048	28.83	1062.17	0.0475	0.0000	0.0475	0.0005	119.00	0.00	119.00	28.83420053	3/2/1987 17:20	0.048
14.50	870	0.049	29.29	1091.46	0.0475	0.0000	0.0475	0.0013	119.77	0.00	119.77	29.29262227	3/2/1987 17:30	0.049
14.67	880	0.033	19.66	1111.12	0.0328	0.0148	0.0475	0.0000	110.91	0.00	110.91	19.65615806	3/2/1987 17:40	0.033
14.83	890	0.028	16.55	1127.66	0.0276	0.0200	0.0475	0.0000	98.94	0.00	98.94	16.54503034	3/2/1987 17:50	0.028
15.00	900	0.043	25.60	1153.26	0.0427	0.0049	0.0475	0.0000	96.03	0.00	96.03	25.60037856	3/2/1987 18:00	0.043
15.17	910	0.048	28.82	1182.08	0.0475	0.0000	0.0475	0.0005	96.33	0.00	96.33	28.81607738	3/2/1987 18:10	0.048
15.33	920	0.067	40.46	1222.54	0.0475	0.0000	0.0475	0.0199	108.28	0.00	108.28	40.46341959	3/2/1987 18:20	0.067
15.50	930	0.074	44.63	1267.17	0.0475	0.0000	0.0475	0.0269	124.39	0.00	124.39	44.63026706	3/2/1987 18:30	0.074
15.67	940	0.078	46.57	1313.75	0.0475	0.0000	0.0475	0.0301	142.45	0.00	142.45	46.57485566	3/2/1987 18:40	0.078
15.83	950	0.079	47.49	1361.24	0.0475	0.0000	0.0475	0.0316	161.43	0.00	161.43	47.49448353	3/2/1987 18:50	0.079
16.00	960	0.062	37.41	1398.65	0.0475	0.0000	0.0475	0.0148	170.32	0.00	170.32	37.41135254	3/2/1987 19:00	0.062
16.17	970	0.057	34.22	1432.88	0.0475	0.0000	0.0475	0.0095	176.03	0.00	176.03	34.22446998	3/2/1987 19:10	0.057
16.33	980	0.056	33.33	1466.21	0.0475	0.0000	0.0475	0.0080	180.85	0.00	180.85	33.33372543	3/2/1987 19:20	0.056
16.50	990	0.074	44.38	1510.59	0.0475	0.0000	0.0475	0.0264	196.71	0.00	196.71	44.37764304	3/2/1987 19:30	0.074
16.67	1000	0.118	71.05	1581.64	0.0475	0.0000	0.0475	0.0709	239.25	0.00	239.25	71.05287089	3/2/1987 19:40	0.118
16.83	1010	0.154	92.38	1674.03	0.0475	0.0000	0.0475	0.1064	303.12	0.00	303.12	92.38426656	3/2/1987 19:50	0.154
17.00	1020	0.188	112.80	1786.83	0.0475	0.0000	0.0475	0.1405	387.41	0.00	387.41	112.8033138	3/2/1987 20:00	0.188
17.17	1030	0.182	108.99	1895.82	0.0475	0.0000	0.0475	0.1341	467.88	0.00	467.88	108.990215	3/2/1987 20:10	0.182
17.33	1040	0.162	97.05	1992.87	0.0475	0.0000	0.0475	0.1142	536.41	0.00	536.41	97.04557904	3/2/1987 20:20	0.162
17.50	1050	0.156	93.74	2086.60	0.0475	0.0000	0.0475	0.1087	601.63	0.00	601.63	93.73646067	3/2/1987 20:30	0.156
17.67	1060	0.135	81.01	2167.61	0.0475	0.0000	0.0475	0.0875	654.13	0.00	654.13	81.00931229	3/2/1987 20:40	0.135
17.83	1070	0.129	77.27	2244.89	0.0475	0.0000	0.0475	0.0813	702.88	0.00	702.88	77.2730811	3/2/1987 20:50	0.129
18.00	1080	0.128	76.52	2321.41	0.0475	0.0000	0.0475	0.0800	750.89	0.00	750.89	76.52054249	3/2/1987 21:00	0.128
18.17	1090	0.128	76.75	2398.16	0.0475	0.0000	0.0475	0.0804	799.12	0.00	799.12	76.74976262	3/2/1987 21:10	0.128
18.33	1100	0.129	77.29	2475.45	0.0475	0.0000	0.0475	0.0813	847.90	0.00	847.90	77.29388253	3/2/1987 21:20	0.129
18.50	1110	0.086	51.74	2527.18	0.0475	0.0000	0.0475	0.0387	871.12	0.00	871.12	51.73535344	3/2/1987 21:30	0.086
18.67	1120	0.051	30.32	2557.50	0.0475	0.0000	0.0475	0.0030	872.92	0.00	872.92	30.31520183	3/2/1987 21:40	0.051



Routing Flow Through Rain Garden  
to Estimate Flow Reduction per GSI Half Block  
1987 Storm  
RG Section 3b

19.33	1160	0.121	72.44	2774.80	0.0475	0.0000	0.0475	0.0732	976.15	0.00	976.15	72.43851784	3/2/1987 22:20	0.121	
19.50	1170	0.130	77.82	2852.62	0.0475	0.0000	0.0475	0.0822	1025.46	0.00	1025.46	77.81976823	3/2/1987 22:30	0.130	
19.67	1180	0.088	52.98	2905.60	0.0475	0.0000	0.0475	0.0408	1049.92	0.00	1049.92	52.98083128	3/2/1987 22:40	0.088	
19.83	1190	0.052	31.21	2936.80	0.0475	0.0000	0.0475	0.0045	1052.61	0.00	1052.61	31.20585331	3/2/1987 22:50	0.052	
20.00	1200	0.040	24.00	2960.80	0.0400	0.0075	0.0475	0.0000	1048.10	0.00	1048.10	23.99715977	3/2/1987 23:00	0.040	
20.17	1210	0.059	35.24	2996.04	0.0475	0.0000	0.0475	0.0112	1054.82	0.00	1054.82	35.23850166	3/2/1987 23:10	0.059	
20.33	1220	0.065	39.08	3035.12	0.0475	0.0000	0.0475	0.0176	1065.39	0.00	1065.39	39.08308627	3/2/1987 23:20	0.065	
20.50	1230	0.045	26.72	3061.84	0.0445	0.0030	0.0475	0.0000	1063.59	0.00	1063.59	26.72037474	3/2/1987 23:30	0.045	
20.67	1240	0.015	8.91	3070.75	0.0148	0.0327	0.0475	0.0000	1043.98	0.00	1043.98	8.90679158	3/2/1987 23:40	0.015	
20.83	1250	0.028	16.71	3087.46	0.0278	0.0197	0.0475	0.0000	1032.18	0.00	1032.18	16.70946758	3/2/1987 23:50	0.028	
21.00	1260	0.032	19.31	3106.77	0.0322	0.0153	0.0475	0.0000	1022.97	0.00	1022.97	19.31035958	3/3/1987 0:00	0.032	
21.17	1270	0.034	20.22	3126.99	0.0337	0.0138	0.0475	0.0000	1014.68	0.00	1014.68	20.22460893	3/3/1987 0:10	0.034	
21.33	1280	0.034	20.53	3147.52	0.0342	0.0133	0.0475	0.0000	1006.69	0.00	1006.69	20.52935872	3/3/1987 0:20	0.034	
21.50	1290	0.058	34.56	3182.08	0.0475	0.0000	0.0475	0.0101	1012.74	0.00	1012.74	34.55837701	3/3/1987 0:30	0.058	
21.67	1300	0.089	53.16	3235.24	0.0475	0.0000	0.0475	0.0411	1037.38	0.00	1037.38	53.16105223	3/3/1987 0:40	0.089	
21.83	1310	0.099	59.63	3294.88	0.0475	0.0000	0.0475	0.0519	1068.50	0.00	1068.50	59.6340897	3/3/1987 0:50	0.099	
22.00	1320	0.103	61.93	3356.80	0.0475	0.0000	0.0475	0.0557	1101.91	0.00	1101.91	61.92545286	3/3/1987 1:00	0.103	
22.17	1330	0.105	62.95	3419.75	0.0475	0.0000	0.0475	0.0574	1136.35	0.00	1136.35	62.95195612	3/3/1987 1:10	0.105	
22.33	1340	0.106	63.42	3483.18	0.0475	0.0000	0.0475	0.0582	1171.25	0.00	1171.25	63.42320398	3/3/1987 1:20	0.106	
22.50	1350	0.083	49.56	3532.74	0.0475	0.0000	0.0475	0.0351	1192.30	0.00	1192.30	49.56130847	3/3/1987 1:30	0.083	
22.67	1360	0.099	59.34	3592.08	0.0475	0.0000	0.0475	0.0514	1223.12	0.00	1223.12	59.3380659	3/3/1987 1:40	0.099	
22.83	1370	0.153	91.55	3683.63	0.0475	0.0000	0.0475	0.1051	1286.16	0.00	1286.16	91.5491124	3/3/1987 1:50	0.153	
23.00	1380	0.195	117.24	3800.86	0.0475	0.0000	0.0475	0.1479	1374.88	0.00	1374.88	117.236348	3/3/1987 2:00	0.195	
23.17	1390	0.162	97.20	3898.07	0.0475	0.0000	0.0475	0.1145	1443.57	0.00	1443.57	97.20424176	3/3/1987 2:10	0.162	
23.33	1400	0.127	76.28	3974.35	0.0475	0.0000	0.0475	0.0796	1491.33	0.00	1491.33	76.27991131	3/3/1987 2:20	0.127	
23.50	1410	0.091	54.72	4029.06	0.0475	0.0000	0.0475	0.0437	1517.53	0.00	1517.53	54.71638473	3/3/1987 2:30	0.091	0.058834822
23.67	1420	0.055	32.94	4062.00	0.0475	0.0000	0.0475	0.0074	1521.95	0.00	1521.95	32.93897389	3/3/1987 2:40	0.055	0.035418251
23.83	1430	0.043	25.68	4087.68	0.0428	0.0047	0.0475	0.0000	1519.12	0.00	1519.12	25.67983694	3/3/1987 2:50	0.043	0.027612728
24.00	1440	0.039	23.30	4110.98	0.0388	0.0087	0.0475	0.0000	1513.90	0.00	1513.90	23.29645884	3/3/1987 3:00	0.039	
24.17	1450	0.062	37.27	4148.25	0.0475	0.0000	0.0475	0.0146	1522.66	0.00	1522.66	37.27445232	3/3/1987 3:10	0.062	
24.33	1460	0.070	42.01	4190.26	0.0475	0.0000	0.0475	0.0225	1536.15	0.00	1536.15	42.005274	3/3/1987 3:20	0.070	
24.50	1470	0.073	43.65	4233.91	0.0475	0.0000	0.0475	0.0252	1551.29	0.00	1551.29	43.65293312	3/3/1987 3:30	0.073	
24.67	1480	0.124	74.13	4308.04	0.0475	0.0000	0.0475	0.0760	1596.90	0.00	1596.90	74.13092071	3/3/1987 3:40	0.124	
24.83	1490	0.116	69.45	4377.49	0.0475	0.0000	0.0475	0.0682	1637.83	0.00	1637.83	69.44707849	3/3/1987 3:50	0.116	
25.00	1500	0.064	38.13	4415.62	0.0475	0.0000	0.0475	0.0160	1647.45	0.00	1647.45	38.12914633	3/3/1987 4:00	0.064	
25.17	1510	0.071	42.70	4458.32	0.0475	0.0000	0.0475	0.0236	1661.63	0.00	1661.63	42.70328893	3/3/1987 4:10	0.071	
25.33	1520	0.099	59.37	4517.69	0.0475	0.0000	0.0475	0.0514	1692.49	0.00	1692.49	59.37338863	3/3/1987 4:20	0.099	
25.50	1530	0.083	49.92	4567.61	0.0475	0.0000	0.0475	0.0357	1713.89	0.00	1713.89	49.91663521	3/3/1987 4:30	0.083	
25.67	1540	0.028	16.64	4584.25	0.0277	0.0198	0.0475	0.0000	1702.02	0.00	1702.02	16.6388784	3/3/1987 4:40	0.028	
25.83	1550	0.009	5.55	4589.80	0.0092	0.0383	0.0475	0.0000	1679.05	0.00	1679.05	5.546292801	3/3/1987 4:50	0.009	
26.00	1560	0.003	1.85	4591.64	0.0031	0.0444	0.0475	0.0000	1652.38	0.00	1652.38	1.848764267	3/3/1987 5:00	0.003	
26.17	1570	0.001	0.62	4592.26	0.0010	0.0465	0.0475	0.0000	1624.48	0.00	1624.48	0.616254756	3/3/1987 5:10	0.001	
26.33	1580	0.076	45.64	4637.90	0.0475	0.0000	0.0475	0.0285	1641.60	0.00	1641.60	45.63505124	3/3/1987 5:20	0.076	
26.50	1590	0.203	121.65	4759.55	0.0475	0.0000	0.0475	0.1552	1734.74	0.00	1734.74	121.6508764	3/3/1987 5:30	0.203	
26.67	1600	0.220	132.25	4891.79	0.0475	0.0000	0.0475	0.1729	1838.47	0.00	1838.47	132.2460833	3/3/1987 5:40	0.220	
26.83	1610	0.176	105.57	4997.37	0.0475	0.0000	0.0475	0.1284	1915.52	0.00	1915.52	105.5721998	3/3/1987 5:50	0.176	
27.00	1620	0.136	81.44	5078.81	0.0475	0.0000	0.0475	0.0882	1968.45	0.00	1968.45	81.44004458	3/3/1987 6:00	0.136	
27.17	1630	0.097	58.07	5136.87	0.0475	0.0000	0.0475	0.0493	1998.00	0.00	1998.00	58.06596973	3/3/1987 6:10	0.097	
27.33	1640	0.058	34.83	5171.70	0.0475	0.0000	0.0475	0.0105	2004.31	0.00	2004.31	34.82924069	3/3/1987 6:20	0.058	
27.50	1650	0.019	11.61	5183.31	0.0193	0.0282	0.0475	0.0000	1987.40	0.00	1987.40	11.6097469	3/3/1987 6:30	0.019	
27.67	1660	0.006	3.87	5187.18	0.0064	0.0411	0.0475	0.0000	1962.76	0.00	1962.76	3.869915633	3/3/1987 6:40	0.006	
27.83	1670	0.002	1.29	5188.47	0.0021	0.0454	0.0475	0.0000	1935.53	0.00	1935.53	1.289971878	3/3/1987 6:50	0.002	
28.00	1680	0.001	0.43	5188.90	0.0007	0.0468	0.0475	0.0000	1907.45	0.00	1907.45	0.429990626	3/3/1987 7:00	0.001	
28.17	1690	0.000	0.14	5189.04	0.0002	0.0473	0.0475	0.0000	1879.08	0.00	1879.08	0.143330209	3/3/1987 7:10	0.000	
28.33	1700	0.000	0.05	5189.09	0.0001	0.0474	0.0475	0.0000	1850.61	0.00	1850.61	0.047776736	3/3/1987 7:20	0.000	
28.50	1710	0.000	0.02	5189.11	0.0000	0.0475	0.0475	0.0000	1822.11	0.00	1822.11	0.015925579	3/3/1987 7:30	0.000	
28.67	1720	0.000	0.01	5189.11	0.0000	0.0475	0.0475	0.0000	1793.60	0.00	1793.60	0.005308526	3/3/1987 7:40	0.000	
28.83	1730	0.000	0.00	5189.11	0.0000	0.0475	0.0475	0.0000	1765.08	0.00	1765.08	0.001769509	3/3/1987 7:50	0.000	
29.00	1740	0.000	0.00	5189.11	0.0000	0.0475	0.0475	0.0000	1736.57	0.00	1736.57	0.000589836	3/3/1987 8:00	0.000	
29.17	1750	0.000	0.00	5189.12	0.0000	0.0475	0.0475	0.0000	1708.05	0.00	1708.05	0.000196612	3/3/1987 8:10	0.000	
29.33	1760	0.000	0.00	5189.12	0.0000	0.0475	0.0475	0.0000	1679.54	0.00	1679.54	6.55374E-05	3/3/1987 8:20	0.000	
29.50	1770	0.000	0.00	5189.12	0.0000	0.0475	0.0475	0.0000	1651.02	0.00	1651.02	2.18458E-05	3/3/1987 8:30	0.000	
29.67	1780	0.000	0.00	5189.12	0.0000	0.0475	0.0475	0.0000	1622.51	0.00	1622.51	7.28193E-06	3/3/1987 8:40	0.000	
29.83	1790	0.000	0.00	5189.12	0.0000	0.0475	0.0475	0.0000	1593.99	0.00	1593.99	2.42731E-06	3/3/1987 8:50	0.000	
30.00	1800	0.000	0.00	5189.12	0.0000	0.0475	0.0475	0.0000	1565.48	0.00	1565.48	8.09103E-07	3/3/1987 9:00	0.000	
30.17	1810	0.000	0.00	5189.12	0.0000	0.0475	0.0475	0.0000	1536.96	0.00	1536.96	2.69701E-07	3/3/1987 9:10	0.000	
30.33	1820	0.000	0.00	5189.12	0.0000	0.0475	0.0475	0.0000	1508.45	0.00	1508.45	8.99004E-08	3/3/1987 9:20	0.000	
30.50	1830	0.000	0.00	5189.12	0.0000	0.0475	0.0475	0.0000	1479.93	0.00	1479.93	2.9			



Routing Flow Through Rain Garden  
to Estimate Flow Reduction per GSI Half Block  
1987 Storm  
RG Section 3b

30.83	1850	0.086	51.76	5256.37	0.0475	0.0000	0.0475	0.0387	1490.16	0.00	1490.16	51.75759129	3/3/1987 9:50	0.086	
31.00	1860	0.211	126.54	5382.91	0.0475	0.0000	0.0475	0.1634	1588.18	0.00	1588.18	126.5359194	3/3/1987 10:00	0.211	
31.17	1870	0.227	136.09	5519.00	0.0475	0.0000	0.0475	0.1793	1695.76	0.00	1695.76	136.0924524	3/3/1987 10:10	0.227	
31.33	1880	0.181	108.39	5627.40	0.0475	0.0000	0.0475	0.1331	1775.63	0.00	1775.63	108.3920741	3/3/1987 10:20	0.181	
31.50	1890	0.298	178.73	5806.13	0.0475	0.0000	0.0475	0.2504	1925.85	0.00	1925.85	178.7309614	3/3/1987 10:30	0.298	
31.67	1900	0.285	170.83	5976.96	0.0475	0.0000	0.0475	0.2372	2068.17	0.00	2068.17	170.8339306	3/3/1987 10:40	0.285	
31.83	1910	0.175	104.91	6081.87	0.0475	0.0000	0.0475	0.1273	2144.56	0.00	2144.56	104.9133792	3/3/1987 10:50	0.175	
32.00	1920	0.192	115.15	6197.02	0.0475	0.0000	0.0475	0.1444	2231.20	0.00	2231.20	115.1500127	3/3/1987 11:00	0.192	
32.17	1930	0.225	134.94	6331.96	0.0475	0.0000	0.0475	0.1774	2337.62	0.00	2337.62	134.9377975	3/3/1987 11:10	0.225	
32.33	1940	0.237	141.93	6473.89	0.0475	0.0000	0.0475	0.1890	2451.04	0.00	2451.04	141.9319205	3/3/1987 11:20	0.237	
32.50	1950	0.214	128.37	6602.27	0.0475	0.0000	0.0475	0.1664	2550.90	0.00	2550.90	128.3745888	3/3/1987 11:30	0.214	
32.67	1960	0.153	91.56	6693.82	0.0475	0.0000	0.0475	0.1051	2613.94	0.00	2613.94	91.55706352	3/3/1987 11:40	0.153	
32.83	1970	0.160	95.75	6789.57	0.0475	0.0000	0.0475	0.1121	2681.17	0.00	2681.17	95.74655651	3/3/1987 11:50	0.160	
33.00	1980	0.189	113.60	6903.17	0.0475	0.0000	0.0475	0.1418	2766.25	0.00	2766.25	113.6021131	3/3/1987 12:00	0.189	
33.17	1990	0.145	87.00	6990.17	0.0475	0.0000	0.0475	0.0975	2824.74	0.00	2824.74	86.99980326	3/3/1987 12:10	0.145	
33.33	2000	0.130	78.25	7068.42	0.0475	0.0000	0.0475	0.0829	2874.47	0.00	2874.47	78.25036491	3/3/1987 12:20	0.130	
33.50	2010	0.153	91.87	7160.29	0.0475	0.0000	0.0475	0.1056	2937.82	0.00	2937.82	91.8666847	3/3/1987 12:30	0.153	
33.67	2020	0.161	96.56	7256.85	0.0475	0.0000	0.0475	0.1134	3005.87	0.00	3005.87	96.55801378	3/3/1987 12:40	0.161	
33.83	2030	0.164	98.27	7355.12	0.0475	0.0000	0.0475	0.1163	3075.62	0.00	3075.62	98.27170157	3/3/1987 12:50	0.164	
34.00	2040	0.165	98.99	7454.11	0.0475	0.0000	0.0475	0.1175	3146.10	0.00	3146.10	98.99025889	3/3/1987 13:00	0.165	
34.17	2050	0.166	99.37	7553.49	0.0475	0.0000	0.0475	0.1181	3216.96	0.00	3216.96	99.37458193	3/3/1987 13:10	0.166	
34.33	2060	0.138	82.99	7636.47	0.0475	0.0000	0.0475	0.0908	3271.43	0.00	3271.43	82.98860084	3/3/1987 13:20	0.138	
34.50	2070	0.157	94.32	7730.80	0.0475	0.0000	0.0475	0.1097	3337.24	0.00	3337.24	94.32296002	3/3/1987 13:30	0.157	
34.67	2080	0.164	98.17	7828.97	0.0475	0.0000	0.0475	0.1161	3406.89	0.00	3406.89	98.17015616	3/3/1987 13:40	0.164	
34.83	2090	0.166	99.66	7928.62	0.0475	0.0000	0.0475	0.1186	3478.03	0.00	3478.03	99.65631578	3/3/1987 13:50	0.166	
35.00	2100	0.195	117.01	8045.63	0.0475	0.0000	0.0475	0.1475	3566.53	0.00	3566.53	117.0096372	3/3/1987 14:00	0.195	
35.17	2110	0.205	123.04	8168.67	0.0475	0.0000	0.0475	0.1575	3661.05	0.00	3661.05	123.0393642	3/3/1987 14:10	0.205	
35.33	2120	0.237	142.10	8310.77	0.0475	0.0000	0.0475	0.1893	3774.63	0.00	3774.63	142.0958993	3/3/1987 14:20	0.237	
35.50	2130	0.276	165.68	8476.44	0.0475	0.0000	0.0475	0.2286	3911.79	0.00	3911.79	165.6768085	3/3/1987 14:30	0.276	
35.67	2140	0.489	293.20	8769.65	0.0475	0.0000	0.0475	0.4411	4176.48	0.20	4057.50	174.2195837	3/3/1987 14:40	0.290	
35.83	2150	0.704	422.44	9192.09	0.0475	0.0000	0.0475	0.6565	4451.42	0.66	4057.50	28.51557937	3/3/1987 14:50	0.048	0.030661913
36.00	2160	0.607	364.22	9556.31	0.0475	0.0000	0.0475	0.5595	4393.20	0.56	4057.50	28.51557938	3/3/1987 15:00	0.048	
36.17	2170	0.404	242.25	9798.56	0.0475	0.0000	0.0475	0.3562	4271.23	0.36	4057.50	28.51557938	3/3/1987 15:10	0.048	
36.33	2180	0.308	184.58	9983.14	0.0475	0.0000	0.0475	0.2601	4213.56	0.26	4057.50	28.51557937	3/3/1987 15:20	0.048	
36.50	2190	0.276	165.58	10148.72	0.0475	0.0000	0.0475	0.2284	4194.56	0.23	4057.50	28.51557938	3/3/1987 15:30	0.048	
36.67	2200	0.237	142.05	10290.78	0.0475	0.0000	0.0475	0.1892	4171.03	0.19	4057.50	28.51557938	3/3/1987 15:40	0.048	
36.83	2210	0.253	151.82	10442.60	0.0475	0.0000	0.0475	0.2055	4180.80	0.21	4057.50	28.51557937	3/3/1987 15:50	0.048	
37.00	2220	0.259	155.22	10597.82	0.0475	0.0000	0.0475	0.2112	4184.20	0.21	4057.50	28.51557937	3/3/1987 16:00	0.048	
37.17	2230	0.203	121.61	10719.43	0.0475	0.0000	0.0475	0.1552	4150.59	0.16	4057.50	28.51557937	3/3/1987 16:10	0.048	
37.33	2240	0.126	75.50	10794.92	0.0475	0.0000	0.0475	0.0783	4104.48	0.08	4057.50	28.51557937	3/3/1987 16:20	0.048	
37.50	2250	0.071	42.66	10837.59	0.0475	0.0000	0.0475	0.0236	4071.64	0.02	4057.50	28.51557938	3/3/1987 16:30	0.048	
37.67	2260	0.082	49.22	10886.81	0.0475	0.0000	0.0475	0.0345	4078.20	0.03	4057.50	28.51557938	3/3/1987 16:40	0.048	
37.83	2270	0.086	51.43	10938.24	0.0475	0.0000	0.0475	0.0382	4080.41	0.04	4057.50	28.51557938	3/3/1987 16:50	0.048	
38.00	2280	0.087	52.19	10990.43	0.0475	0.0000	0.0475	0.0395	4081.17	0.04	4057.50	28.51557938	3/3/1987 17:00	0.048	
38.17	2290	0.058	34.92	11025.35	0.0475	0.0000	0.0475	0.0107	4063.90	0.01	4057.50	28.51557938	3/3/1987 17:10	0.048	
38.33	2300	0.049	29.18	11054.53	0.0475	0.0000	0.0475	0.0011	4058.16	0.00	4057.50	28.51557938	3/3/1987 17:20	0.048	
38.50	2310	0.104	62.37	11116.90	0.0475	0.0000	0.0475	0.0564	4091.35	0.06	4057.50	28.51557937	3/3/1987 17:30	0.048	
38.67	2320	0.122	73.47	11190.37	0.0475	0.0000	0.0475	0.0749	4102.45	0.07	4057.50	28.51557938	3/3/1987 17:40	0.048	
38.83	2330	0.070	42.06	11232.43	0.0475	0.0000	0.0475	0.0226	4071.04	0.02	4057.50	28.51557937	3/3/1987 17:50	0.048	
39.00	2340	0.082	49.19	11281.62	0.0475	0.0000	0.0475	0.0345	4078.17	0.03	4057.50	28.51557937	3/3/1987 18:00	0.048	
39.17	2350	0.145	86.77	11368.39	0.0475	0.0000	0.0475	0.0971	4115.75	0.10	4057.50	28.51557937	3/3/1987 18:10	0.048	
39.33	2360	0.166	99.38	11467.77	0.0475	0.0000	0.0475	0.1181	4128.36	0.12	4057.50	28.51557938	3/3/1987 18:20	0.048	
39.50	2370	0.173	103.67	11571.44	0.0475	0.0000	0.0475	0.1252	4132.65	0.13	4057.50	28.51557938	3/3/1987 18:30	0.048	
39.67	2380	0.146	87.50	11658.94	0.0475	0.0000	0.0475	0.0983	4116.48	0.10	4057.50	28.51557937	3/3/1987 18:40	0.048	
39.83	2390	0.107	64.49	11723.44	0.0475	0.0000	0.0475	0.0600	4093.47	0.06	4057.50	28.51557938	3/3/1987 18:50	0.048	
40.00	2400	0.124	74.53	11797.97	0.0475	0.0000	0.0475	0.0767	4103.51	0.08	4057.50	28.51557938	3/3/1987 19:00	0.048	
40.17	2410	0.159	95.61	11893.58	0.0475	0.0000	0.0475	0.1118	4124.59	0.11	4057.50	28.51557938	3/3/1987 19:10	0.048	
40.33	2420	0.112	67.27	11960.85	0.0475	0.0000	0.0475	0.0646	4096.25	0.06	4057.50	28.51557938	3/3/1987 19:20	0.048	
40.50	2430	0.067	40.14	12000.99	0.0475	0.0000	0.0475	0.0194	4069.12	0.02	4057.50	28.51557938	3/3/1987 19:30	0.048	
40.67	2440	0.081	48.82	12049.81	0.0475	0.0000	0.0475	0.0338	4077.80	0.03	4057.50	28.51557938	3/3/1987 19:40	0.048	
40.83	2450	0.057	34.00	12083.81	0.0475	0.0000	0.0475	0.0091	4062.98	0.01	4057.50	28.51557938	3/3/1987 19:50	0.048	
41.00	2460	0.019	11.33	12095.14	0.0189	0.0286	0.0475	0.0000	4040.31	0.00	4040.31	11.33265965	3/3/1987 20:00	0.019	
41.17	2470	0.065	39.25	12134.40	0.0475	0.0000	0.0475	0.0179	4051.05	0.00	4051.05	39.25420996	3/3/1987 20:10	0.065	
41.33	2480	0.081	48.56	12182.96	0.0475	0.0000	0.0475	0.0334	4071.10	0.02	4057.50	34.95986851	3/3/1987 20:20	0.058	
41.50	2490	0.057	33.94	12216.90	0.0475	0.0000	0.0475	0.0090	4062.92	0.01	4057.50	28.51557937	3/3/1987 20:30	0.048	
41.67	2500	0.048	29.06	12245.96	0.0475	0.0000	0.0475	0.0009	4058.05	0.00	4057.50	28.51557938	3/3/1987 20:40	0.048	
41.83	2510	0.046	27.45	12273.41	0.0457	0.0018	0.0475	0.0000	4056.43	0.00	4056.43	27.44917055	3/3/1987 20:50	0.046	

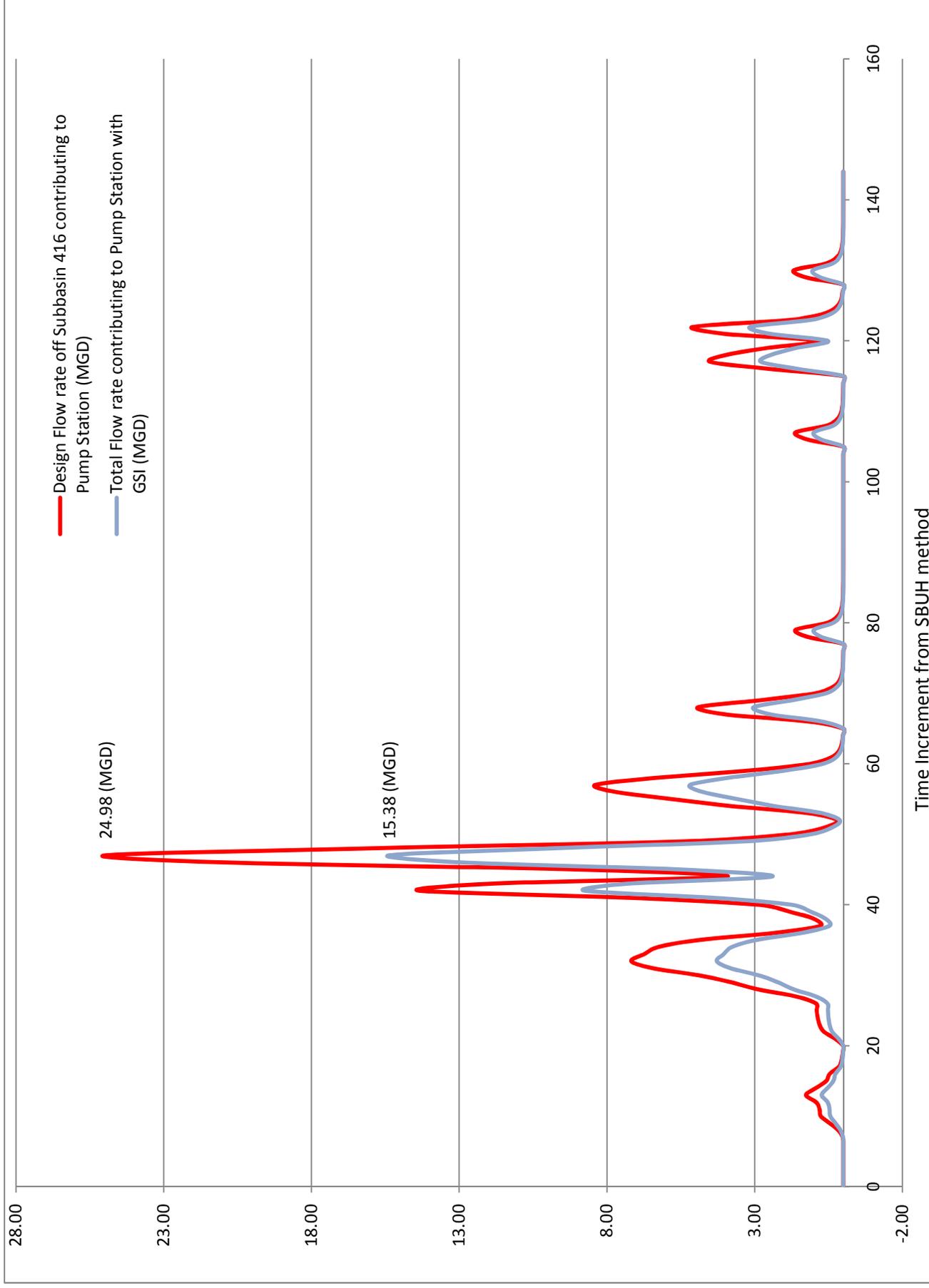


43.16	2590	0.015	9.13	12522.61	0.0152	0.0323	0.0475	0.0000	4036.97	0.00	4036.97	9.125239267	3/3/1987 22:10	0.015
43.33	2600	0.005	3.04	12525.65	0.0051	0.0425	0.0475	0.0000	4011.49	0.00	4011.49	3.041746422	3/3/1987 22:20	0.005
43.50	2610	0.002	1.01	12526.67	0.0017	0.0458	0.0475	0.0000	3983.99	0.00	3983.99	1.013915474	3/3/1987 22:30	0.002
43.66	2620	0.001	0.34	12527.01	0.0006	0.0470	0.0475	0.0000	3955.81	0.00	3955.81	0.337971825	3/3/1987 22:40	0.001
43.83	2630	0.000	0.11	12527.12	0.0002	0.0473	0.0475	0.0000	3927.41	0.00	3927.41	0.112657275	3/3/1987 22:50	0.000
44.00	2640	0.030	17.84	12544.96	0.0297	0.0178	0.0475	0.0000	3916.74	0.00	3916.74	17.84235104	3/3/1987 23:00	0.030
44.16	2650	0.040	23.75	12568.71	0.0396	0.0079	0.0475	0.0000	3911.97	0.00	3911.97	23.75224896	3/3/1987 23:10	0.040
44.33	2660	0.013	7.92	12576.63	0.0132	0.0343	0.0475	0.0000	3891.37	0.00	3891.37	7.917416321	3/3/1987 23:20	0.013
44.50	2670	0.004	2.64	12579.27	0.0044	0.0431	0.0475	0.0000	3865.50	0.00	3865.50	2.639138774	3/3/1987 23:30	0.004
44.66	2680	0.001	0.88	12580.15	0.0015	0.0461	0.0475	0.0000	3837.86	0.00	3837.86	0.879712925	3/3/1987 23:40	0.001
44.83	2690	0.000	0.29	12580.44	0.0005	0.0470	0.0475	0.0000	3809.64	0.00	3809.64	0.293237642	3/3/1987 23:50	0.000
45.00	2700	0.030	17.91	12598.35	0.0299	0.0177	0.0475	0.0000	3799.04	0.00	3799.04	17.91115468	3/4/1987 0:00	0.030
45.16	2710	0.040	23.78	12622.14	0.0396	0.0079	0.0475	0.0000	3794.30	0.00	3794.30	23.78379369	3/4/1987 0:10	0.040
45.33	2720	0.043	25.75	12647.89	0.0429	0.0046	0.0475	0.0000	3791.54	0.00	3791.54	25.74989271	3/4/1987 0:20	0.043
45.50	2730	0.044	26.41	12674.29	0.0440	0.0035	0.0475	0.0000	3789.43	0.00	3789.43	26.40525905	3/4/1987 0:30	0.044
45.66	2740	0.015	8.80	12683.09	0.0147	0.0329	0.0475	0.0000	3769.71	0.00	3769.71	8.801753018	3/4/1987 0:40	0.015
45.83	2750	0.005	2.93	12686.03	0.0049	0.0426	0.0475	0.0000	3744.13	0.00	3744.13	2.933917673	3/4/1987 0:50	0.005
46.00	2760	0.002	0.98	12687.01	0.0016	0.0459	0.0475	0.0000	3716.59	0.00	3716.59	0.977972558	3/4/1987 1:00	0.002
46.16	2770	0.030	18.16	12705.16	0.0303	0.0173	0.0475	0.0000	3706.24	0.00	3706.24	18.15644803	3/4/1987 1:10	0.030
46.33	2780	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3677.72	0.00	3677.72	0	3/4/1987 1:20	0.000
46.50	2790	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3649.20	0.00	3649.20	0	3/4/1987 1:30	0.000
46.66	2800	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3620.69	0.00	3620.69	0	3/4/1987 1:40	0.000
46.83	2810	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3592.17	0.00	3592.17	0	3/4/1987 1:50	0.000
47.00	2820	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3563.66	0.00	3563.66	0	3/4/1987 2:00	0.000
47.16	2830	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3535.14	0.00	3535.14	0	3/4/1987 2:10	0.000
47.33	2840	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3506.63	0.00	3506.63	0	3/4/1987 2:20	0.000
47.50	2850	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3478.11	0.00	3478.11	0	3/4/1987 2:30	0.000
47.66	2860	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3449.60	0.00	3449.60	0	3/4/1987 2:40	0.000
47.83	2870	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3421.08	0.00	3421.08	0	3/4/1987 2:50	0.000
48.00	2880	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3392.56	0.00	3392.56	0	3/4/1987 3:00	0.000
48.16	2890	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3364.05	0.00	3364.05	0	3/4/1987 3:10	0.000
48.33	2900	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3335.53	0.00	3335.53	0	3/4/1987 3:20	0.000
48.50	2910	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3307.02	0.00	3307.02	0	3/4/1987 3:30	0.000
48.66	2920	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3278.50	0.00	3278.50	0	3/4/1987 3:40	0.000
48.83	2930	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3249.99	0.00	3249.99	0	3/4/1987 3:50	0.000
49.00	2940	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3221.47	0.00	3221.47	0	3/4/1987 4:00	0.000
49.16	2950	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3192.96	0.00	3192.96	0	3/4/1987 4:10	0.000
49.33	2960	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3164.44	0.00	3164.44	0	3/4/1987 4:20	0.000
49.50	2970	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3135.92	0.00	3135.92	0	3/4/1987 4:30	0.000
49.66	2980	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3107.41	0.00	3107.41	0	3/4/1987 4:40	0.000
49.83	2990	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3078.89	0.00	3078.89	0	3/4/1987 4:50	0.000
50.00	3000	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3050.38	0.00	3050.38	0	3/4/1987 5:00	0.000
50.16	3010	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	3021.86	0.00	3021.86	0	3/4/1987 5:10	0.000
50.33	3020	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	2993.35	0.00	2993.35	0	3/4/1987 5:20	0.000
50.50	3030	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	2964.83	0.00	2964.83	0	3/4/1987 5:30	0.000
50.66	3040	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	2936.32	0.00	2936.32	0	3/4/1987 5:40	0.000
50.83	3050	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	2907.80	0.00	2907.80	0	3/4/1987 5:50	0.000
51.00	3060	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	2879.28	0.00	2879.28	0	3/4/1987 6:00	0.000
51.16	3070	0.000	0.00	12705.16	0.0000	0.0475	0.0475	0.0000	2850.77	0.00	2850.77	0	3/4/1987 6:10	0.000



SvR Modeled Subbasin 416 Design Flow Rate to Pump Station during 1988 Storm (assumes ROW and Private Parcel tributary area)

SECTION 3b







**King County CSO**  
**Barton Basin Subbasin 416 GSI Analysis**  
SVR Project No. 06053  
Date: 05/26/2010

**Santa Barbara Urban Hydrograph Method (SBUH)**

red text is user entered

Rainfall data provided by King County

conversion from sf to acre

assume that both sides of a street have the same planter width

alleys are assumed to be negligible

a time increment of 9999 indicates that the rain event (provided by King County) has finished

corners at roadway intersections are counted as impervious in the N/S ROW areas

assumes crowned roadway

Typical One Block Characteristics			
Block (N/S) per GIS (lf)	601		
Block (E/W) per GIS (lf)	276		
Private Parcel Area (sf)	165,876	3.81 (ac)	
Roof Area of Private Parcels per Block per GIS (sf)	41,451	0.95 (ac)	
Non Roof Impervious Area of Private Parcels per Block per GIS (sf)	55,937	1.28 (ac)	
Pervious Area of Private Parcels per Block including alleys (sf)	68,488	1.57 (ac)	
ROW width (N/S) (lf)	60		
Planter Width (N/S) (lf)	10		
Width of Impervious in ROW (N/S) (lf)	40		
ROW width (E/W) (lf)	60		
Planter Width (E/W) (lf)	10		
Width of Impervious in ROW (E/W) (lf)	40		
ROW Impervious Area (N/S) (sf)	26440	0.61 (ac)	
ROW Pervious Area (N/S) (sf)	12020	0.28 (ac)	
ROW Impervious Area (E/W) (sf)	11040	0.25 (ac)	
ROW Pervious Area (E/W) (sf)	5520	0.13 (ac)	

		Percentage to RG	Effective Area to RG	CN	Impervious to RG (ac)	Pervious to RG (ac)	Percentage Impervious	Percentage Pervious
<b>PRIVATE PARCEL CHARACTERISTICS</b>								
Total Roof Area per One Block (ac)	0.95	50%	100%					
Roof Area disconnected		60%	0.29	86	0.00	0.29	0.00%	11.26%
Total Non-Roof Impervious Area Per One Block (ac)	1.28							
Non-Roof Impervious Area to RG (ac)		50%	0.32	86	0.00	0.32	0.00%	12.66%
Total Pervious Area per One Block (ac)	1.57							
Pervious Area to RG (ac)		50%	0.39	86	0.00	0.39	0.00%	15.50%
<b>N/S ROADWAY CHARACTERISTICS</b>								
One N/S ROW to RG per One Block		50%						
Total ROW Impervious Area (N/S) fronting a Block (ac)	0.61							
ROW Impervious Area (N/S) to RG (ac)			0.30	98	0.30	0	11.97%	0.00%
Total ROW Pervious Area (N/S) fronting a Block (ac)	0.28							
ROW Pervious Area (N/S) to RG (ac)			0.14	86	0	0.14	0.00%	5.44%
<b>E/W ROADWAY CHARACTERISTICS</b>								
One E/W ROW to RG per One Block		50%						
Total ROW Impervious Area (E/W) fronting One Block(ac)	0.25							
ROW Impervious Area (E/W) to RG (ac)			0.13	98	0.13	0	5.00%	0.00%
Total ROW Pervious Area (E/W) fronting One Block(ac)	0.13							
ROW Pervious Area (E/W) to RG (ac)			0.06	86	0	0.06	0.00%	2.50%
							16.97%	47.36%

Total Areas (ac)	0.43	1.20	Total Area contributing flow to rain garden (ac)	1.63	Total Foot Print Area of Half Block (ac)	2.54
CN	98	86				

**Rainfall Distribution: 1988 Storm** this field needs to be year of storm followed a space then "Storm". Example "1984 Storm"

Max Time Increment 278

Pt = 1.45 inches

Tc = 10 minutes

w = 0.33

Sp = 1.63

dt = 10 minutes

Si = 0.20

Time Increment	Time (minutes)	Rainfall Distribution (fraction)	Incremental Rainfall (inches)	Accumulated Rainfall (inches)	Pervious Accumulated Runoff (inches)	Pervious Area Increment Runoff (inches)	Impervious Accumulated Runoff (inches)	Impervious Area Incr. Runoff (inches)	Rainfall		Peak = 0.455 cfs		Difference Between Instant and Design Flow
									Total Runoff (inches)	Instant Flow rate (cfs)	Design Flow rate (cfs)		
0	0	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
1	10	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
2	20	0.0069	0.0100	0.010	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
3	30	0.0000	0.0000	0.010	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
4	40	0.0000	0.0000	0.010	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
5	50	0.0138	0.0200	0.030	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
6	60	0.0069	0.0100	0.040	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
7	70	0.0069	0.0100	0.050	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
8	80	0.0138	0.0200	0.070	0.000	0.000	0.004	0.003	0.001	0.01	0.01	0.003	0.01
9	90	0.0138	0.0200	0.090	0.000	0.000	0.010	0.006	0.002	0.02	0.02	0.009	0.01
10	100	0.0138	0.0200	0.110	0.000	0.000	0.018	0.008	0.002	0.02	0.02	0.015	0.01
11	110	0.0069	0.0100	0.120	0.000	0.000	0.022	0.005	0.001	0.01	0.01	0.016	0.00
12	120	0.0138	0.0200	0.140	0.000	0.000	0.032	0.010	0.003	0.03	0.03	0.018	0.01
13	130	0.0138	0.0200	0.160	0.000	0.000	0.044	0.012	0.003	0.03	0.03	0.025	0.00
14	140	0.0000	0.0000	0.160	0.000	0.000	0.044	0.000	0.000	0.00	0.00	0.018	-0.02
15	150	0.0069	0.0100	0.170	0.000	0.000	0.050	0.006	0.002	0.02	0.02	0.011	0.00
16	160	0.0000	0.0000	0.170	0.000	0.000	0.050	0.000	0.000	0.00	0.00	0.009	-0.01
17	170	0.0000	0.0000	0.170	0.000	0.000	0.050	0.000	0.000	0.00	0.00	0.003	0.00
18	180	0.0000	0.0000	0.170	0.000	0.000	0.050	0.000	0.000	0.00	0.00	0.001	0.00
19	190	0.0000	0.0000	0.170	0.000	0.000	0.050	0.000	0.000	0.00	0.00	0.000	0.00
20	200	0.0000	0.0000	0.170	0.000	0.000	0.050	0.000	0.000	0.00	0.00	0.000	0.00
21	210	0.0069	0.0100	0.180	0.000	0.000	0.056	0.006	0.002	0.02	0.02	0.006	0.01
22	220	0.0069	0.0100	0.190	0.000	0.000	0.063	0.007	0.002	0.02	0.02	0.013	0.00
23	230	0.0069	0.0100	0.200	0.000	0.000	0.070	0.007	0.002	0.02	0.02	0.016	0.00
24	240	0.0069	0.0100	0.210	0.000	0.000	0.077	0.007	0.002	0.02	0.02	0.017	0.00
25	250	0.0069	0.0100	0.220	0.000	0.000	0.084	0.007	0.002	0.02	0.02	0.018	0.00
26	260	0.0069	0.0100	0.230	0.000	0.000	0.091	0.007	0.002	0.02	0.02	0.018	0.00
27	270	0.0207	0.0300	0.260	0.000	0.000	0.114	0.022	0.006	0.06	0.06	0.032	0.03
28	280	0.0276	0.0400	0.300	0.000	0.000	0.145	0.032	0.008	0.08	0.08	0.057	0.02
29	290	0.0276	0.0400	0.340	0.000	0.000	0.178	0.033	0.009	0.09	0.09	0.075	0.01
30	300	0.0345	0.0500	0.390	0.002	0.002	0.220	0.043	0.013	0.13	0.13	0.096	0.03
31	310	0.0345	0.0500	0.440	0.008	0.005	0.264	0.044	0.015	0.15	0.15	0.125	0.03
32	320	0.0276	0.0400	0.480	0.013	0.006	0.300	0.036	0.014	0.14	0.14	0.137	0.00
33	330	0.0207	0.0300	0.510	0.019	0.005	0.327	0.027	0.011	0.11	0.11	0.127	-0.02
34	340	0.0207	0.0300	0.540	0.025	0.006	0.354	0.027	0.012	0.12	0.12	0.118	0.00
35	350	0.0069	0.0100	0.550	0.027	0.002	0.363	0.009	0.004	0.04	0.04	0.091	-0.05
36	360	0.0000	0.0000	0.550	0.027	0.000	0.363	0.000	0.000	0.00	0.00	0.044	-0.04
37	370	0.0000	0.0000	0.550	0.027	0.000	0.363	0.000	0.000	0.00	0.00	0.015	-0.01
38	380	0.0069	0.0100	0.560	0.030	0.002	0.373	0.009	0.004	0.04	0.04	0.018	0.02
39	390	0.0069	0.0100	0.570	0.032	0.002	0.382	0.009	0.004	0.04	0.04	0.034	0.01
40	400	0.0138	0.0200	0.590	0.037	0.005	0.400	0.018	0.009	0.08	0.08	0.053	0.03
41	410	0.0414	0.0600	0.650	0.054	0.017	0.456	0.056	0.027	0.27	0.27	0.136	0.13
42	420	0.0552	0.0800	0.730	0.080	0.027	0.532	0.075	0.039	0.39	0.39	0.265	0.12
43	430	0.0000	0.0000	0.730	0.080	0.000	0.532	0.000	0.000	0.00	0.00	0.218	-0.22
44	440	0.0000	0.0000	0.730	0.080	0.000	0.532	0.000	0.000	0.00	0.00	0.073	-0.07
45	450	0.0552	0.0800	0.810	0.111	0.031	0.608	0.076	0.043	0.42	0.42	0.164	0.26
46	460	0.0690	0.1000	0.910	0.154	0.043	0.704	0.096	0.057	0.56	0.56	0.383	0.18
47	470	0.0483	0.0700	0.980	0.188	0.033	0.772	0.068	0.042	0.42	0.42	0.455	-0.04
48	480	0.0000	0.0000	0.980	0.188	0.000	0.772	0.000	0.000	0.00	0.00	0.291	-0.29
49	490	0.0000	0.0000	0.980	0.188	0.000	0.772	0.000	0.000	0.00	0.00	0.097	-0.10
50	500	0.0000	0.0000	0.980	0.188	0.000	0.772	0.000	0.000	0.00	0.00	0.032	-0.03
51	510	0.0000	0.0000	0.980	0.188	0.000	0.772	0.000	0.000	0.00	0.00	0.011	-0.01
52	520	0.0000	0.0000	0.980	0.188	0.000	0.772	0.000	0.000	0.00	0.00	0.004	0.00
53	530	0.0069	0.0100	0.990	0.193	0.005	0.781	0.010	0.006	0.06	0.06	0.022	0.04
54	540	0.0138	0.0200	1.010	0.203	0.010	0.801	0.019	0.012	0.12	0.12	0.069	0.05
55	550	0.0138	0.0200	1.030	0.213	0.010	0.820	0.019	0.013	0.12	0.12	0.105	0.02
56	560	0.0207	0.0300	1.060	0.228	0.016	0.849	0.029	0.019	0.19	0.19	0.140	0.05
57	570	0.0138	0.0200	1.080	0.239	0.011	0.869	0.019	0.013	0.13	0.13	0.152	-0.02
58	580	0.0069	0.0100	1.090	0.244	0.005	0.878	0.010	0.007	0.06	0.06	0.115	-0.05



1988 Storm  
Section 3b  
Estimate of Flows to  
Rain Garden

59	590	0.0000	0.0000	1.090	0.244	0.000	0.878	0.000	0.000	0.00	0.060	-0.06
60	600	0.0000	0.0000	1.090	0.244	0.000	0.878	0.000	0.000	0.00	0.020	-0.02
61	610	0.0000	0.0000	1.090	0.244	0.000	0.878	0.000	0.000	0.00	0.007	-0.01
62	620	0.0000	0.0000	1.090	0.244	0.000	0.878	0.000	0.000	0.00	0.002	0.00
63	630	0.0000	0.0000	1.090	0.244	0.000	0.878	0.000	0.000	0.00	0.001	0.00
64	640	0.0000	0.0000	1.090	0.244	0.000	0.878	0.000	0.000	0.00	0.000	0.00
65	650	0.0000	0.0000	1.090	0.244	0.000	0.878	0.000	0.000	0.00	0.000	0.00
66	660	0.0069	0.0100	1.100	0.250	0.005	0.888	0.010	0.007	0.06	0.022	0.04
67	670	0.0138	0.0200	1.120	0.261	0.011	0.908	0.019	0.013	0.13	0.072	0.06
68	680	0.0069	0.0100	1.130	0.266	0.006	0.917	0.010	0.007	0.07	0.089	-0.02
69	690	0.0000	0.0000	1.130	0.266	0.000	0.917	0.000	0.000	0.00	0.051	-0.05
70	700	0.0000	0.0000	1.130	0.266	0.000	0.917	0.000	0.000	0.00	0.017	-0.02
71	710	0.0000	0.0000	1.130	0.266	0.000	0.917	0.000	0.000	0.00	0.006	-0.01
72	720	0.0000	0.0000	1.130	0.266	0.000	0.917	0.000	0.000	0.00	0.002	0.00
73	730	0.0000	0.0000	1.130	0.266	0.000	0.917	0.000	0.000	0.00	0.001	0.00
74	740	0.0000	0.0000	1.130	0.266	0.000	0.917	0.000	0.000	0.00	0.000	0.00
75	750	0.0000	0.0000	1.130	0.266	0.000	0.917	0.000	0.000	0.00	0.000	0.00
76	760	0.0000	0.0000	1.130	0.266	0.000	0.917	0.000	0.000	0.00	0.000	0.00
77	770	0.0000	0.0000	1.130	0.266	0.000	0.917	0.000	0.000	0.00	0.000	0.00
78	780	0.0069	0.0100	1.140	0.272	0.006	0.927	0.010	0.007	0.07	0.022	0.04
79	790	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.029	-0.03
80	800	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.010	-0.01
81	810	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.003	0.00
82	820	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.001	0.00
83	830	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.000	0.00
84	840	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.000	0.00
85	850	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.000	0.00
86	860	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.000	0.00
87	870	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.000	0.00
88	880	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.000	0.00
89	890	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.000	0.00
90	900	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.000	0.00
91	910	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.000	0.00
92	920	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.000	0.00
93	930	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.000	0.00
94	940	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.000	0.00
95	950	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.000	0.00
96	960	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.000	0.00
97	970	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.000	0.00
98	980	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.000	0.00
99	990	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.000	0.00
100	1000	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.000	0.00
101	1010	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.000	0.00
102	1020	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.000	0.00
103	1030	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.000	0.00
104	1040	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.000	0.00
105	1050	0.0000	0.0000	1.140	0.272	0.000	0.927	0.000	0.000	0.00	0.000	0.00
106	1060	0.0069	0.0100	1.150	0.277	0.006	0.937	0.010	0.007	0.07	0.022	0.04
107	1070	0.0000	0.0000	1.150	0.277	0.000	0.937	0.000	0.000	0.00	0.029	-0.03
108	1080	0.0000	0.0000	1.150	0.277	0.000	0.937	0.000	0.000	0.00	0.010	-0.01
109	1090	0.0000	0.0000	1.150	0.277	0.000	0.937	0.000	0.000	0.00	0.003	0.00
110	1100	0.0000	0.0000	1.150	0.277	0.000	0.937	0.000	0.000	0.00	0.001	0.00
111	1110	0.0000	0.0000	1.150	0.277	0.000	0.937	0.000	0.000	0.00	0.000	0.00
112	1120	0.0000	0.0000	1.150	0.277	0.000	0.937	0.000	0.000	0.00	0.000	0.00
113	1130	0.0000	0.0000	1.150	0.277	0.000	0.937	0.000	0.000	0.00	0.000	0.00
114	1140	0.0000	0.0000	1.150	0.277	0.000	0.937	0.000	0.000	0.00	0.000	0.00
115	1150	0.0000	0.0000	1.150	0.277	0.000	0.937	0.000	0.000	0.00	0.000	0.00
116	1160	0.0138	0.0200	1.170	0.288	0.011	0.956	0.020	0.013	0.13	0.044	0.09
117	1170	0.0069	0.0100	1.180	0.294	0.006	0.966	0.010	0.007	0.07	0.081	-0.01
118	1180	0.0069	0.0100	1.190	0.300	0.006	0.976	0.010	0.007	0.07	0.072	0.00
119	1190	0.0000	0.0000	1.190	0.300	0.000	0.976	0.000	0.000	0.00	0.046	-0.05
120	1200	0.0000	0.0000	1.190	0.300	0.000	0.976	0.000	0.000	0.00	0.015	-0.02
121	1210	0.0207	0.0300	1.220	0.317	0.017	1.005	0.029	0.021	0.20	0.073	0.13
122	1220	0.0000	0.0000	1.220	0.317	0.000	1.005	0.000	0.000	0.00	0.092	-0.09
123	1230	0.0000	0.0000	1.220	0.317	0.000	1.005	0.000	0.000	0.00	0.031	-0.03
124	1240	0.0000	0.0000	1.220	0.317	0.000	1.005	0.000	0.000	0.00	0.010	-0.01
125	1250	0.0000	0.0000	1.220	0.317	0.000	1.005	0.000	0.000	0.00	0.003	0.00
126	1260	0.0000	0.0000	1.220	0.317	0.000	1.005	0.000	0.000	0.00	0.001	0.00
127	1270	0.0000	0.0000	1.220	0.317	0.000	1.005	0.000	0.000	0.00	0.000	0.00
128	1280	0.0000	0.0000	1.220	0.317	0.000	1.005	0.000	0.000	0.00	0.000	0.00
129	1290	0.0069	0.0100	1.230	0.323	0.006	1.015	0.010	0.007	0.07	0.023	0.05
130	1300	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.030	-0.03
131	1310	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.010	-0.01
132	1320	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.003	0.00
133	1330	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.001	0.00
134	1340	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.000	0.00
135	1350	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.000	0.00
136	1360	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.000	0.00
137	1370	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.000	0.00
138	1380	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.000	0.00
139	1390	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.000	0.00
140	1400	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.000	0.00
141	1410	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.000	0.00
142	1420	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.000	0.00
143	1430	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.000	0.00
144	1440	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.000	0.00
145	1450	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.000	0.00
146	1460	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.000	0.00
147	1470	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.000	0.00
148	1480	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.000	0.00
149	1490	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.000	0.00
150	1500	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.000	0.00
151	1510	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.000	0.00
152	1520	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000				



1988 Storm  
Section 3b  
Estimate of Flows to  
Rain Garden

187	1870	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
188	1880	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
189	1890	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
190	1900	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
191	1910	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
192	1920	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
193	1930	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
194	1940	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
195	1950	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
196	1960	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
197	1970	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
198	1980	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
199	1990	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
200	2000	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
201	2010	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
202	2020	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
203	2030	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
204	2040	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
205	2050	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
206	2060	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
207	2070	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
208	2080	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
209	2090	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
210	2100	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
211	2110	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
212	2120	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
213	2130	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
214	2140	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
215	2150	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
216	2160	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
217	2170	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
218	2180	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
219	2190	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
220	2200	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
221	2210	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
222	2220	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
223	2230	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
224	2240	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
225	2250	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
226	2260	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
227	2270	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
228	2280	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
229	2290	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
230	2300	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
231	2310	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
232	2320	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
233	2330	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
234	2340	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
235	2350	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
236	2360	0.0000	0.0000	1.230	0.323	0.000	1.015	0.000	0.000	0.00	0.00	0.00
237	2370	0.0069	0.0100	1.240	0.329	0.006	1.025	0.010	0.007	0.07	0.023	0.05
238	2380	0.0000	0.0000	1.240	0.329	0.000	1.025	0.000	0.000	0.00	0.030	-0.03
239	2390	0.0000	0.0000	1.240	0.329	0.000	1.025	0.000	0.000	0.00	0.010	-0.01
240	2400	0.0000	0.0000	1.240	0.329	0.000	1.025	0.000	0.000	0.00	0.003	0.00
241	2410	0.0000	0.0000	1.240	0.329	0.000	1.025	0.000	0.000	0.00	0.001	0.00
242	2420	0.0000	0.0000	1.240	0.329	0.000	1.025	0.000	0.000	0.00	0.000	0.00
243	2430	0.0069	0.0100	1.250	0.335	0.006	1.035	0.010	0.007	0.07	0.023	0.05
244	2440	0.0000	0.0000	1.250	0.335	0.000	1.035	0.000	0.000	0.00	0.030	-0.03
245	2450	0.0000	0.0000	1.250	0.335	0.000	1.035	0.000	0.000	0.00	0.010	-0.01
246	2460	0.0069	0.0100	1.260	0.341	0.006	1.044	0.010	0.007	0.07	0.026	0.04
247	2470	0.0069	0.0100	1.270	0.347	0.006	1.054	0.010	0.007	0.07	0.055	0.01
248	2480	0.0138	0.0200	1.290	0.359	0.012	1.074	0.020	0.014	0.14	0.087	0.05
249	2490	0.0069	0.0100	1.300	0.365	0.006	1.084	0.010	0.007	0.07	0.099	-0.03
250	2500	0.0069	0.0100	1.310	0.371	0.006	1.093	0.010	0.007	0.07	0.079	-0.01
251	2510	0.0138	0.0200	1.330	0.383	0.012	1.113	0.020	0.014	0.14	0.097	0.04
252	2520	0.0069	0.0100	1.340	0.389	0.006	1.123	0.010	0.007	0.07	0.102	-0.03
253	2530	0.0000	0.0000	1.340	0.389	0.000	1.123	0.000	0.000	0.00	0.058	-0.06
254	2540	0.0000	0.0000	1.340	0.389	0.000	1.123	0.000	0.000	0.00	0.019	-0.02
255	2550	0.0000	0.0000	1.340	0.389	0.000	1.123	0.000	0.000	0.00	0.006	-0.01
256	2560	0.0069	0.0100	1.350	0.396	0.006	1.133	0.010	0.007	0.07	0.026	0.05
257	2570	0.0000	0.0000	1.350	0.396	0.000	1.133	0.000	0.000	0.00	0.032	-0.03
258	2580	0.0069	0.0100	1.360	0.402	0.006	1.142	0.010	0.007	0.07	0.034	0.04
259	2590	0.0069	0.0100	1.370	0.408	0.006	1.152	0.010	0.007	0.07	0.059	0.01
260	2600	0.0138	0.0200	1.390	0.421	0.013	1.172	0.020	0.014	0.14	0.091	0.05
261	2610	0.0069	0.0100	1.400	0.427	0.006	1.182	0.010	0.007	0.07	0.102	-0.03
262	2620	0.0138	0.0200	1.420	0.440	0.013	1.201	0.020	0.015	0.14	0.106	0.04
263	2630	0.0138	0.0200	1.440	0.453	0.013	1.221	0.020	0.015	0.14	0.132	0.01
264	2640	0.0069	0.0100	1.450	0.459	0.006	1.231	0.010	0.007	0.07	0.116	-0.04
265	2650	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.063	-0.06
266	2660	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.021	-0.02
267	2670	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.007	-0.01
268	2680	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.002	0.00
269	2690	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.001	0.00
270	2700	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.000	0.00
271	2710	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.000	0.00
272	2720	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.000	0.00
273	2730	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.000	0.00
274	2740	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.000	0.00
275	2750	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.000	0.00
276	2760	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.000	0.00
277	2770	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.000	0.00
278	2780	0.0000	0.0000	1.450	0.459	0.000	1.231	0.000	0.000	0.00	0.000	0.00
9999	9999	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.00
9999	9999	0.0000	0.0000	0.000								





King County CSO  
Barton Basin Subbasin 416 - GSI Option  
SvR Project No. 06053  
DATE: 05/26/2010

RAIN GARDEN SYSTEM COMPONENTS			
	Infiltration Rate into Native Subgrade (in/hr)		0.50
<b>SECTION 01 RG</b>	1.5	16.67	3.00% (biosoil depth/lf/slope)
	Number of Section 1 Rain Gardens for Basin (ea)		0
	Total Infiltration Area for Section 1 Rain Gardens (sf)*		0
	Storage Capacity for a single Section 1 Rain Garden (cf)		59
	Total Storage Capacity for Section 1 Rain Gardens (cf)		0
<b>SECTION 02 RG</b>	1.5	42	2.00% (biosoil depth/lf/slope)
	Number of Section 2 Rain Gardens for Basin (ea)		0
	Total Infiltration Area for Section 2 Rain Gardens (sf)*		0
	Storage Capacity for a single Section 2 Rain Garden (cf)		232
	Total Storage Capacity for Section 2 Rain Gardens (cf)		0
<b>SECTION 03 RG</b>	1.5	42	2.00% (biosoil depth/lf/slope)
	Number of Section 3 Rain Gardens for Basin (ea)		9
	Total Infiltration Area for Section 3 Rain Gardens (sf)*		4106
	Storage Capacity for a single Section 3 Rain Garden (cf)		451
	Total Storage Capacity for Section 3 Rain Gardens (cf)		4057

**CONVERSION FACTORS**

conversion factor from cfs to MGD:	0.6452
conversion factor from cfs to cf/per time step:	600

**Results Summary**

Total Volume of Runoff Removed of entire storm event duration (cf)	3,925	(per GSI half block)
Total Volume of Runoff Removed of entire storm event duration (gal)	29357.39	(per GSI half block)
Total volume of runoff removed from 8:50 to 9:50 of the 1984 storm	0.030999139	(gal per GSI half block)
	1.013562785	(gal)

Rainfall Distribution: 1988 Storm

**RAIN GARDEN SYSTEM SUMMARY**

Total Infiltration Flow (cfs)	0.0475
Total Swale Storage Capacity (cf)	4057.5

Flow reduction from subbasin 416 (MGD)

9.6

Calculated from Pump Station Data received  
03/24/2010

Flow reduction from assumed half block at peak flow (MGD)

0.293609569

**Number of half blocks needed to get total flow reduction out of subbasin 416**

**32.7**

Time (hours)	Time (minutes)	Design Flow Rate from Rain Event (cfs)	Inflow Water Volume (cf)	Inflow Cumm. Volume (cf)	Initial Exfiltration to Native Subgrade of Inflow (cfs)	Infiltration into Native Subgrade of Stored Water (cfs)	Total Infiltration into Native Subgrade (cfs)	Inflow to Swale After Infiltration into Native Subgrade (cfs)	Swale Storage before Overflow Volume (cf)	Overtop Flow to Pump Station (cfs)	Runoff Stored in Swale Storage Volume (cf)	Volume of Runoff Removed From Pump Station (cf)	Date & Time	Amount Flow Reduced to Pump Station (cfs)	Amount Flow Reduced to Pump Station (MGD)
0	0	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0			
0.17	10	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/22/1988 3:51	0.000	
0.33	20	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/22/1988 4:01	0.000	
0.50	30	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/22/1988 4:11	0.000	
0.67	40	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/22/1988 4:21	0.000	
0.83	50	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/22/1988 4:31	0.000	
1.00	60	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/22/1988 4:41	0.000	
1.17	70	0.000	0.21	0.21	0.0003	0.0000	0.0003	0.0000	0.00	0.00	0.00	0.205863685	11/22/1988 4:51	0.000	
1.33	80	0.003	1.97	2.18	0.0033	0.0000	0.0033	0.0000	0.00	0.00	0.00	1.969248035	11/22/1988 5:01	0.003	
1.50	90	0.009	5.42	7.60	0.0090	0.0000	0.0090	0.0000	0.00	0.00	0.00	5.422577392	11/22/1988 5:11	0.009	
1.67	100	0.015	9.02	16.62	0.0150	0.0000	0.0150	0.0000	0.00	0.00	0.00	9.024694025	11/22/1988 5:21	0.015	
1.83	110	0.016	9.56	26.18	0.0159	0.0000	0.0159	0.0000	0.00	0.00	0.00	9.558660483	11/22/1988 5:31	0.016	
2.00	120	0.018	10.95	37.14	0.0183	0.0000	0.0183	0.0000	0.00	0.00	0.00	10.95434542	11/22/1988 5:41	0.018	
2.17	130	0.025	15.00	52.14	0.0250	0.0000	0.0250	0.0000	0.00	0.00	0.00	15.00296298	11/22/1988 5:51	0.025	
2.33	140	0.018	10.99	63.13	0.0183	0.0000	0.0183	0.0000	0.00	0.00	0.00	10.98903608	11/22/1988 6:01	0.018	
2.50	150	0.011	6.86	69.98	0.0114	0.0000	0.0114	0.0000	0.00	0.00	0.00	6.856114687	11/22/1988 6:11	0.011	
2.67	160	0.009	5.48	75.46	0.0091	0.0000	0.0091	0.0000	0.00	0.00	0.00	5.478474223	11/22/1988 6:21	0.009	
2.83	170	0.003	1.83	77.29	0.0030	0.0000	0.0030	0.0000	0.00	0.00	0.00	1.826158074	11/22/1988 6:31	0.003	
3.00	180	0.001	0.61	77.90	0.0010	0.0000	0.0010	0.0000	0.00	0.00	0.00	0.608719358	11/22/1988 6:41	0.001	
3.17	190	0.000	0.20	78.10	0.0003	0.0000	0.0003	0.0000	0.00	0.00	0.00	0.202906453	11/22/1988 6:51	0.000	
3.33	200	0.000	0.07	78.17	0.0001	0.0000	0.0001	0.0000	0.00	0.00	0.00	0.067635484	11/22/1988 7:01	0.000	
3.50	210	0.006	3.33	81.50	0.0056	0.0000	0.0056	0.0000	0.00	0.00	0.00	3.33290132	11/22/1988 7:11	0.006	
3.67	220	0.013	7.84	89.34	0.0131	0.0000	0.0131	0.0000	0.00	0.00	0.00	7.838975519	11/22/1988 7:21	0.013	
3.83	230	0.016	9.55	98.89	0.0159	0.0000	0.0159	0.0000	0.00	0.00	0.00	9.546731472	11/22/1988 7:31	0.016	
4.00	240	0.017	10.30	109.19	0.0172	0.0000	0.0172	0.0000	0.00	0.00	0.00	10.3049423	11/22/1988 7:41	0.017	
4.17	250	0.018	10.73	119.92	0.0179	0.0000	0.0179	0.0000	0.00	0.00	0.00	10.73164096	11/22/1988 7:51	0.018	
4.33	260	0.018	11.03	130.96	0.0184	0.0000	0.0184	0.0000	0.00	0.00	0.00	11.03438482	11/22/1988 8:01	0.018	
4.50	270	0.032	19.15	150.11	0.0319	0.0000	0.0319	0.0000	0.00	0.00	0.00	19.15442703	11/22/1988 8:11	0.032	
4.67	280	0.057	34.49	184.60	0.0475	0.0000	0.0475	0.0100	5.98	0.00	5.98	34.49345713	11/22/1988 8:21	0.057	
4.83	290	0.075	45.18	229.79	0.0475	0.0000	0.0475	0.0278	22.65	0.00	22.65	45.1837533	11/22/1988 8:31	0.075	
5.00	300	0.096	57.86	287.65	0.0475	0.0000	0.0475	0.0489	51.99	0.00	51.99	57.86142677	11/22/1988 8:41	0.096	
5.17	310	0.125	74.94	362.59	0.0475	0.0000	0.0475	0.0774	98.41	0.00	98.41	74.93598345	11/22/1988 8:51	0.125	
5.33	320	0.137	82.22	444.81	0.0475	0.0000	0.0475	0.0895	152.12	0.00	152.12	82.22331537	11/22/1988 9:01	0.137	
5.50	330	0.127	76.46	521.27	0.0475	0.0000	0.0475	0.0799	200.07	0.00	200.07	76.46058838	11/22/1988 9:11	0.127	
5.67	340	0.118	70.67	591.94	0.0475	0.0000	0.0475	0.0703	242.22	0.00	242.22	70.66633634	11/22/1988 9:21	0.118	
5.83	350	0.091	54.81	646.75	0.0475	0.0000	0.0475	0.0438	268.51	0.00	268.51	54.81175602	11/22/1988 9:31	0.091	
6.00	360	0.044	26.29	673.04	0.0438	0.0037	0.0475	0.0000	266.29	0.00	266.29	26.29071309	11/22/1988 9:41	0.044	
6.17	370	0.015	8.76	681.80	0.0146	0.0329	0.0475	0.0000	246.54	0.00	246.54	8.76357103	11/22/1988 9:51	0.015	
6.33	380	0.018	11.07	692.88	0.0185	0.0291	0.0475	0.0000	229.09	0.00	229.09	11.0744539	11/22/1988 10:01	0.018	
6.50	390	0.034	20.13	713.01	0.0335	0.0140	0.0475	0.0000	220.71	0.00	220.71	20.12871685	11/22/1988 10:11	0.034	
6.67	400	0.053	31.94	744.95	0.0475	0.0000	0.0475	0.0057	224.14	0.00	224.14	31.94420583	11/22/1988 10:21	0.053	
6.83	410	0.136	81.35	826.30	0.0475	0.0000	0.0475	0.0881	276.97	0.00	276.97	81.35458275	11/22/1988 10:31	0.136	



7.00	420	0.265	158.74	985.04	0.0475	0.0000	0.0475	0.2170	407.20	0.00	407.20	158.7364706	11/22/1988 10:41	0.265	
7.17	430	0.218	130.77	1115.82	0.0475	0.0000	0.0475	0.1704	509.45	0.00	509.45	130.774584	11/22/1988 10:51	0.218	
7.33	440	0.073	43.59	1159.41	0.0475	0.0000	0.0475	0.0251	524.53	0.00	524.53	43.591528	11/22/1988 11:01	0.073	
7.50	450	0.164	98.67	1258.07	0.0475	0.0000	0.0475	0.1169	594.68	0.00	594.68	98.6665278	11/22/1988 11:11	0.164	
7.67	460	0.383	229.91	1487.98	0.0475	0.0000	0.0475	0.3357	796.08	0.00	796.08	229.9114585	11/22/1988 11:21	0.383	
7.83	470	0.455	273.06	1761.04	0.0475	0.0000	0.0475	0.4076	1040.62	0.00	1040.62	273.0568987	11/22/1988 11:31	0.455	0.293609569
8.00	480	0.291	174.55	1935.59	0.0475	0.0000	0.0475	0.2434	1186.66	0.00	1186.66	174.5521148	11/22/1988 11:41	0.291	
8.17	490	0.097	58.18	1993.78	0.0475	0.0000	0.0475	0.0494	1216.32	0.00	1216.32	58.18403825	11/22/1988 11:51	0.097	
8.33	500	0.032	19.39	2013.17	0.0323	0.0152	0.0475	0.0000	1207.20	0.00	1207.20	19.39467942	11/22/1988 12:01	0.032	
8.50	510	0.011	6.46	2019.64	0.0108	0.0368	0.0475	0.0000	1185.15	0.00	1185.15	6.464893139	11/22/1988 12:11	0.011	
8.67	520	0.004	2.15	2021.79	0.0036	0.0439	0.0475	0.0000	1158.79	0.00	1158.79	2.15496438	11/22/1988 12:21	0.004	
8.83	530	0.022	12.93	2034.72	0.0216	0.0260	0.0475	0.0000	1143.21	0.00	1143.21	12.93004441	11/22/1988 12:31	0.022	
9.00	540	0.069	41.14	2075.87	0.0475	0.0000	0.0475	0.0210	1155.83	0.00	1155.83	41.1445793	11/22/1988 12:41	0.069	
9.17	550	0.105	63.22	2139.09	0.0475	0.0000	0.0475	0.0578	1190.54	0.00	1190.54	63.22047483	11/22/1988 12:51	0.105	
9.33	560	0.140	83.75	2222.84	0.0475	0.0000	0.0475	0.0921	1245.78	0.00	1245.78	83.7528003	11/22/1988 13:01	0.140	
9.50	570	0.152	91.22	2214.06	0.0475	0.0000	0.0475	0.1045	1308.48	0.00	1308.48	91.21714801	11/22/1988 13:11	0.152	
9.67	580	0.115	68.75	2382.81	0.0475	0.0000	0.0475	0.0671	1348.71	0.00	1348.71	68.7494529	11/22/1988 13:21	0.115	
9.83	590	0.060	35.76	2418.56	0.0475	0.0000	0.0475	0.0121	1355.95	0.00	1355.95	35.75720848	11/22/1988 13:31	0.060	
10.00	600	0.020	11.92	2430.48	0.0199	0.0277	0.0475	0.0000	1339.36	0.00	1339.36	11.91906949	11/22/1988 13:41	0.020	
10.17	610	0.007	3.97	2434.46	0.0066	0.0409	0.0475	0.0000	1314.82	0.00	1314.82	3.973023164	11/22/1988 13:51	0.007	
10.33	620	0.002	1.32	2435.78	0.0022	0.0453	0.0475	0.0000	1287.62	0.00	1287.62	1.324341055	11/22/1988 14:01	0.002	
10.50	630	0.001	0.44	2436.22	0.0007	0.0468	0.0475	0.0000	1259.55	0.00	1259.55	0.441447018	11/22/1988 14:11	0.001	
10.67	640	0.000	0.15	2436.37	0.0002	0.0473	0.0475	0.0000	1231.18	0.00	1231.18	0.147149006	11/22/1988 14:21	0.000	
10.83	650	0.000	0.05	2436.42	0.0001	0.0474	0.0475	0.0000	1202.71	0.00	1202.71	0.049049669	11/22/1988 14:31	0.000	
11.00	660	0.022	12.92	2449.33	0.0215	0.0260	0.0475	0.0000	1187.11	0.00	1187.11	12.91552811	11/22/1988 14:41	0.022	
11.17	670	0.072	43.18	2492.51	0.0475	0.0000	0.0475	0.0244	1201.77	0.00	1201.77	43.17508018	11/22/1988 14:51	0.072	
11.33	680	0.089	53.43	2545.94	0.0475	0.0000	0.0475	0.0415	1226.69	0.00	1226.69	53.43250333	11/22/1988 15:01	0.089	
11.50	690	0.051	30.88	2576.82	0.0475	0.0000	0.0475	0.0039	1229.06	0.00	1229.06	30.88091846	11/22/1988 15:11	0.051	
11.67	700	0.017	10.29	2587.12	0.0172	0.0304	0.0475	0.0000	1210.83	0.00	1210.83	10.29363949	11/22/1988 15:21	0.017	
11.83	710	0.006	3.43	2590.55	0.0057	0.0418	0.0475	0.0000	1185.75	0.00	1185.75	3.431213162	11/22/1988 15:31	0.006	
12.00	720	0.002	1.14	2591.69	0.0019	0.0456	0.0475	0.0000	1158.38	0.00	1158.38	1.143737721	11/22/1988 15:41	0.002	
12.17	730	0.001	0.38	2592.07	0.0006	0.0469	0.0475	0.0000	1130.24	0.00	1130.24	0.381245907	11/22/1988 15:51	0.001	
12.33	740	0.000	0.13	2592.20	0.0002	0.0473	0.0475	0.0000	1101.86	0.00	1101.86	0.127081969	11/22/1988 16:01	0.000	
12.50	750	0.000	0.04	2592.24	0.0001	0.0475	0.0475	0.0000	1073.38	0.00	1073.38	0.042360656	11/22/1988 16:11	0.000	
12.67	760	0.000	0.01	2592.26	0.0000	0.0475	0.0475	0.0000	1044.88	0.00	1044.88	0.014120219	11/22/1988 16:21	0.000	
12.83	770	0.000	0.00	2592.26	0.0000	0.0475	0.0475	0.0000	1016.37	0.00	1016.37	0.00470674	11/22/1988 16:31	0.000	
13.00	780	0.022	13.13	2605.39	0.0219	0.0256	0.0475	0.0000	1000.98	0.00	1000.98	13.12717899	11/22/1988 16:41	0.022	
13.17	790	0.029	17.50	2622.89	0.0292	0.0184	0.0475	0.0000	989.97	0.00	989.97	17.50133641	11/22/1988 16:51	0.029	
13.33	800	0.010	5.83	2628.72	0.0097	0.0378	0.0475	0.0000	967.29	0.00	967.29	5.833778802	11/22/1988 17:01	0.010	
13.50	810	0.003	1.94	2630.67	0.0032	0.0443	0.0475	0.0000	940.71	0.00	940.71	1.944592934	11/22/1988 17:11	0.003	
13.67	820	0.001	0.65	2631.32	0.0011	0.0464	0.0475	0.0000	912.85	0.00	912.85	0.648197645	11/22/1988 17:21	0.001	
13.83	830	0.000	0.22	2631.53	0.0004	0.0472	0.0475	0.0000	884.55	0.00	884.55	0.216065882	11/22/1988 17:31	0.000	
14.00	840	0.000	0.07	2631.60	0.0001	0.0474	0.0475	0.0000	856.10	0.00	856.10	0.072021961	11/22/1988 17:41	0.000	
14.17	850	0.000	0.02	2631.63	0.0000	0.0475	0.0475	0.0000	827.61	0.00	827.61	0.02400732	11/22/1988 17:51	0.000	
14.33	860	0.000	0.01	2631.64	0.0000	0.0475	0.0475	0.0000	799.10	0.00	799.10	0.00800244	11/22/1988 18:01	0.000	
14.50	870	0.000	0.00	2631.64	0.0000	0.0475	0.0475	0.0000	770.59	0.00	770.59	0.00266748	11/22/1988 18:11	0.000	
14.67	880	0.000	0.00	2631.64	0.0000	0.0475	0.0475	0.0000	742.08	0.00	742.08	0.00088916	11/22/1988 18:21	0.000	
14.83	890	0.000	0.00	2631.64	0.0000	0.0475	0.0475	0.0000	713.56	0.00	713.56	0.000296387	11/22/1988 18:31	0.000	
15.00	900	0.000	0.00	2631.64	0.0000	0.0475	0.0475	0.0000	685.05	0.00	685.05	9.87956E-05	11/22/1988 18:41	0.000	
15.17	910	0.000	0.00	2631.64	0.0000	0.0475	0.0475	0.0000	656.53	0.00	656.53	3.29319E-05	11/22/1988 18:51	0.000	
15.33	920	0.000	0.00	2631.64	0.0000	0.0475	0.0475	0.0000	628.02	0.00	628.02	1.09773E-05	11/22/1988 19:01	0.000	
15.50	930	0.000	0.00	2631.64	0.0000	0.0475	0.0475	0.0000	599.50	0.00	599.50	3.65909E-06	11/22/1988 19:11	0.000	
15.67	940	0.000	0.00	2631.64	0.0000	0.0475	0.0475	0.0000	570.98	0.00	570.98	1.2197E-06	11/22/1988 19:21	0.000	
15.83	950	0.000	0.00	2631.64	0.0000	0.0475	0.0475	0.0000	542.47	0.00	542.47	4.06566E-07	11/22/1988 19:31	0.000	
16.00	960	0.000	0.00	2631.64	0.0000	0.0475	0.0475	0.0000	513.95	0.00	513.95	1.35522E-07	11/22/1988 19:41	0.000	
16.17	970	0.000	0.00	2631.64	0.0000	0.0475	0.0475	0.0000	485.44	0.00	485.44	4.5174E-08	11/22/1988 19:51	0.000	
16.33	980	0.000	0.00	2631.64	0.0000	0.0475	0.0475	0.0000	456.92	0.00	456.92	1.5058E-08	11/22/1988 20:01	0.000	
16.50	990	0.000	0.00	2631.64	0.0000	0.0475	0.0475	0.0000	428.41	0.00	428.41	5.01933E-09	11/22/1988 20:11	0.000	
16.67	1000	0.000	0.00	2631.64	0.0000	0.0475	0.0475	0.0000	399.89	0.00	399.89	1.67311E-09	11/22/1988 20:21	0.000	
16.83	1010	0.000	0.00	2631.64	0.0000	0.0475	0.0475	0.0000	371.38	0.00	371.38	5.57704E-10	11/22/1988 20:31	0.000	
17.00	1020	0.000	0.00	2631.64	0.0000	0.0475	0.0475	0.0000	342.86	0.00	342.86	1.85901E-10	11/22/1988 20:41	0.000	
17.17	1030	0.000	0.00	2631.64	0.0000	0.0475	0.0475	0.0000	314.34	0.00	314.34	6.19671E-11	11/22/1988 20:51	0.000	
17.33	1040	0.000	0.00	2631.64	0.0000	0.0475	0.0475	0.0000	285.83	0.00	285.83	2.06557E-11	11/22/1988 21:01	0.000	
17.50	1050	0.000	0.00	2631.64	0.0000	0.0475	0.0475	0.0000	257.31	0.00	257.31	6.88523E-12	11/22/1988 21:11	0.000	
17.67	1060	0.022	13.18	2644.82	0.0220	0.0256	0.0475	0.0000	241.98	0.00	241.98	13.1804356	11/22/1988 21:21	0.022	
17.83	1070	0.029	17.57	2662.39	0.0293	0.0182	0.0475	0.0000	231.04	0.00	231.04	17.57391414	11/22/1988 21:31	0.029	
18.00	1080	0.010	5.86	2668.25	0.0098	0.0378	0.0475	0.0000	208.38	0.00	208.38	5.857971379	11/22/1988 21:41	0.010	
18.17	1090	0.003	1.95	2670.20	0.0033	0.04									



RG Section 3b														
19.33	1160	0.044	26.52	2697.70	0.0442	0.0033	0.0475	0.0000	9.71	0.00	9.71	26.52349831	11/22/1988 23:01	0.044
19.50	1170	0.081	48.70	2746.41	0.0475	0.0000	0.0475	0.0336	29.89	0.00	29.89	48.7045994	11/22/1988 23:11	0.081
19.67	1180	0.072	42.97	2789.38	0.0475	0.0000	0.0475	0.0241	44.35	0.00	44.35	42.96866307	11/22/1988 23:21	0.072
19.83	1190	0.046	27.72	2817.09	0.0462	0.0013	0.0475	0.0000	43.55	0.00	43.55	27.71585646	11/22/1988 23:31	0.046
20.00	1200	0.015	9.24	2826.33	0.0154	0.0321	0.0475	0.0000	24.27	0.00	24.27	9.238618821	11/22/1988 23:41	0.015
20.17	1210	0.073	43.56	2869.90	0.0475	0.0000	0.0475	0.0251	39.32	0.00	39.32	43.56491484	11/22/1988 23:51	0.073
20.33	1220	0.092	55.01	2924.90	0.0475	0.0000	0.0475	0.0442	65.81	0.00	65.81	55.00701351	11/23/1988 0:01	0.092
20.50	1230	0.031	18.34	2943.24	0.0306	0.0170	0.0475	0.0000	55.63	0.00	55.63	18.33567117	11/23/1988 0:11	0.031
20.67	1240	0.010	6.11	2949.35	0.0102	0.0373	0.0475	0.0000	33.23	0.00	33.23	6.11189039	11/23/1988 0:21	0.010
20.83	1250	0.003	2.04	2951.39	0.0034	0.0441	0.0475	0.0000	6.75	0.00	6.75	2.037296797	11/23/1988 0:31	0.003
21.00	1260	0.001	0.68	2952.07	0.0011	0.0464	0.0475	0.0000	-21.09	0.00	0.00	0.679098932	11/23/1988 0:41	0.001
21.17	1270	0.000	0.23	2952.29	0.0004	0.0000	0.0004	0.0000	0.00	0.00	0.00	0.226366311	11/23/1988 0:51	0.000
21.33	1280	0.000	0.08	2952.37	0.0001	0.0000	0.0001	0.0000	0.00	0.00	0.00	0.075455437	11/23/1988 1:01	0.000
21.50	1290	0.023	13.62	2965.99	0.0227	0.0000	0.0227	0.0000	0.00	0.00	0.00	13.62036047	11/23/1988 1:11	0.023
21.67	1300	0.030	18.14	2984.12	0.0302	0.0000	0.0302	0.0000	0.00	0.00	0.00	18.13532882	11/23/1988 1:21	0.030
21.83	1310	0.010	6.05	2990.17	0.0101	0.0000	0.0101	0.0000	0.00	0.00	0.00	6.045109606	11/23/1988 1:31	0.010
22.00	1320	0.003	2.02	2992.18	0.0034	0.0000	0.0034	0.0000	0.00	0.00	0.00	2.015036535	11/23/1988 1:41	0.003
22.17	1330	0.001	0.67	2992.86	0.0011	0.0000	0.0011	0.0000	0.00	0.00	0.00	0.671678845	11/23/1988 1:51	0.001
22.33	1340	0.000	0.22	2993.08	0.0004	0.0000	0.0004	0.0000	0.00	0.00	0.00	0.223892948	11/23/1988 2:01	0.000
22.50	1350	0.000	0.07	2993.15	0.0001	0.0000	0.0001	0.0000	0.00	0.00	0.00	0.074630983	11/23/1988 2:11	0.000
22.67	1360	0.000	0.02	2993.18	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.024876994	11/23/1988 2:21	0.000
22.83	1370	0.000	0.01	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.008292331	11/23/1988 2:31	0.000
23.00	1380	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00276411	11/23/1988 2:41	0.000
23.17	1390	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00092137	11/23/1988 2:51	0.000
23.33	1400	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.000307123	11/23/1988 3:01	0.000
23.50	1410	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.000102374	11/23/1988 3:11	0.000
23.67	1420	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	3.41248E-05	11/23/1988 3:21	0.000
23.83	1430	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.13749E-05	11/23/1988 3:31	0.000
24.00	1440	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	3.79165E-06	11/23/1988 3:41	0.000
24.17	1450	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.26388E-06	11/23/1988 3:51	0.000
24.33	1460	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	4.21294E-07	11/23/1988 4:01	0.000
24.50	1470	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.40431E-07	11/23/1988 4:11	0.000
24.67	1480	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	4.68105E-08	11/23/1988 4:21	0.000
24.83	1490	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.56035E-08	11/23/1988 4:31	0.000
25.00	1500	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	5.20116E-09	11/23/1988 4:41	0.000
25.17	1510	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.73372E-09	11/23/1988 4:51	0.000
25.33	1520	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	5.77907E-10	11/23/1988 5:01	0.000
25.50	1530	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.92636E-10	11/23/1988 5:11	0.000
25.67	1540	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	6.42119E-11	11/23/1988 5:21	0.000
25.83	1550	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	2.1404E-11	11/23/1988 5:31	0.000
26.00	1560	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	7.13465E-12	11/23/1988 5:41	0.000
26.17	1570	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	2.37822E-12	11/23/1988 5:51	0.000
26.33	1580	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	7.92739E-13	11/23/1988 6:01	0.000
26.50	1590	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	2.64246E-13	11/23/1988 6:11	0.000
26.67	1600	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	8.80821E-14	11/23/1988 6:21	0.000
26.83	1610	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	2.93607E-14	11/23/1988 6:31	0.000
27.00	1620	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	9.7869E-15	11/23/1988 6:41	0.000
27.17	1630	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	3.2623E-15	11/23/1988 6:51	0.000
27.33	1640	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.08743E-15	11/23/1988 7:01	0.000
27.50	1650	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	3.62478E-16	11/23/1988 7:11	0.000
27.67	1660	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.20826E-16	11/23/1988 7:21	0.000
27.83	1670	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	4.02753E-17	11/23/1988 7:31	0.000
28.00	1680	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.34251E-17	11/23/1988 7:41	0.000
28.17	1690	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	4.47504E-18	11/23/1988 7:51	0.000
28.33	1700	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.49168E-18	11/23/1988 8:01	0.000
28.50	1710	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	4.97226E-19	11/23/1988 8:11	0.000
28.67	1720	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.65742E-19	11/23/1988 8:21	0.000
28.83	1730	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	5.52474E-20	11/23/1988 8:31	0.000
29.00	1740	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.84158E-20	11/23/1988 8:41	0.000
29.17	1750	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	6.13859E-21	11/23/1988 8:51	0.000
29.33	1760	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	2.0462E-21	11/23/1988 9:01	0.000
29.50	1770	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	6.82066E-22	11/23/1988 9:11	0.000
29.67	1780	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	2.27355E-22	11/23/1988 9:21	0.000
29.83	1790	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	7.57851E-23	11/23/1988 9:31	0.000
30.00	1800	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	2.52617E-23	11/23/1988 9:41	0.000
30.17	1810	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	8.42057E-24	11/23/1988 9:51	0.000
30.33	1820	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	2.80686E-24	11/23/1988 10:01	0.000
30.50	1830	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	9.35619E-25	11/23/1988 10:11	0.000
30.67	1840	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	3.11873E-25	11/23/1988 10:21	0.000

1.1008E-07  
3.66934E-08  
1.22311E-08



													RG Section 3b		
30.83	1850	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.03958E-25	11/23/1988 10:31	0.000
31.00	1860	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	3.46525E-26	11/23/1988 10:41	0.000
31.17	1870	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.15508E-26	11/23/1988 10:51	0.000
31.33	1880	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	3.85028E-27	11/23/1988 11:01	0.000
31.50	1890	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.28343E-27	11/23/1988 11:11	0.000
31.67	1900	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	4.27809E-28	11/23/1988 11:21	0.000
31.83	1910	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.42603E-28	11/23/1988 11:31	0.000
32.00	1920	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	4.75344E-29	11/23/1988 11:41	0.000
32.17	1930	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.58448E-29	11/23/1988 11:51	0.000
32.33	1940	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	5.2816E-30	11/23/1988 12:01	0.000
32.50	1950	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.76053E-30	11/23/1988 12:11	0.000
32.67	1960	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	5.86844E-31	11/23/1988 12:21	0.000
32.83	1970	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.95615E-31	11/23/1988 12:31	0.000
33.00	1980	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	6.52049E-32	11/23/1988 12:41	0.000
33.17	1990	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	2.1735E-32	11/23/1988 12:51	0.000
33.33	2000	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	7.24499E-33	11/23/1988 13:01	0.000
33.50	2010	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	2.415E-33	11/23/1988 13:11	0.000
33.67	2020	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	8.04999E-34	11/23/1988 13:21	0.000
33.83	2030	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	2.68333E-34	11/23/1988 13:31	0.000
34.00	2040	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	8.94443E-35	11/23/1988 13:41	0.000
34.17	2050	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	2.98148E-35	11/23/1988 13:51	0.000
34.33	2060	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	9.93825E-36	11/23/1988 14:01	0.000
34.50	2070	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	3.31275E-36	11/23/1988 14:11	0.000
34.67	2080	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.10425E-36	11/23/1988 14:21	0.000
34.83	2090	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	3.68083E-37	11/23/1988 14:31	0.000
35.00	2100	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.22694E-37	11/23/1988 14:41	0.000
35.17	2110	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	4.08982E-38	11/23/1988 14:51	0.000
35.33	2120	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.36327E-38	11/23/1988 15:01	0.000
35.50	2130	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	4.54424E-39	11/23/1988 15:11	0.000
35.67	2140	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.51475E-39	11/23/1988 15:21	0.000
35.83	2150	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	5.04916E-40	11/23/1988 15:31	0.000
36.00	2160	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.68305E-40	11/23/1988 15:41	0.000
36.17	2170	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	5.61017E-41	11/23/1988 15:51	0.000
36.33	2180	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.87006E-41	11/23/1988 16:01	0.000
36.50	2190	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	6.23353E-42	11/23/1988 16:11	0.000
36.67	2200	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	2.07784E-42	11/23/1988 16:21	0.000
36.83	2210	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	6.92614E-43	11/23/1988 16:31	0.000
37.00	2220	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	2.30871E-43	11/23/1988 16:41	0.000
37.17	2230	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	7.69571E-44	11/23/1988 16:51	0.000
37.33	2240	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	2.56524E-44	11/23/1988 17:01	0.000
37.50	2250	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	8.55079E-45	11/23/1988 17:11	0.000
37.67	2260	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	2.85026E-45	11/23/1988 17:21	0.000
37.83	2270	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	9.50088E-46	11/23/1988 17:31	0.000
38.00	2280	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	3.16696E-46	11/23/1988 17:41	0.000
38.17	2290	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.05565E-46	11/23/1988 17:51	0.000
38.33	2300	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	3.51884E-47	11/23/1988 18:01	0.000
38.50	2310	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.17295E-47	11/23/1988 18:11	0.000
38.67	2320	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	3.90983E-48	11/23/1988 18:21	0.000
38.83	2330	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.30328E-48	11/23/1988 18:31	0.000
39.00	2340	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	4.34425E-49	11/23/1988 18:41	0.000
39.17	2350	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	1.44808E-49	11/23/1988 18:51	0.000
39.33	2360	0.000	0.00	2993.19	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	4.82695E-50	11/23/1988 19:01	0.000
39.50	2370	0.023	13.64	3006.84	0.0227	0.0000	0.0227	0.0000	0.0000	0.00	0.00	0.00	13.64423974	11/23/1988 19:11	0.023
39.67	2380	0.030	18.19	3025.03	0.0303	0.0000	0.0303	0.0000	0.0000	0.00	0.00	0.00	18.19231965	11/23/1988 19:21	0.030
39.83	2390	0.010	6.06	3031.09	0.0101	0.0000	0.0101	0.0000	0.0000	0.00	0.00	0.00	6.06410655	11/23/1988 19:31	0.010
40.00	2400	0.003	2.02	3033.11	0.0034	0.0000	0.0034	0.0000	0.0000	0.00	0.00	0.00	2.02136885	11/23/1988 19:41	0.003
40.17	2410	0.001	0.67	3033.79	0.0011	0.0000	0.0011	0.0000	0.0000	0.00	0.00	0.00	0.673789617	11/23/1988 19:51	0.001
40.33	2420	0.000	0.22	3034.01	0.0004	0.0000	0.0004	0.0000	0.0000	0.00	0.00	0.00	0.224596539	11/23/1988 20:01	0.000
40.50	2430	0.023	13.77	3047.78	0.0229	0.0000	0.0229	0.0000	0.0000	0.00	0.00	0.00	13.76754483	11/23/1988 20:11	0.023
40.67	2440	0.030	18.28	3066.06	0.0305	0.0000	0.0305	0.0000	0.0000	0.00	0.00	0.00	18.28186093	11/23/1988 20:21	0.030
40.83	2450	0.010	6.09	3072.16	0.0102	0.0000	0.0102	0.0000	0.0000	0.00	0.00	0.00	6.093953642	11/23/1988 20:31	0.010
41.00	2460	0.026	15.77	3087.93	0.0263	0.0000	0.0263	0.0000	0.0000	0.00	0.00	0.00	15.77185493	11/23/1988 20:41	0.026
41.17	2470	0.055	32.79	3120.71	0.0475	0.0000	0.0475	0.0071	0.0000	4.27	0.00	4.27	32.78564444	11/23/1988 20:51	0.055
41.33	2480	0.087	52.43	3173.14	0.0475	0.0000	0.0475	0.0399	28.19	0.00	28.19	52.43162798	11/23/1988 21:01	0.087	
41.50	2490	0.099	59.12	3232.26	0.0475	0.0000	0.0475	0.0510	58.79	0.00	58.79	59.11880256	11/23/1988 21:11	0.099	
41.67	2500	0.079	47.60	3279.87	0.0475	0.0000	0.0475	0.0318	77.88	0.00	77.88	47.60402562	11/23/1988 21:21	0.079	
41.83	2510	0.097	57.92	3337.78	0.0475	0.0000	0.0475	0.0490	107.28	0.00	107.28				



														RG Section 3b	
43.16	2590	0.059	35.29	3539.87	0.0475	0.0000	0.0475	0.0113	81.24	0.00	81.24	35.29318895	11/23/1988 22:51	0.059	
43.33	2600	0.091	54.58	3594.45	0.0475	0.0000	0.0475	0.0434	107.31	0.00	107.31	54.58202606	11/23/1988 23:01	0.091	
43.50	2610	0.102	61.13	3655.59	0.0475	0.0000	0.0475	0.0544	139.93	0.00	139.93	61.13490789	11/23/1988 23:11	0.102	
43.66	2620	0.106	63.56	3719.15	0.0475	0.0000	0.0475	0.0584	174.97	0.00	174.97	63.56157054	11/23/1988 23:21	0.106	
43.83	2630	0.132	79.00	3798.15	0.0475	0.0000	0.0475	0.0841	225.46	0.00	225.46	79.00197987	11/23/1988 23:31	0.132	
44.00	2640	0.116	69.87	3868.02	0.0475	0.0000	0.0475	0.0689	266.82	0.00	266.82	69.87070261	11/23/1988 23:41	0.116	
44.16	2650	0.063	37.84	3905.86	0.0475	0.0000	0.0475	0.0155	276.14	0.00	276.14	37.84101173	11/23/1988 23:51	0.063	
44.33	2660	0.021	12.61	3918.48	0.0210	0.0265	0.0475	0.0000	260.24	0.00	260.24	12.61367058	11/24/1988 0:01	0.021	
44.50	2670	0.007	4.20	3922.68	0.0070	0.0405	0.0475	0.0000	235.93	0.00	235.93	4.204556859	11/24/1988 0:11	0.007	
44.66	2680	0.002	1.40	3924.08	0.0023	0.0452	0.0475	0.0000	208.81	0.00	208.81	1.401518953	11/24/1988 0:21	0.002	
44.83	2690	0.001	0.47	3924.55	0.0008	0.0467	0.0475	0.0000	180.77	0.00	180.77	0.467172984	11/24/1988 0:31	0.001	
45.00	2700	0.000	0.16	3924.71	0.0003	0.0473	0.0475	0.0000	152.41	0.00	152.41	0.155724328	11/24/1988 0:41	0.000	
45.16	2710	0.000	0.05	3924.76	0.0001	0.0474	0.0475	0.0000	123.94	0.00	123.94	0.051908109	11/24/1988 0:51	0.000	
45.33	2720	0.000	0.02	3924.78	0.0000	0.0475	0.0475	0.0000	95.44	0.00	95.44	0.017302703	11/24/1988 1:01	0.000	
45.50	2730	0.000	0.01	3924.78	0.0000	0.0475	0.0475	0.0000	66.93	0.00	66.93	0.005767568	11/24/1988 1:11	0.000	
45.66	2740	0.000	0.00	3924.78	0.0000	0.0475	0.0475	0.0000	38.42	0.00	38.42	0.001922523	11/24/1988 1:21	0.000	
45.83	2750	0.000	0.00	3924.78	0.0000	0.0475	0.0475	0.0000	9.91	0.00	9.91	0.000640841	11/24/1988 1:31	0.000	
46.00	2760	0.000	0.00	3924.79	0.0000	0.0475	0.0475	0.0000	-18.61	0.00	0.00	0.000213614	11/24/1988 1:41	0.000	
46.16	2770	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	7.12045E-05	11/24/1988 1:51	0.000	
46.33	2780	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	2.37348E-05	11/24/1988 2:01	0.000	
46.50	2790	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/24/1988 2:11	0.000	
46.66	2800	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/24/1988 2:21	0.000	
46.83	2810	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/24/1988 2:31	0.000	
47.00	2820	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/24/1988 2:41	0.000	
47.16	2830	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/24/1988 2:51	0.000	
47.33	2840	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/24/1988 3:01	0.000	
47.50	2850	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/24/1988 3:11	0.000	
47.66	2860	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/24/1988 3:21	0.000	
47.83	2870	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/24/1988 3:31	0.000	
48.00	2880	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/24/1988 3:41	0.000	
48.16	2890	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/24/1988 3:51	0.000	
48.33	2900	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/24/1988 4:01	0.000	
48.50	2910	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/24/1988 4:11	0.000	
48.66	2920	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/24/1988 4:21	0.000	
48.83	2930	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/24/1988 4:31	0.000	
49.00	2940	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/24/1988 4:41	0.000	
49.16	2950	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/24/1988 4:51	0.000	
49.33	2960	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/24/1988 5:01	0.000	
49.50	2970	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/24/1988 5:11	0.000	
49.66	2980	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/24/1988 5:21	0.000	
49.83	2990	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/24/1988 5:31	0.000	
50.00	3000	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/24/1988 5:41	0.000	
50.16	3010	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
50.33	3020	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
50.50	3030	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
50.66	3040	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
50.83	3050	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
51.00	3060	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
51.16	3070	0.000	0.00	3924.79	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	



**ADDENDUM #2 TO TECHNICAL MEMORANDUM 600.6  
VOLUME COMPARISON AND GSI RECOMMENDATIONS**





## Addendum #2 to Technical Memorandum 600.6

DATE: June 29, 2010

TO: Allen deSteiguer, PE, Carrollo Engineers

FROM: Greg Giraldo, PE  
Kathryn Gwilym, PE

RE: Volume Comparison and GSI Recommendation  
**King County CSO, Barton Basin GSI Alternative**  
SvR Project No. 06053

King County (KC) staff requested a volume comparison as a follow-up to Technical Memorandum 600.6 (TM600.6) and Addendum to 600.6 dated May 27, 2010 (Addendum to 600.6). We were requested to estimate, using the Santa Barbara Urban Hydrograph (SBUH) model, the volume of storage available and the estimated volume of stormwater that would be removed from the system during the peak event. This memorandum summarizes the results from our analysis using the data previously presented in TM 600.6, and provides strategies for implementing GSI.

In addition to estimating volume of storage, King County requested that we revise the model in order to provide a basis for comparing the SBUH model and the King County model. Although revising the drainage contributing area and revising the time of concentration provides a basis of comparison for the two models (as documented in Addendum to 600.6) it should be noted that two different models will produce two dissimilar answers. The SBUH model takes the bottom of the basin flows and distributes them equally among the blocks. This simplified method (used for planning) allowed for a block scale analysis; however, it can over-estimate the flow rate for entire subbasin when blocks are added together by assuming peak flows from each block occur at the same time step.

Table A2-I shows five scenarios using different contributing area assumptions, the available storage volume provided by the rain gardens, and the volume of water that was removed during the peak flow of the 1984 storm event. Assumptions for the tributary area will affect the performance of the rain gardens and the amount of stormwater that is able to be prevented from being discharged into the Combined Sanitary Sewer (CSS) during the peak. The five scenarios are defined as follows:

- **Scenario 1** assumes that only the ROW impervious and ROW pervious area flows to the rain garden. See TM 600.6 for description of this analysis.
- **Scenario 2** assumes that both the ROW and a portion of the parcel area (portion of roofs with disconnected downspouts, parcel pavement and parcel pervious areas) sheet flows to the rain garden. See TM 600.6 for description of this analysis.

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- **Scenario 3 and 4** is a hybrid approach which takes the most feasible half streets within the project study area and applies rain gardens along those streets. Scenario 3 and 4 also uses a combination of rain garden Sections 2 and 3 (see Figure 4 in TM 600.6) so there would be less impact to parking along the street as compared to Scenario 2. See TM 600.6 for a description and maps of the most feasible streets (Figure 2A-2C). Scenario 3 assumes a tributary area from the public right-of-way and Scenario 4 assumes a tributary area from both the public right-of-way and portion of the parcels. The characteristics for the flow coming off the parcel in Scenario 4 use the same parameters as Scenario 2, which was reported in TM 600.6.
- **Scenario 5** is King County's analysis as is listed for comparison.

Results for peak flow for Scenario 1 (ROW only) and 2 (ROW+Parcel) were presented in TM 600.6 and Addendum TM 600.6. Scenarios 3 and 4 include the following revisions from Scenario 1 and 2:

- Existing 10-foot planter would be retrofitted with a section similar to Section 2 (see Figure 4 in TM 600.6).
- Curb bulbs using Section 3 (see Figure 4 in TM 600.6) would be installed just upstream from the intersection and catch basins.

While all of the scenarios would provide for at least one on-street parking space for each house along the street frontage, in accordance with Seattle Public Utilities guidance, the Scenario 3 and 4 approaches would minimize the parking impacts on the neighborhood as compared to Scenario 2. Scenario 1 would have the least amount of parking impacts. Scenarios 3 and 4 are based on the current model approach and assumptions; however, these scenarios do not provide similar peak flow reduction (based on the modeling inputs and assumptions). Instead they provide a strategy for implementing GSI in conjunction with modeling and monitoring efforts during design (see Appendix for assumptions for rain gardens in Scenario 3 and 4).

In TM 600.6 and Addendum to 600.6 (dated May 27, 2010), we noted modeled flow results varied depending upon the assumptions related to the contributing area flowing to the rain garden (ROW only or ROW + Parcel). As documented in King County's site reconnaissance (TM 200.7 and TM 600.5) and review of available GIS mapping data, there are some discrepancies between how much area is directly tightlined to the combined sanitary sewer (CSS) within Barton subbasin 416. As a result, in our analysis as described in TM 600.6 (see Table 3 of TM 600.6) we provided a range for how many half blocks were estimated to need GSI in order to reduce the peak by 14.6 MGD (see footnote 1 in Table A2-1). Table A2-I provides the additional information of the volume controlled from the analysis previously presented in TM 600.6 for scenario 1 and 2.



**Table A2-I: Comparison of Volume vs. Tributary Area Draining to Rain Garden**

Modeled Area Type	Modeled Tributary Areas to Rain Gardens	# of half streets to receive GSI <sup>1</sup>	Rain Garden X-section <sup>2</sup>	Available Volume Storage in Rain Gardens (Gallons)	Volume Removed during 1984 Peak by Rain Gardens <sup>6</sup> (Gallons)	Total Volume Removed during entire 1984 Storm via the rain gardens <sup>9</sup> (Gallons)	Construction Cost (Millions)
1 - ROW only	28.0ac ROW Impervious; 13ac ROW Pervious	65 N/S 65 E/W	2b	1,352,600	225,400	2,020,200	\$11.9M <sup>10</sup>
2 - ROW + Parcel <sup>3</sup>	13.8ac ROW Impervious; 10.2ac Parcel Pavement 9.3ac Roof (disconnected); 18.9ac Parcel+ROW Pervious	32 N/S 32 E/W	3a/3b	936,400	136,200	1,825,400	\$10.2M <sup>10</sup>
3 - ROW only - Applying GSI to High/Most Feasible Streets <sup>4</sup> w/n Project Study Area <sup>5</sup> shown in Figure 2C <sup>4</sup>	12.9 ac ROW Impervious; 6.0 ac ROW Pervious.	34 N/S 22 E/W which is equivalent in area to 30 N/S and 30 E/W streets	Combination 3a/2a Combination 3b/2b	666,700	104,000	932,400	\$9.5M <sup>11</sup>
4 - ROW + Parcel - Applying GSI to High/Most Feasible Streets <sup>4</sup> w/n Project Study Area <sup>5</sup> shown in Figure 2C <sup>4</sup>	12.9 ac ROW Impervious; 6.0 ac ROW Pervious. 9.6ac Parcel Pavement; 8.7ac Roof (disconnected); 11.7 ac Parcel pervious	34 N/S 22 E/W which is equivalent in area to 30 N/S and 30 E/W streets	Combination 3a/2a Combination 3b/2b	666,700	14,300	1,316,300	\$9.5M <sup>11</sup>
5 -King County GSI	26 acres of impervious <sup>7</sup>	60 N/S half streets and 12 E/W half streets <sup>7</sup>		410,000 <sup>8</sup>	Not Included in TM 600.5	780,845 <sup>7</sup>	\$8.3M <sup>7</sup>

<sup>1</sup>See SvR Technical Memorandum 600.6 for assumptions and calculations for half blocks. TM 600.6 references half blocks for the planning level modeling approach conducted by SvR. A half block was defined as 1 North/South (N/S) half street and 1 East/West (E/W) half street plus half of the housing parcel block fronting those streets.

<sup>2</sup>See Figure 4 in TM 600.6 for cross section.

<sup>3</sup>ROW+Parcel = Average # of half blocks tabulated between Section 3a and 3b as noted in TM 600.6. Storage volume, volume removed and construction costs are noted in Table as the average between modeled 3a and 3b sections.

<sup>4</sup>See Figure 2C in TM 600.6. The High/Most Feasible Streets are the dark green shown in the figure. They include those with 3% or less average longitudinal slope and have an existing 10-foot planter strip available for retrofit. The next feasible/ease of implementation GSI are shown in Figure 2C in lighter green colors. Additional streets are feasible but would require more impact for implementation of rain garden. See TM 600.6.

<sup>5</sup>Project Study Area that SvR was scoped to review for GSI in Barton basin was within subbasin 416 between SW Othello Street to SW Barton Street and 34<sup>th</sup> Avenue SW to east edge of subbasin 416 approximately 30<sup>th</sup> Avenue SW.

<sup>6</sup>Peak volume removed was measured from 9:30 to 9:50 on November 2, 1984. Actual peak is from 9:30 to 9:54 am (per emailed spreadsheet received from Kevin Shock on 6/14/2010 and as shown in Figure 3-1 in King County TM 600.5 May 2010 report) but from 9:50 to 10:00 there is no rain fall.

<sup>7</sup>Information from King County Technical Memorandum 600.5, dated May 2010 and received May 28, 2010. KC TM 600.5's Table 3-1 notes mitigated area. KC TM 600-5's Table 3-3 reported number of streets as 30 North-west and 6 East-west which were assumed to be both sides of the ROW so doubled to determine number of half streets. Cost reported in Table 3-4.

<sup>8</sup>Volume available estimated at 0.88acres x (10 inches ponding + 18 inches x 40-percent void space) based on information in King County Technical Memorandum 600.5 and then converted units to gallons.

<sup>9</sup>Analysis of 1984 storm begins at 10:00 on 11/01/84 and ends at 10:00 on 11/02/84.

<sup>10</sup>For cost assumptions see SvR's TM 600.6.

<sup>11</sup>Cost assumption for scenario 3 and 4 are the same as noted in TM 600.6; however, a 40% contingency was included to account for the potential of having to retrofit secondary and other additional streets aside from the primary for rain gardens. Final determination of location would be determined during design phase and modeling.





As shown in Table A2-I, the modeled volume controlled during the 1984 storm event period is higher than modeled flow noted in KC TM 600.5 (Scenario 5). The amount of storage available for the rain gardens is also higher for Scenarios 1-4 compared to Scenario 5. For reference, we have included the planning construction cost estimates for each scenario. See TM 600.6 for assumptions on construction costs. See the Appendix in this Addendum for calculations related to volume.

### **Summary and Options for Implementation**

The sizing of rain gardens and number of rain gardens within a CSO basin requires a different approach than when sizing a central storage facility downstream. Typically when sizing a central storage facility, flow only needs to be monitored at one or two locations in close proximity to where the central facility will be located. However, when it comes to rain gardens that are spread across a large basin, the amount of flow going to each of the rain gardens will affect each rain garden's performance and sizing.

In our analysis reported in TM 600.6, we estimated the number of half blocks and type of rain gardens that would be required for this planning phase. The overall capital construction costs for the various scenarios were estimated to be within 15-percent of each other (\$10.2 Million to \$11.9 Million). However, the number of half blocks (see Footnote 1 in Table A2-I) requiring implementation varied from 32 (with a high degree of impact, i.e. curb bulbs) to 65 (with a low degree of impact, retrofit within existing planter).

We recommend GSI be implemented within the Barton Basin and additional field data and flow monitoring be collected before designing the rain gardens in the next design phase. Along with the recommendations in TM 600.6, we would recommend that KC identify how much area actually drains to the public right-of-way and into the CSS, such as:

- Conduct smoke/dye testing to determine the number of downspouts that are disconnected which could then contribute to sheet flow off the parcel and into the ROW with a CSS during heavy rains.
- Install flow monitoring at catch basins before implementation of GSI for several of the blocks in order to gather data and compare the estimated modeling results for flow off a block verses reported field monitoring.

By gathering this additional field information, the County would then be able to better calibrate the models with field conditions at the block scale and determine the number of rain gardens and size required. The following are two options for implementation of GSI in the Barton Basin:



*Implementation Option A - Grey Option with GSI prototype*

If gathering field flow information at each of the blocks in the project study area is not feasible, then we would recommend KC install prototype rain gardens in the right-of-way on two housing blocks with varying conditions and monitor the before and after performance of GSI. This information can then be used to evaluate the efficacy of applying the rain gardens to a large scale project area. We recommend that this option also install a storage tank downstream to meet Ecology's CSO control requirements. The information gathered from the block scale monitoring of the rain gardens could then be used for applying GSI to other King County basins.

*Implementation Option B – Maximize GSI and Monitor:*

A second option would be to construct the rain gardens on all the feasible streets identified in Figure 2C of TM 600.6. The high/most feasible streets and moderate feasible streets are identified in dark to medium green, respectively, in Figure 2C. These streets have approximately 5% or less slope with an approximate existing 10-foot planter width available for retrofit. During the design phase of the project, GSI would at a minimum be applied to all high /most feasible streets, and then the next level of feasible streets (moderate) would also be considered for implementation of rain gardens as needed. The number of high/most feasible streets (34 N/S and 22 E/W) plus the moderate feasible streets (13 N/S and 4 E/W) is comparable in area to the number of streets that were modeled under Scenario 2, which referenced 32 half blocks for a planning construction cost estimate of \$10.2 million.

We recommend that the County proceed with Option B for implementing GSI. This option also includes collecting additional field data and conducting flow monitoring before designing the rain gardens in order to better calibrate the model, adjust modeling assumptions, and optimize the size of the rain gardens while balancing the impacts to parking. In addition we recommend that the project use a suitable model for designing GSI within the basin. A model such as EPA-SWMM that is capable of block scale analysis and routing of stormwater through each GSI element.

**Enclosure:** Appendix

**Reference:**

- Technical Memorandum 600.6 – GSI Planning and Analysis Confirmation, initially issued May 13, 2010 with follow-up revisions dated June 22, 2010.
- Addendum to Technical Memorandum 600.6 – Sensitivity Analysis for GSI alternative modeling, issued May 27, 2010.



**King County CSO**  
**Barton Basin Subbasin 416 - GSI Option**  
SVR Project No. 06053  
DATE: 06/14/2010

**RAIN GARDEN SYSTEM COMPONENTS**

Infiltration Rate into Native Subgrade (in/hr)	0.50
<b>SECTION 01 RG</b>	1.5 25.00 2.00% (biosoil depth/lf/slope)
Number of Section 1 Rain Gardens for Basin (ea)	0
Total Infiltration Area for Section 1 Rain Gardens (sf)*	0
Storage Capacity for a single Section 1 Rain Garden (cf)	88
Total Storage Capacity for Section 1 Rain Gardens (cf)	0
<b>SECTION 02 RG</b>	1.5 42 2.00% (biosoil depth/lf/slope)
Number of Section 2 Rain Gardens for Basin (ea)	12
Total Infiltration Area for Section 2 Rain Gardens (sf)*	2890
Storage Capacity for a single Section 2 Rain Garden (cf)	232
Total Storage Capacity for Section 2 Rain Gardens (cf)	2782
<b>SECTION 03 RG</b>	1.5 42 2.00% (biosoil depth/lf/slope)
Number of Section 3 Rain Gardens for Basin (ea)	0
Total Infiltration Area for Section 3 Rain Gardens (sf)*	0
Storage Capacity for a single Section 3 Rain Garden (cf)	451
Total Storage Capacity for Section 3 Rain Gardens (cf)	0

**CONVERSION FACTORS**

conversion factor from cf to gallons	7.48
conversion factor from cfs to MGD:	0.6452
conversion factor from cfs to cf/per time step:	600

**RESULTS SUMMARY**

volume controlled from 10:00 on 11/01/84 to 10:00 on 11/02/84	4,155	(cf per GSI half block)
	31,080	(gal per GSI half block)
<hr/>		
Total volume of runoff removed from 9:30 to 9:50 of the 1984 storm	3,467	(gal per GSI half block)
<hr/>		
Number of half blocks modified with GSI	65	
volume controlled during 9:30 to 9:50 on 11/02/84 (gal)	225,373	
volume of rain gardens in subbasin 416 (gal)	1,352,568	
flow reduction at peak (MGD)	14.6	
volume controlled from 10:00 on 11/01/84 to 10:00 on 11/02/84 (gal)	2,020,211	

Rainfall Distribution: 1984 Storm

**RAIN GARDEN SYSTEM SUMMARY**

Total Infiltration Flow (cfs)	0.0334
Total Swale Storage Capacity (cf)	2781.9

Target flow reduction from subbasin 416 (MGD) **14.6** per John Phillips  
Flow reduction from assumed half block at peak flow (MGD) 0.224952925  
Half blocks needed to get total flow reduction out of subbasin 416 **64.9** → **65**

Time (hours)	Time (minutes)	Design Flow Rate from Rain Event (cfs)	Inflow Water Volume (cf)	Inflow Cumm. Volume (cf)	Check if inflow infiltrates Initial Exfiltration to Native Subgrade of Inflow (cfs)	Check if storage infiltrates Infiltration into Native Subgrade of Stored Water (cfs)	Total Infiltration into Native Subgrade (cfs)	Inflow to Swale After Infiltration into Native Subgrade (cfs)	Swale Storage before Overflow Volume (cf)	Overtop Flow to Pump Station (cfs)	Runoff Stored in Swale Storage Volume (cf)	Volume of Runoff Removed From Pump Station (cf)	Date & Time	Amount Flow Reduced to Pump Station (cfs)	Amount Flow Reduced to Pump Station (MGD)
0	0	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0			
0.17	10	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:00	0.000	
0.33	20	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:10	0.000	
0.50	30	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:20	0.000	
0.67	40	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:30	0.000	
0.83	50	0.003	1.90	1.90	0.0032	0.0000	0.0032	0.0000	0.00	0.00	0.00	1.900626807	11/1/1984 10:40	0.003	
1.00	60	0.009	5.61	7.51	0.0093	0.0000	0.0093	0.0000	0.00	0.00	0.00	5.605567335	11/1/1984 10:50	0.009	
1.17	70	0.015	9.09	16.59	0.0151	0.0000	0.0151	0.0000	0.00	0.00	0.00	9.085690673	11/1/1984 11:00	0.015	
1.33	80	0.020	12.17	28.77	0.0203	0.0000	0.0203	0.0000	0.00	0.00	0.00	12.17466638	11/1/1984 11:10	0.020	
1.50	90	0.030	17.81	46.58	0.0297	0.0000	0.0297	0.0000	0.00	0.00	0.00	17.8143958	11/1/1984 11:20	0.030	
1.67	100	0.035	21.20	67.78	0.0334	0.0000	0.0334	0.0019	1.13	0.00	1.13	21.19743158	11/1/1984 11:30	0.035	
1.83	110	0.034	20.50	88.28	0.0334	0.0000	0.0334	0.0007	1.56	0.00	1.56	20.50300898	11/1/1984 11:40	0.034	
2.00	120	0.035	21.06	109.35	0.0334	0.0000	0.0334	0.0017	2.56	0.00	2.56	21.06473615	11/1/1984 11:50	0.035	
2.17	130	0.030	18.09	127.43	0.0301	0.0033	0.0334	0.0000	0.57	0.00	0.57	18.08536098	11/1/1984 12:00	0.030	
2.33	140	0.029	17.54	144.97	0.0292	0.0042	0.0334	0.0000	-1.96	0.00	0.00	17.53865912	11/1/1984 12:10	0.029	
2.50	150	0.043	25.66	170.63	0.0334	0.0000	0.0334	0.0093	5.59	0.00	5.59	25.6553555	11/1/1984 12:20	0.043	
2.67	160	0.055	33.13	203.76	0.0334	0.0000	0.0334	0.0218	18.65	0.00	18.65	33.13403255	11/1/1984 12:30	0.055	
2.83	170	0.061	36.48	240.24	0.0334	0.0000	0.0334	0.0273	35.06	0.00	35.06	36.47754794	11/1/1984 12:40	0.061	
3.00	180	0.080	47.78	288.01	0.0334	0.0000	0.0334	0.0462	62.77	0.00	62.77	47.77688775	11/1/1984 12:50	0.080	
3.17	190	0.080	48.09	336.10	0.0334	0.0000	0.0334	0.0467	90.78	0.00	90.78	48.08714279	11/1/1984 13:00	0.080	
3.33	200	0.075	44.98	381.08	0.0334	0.0000	0.0334	0.0415	115.70	0.00	115.70	44.98314287	11/1/1984 13:10	0.075	
3.50	210	0.100	59.81	440.89	0.0334	0.0000	0.0334	0.0662	155.44	0.00	155.44	59.81060881	11/1/1984 13:20	0.100	
3.67	220	0.110	66.19	507.08	0.0334	0.0000	0.0334	0.0769	201.56	0.00	201.56	66.18986175	11/1/1984 13:30	0.110	
3.83	230	0.107	64.45	571.54	0.0334	0.0000	0.0334	0.0740	245.94	0.00	245.94	64.45468198	11/1/1984 13:40	0.107	
4.00	240	0.108	64.89	636.43	0.0334	0.0000	0.0334	0.0747	290.76	0.00	290.76	64.88628415	11/1/1984 13:50	0.108	
4.17	250	0.101	60.31	696.74	0.0334	0.0000	0.0334	0.0671	331.00	0.00	331.00	60.31248582	11/1/1984 14:00	0.101	
4.33	260	0.080	48.14	744.88	0.0334	0.0000	0.0334	0.0468	359.07	0.00	359.07	48.13781342	11/1/1984 14:10	0.080	
4.50	270	0.065	38.72	783.60	0.0334	0.0000	0.0334	0.0311	377.73	0.00	377.73	38.72385189	11/1/1984 14:20	0.065	
4.67	280	0.060	35.78	819.38	0.0334	0.0000	0.0334	0.0262	393.43	0.00	393.43	35.77643213	11/1/1984 14:30	0.060	
4.83	290	0.078	46.63	866.01	0.0334	0.0000	0.0334	0.0443	420.00	0.00	420.00	46.63284372	11/1/1984 14:40	0.078	
5.00	300	0.094	56.41	922.42	0.0334	0.0000	0.0334	0.0606	456.34	0.00	456.34	56.40882598	11/1/1984 14:50	0.094	
5.17	310	0.100	60.23	982.65	0.0334	0.0000	0.0334	0.0669	496.50	0.00	496.50	60.22934692	11/1/1984 15:00	0.100	
5.33	320	0.113	67.94	1050.59	0.0334	0.0000	0.0334	0.0798	544.37	0.00	544.37	67.94245789	11/1/1984 15:10	0.113	
5.50	330	0.118	71.07	1121.66	0.0334	0.0000	0.0334	0.0850	595.37	0.00	595.37	71.07203902	11/1/1984 15:20	0.118	
5.67	340	0.111	66.46	1188.13	0.0334	0.0000	0.0334	0.0773	641.77	0.00	641.77	66.46357161	11/1/1984 15:30	0.111	
5.83	350	0.109	65.36	1253.48	0.0334	0.0000	0.0334	0.0755	687.05	0.00	687.05	65.35638515	11/1/1984 15:40	0.109	
6.00	360	0.109	65.29	1318.77	0.0334	0.0000	0.0334	0.0754	732.27	0.00	732.27	65.2909189	11/1/1984 15:50	0.109	
6.17	370	0.088	53.05	1371.82	0.0334	0.0000	0.0334	0.0550	765.25	0.00	765.25	53.04664664	11/1/1984 16:00	0.088	
6.33	380	0.061	36.53	1408.35	0.0334	0.0000	0.0334	0.0274	781.71	0.00	781.71	36.53184299	11/1/1984 16:10	0.061	
6.50	390	0.041	24.78	1433.13	0.0334	0.0000	0.0334	0.0079	786.43	0.00	786.43	24.7824167	11/1/1984 16:20	0.041	
6.67	400	0.035	20.89	1454.02	0.0334	0.0000	0.0334	0.0014	787.25	0.00	787.25	20.89120721	11/1/1984 16:30	0.035	
6.83	410	0.022	13.29	1467.31	0.0221	0.0113	0.0334	0.0000	780.46	0.00	780.46	13.28520482	11/1/1984 16:40	0.022	
7.00	420	0.007	4.43	1471.74	0.0074	0.0261	0.0334	0.0000	764.82	0.00	764.82	4.428401606	11/1/1984 16:50	0.007	
7.17	430	0.013	7.81	1479.55	0.0130	0.0204	0.0334	0.0000	752.56	0.00	752.56	7.809950826	11/1/1984 17:00	0.013	
7.33	440	0.015	8.94	1488.49	0.0149	0.0186	0.0334	0.0000	741.43	0.00	741.43	8.9371339	11/1/1984 17:10	0.015	
7.50	450	0.005	2.98	1491.46	0.0050	0.0285	0.0334	0.0000	724.34	0.00	724.34	2.979044633	11/1/1984 17:20	0.005	
7.67	460	0.002	0.99	1492.46	0.0017	0.0318	0.0334	0.0000	705.27	0.00	705.27	0.993014878	11/1/1984 17:30	0.002	



7.83	470	0.001	0.33	1492.79	0.0006	0.0329	0.0334	0.0000	685.53	0.00	685.53	0.331004959	11/1/1984 17:40	0.001
8.00	480	0.021	12.81	1505.60	0.0214	0.0121	0.0334	0.0000	678.27	0.00	678.27	12.81427851	11/1/1984 17:50	0.021
8.17	490	0.050	29.73	1535.33	0.0334	0.0000	0.0334	0.0161	687.93	0.00	687.93	29.72654198	11/1/1984 18:00	0.050
8.33	500	0.059	35.46	1570.79	0.0334	0.0000	0.0334	0.0256	703.32	0.00	703.32	35.45705237	11/1/1984 18:10	0.059
8.50	510	0.062	37.46	1608.24	0.0334	0.0000	0.0334	0.0290	720.70	0.00	720.70	37.45763197	11/1/1984 18:20	0.062
8.67	520	0.074	44.67	1652.91	0.0334	0.0000	0.0334	0.0410	745.31	0.00	745.31	44.67062384	11/1/1984 18:30	0.074
8.83	530	0.089	53.67	1706.58	0.0334	0.0000	0.0334	0.0560	778.91	0.00	778.91	53.66992088	11/1/1984 18:40	0.089
9.00	540	0.095	56.85	1763.44	0.0334	0.0000	0.0334	0.0613	815.69	0.00	815.69	56.85265588	11/1/1984 18:50	0.095
9.17	550	0.097	58.09	1821.53	0.0334	0.0000	0.0334	0.0634	853.71	0.00	853.71	58.08915945	11/1/1984 19:00	0.097
9.33	560	0.109	65.25	1886.78	0.0334	0.0000	0.0334	0.0753	898.89	0.00	898.89	65.25268773	11/1/1984 19:10	0.109
9.50	570	0.080	48.03	1934.81	0.0334	0.0000	0.0334	0.0466	926.85	0.00	926.85	48.0283904	11/1/1984 19:20	0.080
9.67	580	0.049	29.20	1964.01	0.0334	0.0000	0.0334	0.0152	935.98	0.00	935.98	29.20093819	11/1/1984 19:30	0.049
9.83	590	0.049	29.53	1993.54	0.0334	0.0000	0.0334	0.0158	945.45	0.00	945.45	29.53364677	11/1/1984 19:40	0.049
10.00	600	0.038	23.07	2016.61	0.0334	0.0000	0.0334	0.0050	948.45	0.00	948.45	23.06998223	11/1/1984 19:50	0.038
10.17	610	0.024	14.31	2030.92	0.0238	0.0096	0.0334	0.0000	942.68	0.00	942.68	14.3069014	11/1/1984 20:00	0.024
10.33	620	0.019	11.39	2042.31	0.0190	0.0145	0.0334	0.0000	934.01	0.00	934.01	11.3941499	11/1/1984 20:10	0.019
10.50	630	0.051	30.35	2072.66	0.0334	0.0000	0.0334	0.0171	944.29	0.00	944.29	30.34740281	11/1/1984 20:20	0.051
10.67	640	0.072	43.36	2116.02	0.0334	0.0000	0.0334	0.0388	967.58	0.00	967.58	43.36226966	11/1/1984 20:30	0.072
10.83	650	0.057	34.45	2150.47	0.0334	0.0000	0.0334	0.0240	981.96	0.00	981.96	34.44910265	11/1/1984 20:40	0.057
11.00	660	0.030	18.16	2168.63	0.0303	0.0032	0.0334	0.0000	980.05	0.00	980.05	18.15574833	11/1/1984 20:50	0.030
11.17	670	0.021	12.73	2181.36	0.0212	0.0122	0.0334	0.0000	972.71	0.00	972.71	12.73221472	11/1/1984 21:00	0.021
11.33	680	0.018	10.92	2192.28	0.0182	0.0152	0.0334	0.0000	963.56	0.00	963.56	10.92437018	11/1/1984 21:10	0.018
11.50	690	0.006	3.64	2195.93	0.0061	0.0274	0.0334	0.0000	947.14	0.00	947.14	3.641456727	11/1/1984 21:20	0.006
11.67	700	0.013	7.90	2203.83	0.0132	0.0203	0.0334	0.0000	934.97	0.00	934.97	7.90161	11/1/1984 21:30	0.013
11.83	710	0.027	16.02	2219.84	0.0267	0.0068	0.0334	0.0000	930.92	0.00	930.92	16.01685421	11/1/1984 21:40	0.027
12.00	720	0.020	12.03	2231.88	0.0201	0.0134	0.0334	0.0000	922.88	0.00	922.88	12.03414452	11/1/1984 21:50	0.020
12.17	730	0.018	10.71	2242.59	0.0179	0.0156	0.0334	0.0000	913.52	0.00	913.52	10.71388771	11/1/1984 22:00	0.018
12.33	740	0.017	10.27	2252.87	0.0171	0.0163	0.0334	0.0000	903.73	0.00	903.73	10.27380211	11/1/1984 22:10	0.017
12.50	750	0.006	3.42	2256.29	0.0057	0.0277	0.0334	0.0000	887.08	0.00	887.08	3.424600704	11/1/1984 22:20	0.006
12.67	760	0.002	1.14	2257.43	0.0019	0.0315	0.0334	0.0000	868.16	0.00	868.16	1.141533568	11/1/1984 22:30	0.002
12.83	770	0.001	0.38	2257.81	0.0006	0.0328	0.0334	0.0000	848.47	0.00	848.47	0.380511189	11/1/1984 22:40	0.001
13.00	780	0.000	0.13	2257.94	0.0002	0.0332	0.0334	0.0000	828.52	0.00	828.52	0.126837063	11/1/1984 22:50	0.000
13.17	790	0.000	0.04	2257.98	0.0001	0.0334	0.0334	0.0000	808.50	0.00	808.50	0.042279021	11/1/1984 23:00	0.000
13.33	800	0.011	6.72	2264.71	0.0112	0.0222	0.0334	0.0000	795.15	0.00	795.15	6.723824864	11/1/1984 23:10	0.011
13.50	810	0.026	15.67	2280.37	0.0261	0.0073	0.0334	0.0000	790.75	0.00	790.75	15.66787833	11/1/1984 23:20	0.026
13.67	820	0.031	18.66	2299.04	0.0311	0.0023	0.0334	0.0000	789.34	0.00	789.34	18.66342426	11/1/1984 23:30	0.031
13.83	830	0.022	12.95	2311.98	0.0216	0.0119	0.0334	0.0000	782.22	0.00	782.22	12.94506805	11/1/1984 23:40	0.022
14.00	840	0.007	4.32	2316.30	0.0072	0.0263	0.0334	0.0000	766.47	0.00	766.47	4.315022683	11/1/1984 23:50	0.007
14.17	850	0.002	1.44	2317.74	0.0024	0.0311	0.0334	0.0000	747.83	0.00	747.83	1.438340894	11/2/1984 0:00	0.002
14.33	860	0.001	0.48	2318.21	0.0008	0.0326	0.0334	0.0000	728.24	0.00	728.24	0.479446965	11/2/1984 0:10	0.001
14.50	870	0.000	0.16	2318.37	0.0003	0.0332	0.0334	0.0000	708.33	0.00	708.33	0.159815655	11/2/1984 0:20	0.000
14.67	880	0.000	0.05	2318.43	0.0001	0.0334	0.0334	0.0000	688.32	0.00	688.32	0.053271885	11/2/1984 0:30	0.000
14.83	890	0.011	6.75	2325.18	0.0112	0.0222	0.0334	0.0000	675.00	0.00	675.00	6.748655864	11/2/1984 0:40	0.011
15.00	900	0.026	15.72	2340.89	0.0262	0.0073	0.0334	0.0000	670.65	0.00	670.65	15.71823923	11/2/1984 0:50	0.026
15.17	910	0.031	18.72	2359.62	0.0312	0.0022	0.0334	0.0000	669.30	0.00	669.30	18.72180016	11/2/1984 1:00	0.031
15.33	920	0.022	12.99	2372.60	0.0216	0.0118	0.0334	0.0000	662.21	0.00	662.21	12.98519843	11/2/1984 1:10	0.022
15.50	930	0.018	11.08	2383.68	0.0185	0.0150	0.0334	0.0000	653.23	0.00	653.23	11.07972836	11/2/1984 1:20	0.018
15.67	940	0.029	17.20	2400.88	0.0287	0.0048	0.0334	0.0000	650.36	0.00	650.36	17.20255319	11/2/1984 1:30	0.029
15.83	950	0.021	12.49	2413.38	0.0208	0.0126	0.0334	0.0000	642.78	0.00	642.78	12.49216591	11/2/1984 1:40	0.021
16.00	960	0.007	4.16	2417.54	0.0069	0.0265	0.0334	0.0000	626.88	0.00	626.88	4.164055302	11/2/1984 1:50	0.007
16.17	970	0.002	1.39	2418.93	0.0023	0.0311	0.0334	0.0000	608.19	0.00	608.19	1.388018434	11/2/1984 2:00	0.002
16.33	980	0.001	0.46	2419.39	0.0008	0.0327	0.0334	0.0000	588.59	0.00	588.59	0.462672811	11/2/1984 2:10	0.001
16.50	990	0.000	0.15	2419.55	0.0003	0.0332	0.0334	0.0000	568.67	0.00	568.67	0.15422427	11/2/1984 2:20	0.000
16.67	1000	0.011	6.82	2426.36	0.0114	0.0221	0.0334	0.0000	555.42	0.00	555.42	6.81596559	11/2/1984 2:30	0.011
16.83	1010	0.015	9.04	2435.40	0.0151	0.0184	0.0334	0.0000	544.39	0.00	544.39	9.03654603	11/2/1984 2:40	0.015
17.00	1020	0.005	3.01	2438.41	0.0050	0.0284	0.0334	0.0000	527.33	0.00	527.33	3.01218201	11/2/1984 2:50	0.005
17.17	1030	0.036	21.34	2459.75	0.0334	0.0000	0.0334	0.0021	528.60	0.00	528.60	21.33644097	11/2/1984 3:00	0.036
17.33	1040	0.057	34.23	2493.98	0.0334	0.0000	0.0334	0.0236	542.76	0.00	542.76	34.2346465	11/2/1984 3:10	0.057
17.50	1050	0.064	38.61	2532.59	0.0334	0.0000	0.0334	0.0309	561.30	0.00	561.30	38.60901216	11/2/1984 3:20	0.064
17.67	1060	0.090	53.74	2586.33	0.0334	0.0000	0.0334	0.0561	594.97	0.00	594.97	53.73840931	11/2/1984 3:30	0.090
17.83	1070	0.087	52.04	2638.37	0.0334	0.0000	0.0334	0.0533	626.94	0.00	626.94	52.04427864	11/2/1984 3:40	0.087
18.00	1080	0.086	51.57	2689.94	0.0334	0.0000	0.0334	0.0525	658.44	0.00	658.44	51.56576199	11/2/1984 3:50	0.086
18.17	1090	0.086	51.46	2741.40	0.0334	0.0000	0.0334	0.0523	689.83	0.00	689.83	51.46217019	11/2/1984 4:00	0.086
18.33	1100	0.063	37.75	2779.15	0.0334	0.0000	0.0334	0.0295	707.51	0.00	707.51	37.75115306	11/2/1984 4:10	0.063
18.50	1110	0.032	19.45	2798.61	0.0324	0.0010	0.0334	0.0000	706.90	0.00	706.90	19.4548192	11/2/1984 4:20	0.032
18.67	1120	0.011	6.48	2805.09	0.0108	0.0226	0.0334	0.0000	693.32	0.00	693.32	6.484939734	11/2/1984 4:30	0.011
18.83	1130	0.015	9.04	2814.13	0.0151	0.0184	0.0334	0.0000	682.28	0.00	682.28	9.038074298	11/2/1984 4:40	0.015
19.00	1140	0.016	9.89	2824.02	0.0165	0.0170	0.0334	0.0000	672.10	0.00	672.10	9.889119152	11/2/1984 4:50	0.016
19.17	1150	0.005	3.30	2827.32	0.0055	0.0280	0.0334	0.0000	655.33	0.00	655.33	3.296373051	11/2/1984 5:00	0.005
19.33	1160	0.002	1.10	2828.41	0.0018	0.0316	0.0334	0.0000	636.36	0.00	636.36	1.098791017	11/2/1984 5:10	0.002
19.50	1170	0.081	48.65	287										



20.83	1250	0.034	20.63	3129.90	0.0334	0.0000	0.0334	0.0009	757.22	0.00	757.22	20.62893067	11/2/1984 6:40	0.034	
21.00	1260	0.023	13.83	3143.73	0.0231	0.0104	0.0334	0.0000	750.98	0.00	750.98	13.83081518	11/2/1984 6:50	0.023	
21.17	1270	0.031	18.52	3162.25	0.0309	0.0026	0.0334	0.0000	749.43	0.00	749.43	18.52375145	11/2/1984 7:00	0.031	
21.33	1280	0.068	41.01	3203.26	0.0334	0.0000	0.0334	0.0349	770.38	0.00	770.38	41.01327857	11/2/1984 7:10	0.068	
21.50	1290	0.116	69.50	3272.76	0.0334	0.0000	0.0334	0.0824	819.81	0.00	819.81	69.49861027	11/2/1984 7:20	0.116	
21.67	1300	0.132	79.13	3351.89	0.0334	0.0000	0.0334	0.0984	878.86	0.00	878.86	79.12727626	11/2/1984 7:30	0.132	
21.83	1310	0.114	68.42	3420.31	0.0334	0.0000	0.0334	0.0806	927.21	0.00	927.21	68.41945057	11/2/1984 7:40	0.114	
22.00	1320	0.061	36.84	3457.15	0.0334	0.0000	0.0334	0.0279	943.98	0.00	943.98	36.83689993	11/2/1984 7:50	0.061	
22.17	1330	0.032	19.30	3476.45	0.0322	0.0013	0.0334	0.0000	943.21	0.00	943.21	19.29998862	11/2/1984 8:00	0.032	
22.33	1340	0.022	13.45	3489.90	0.0224	0.0110	0.0334	0.0000	936.60	0.00	936.60	13.45435151	11/2/1984 8:10	0.022	
22.50	1350	0.007	4.48	3494.39	0.0075	0.0260	0.0334	0.0000	921.01	0.00	921.01	4.484783837	11/2/1984 8:20	0.007	
22.67	1360	0.002	1.49	3495.88	0.0025	0.0310	0.0334	0.0000	902.44	0.00	902.44	1.494927946	11/2/1984 8:30	0.002	
22.83	1370	0.001	0.50	3496.38	0.0008	0.0326	0.0334	0.0000	882.87	0.00	882.87	0.498309315	11/2/1984 8:40	0.001	
23.00	1380	0.024	14.22	3510.60	0.0237	0.0097	0.0334	0.0000	877.02	0.00	877.02	14.21959294	11/2/1984 8:50	0.024	0.015289885
23.17	1390	0.043	25.83	3536.42	0.0334	0.0000	0.0334	0.0096	882.77	0.00	882.77	25.82575075	11/2/1984 9:00	0.043	0.027769624
23.33	1400	0.026	15.64	3552.06	0.0261	0.0074	0.0334	0.0000	878.34	0.00	878.34	15.64098018	11/2/1984 9:10	0.026	0.016818258
23.50	1410	0.232	139.50	3691.56	0.0334	0.0000	0.0334	0.1990	997.77	0.00	997.77	139.4988459	11/2/1984 9:20	0.232	0.149998759
23.67	1420	0.349	209.21	3900.77	0.0334	0.0000	0.0334	0.3152	1186.91	0.00	1186.91	209.2062202	11/2/1984 9:30	0.349	0.224952925
23.83	1430	0.247	148.01	4048.78	0.0334	0.0000	0.0334	0.2132	1314.85	0.00	1314.85	148.0098299	11/2/1984 9:40	0.247	0.159150355
24.00	1440	0.177	106.32	4155.10	0.0334	0.0000	0.0334	0.1438	1401.10	0.00	1401.10	106.3230673	11/2/1984 9:50	0.177	0.114325879
24.17	1450	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1381.04	0.00	1381.04	0	11/2/1984 10:00	0.000	
24.33	1460	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1360.97	0.00	1360.97	0	11/2/1984 10:10	0.000	
24.50	1470	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1340.90	0.00	1340.90	0	11/2/1984 10:20	0.000	
24.67	1480	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1320.83	0.00	1320.83	0	11/2/1984 10:30	0.000	
24.83	1490	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1300.76	0.00	1300.76	0	11/2/1984 10:40	0.000	
25.00	1500	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1280.69	0.00	1280.69	0	11/2/1984 10:50	0.000	
25.17	1510	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1260.62	0.00	1260.62	0	11/2/1984 11:00	0.000	
25.33	1520	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1240.55	0.00	1240.55	0	11/2/1984 11:10	0.000	
25.50	1530	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1220.48	0.00	1220.48	0	11/2/1984 11:20	0.000	
25.67	1540	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1200.41	0.00	1200.41	0	11/2/1984 11:30	0.000	
25.83	1550	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1180.34	0.00	1180.34	0	11/2/1984 11:40	0.000	
26.00	1560	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1160.27	0.00	1160.27	0	11/2/1984 11:50	0.000	
26.17	1570	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1140.20	0.00	1140.20	0	11/2/1984 12:00	0.000	
26.33	1580	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1120.13	0.00	1120.13	0	11/2/1984 12:10	0.000	
26.50	1590	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1100.06	0.00	1100.06	0	11/2/1984 12:20	0.000	
26.67	1600	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1079.99	0.00	1079.99	0	11/2/1984 12:30	0.000	
26.83	1610	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1059.92	0.00	1059.92	0	11/2/1984 12:40	0.000	
27.00	1620	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1039.85	0.00	1039.85	0	11/2/1984 12:50	0.000	
27.17	1630	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	1019.79	0.00	1019.79	0	11/2/1984 13:00	0.000	
27.33	1640	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	999.72	0.00	999.72	0	11/2/1984 13:10	0.000	
27.50	1650	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	979.65	0.00	979.65	0	11/2/1984 13:20	0.000	
27.67	1660	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	959.58	0.00	959.58	0	11/2/1984 13:30	0.000	
27.83	1670	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	939.51	0.00	939.51	0	11/2/1984 13:40	0.000	
28.00	1680	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	919.44	0.00	919.44	0	11/2/1984 13:50	0.000	
28.17	1690	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	899.37	0.00	899.37	0	11/2/1984 14:00	0.000	
28.33	1700	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	879.30	0.00	879.30	0	11/2/1984 14:10	0.000	
28.50	1710	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	859.23	0.00	859.23	0	11/2/1984 14:20	0.000	
28.67	1720	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	839.16	0.00	839.16	0	11/2/1984 14:30	0.000	
28.83	1730	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	819.09	0.00	819.09	0	11/2/1984 14:40	0.000	
29.00	1740	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	799.02	0.00	799.02	0	11/2/1984 14:50	0.000	
29.17	1750	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	778.95	0.00	778.95	0	11/2/1984 15:00	0.000	
29.33	1760	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	758.88	0.00	758.88	0	11/2/1984 15:10	0.000	
29.50	1770	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	738.81	0.00	738.81	0	11/2/1984 15:20	0.000	
29.67	1780	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	718.74	0.00	718.74	0	11/2/1984 15:30	0.000	
29.83	1790	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	698.67	0.00	698.67	0	11/2/1984 15:40	0.000	
30.00	1800	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	678.60	0.00	678.60	0	11/2/1984 15:50	0.000	
30.17	1810	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	658.54	0.00	658.54	0	11/2/1984 16:00	0.000	
30.33	1820	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	638.47	0.00	638.47	0	11/2/1984 16:10	0.000	
30.50	1830	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	618.40	0.00	618.40	0	11/2/1984 16:20	0.000	
30.67	1840	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	598.33	0.00	598.33	0	11/2/1984 16:30	0.000	
30.83	1850	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	578.26	0.00	578.26	0	11/2/1984 16:40	0.000	
31.00	1860	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	558.19	0.00	558.19	0	11/2/1984 16:50	0.000	
31.17	1870	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	538.12	0.00	538.12	0	11/2/1984 17:00	0.000	
31.33	1880	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	518.05	0.00	518.05	0	11/2/1984 17:10	0.000	
31.50	1890	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	497.98	0.00	497.98	0	11/2/1984 17:20	0.000	
31.67	1900	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	477.91	0.00	477.91	0	11/2/1984 17:30	0.000	
31.83	1910	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	457.84	0.00	457.84	0	11/2/1984 17:40	0.000	
32.00	1920	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	437.77	0.00	437.77	0	11/2/1984 17:50	0.000	
32.17	1930	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	417.70	0.00	417.70	0	11/2/1984 18:00	0.000	
32.33	1940	0.000	0.00	4155.10	0.0000	0.0334	0.0334	0.0000	397.63	0.00	397.63	0	11/2/1984 18:10	0.000	
32.50	1950	0.000	0.00	4155.10	0.0000	0									







46.83	2810	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
47.00	2820	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
47.16	2830	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
47.33	2840	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
47.50	2850	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
47.66	2860	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
47.83	2870	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.00	2880	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.16	2890	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.33	2900	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.50	2910	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.66	2920	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.83	2930	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.00	2940	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.16	2950	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.33	2960	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.50	2970	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.66	2980	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.83	2990	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.00	3000	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.16	3010	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.33	3020	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.50	3030	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.66	3040	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.83	3050	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
51.00	3060	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
51.16	3070	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000





**King County CSO  
Barton Basin Subbasin 416 - GSI Option**

SvR Project No. 06053

DATE: 06/14/2010

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**RAIN GARDEN SYSTEM COMPONENTS**

Infiltration Rate into Native Subgrade (in/hr)				<b>0.50</b>
<b>SECTION 01 RG</b>	1.5	16.67	3.00% (biosoil depth/lf/slope)	
Number of Section 1 Rain Gardens for Basin (ea)				<b>0</b>
Total Infiltration Area for Section 1 Rain Gardens (sf)*				0
Storage Capacity for a single Section 1 Rain Garden (cf)				59
Total Storage Capacity for Section 1 Rain Gardens (cf)				0
<b>SECTION 02 RG</b>	1.5	42	2.00% (biosoil depth/lf/slope)	
Number of Section 2 Rain Gardens for Basin (ea)				<b>0</b>
Total Infiltration Area for Section 2 Rain Gardens (sf)*				0
Storage Capacity for a single Section 2 Rain Garden (cf)				232
Total Storage Capacity for Section 2 Rain Gardens (cf)				0
<b>SECTION 03 RG</b>	1.5	28	3.00% (biosoil depth/lf/slope)	
Number of Section 3 Rain Gardens for Basin (ea)				<b>13</b>
Total Infiltration Area for Section 3 Rain Gardens (sf)*				3954
Storage Capacity for a single Section 3 Rain Garden (cf)				301
Total Storage Capacity for Section 3 Rain Gardens (cf)				3907

**CONVERSION FACTORS**

conversion factor from cf to gallons	7.48
conversion factor from cfs to MGD:	0.6452
conversion factor from cfs to cf/per time step:	600

**RESULTS SUMMARY**

volume controlled from 10:00 on 11/01/84 to 10:00 on 11/02/84	7,620	(cf per GSI half block)
	56,997	(gal per GSI half block)
<hr/>		
Total volume of runoff removed from 9:30 to 9:50 of the 1984 storm	3,369	(gal per GSI half block)
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Assumed Half blocks to modify with GSI	35.0	
volume controlled during 9:30 to 9:50 on 11/02/84 (gal)	117,928	
volume of rain gardens in subbasin 416 (gal)	1,022,892	
flow reduction at peak (MGD)	14.9	
volume controlled from 10:00 on 11/01/84 to 10:00 on 11/02/84 (gal)	1,994,903	

**Scenario 2 is the average  
of 3a and 3b results**

**Rainfall Distribution: 1984 Storm**

**RAIN GARDEN SYSTEM SUMMARY**

Total Infiltration Flow (cfs)	0.0458
Total Swale Storage Capacity (cf)	3907.2

Target flow reduction from subbasin 416 (MGD)	<b>14.6</b>	per John Phillips
Flow reduction from assumed half block at peak flow(MGD)	0.425305755	
Half blocks needed to get total flow reduction out of subbasin 416	34.3	→ 35

**3a/3b Average = 32**

Time (hours)	Time (minutes)	Design Flow Rate from Rain Event (cfs)	Inflow Water Volume (cf)	Inflow Cumm. Volume (cf)	Check if inflow infiltrates Initial Exfiltration to Native Subgrade of Inflow (cfs)	Check if storage infiltrates Infiltration into Native Subgrade of Stored Water (cfs)	Total Infiltration into Native Subgrade (cfs)	Inflow to Swale After Infiltration into Native Subgrade (cfs)	Swale Storage before Overflow Volume (cf)	Overtop Flow to Pump Station (cfs)	Runoff Stored in Swale Storage Volume (cf)	Volume of Runoff Removed From Pump Station (cf)	Date & Time	Amount Flow Reduced to Pump Station (cfs)	Amount Flow Reduced to Pump Station (MGD)
0	0	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0			
0.17	10	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:00	0.000	
0.33	20	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:10	0.000	
0.50	30	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:20	0.000	
0.67	40	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:30	0.000	
0.83	50	0.003	1.90	1.90	0.0032	0.0000	0.0032	0.0000	0.00	0.00	0.00	1.900626807	11/1/1984 10:40	0.003	
1.00	60	0.009	5.61	7.51	0.0093	0.0000	0.0093	0.0000	0.00	0.00	0.00	5.605567335	11/1/1984 10:50	0.009	
1.17	70	0.015	9.09	16.59	0.0151	0.0000	0.0151	0.0000	0.00	0.00	0.00	9.085690673	11/1/1984 11:00	0.015	
1.33	80	0.020	12.17	28.77	0.0203	0.0000	0.0203	0.0000	0.00	0.00	0.00	12.17466638	11/1/1984 11:10	0.020	
1.50	90	0.030	17.81	46.58	0.0297	0.0000	0.0297	0.0000	0.00	0.00	0.00	17.8143958	11/1/1984 11:20	0.030	
1.67	100	0.035	21.20	67.78	0.0353	0.0000	0.0353	0.0000	0.00	0.00	0.00	21.19743158	11/1/1984 11:30	0.035	
1.83	110	0.034	20.50	88.28	0.0342	0.0000	0.0342	0.0000	0.00	0.00	0.00	20.50300898	11/1/1984 11:40	0.034	
2.00	120	0.035	21.06	109.35	0.0351	0.0000	0.0351	0.0000	0.00	0.00	0.00	21.06473615	11/1/1984 11:50	0.035	
2.17	130	0.030	18.09	127.43	0.0301	0.0000	0.0301	0.0000	0.00	0.00	0.00	18.08536098	11/1/1984 12:00	0.030	
2.33	140	0.029	17.54	144.97	0.0292	0.0000	0.0292	0.0000	0.00	0.00	0.00	17.53865912	11/1/1984 12:10	0.029	
2.50	150	0.043	25.66	170.63	0.0428	0.0000	0.0428	0.0000	0.00	0.00	0.00	25.6553555	11/1/1984 12:20	0.043	
2.67	160	0.055	33.13	203.76	0.0458	0.0000	0.0458	0.0095	5.68	0.00	5.68	33.13403255	11/1/1984 12:30	0.055	
2.83	170	0.061	36.63	240.39	0.0458	0.0000	0.0458	0.0153	14.85	0.00	14.85	36.63065266	11/1/1984 12:40	0.061	
3.00	180	0.085	50.79	291.18	0.0458	0.0000	0.0458	0.0389	38.18	0.00	38.18	50.79371058	11/1/1984 12:50	0.085	
3.17	190	0.090	53.97	345.16	0.0458	0.0000	0.0458	0.0442	64.70	0.00	64.70	53.97339262	11/1/1984 13:00	0.090	
3.33	200	0.091	54.66	399.82	0.0458	0.0000	0.0458	0.0453	91.90	0.00	91.90	54.66401283	11/1/1984 13:10	0.091	
3.50	210	0.131	78.42	478.24	0.0458	0.0000	0.0458	0.0849	142.86	0.00	142.86	78.41902389	11/1/1984 13:20	0.131	
3.67	220	0.153	91.89	570.13	0.0458	0.0000	0.0458	0.1074	207.29	0.00	207.29	91.89092043	11/1/1984 13:30	0.153	
3.83	230	0.157	94.20	664.33	0.0458	0.0000	0.0458	0.1112	274.03	0.00	274.03	94.19797599	11/1/1984 13:40	0.157	
4.00	240	0.165	99.16	763.49	0.0458	0.0000	0.0458	0.1195	345.73	0.00	345.73	99.15660697	11/1/1984 13:50	0.165	
4.17	250	0.159	95.35	858.83	0.0458	0.0000	0.0458	0.1131	413.62	0.00	413.62	95.34640582	11/1/1984 14:00	0.159	
4.33	260	0.130	78.02	936.85	0.0458	0.0000	0.0458	0.0843	464.18	0.00	464.18	78.02086674	11/1/1984 14:10	0.130	
4.50	270	0.107	64.10	1000.96	0.0458	0.0000	0.0458	0.0611	500.83	0.00	500.83	64.10279216	11/1/1984 14:20	0.107	
4.67	280	0.101	60.31	1061.27	0.0458	0.0000	0.0458	0.0548	533.68	0.00	533.68	60.31251706	11/1/1984 14:30	0.101	
4.83	290	0.134	80.35	1141.62	0.0458	0.0000	0.0458	0.0881	586.57	0.00	586.57	80.34751225	11/1/1984 14:40	0.134	
5.00	300	0.165	98.77	1240.38	0.0458	0.0000	0.0458	0.1188	657.88	0.00	657.88	98.76706303	11/1/1984 14:50	0.165	
5.17	310	0.179	107.50	1347.88	0.0458	0.0000	0.0458	0.1334	737.92	0.00	737.92	107.5018434	11/1/1984 15:00	0.179	
5.33	320	0.206	123.51	1471.40	0.0458	0.0000	0.0458	0.1601	833.97	0.00	833.97	123.5106495	11/1/1984 15:10	0.206	
5.50	330	0.219	131.49	1602.89	0.0458	0.0000	0.0458	0.1734	938.01	0.00	938.01	131.4936174	11/1/1984 15:20	0.219	
5.67	340	0.208	124.79	1727.68	0.0458	0.0000	0.0458	0.1622	1035.33	0.00	1035.33	124.7867403	11/1/1984 15:30	0.208	
5.83	350	0.208	124.63	1852.30	0.0458	0.0000	0.0458	0.1619	1132.50	0.00	1132.50	124.6276671	11/1/1984 15:40	0.208	
6.00	360	0.210	126.06	1978.36	0.0458	0.0000	0.0458	0.1643	1231.10	0.00	1231.10	126.0571051	11/1/1984 15:50	0.210	
6.17	370	0.172	103.41	2081.77	0.0458	0.0000	0.0458	0.1266	1307.05	0.00	1307.05	103.4069694	11/1/1984 16:00	0.172	
6.33	380	0.119	71.70	2153.46	0.0458	0.0000	0.0458	0.0737	1351.29	0.00	1351.29	71.69611608	11/1/1984 16:10	0.119	
6.50	390	0.082	48.91	2202.37	0.0458	0.0000	0.0458	0.0358	1372.74	0.00	1372.74	48.90884629	11/1/1984 16:20	0.082	
6.67	400	0.069	41.44	2243.81	0.0458	0.0000	0.0458	0.0233	1386.72	0.00	1386.72	41.43876698	11/1/1984 16:30	0.069	
6.83	410	0.044	26.41	2270.22	0.0440	0.0017	0.0458	0.0000	1385.67	0.00	1385.67	26.41204143	11/1/1984 16:40	0.044	
7.00	420	0.015	8.80	2279.03	0.0147	0.0311	0.0458	0.0000	1367.02	0.00	1367.02	8.80401381	11/1/1984 16:50	0.015	
7.17	430	0.026	15.60	2294.62	0.0260	0.0198	0.0458	0.0000	1355.15	0.00	1355.15	15.59538824	11/1/1984 17:00	0.026	



7.33	440	0.030	17.86	2312.48	0.0298	0.0160	0.0458	0.0000	1345.55	0.00	1345.55	17.85917971	11/1/1984 17:10	0.030	ROW and Private Parcel
7.50	450	0.010	5.95	2318.43	0.0099	0.0358	0.0458	0.0000	1324.05	0.00	1324.05	5.953059904	11/1/1984 17:20	0.010	
7.67	460	0.003	1.98	2320.42	0.0033	0.0425	0.0458	0.0000	1298.57	0.00	1298.57	1.984353301	11/1/1984 17:30	0.003	
7.83	470	0.001	0.66	2321.08	0.0011	0.0447	0.0458	0.0000	1271.78	0.00	1271.78	0.6614511	11/1/1984 17:40	0.001	
8.00	480	0.043	25.72	2346.80	0.0429	0.0029	0.0458	0.0000	1270.04	0.00	1270.04	25.72349642	11/1/1984 17:50	0.043	
8.17	490	0.100	59.82	2406.62	0.0458	0.0000	0.0458	0.0539	1302.40	0.00	1302.40	59.81741393	11/1/1984 18:00	0.100	
8.33	500	0.119	71.65	2478.27	0.0458	0.0000	0.0458	0.0737	1346.59	0.00	1346.59	71.6497663	11/1/1984 18:10	0.119	
8.50	510	0.127	76.05	2554.32	0.0458	0.0000	0.0458	0.0810	1395.18	0.00	1395.18	76.04967545	11/1/1984 18:20	0.127	
8.67	520	0.152	91.25	2645.57	0.0458	0.0000	0.0458	0.1063	1458.97	0.00	1458.97	91.24862698	11/1/1984 18:30	0.152	
8.83	530	0.184	110.30	2755.87	0.0458	0.0000	0.0458	0.1381	1541.81	0.00	1541.81	110.2975133	11/1/1984 18:40	0.184	
9.00	540	0.196	117.58	2873.45	0.0458	0.0000	0.0458	0.1502	1631.93	0.00	1631.93	117.5802183	11/1/1984 18:50	0.196	
9.17	550	0.202	120.91	2994.35	0.0458	0.0000	0.0458	0.1557	1725.38	0.00	1725.38	120.9069794	11/1/1984 19:00	0.202	
9.33	560	0.228	136.81	3131.16	0.0458	0.0000	0.0458	0.1823	1834.73	0.00	1834.73	136.8091982	11/1/1984 19:10	0.228	
9.50	570	0.168	101.03	3232.20	0.0458	0.0000	0.0458	0.1226	1908.30	0.00	1908.30	101.0324817	11/1/1984 19:20	0.168	
9.67	580	0.103	61.66	3293.86	0.0458	0.0000	0.0458	0.0570	1942.51	0.00	1942.51	61.66489707	11/1/1984 19:30	0.103	
9.83	590	0.104	62.60	3356.46	0.0458	0.0000	0.0458	0.0586	1977.65	0.00	1977.65	62.60238865	11/1/1984 19:40	0.104	
10.00	600	0.082	49.03	3405.49	0.0458	0.0000	0.0458	0.0360	1999.23	0.00	1999.23	49.03102999	11/1/1984 19:50	0.082	
10.17	610	0.051	30.45	3435.94	0.0458	0.0000	0.0458	0.0050	2002.21	0.00	2002.21	30.44722397	11/1/1984 20:00	0.051	
10.33	620	0.040	24.30	3460.24	0.0405	0.0053	0.0458	0.0000	1999.05	0.00	1999.05	24.29564605	11/1/1984 20:10	0.040	
10.50	630	0.108	64.94	3525.18	0.0458	0.0000	0.0458	0.0625	2036.53	0.00	2036.53	64.93806144	11/1/1984 20:20	0.108	
10.67	640	0.155	93.01	3618.18	0.0458	0.0000	0.0458	0.1092	2102.08	0.00	2102.08	93.00716016	11/1/1984 20:30	0.155	
10.83	650	0.123	74.07	3692.25	0.0458	0.0000	0.0458	0.0777	2148.69	0.00	2148.69	74.06515819	11/1/1984 20:40	0.123	
11.00	660	0.065	39.08	3731.33	0.0458	0.0000	0.0458	0.0194	2160.31	0.00	2160.31	39.08295923	11/1/1984 20:50	0.065	
11.17	670	0.046	27.46	3758.79	0.0458	0.0000	0.0458	0.0000	2160.31	0.00	2160.31	27.4619378	11/1/1984 21:00	0.046	
11.33	680	0.039	23.59	3782.38	0.0393	0.0065	0.0458	0.0000	2156.44	0.00	2156.44	23.588264	11/1/1984 21:10	0.039	
11.50	690	0.013	7.86	3790.24	0.0131	0.0327	0.0458	0.0000	2136.85	0.00	2136.85	7.862754665	11/1/1984 21:20	0.013	
11.67	700	0.028	17.09	3807.34	0.0285	0.0173	0.0458	0.0000	2126.48	0.00	2126.48	17.09446975	11/1/1984 21:30	0.028	
11.83	710	0.058	34.68	3842.02	0.0458	0.0000	0.0458	0.0120	2133.71	0.00	2133.71	34.68408837	11/1/1984 21:40	0.058	
12.00	720	0.043	26.07	3868.10	0.0435	0.0023	0.0458	0.0000	2132.32	0.00	2132.32	26.07374306	11/1/1984 21:50	0.043	
12.17	730	0.039	23.24	3891.34	0.0387	0.0070	0.0458	0.0000	2128.11	0.00	2128.11	23.24202522	11/1/1984 22:00	0.039	
12.33	740	0.037	22.30	3913.64	0.0372	0.0086	0.0458	0.0000	2122.95	0.00	2122.95	22.29811927	11/1/1984 22:10	0.037	
12.50	750	0.012	7.43	3921.07	0.0124	0.0334	0.0458	0.0000	2102.92	0.00	2102.92	7.432706422	11/1/1984 22:20	0.012	
12.67	760	0.004	2.48	3923.55	0.0041	0.0416	0.0458	0.0000	2077.94	0.00	2077.94	2.477568807	11/1/1984 22:30	0.004	
12.83	770	0.001	0.83	3924.37	0.0014	0.0444	0.0458	0.0000	2051.31	0.00	2051.31	0.825856269	11/1/1984 22:40	0.001	
13.00	780	0.000	0.28	3924.65	0.0005	0.0453	0.0458	0.0000	2024.12	0.00	2024.12	0.275285423	11/1/1984 22:50	0.000	
13.17	790	0.000	0.09	3924.74	0.0002	0.0456	0.0458	0.0000	1996.76	0.00	1996.76	0.091761808	11/1/1984 23:00	0.000	
13.33	800	0.024	14.62	3939.36	0.0244	0.0214	0.0458	0.0000	1983.92	0.00	1983.92	14.61933703	11/1/1984 23:10	0.024	
13.50	810	0.057	34.09	3973.45	0.0458	0.0000	0.0458	0.0110	1990.55	0.00	1990.55	34.0881654	11/1/1984 23:20	0.057	
13.67	820	0.068	40.65	4014.10	0.0458	0.0000	0.0458	0.0220	2003.74	0.00	2003.74	40.65246943	11/1/1984 23:30	0.068	
13.83	830	0.047	28.21	4042.31	0.0458	0.0000	0.0458	0.0013	2004.49	0.00	2004.49	28.21426748	11/1/1984 23:40	0.047	
14.00	840	0.016	9.40	4051.72	0.0157	0.0301	0.0458	0.0000	1986.44	0.00	1986.44	9.404755826	11/1/1984 23:50	0.016	
14.17	850	0.005	3.13	4054.85	0.0052	0.0405	0.0458	0.0000	1962.12	0.00	1962.12	3.134918609	11/2/1984 0:00	0.005	
14.33	860	0.002	1.04	4055.90	0.0017	0.0440	0.0458	0.0000	1935.70	0.00	1935.70	1.04497287	11/2/1984 0:10	0.002	
14.50	870	0.001	0.35	4056.25	0.0006	0.0452	0.0458	0.0000	1908.59	0.00	1908.59	0.34832429	11/2/1984 0:20	0.001	
14.67	880	0.000	0.12	4056.36	0.0002	0.0456	0.0458	0.0000	1881.25	0.00	1881.25	0.116108097	11/2/1984 0:30	0.000	
14.83	890	0.025	14.74	4071.10	0.0246	0.0212	0.0458	0.0000	1868.53	0.00	1868.53	14.73888167	11/2/1984 0:40	0.025	
15.00	900	0.057	34.35	4105.45	0.0458	0.0000	0.0458	0.0115	1875.42	0.00	1875.42	34.34965272	11/2/1984 0:50	0.057	
15.17	910	0.068	40.96	4146.41	0.0458	0.0000	0.0458	0.0225	1888.92	0.00	1888.92	40.95885028	11/2/1984 1:00	0.068	
15.33	920	0.047	28.43	4174.84	0.0458	0.0000	0.0458	0.0016	1889.89	0.00	1889.89	28.42540294	11/2/1984 1:10	0.047	
15.50	930	0.040	24.28	4199.12	0.0405	0.0053	0.0458	0.0000	1886.71	0.00	1886.71	24.28313802	11/2/1984 1:20	0.040	
15.67	940	0.063	37.75	4236.86	0.0458	0.0000	0.0458	0.0171	1897.00	0.00	1897.00	37.74555447	11/2/1984 1:30	0.063	
15.83	950	0.046	27.43	4264.29	0.0457	0.0001	0.0458	0.0000	1896.97	0.00	1896.97	27.4250229	11/2/1984 1:40	0.046	
16.00	960	0.015	9.14	4273.43	0.0152	0.0305	0.0458	0.0000	1878.65	0.00	1878.65	9.141674302	11/2/1984 1:50	0.015	
16.17	970	0.005	3.05	4276.48	0.0051	0.0407	0.0458	0.0000	1854.24	0.00	1854.24	3.047224767	11/2/1984 2:00	0.005	
16.33	980	0.002	1.02	4277.49	0.0017	0.0441	0.0458	0.0000	1827.79	0.00	1827.79	1.015741589	11/2/1984 2:10	0.002	
16.50	990	0.001	0.34	4277.83	0.0006	0.0452	0.0458	0.0000	1800.67	0.00	1800.67	0.33858053	11/2/1984 2:20	0.001	
16.67	1000	0.025	14.99	4292.82	0.0250	0.0208	0.0458	0.0000	1788.21	0.00	1788.21	14.9908217	11/2/1984 2:30	0.025	
16.83	1010	0.033	19.87	4312.70	0.0331	0.0126	0.0458	0.0000	1780.62	0.00	1780.62	19.87490209	11/2/1984 2:40	0.033	
17.00	1020	0.011	6.62	4319.32	0.0110	0.0347	0.0458	0.0000	1759.79	0.00	1759.79	6.624967362	11/2/1984 2:50	0.011	
17.17	1030	0.078	47.05	4366.37	0.0458	0.0000	0.0458	0.0326	1779.38	0.00	1779.38	47.04725269	11/2/1984 3:00	0.078	
17.33	1040	0.126	75.53	4441.91	0.0458	0.0000	0.0458	0.0801	1827.45	0.00	1827.45	75.53480112	11/2/1984 3:10	0.126	
17.50	1050	0.142	85.43	4527.33	0.0458	0.0000	0.0458	0.0966	1885.42	0.00	1885.42	85.42859048	11/2/1984 3:20	0.142	
17.67	1060	0.199	119.24	4646.57	0.0458	0.0000	0.0458	0.1530	1977.20	0.00	1977.20	119.2375802	11/2/1984 3:30	0.199	
17.83	1070	0.193	115.78	4762.35	0.0458	0.0000	0.0458	0.1472	2065.52	0.00	2065.52	115.7754693	11/2/1984 3:40	0.193	
18.00	1080	0.192	115.08	4877.43	0.0458	0.0000	0.0458	0.1460	2153.14	0.00	2153.14	115.0813695	11/2/1984 3:50	0.192	
18.17	1090	0.192	115.15	4992.58	0.0458	0.0000	0.0458	0.1462	2240.83	0.00	2240.83	115.1488475	11/2/1984 4:00	0.192	
18.33	1100	0.141	84.63	5077.21	0.0458	0.0000	0.0458	0.0953	2298.01	0.00	2298.01	84.63226049	11/2/1984 4:10	0.141	
18.50	1110	0.073	43.66	5120.87	0.0458	0.0000	0.0458								



19.83	1190	0.151	90.46	5565.40	0.0458	0.0000	0.0458	0.1050	2539.07	0.00	2539.07	90.45847505	11/2/1984 5:40	0.151	ROW and Private Parcel
20.00	1200	0.050	30.15	5595.55	0.0458	0.0000	0.0458	0.0045	2541.76	0.00	2541.76	30.15282502	11/2/1984 5:50	0.050	
20.17	1210	0.017	10.05	5605.60	0.0168	0.0290	0.0458	0.0000	2524.35	0.00	2524.35	10.05094167	11/2/1984 6:00	0.017	
20.33	1220	0.058	34.86	5640.47	0.0458	0.0000	0.0458	0.0123	2531.76	0.00	2531.76	34.86452382	11/2/1984 6:10	0.058	
20.50	1230	0.151	90.60	5731.06	0.0458	0.0000	0.0458	0.1052	2594.90	0.00	2594.90	90.59664165	11/2/1984 6:20	0.151	
20.67	1240	0.156	93.53	5824.59	0.0458	0.0000	0.0458	0.1101	2660.97	0.00	2660.97	93.52971004	11/2/1984 6:30	0.156	
20.83	1250	0.078	47.05	5871.64	0.0458	0.0000	0.0458	0.0326	2680.55	0.00	2680.55	47.04647572	11/2/1984 6:40	0.078	
21.00	1260	0.053	31.58	5903.22	0.0458	0.0000	0.0458	0.0069	2684.67	0.00	2684.67	31.57647023	11/2/1984 6:50	0.053	
21.17	1270	0.071	42.34	5945.55	0.0458	0.0000	0.0458	0.0248	2699.55	0.00	2699.55	42.33828806	11/2/1984 7:00	0.071	
21.33	1280	0.157	93.94	6039.50	0.0458	0.0000	0.0458	0.1108	2766.04	0.00	2766.04	93.94241736	11/2/1984 7:10	0.157	
21.50	1290	0.266	159.51	6199.00	0.0458	0.0000	0.0458	0.2201	2898.08	0.00	2898.08	159.5055119	11/2/1984 7:20	0.266	
21.67	1300	0.303	182.08	6381.09	0.0458	0.0000	0.0458	0.2577	3052.71	0.00	3052.71	182.0844789	11/2/1984 7:30	0.303	
21.83	1310	0.263	157.78	6538.86	0.0458	0.0000	0.0458	0.2172	3183.03	0.00	3183.03	157.7777892	11/2/1984 7:40	0.263	
22.00	1320	0.142	85.04	6623.90	0.0458	0.0000	0.0458	0.0960	3240.61	0.00	3240.61	85.03978877	11/2/1984 7:50	0.142	
22.17	1330	0.074	44.60	6668.51	0.0458	0.0000	0.0458	0.0286	3257.75	0.00	3257.75	44.60183741	11/2/1984 8:00	0.074	
22.33	1340	0.052	31.12	6699.63	0.0458	0.0000	0.0458	0.0061	3261.41	0.00	3261.41	31.12252028	11/2/1984 8:10	0.052	
22.50	1350	0.017	10.37	6710.00	0.0173	0.0285	0.0458	0.0000	3244.33	0.00	3244.33	10.37417343	11/2/1984 8:20	0.017	
22.67	1360	0.006	3.46	6713.46	0.0058	0.0400	0.0458	0.0000	3220.33	0.00	3220.33	3.458057809	11/2/1984 8:30	0.006	
22.83	1370	0.002	1.15	6714.61	0.0019	0.0438	0.0458	0.0000	3194.02	0.00	3194.02	1.152685936	11/2/1984 8:40	0.002	
23.00	1380	0.055	32.96	6747.57	0.0458	0.0000	0.0458	0.0092	3199.52	0.00	3199.52	32.95705328	11/2/1984 8:50	0.055	
23.17	1390	0.100	59.88	6807.45	0.0458	0.0000	0.0458	0.0540	3231.94	0.00	3231.94	59.87572031	11/2/1984 9:00	0.100	
23.33	1400	0.060	36.28	6843.72	0.0458	0.0000	0.0458	0.0147	3240.76	0.00	3240.76	36.2757847	11/2/1984 9:10	0.060	
23.50	1410	0.543	325.78	7169.50	0.0458	0.0000	0.0458	0.4972	3539.07	0.00	3539.07	325.777746	11/2/1984 9:20	0.543	0.350298652
23.67	1420	0.815	489.14	7658.64	0.0458	0.0000	0.0458	0.7695	4000.76	0.16	3907.15	395.5343519	11/2/1984 9:30	0.659	0.425305755
23.83	1430	0.579	347.56	8006.21	0.0458	0.0000	0.0458	0.5335	4227.26	0.53	3907.15	27.45872188	11/2/1984 9:40	0.046	0.029525507
24.00	1440	0.417	250.37	8256.58	0.0458	0.0000	0.0458	0.3715	4130.07	0.37	3907.15	27.45872188	11/2/1984 9:50	0.046	
24.17	1450	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3879.69	0.00	3879.69	0	11/2/1984 10:00	0.000	
24.33	1460	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3852.23	0.00	3852.23	0	11/2/1984 10:10	0.000	
24.50	1470	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3824.77	0.00	3824.77	0	11/2/1984 10:20	0.000	
24.67	1480	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3797.32	0.00	3797.32	0	11/2/1984 10:30	0.000	
24.83	1490	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3769.86	0.00	3769.86	0	11/2/1984 10:40	0.000	
25.00	1500	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3742.40	0.00	3742.40	0	11/2/1984 10:50	0.000	
25.17	1510	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3714.94	0.00	3714.94	0	11/2/1984 11:00	0.000	
25.33	1520	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3687.48	0.00	3687.48	0	11/2/1984 11:10	0.000	
25.50	1530	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3660.02	0.00	3660.02	0	11/2/1984 11:20	0.000	
25.67	1540	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3632.56	0.00	3632.56	0	11/2/1984 11:30	0.000	
25.83	1550	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3605.10	0.00	3605.10	0	11/2/1984 11:40	0.000	
26.00	1560	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3577.65	0.00	3577.65	0	11/2/1984 11:50	0.000	
26.17	1570	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3550.19	0.00	3550.19	0	11/2/1984 12:00	0.000	
26.33	1580	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3522.73	0.00	3522.73	0	11/2/1984 12:10	0.000	
26.50	1590	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3495.27	0.00	3495.27	0	11/2/1984 12:20	0.000	
26.67	1600	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3467.81	0.00	3467.81	0	11/2/1984 12:30	0.000	
26.83	1610	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3440.35	0.00	3440.35	0	11/2/1984 12:40	0.000	
27.00	1620	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3412.89	0.00	3412.89	0	11/2/1984 12:50	0.000	
27.17	1630	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3385.43	0.00	3385.43	0	11/2/1984 13:00	0.000	
27.33	1640	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3357.98	0.00	3357.98	0	11/2/1984 13:10	0.000	
27.50	1650	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3330.52	0.00	3330.52	0	11/2/1984 13:20	0.000	
27.67	1660	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3303.06	0.00	3303.06	0	11/2/1984 13:30	0.000	
27.83	1670	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3275.60	0.00	3275.60	0	11/2/1984 13:40	0.000	
28.00	1680	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3248.14	0.00	3248.14	0	11/2/1984 13:50	0.000	
28.17	1690	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3220.68	0.00	3220.68	0	11/2/1984 14:00	0.000	
28.33	1700	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3193.22	0.00	3193.22	0	11/2/1984 14:10	0.000	
28.50	1710	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3165.77	0.00	3165.77	0	11/2/1984 14:20	0.000	
28.67	1720	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3138.31	0.00	3138.31	0	11/2/1984 14:30	0.000	
28.83	1730	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3110.85	0.00	3110.85	0	11/2/1984 14:40	0.000	
29.00	1740	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3083.39	0.00	3083.39	0	11/2/1984 14:50	0.000	
29.17	1750	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3055.93	0.00	3055.93	0	11/2/1984 15:00	0.000	
29.33	1760	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3028.47	0.00	3028.47	0	11/2/1984 15:10	0.000	
29.50	1770	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	3001.01	0.00	3001.01	0	11/2/1984 15:20	0.000	
29.67	1780	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2973.55	0.00	2973.55	0	11/2/1984 15:30	0.000	
29.83	1790	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2946.10	0.00	2946.10	0	11/2/1984 15:40	0.000	
30.00	1800	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2918.64	0.00	2918.64	0	11/2/1984 15:50	0.000	
30.17	1810	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2891.18	0.00	2891.18	0	11/2/1984 16:00	0.000	
30.33	1820	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2863.72	0.00	2863.72	0	11/2/1984 16:10	0.000	
30.50	1830	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2836.26	0.00	2836.26	0	11/2/1984 16:20	0.000	
30.67	1840	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2808.80	0.00	2808.80	0	11/2/1984 16:30	0.000	
30.83	1850	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2781.34	0.00	2781.34	0	11/2/1984 16:40	0.000	
31.00	1860	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2753.88	0.00	2753.88	0	11/2/1984 16:50	0.000	
31.17	1870	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2726.43	0.00	2726.43	0	11/2/1984 17:00	0.000	
31.33	1880	0.000	0.00	8256.58	0.0000										



32.33	1940	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2534.21	0.00	2534.21	0	11/2/1984 18:10	0.000	ROW and Private Parcel
32.50	1950	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2506.76	0.00	2506.76	0	11/2/1984 18:20	0.000	
32.67	1960	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2479.30	0.00	2479.30	0	11/2/1984 18:30	0.000	
32.83	1970	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2451.84	0.00	2451.84	0	11/2/1984 18:40	0.000	
33.00	1980	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2424.38	0.00	2424.38	0	11/2/1984 18:50	0.000	
33.17	1990	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2396.92	0.00	2396.92	0	11/2/1984 19:00	0.000	
33.33	2000	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2369.46	0.00	2369.46	0	11/2/1984 19:10	0.000	
33.50	2010	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2342.00	0.00	2342.00	0	11/2/1984 19:20	0.000	
33.67	2020	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2314.54	0.00	2314.54	0	11/2/1984 19:30	0.000	
33.83	2030	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2287.09	0.00	2287.09	0	11/2/1984 19:40	0.000	
34.00	2040	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2259.63	0.00	2259.63	0	11/2/1984 19:50	0.000	
34.17	2050	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2232.17	0.00	2232.17	0	11/2/1984 20:00	0.000	
34.33	2060	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2204.71	0.00	2204.71	0	11/2/1984 20:10	0.000	
34.50	2070	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2177.25	0.00	2177.25	0	11/2/1984 20:20	0.000	
34.67	2080	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2149.79	0.00	2149.79	0	11/2/1984 20:30	0.000	
34.83	2090	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2122.33	0.00	2122.33	0	11/2/1984 20:40	0.000	
35.00	2100	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2094.87	0.00	2094.87	0	11/2/1984 20:50	0.000	
35.17	2110	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2067.42	0.00	2067.42	0	11/2/1984 21:00	0.000	
35.33	2120	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2039.96	0.00	2039.96	0	11/2/1984 21:10	0.000	
35.50	2130	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	2012.50	0.00	2012.50	0	11/2/1984 21:20	0.000	
35.67	2140	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1985.04	0.00	1985.04	0	11/2/1984 21:30	0.000	
35.83	2150	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1957.58	0.00	1957.58	0	11/2/1984 21:40	0.000	
36.00	2160	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1930.12	0.00	1930.12	0	11/2/1984 21:50	0.000	
36.17	2170	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1902.66	0.00	1902.66	0	11/2/1984 22:00	0.000	
36.33	2180	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1875.21	0.00	1875.21	0	11/2/1984 22:10	0.000	
36.50	2190	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1847.75	0.00	1847.75	0	11/2/1984 22:20	0.000	
36.67	2200	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1820.29	0.00	1820.29	0	11/2/1984 22:30	0.000	
36.83	2210	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1792.83	0.00	1792.83	0	11/2/1984 22:40	0.000	
37.00	2220	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1765.37	0.00	1765.37	0	11/2/1984 22:50	0.000	
37.17	2230	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1737.91	0.00	1737.91	0	11/2/1984 23:00	0.000	
37.33	2240	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1710.45	0.00	1710.45	0	11/2/1984 23:10	0.000	
37.50	2250	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1682.99	0.00	1682.99	0	11/2/1984 23:20	0.000	
37.67	2260	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1655.54	0.00	1655.54	0	11/2/1984 23:30	0.000	
37.83	2270	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1628.08	0.00	1628.08	0	11/2/1984 23:40	0.000	
38.00	2280	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1600.62	0.00	1600.62	0	11/2/1984 23:50	0.000	
38.17	2290	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1573.16	0.00	1573.16	0	1/0/1900 0:00	0.000	
38.33	2300	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1545.70	0.00	1545.70	0	1/0/1900 0:00	0.000	
38.50	2310	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1518.24	0.00	1518.24	0	1/0/1900 0:00	0.000	
38.67	2320	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1490.78	0.00	1490.78	0	1/0/1900 0:00	0.000	
38.83	2330	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1463.32	0.00	1463.32	0	1/0/1900 0:00	0.000	
39.00	2340	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1435.87	0.00	1435.87	0	1/0/1900 0:00	0.000	
39.17	2350	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1408.41	0.00	1408.41	0	1/0/1900 0:00	0.000	
39.33	2360	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1380.95	0.00	1380.95	0	1/0/1900 0:00	0.000	
39.50	2370	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1353.49	0.00	1353.49	0	1/0/1900 0:00	0.000	
39.67	2380	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1326.03	0.00	1326.03	0	1/0/1900 0:00	0.000	
39.83	2390	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1298.57	0.00	1298.57	0	1/0/1900 0:00	0.000	
40.00	2400	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1271.11	0.00	1271.11	0	1/0/1900 0:00	0.000	
40.17	2410	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1243.65	0.00	1243.65	0	1/0/1900 0:00	0.000	
40.33	2420	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1216.20	0.00	1216.20	0	1/0/1900 0:00	0.000	
40.50	2430	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1188.74	0.00	1188.74	0	1/0/1900 0:00	0.000	
40.67	2440	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1161.28	0.00	1161.28	0	1/0/1900 0:00	0.000	
40.83	2450	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1133.82	0.00	1133.82	0	1/0/1900 0:00	0.000	
41.00	2460	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1106.36	0.00	1106.36	0	1/0/1900 0:00	0.000	
41.17	2470	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1078.90	0.00	1078.90	0	1/0/1900 0:00	0.000	
41.33	2480	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1051.44	0.00	1051.44	0	1/0/1900 0:00	0.000	
41.50	2490	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	1023.98	0.00	1023.98	0	1/0/1900 0:00	0.000	
41.67	2500	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	996.53	0.00	996.53	0	1/0/1900 0:00	0.000	
41.83	2510	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	969.07	0.00	969.07	0	1/0/1900 0:00	0.000	
42.00	2520	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	941.61	0.00	941.61	0	1/0/1900 0:00	0.000	
42.16	2530	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	914.15	0.00	914.15	0	1/0/1900 0:00	0.000	
42.33	2540	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	886.69	0.00	886.69	0	1/0/1900 0:00	0.000	
42.50	2550	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	859.23	0.00	859.23	0	1/0/1900 0:00	0.000	
42.66	2560	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	831.77	0.00	831.77	0	1/0/1900 0:00	0.000	
42.83	2570	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	804.31	0.00	804.31	0	1/0/1900 0:00	0.000	
43.00	2580	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	776.86	0.00	776.86	0	1/0/1900 0:00	0.000	
43.16	2590	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	749.40	0.00	749.40	0	1/0/1900 0:00	0.000	
43.33	2600	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	721.94	0.00	721.94	0	1/0/1900 0:00	0.000	
43.50	2610	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	694.48	0.00	694.48	0	1/0/1900 0:00	0.000	
43.66	2620	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	667.02	0.00	667.02	0	1/0/1900 0:00	0.000	
43.83	2630	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	639.56	0.00	639.56	0	1/0/1900 0:00	0.000	
44.00	2640	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	612.10	0.00	612.10	0	1/0/1900 0:00	0.000	
44.16	2650	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	584.65	0.00					



44.83	2690	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	474.81	0.00	474.81	0	1/0/1900 0:00	0.000	ROW and Private Parcel
45.00	2700	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	447.35	0.00	447.35	0	1/0/1900 0:00	0.000	
45.16	2710	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	419.89	0.00	419.89	0	1/0/1900 0:00	0.000	
45.33	2720	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	392.43	0.00	392.43	0	1/0/1900 0:00	0.000	
45.50	2730	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	364.98	0.00	364.98	0	1/0/1900 0:00	0.000	
45.66	2740	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	337.52	0.00	337.52	0	1/0/1900 0:00	0.000	
45.83	2750	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	310.06	0.00	310.06	0	1/0/1900 0:00	0.000	
46.00	2760	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	282.60	0.00	282.60	0	1/0/1900 0:00	0.000	
46.16	2770	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	255.14	0.00	255.14	0	1/0/1900 0:00	0.000	
46.33	2780	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	227.68	0.00	227.68	0	1/0/1900 0:00	0.000	
46.50	2790	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	200.22	0.00	200.22	0	1/0/1900 0:00	0.000	
46.66	2800	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	172.76	0.00	172.76	0	1/0/1900 0:00	0.000	
46.83	2810	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	145.31	0.00	145.31	0	1/0/1900 0:00	0.000	
47.00	2820	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	117.85	0.00	117.85	0	1/0/1900 0:00	0.000	
47.16	2830	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	90.39	0.00	90.39	0	1/0/1900 0:00	0.000	
47.33	2840	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	62.93	0.00	62.93	0	1/0/1900 0:00	0.000	
47.50	2850	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	35.47	0.00	35.47	0	1/0/1900 0:00	0.000	
47.66	2860	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	8.01	0.00	8.01	0	1/0/1900 0:00	0.000	
47.83	2870	0.000	0.00	8256.58	0.0000	0.0458	0.0458	0.0000	-19.45	0.00	0.00	0	1/0/1900 0:00	0.000	
48.00	2880	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
48.16	2890	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
48.33	2900	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
48.50	2910	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
48.66	2920	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
48.83	2930	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
49.00	2940	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
49.16	2950	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
49.33	2960	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
49.50	2970	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
49.66	2980	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
49.83	2990	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
50.00	3000	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
50.16	3010	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
50.33	3020	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
50.50	3030	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
50.66	3040	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
50.83	3050	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
51.00	3060	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
51.16	3070	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	





**King County CSO**  
**Barton Basin Subbasin 416 - GSI Option**  
SvR Project No. 06053  
DATE: 06/14/2010

**RAIN GARDEN SYSTEM COMPONENTS**

Infiltration Rate into Native Subgrade (in/hr)				<b>0.50</b>
<b>SECTION 01 RG</b>	1.5	16.67	3.00% (biosoil depth/lf/slope)	
Number of Section 1 Rain Gardens for Basin (ea)				<b>0</b>
Total Infiltration Area for Section 1 Rain Gardens (sf)*				0
Storage Capacity for a single Section 1 Rain Garden (cf)				59
Total Storage Capacity for Section 1 Rain Gardens (cf)				0
<b>SECTION 02 RG</b>	1.5	42	2.00% (biosoil depth/lf/slope)	
Number of Section 2 Rain Gardens for Basin (ea)				<b>0</b>
Total Infiltration Area for Section 2 Rain Gardens (sf)*				0
Storage Capacity for a single Section 2 Rain Garden (cf)				232
Total Storage Capacity for Section 2 Rain Gardens (cf)				0
<b>SECTION 03 RG</b>	1.5	42	2.00% (biosoil depth/lf/slope)	
Number of Section 3 Rain Gardens for Basin (ea)				<b>9</b>
Total Infiltration Area for Section 3 Rain Gardens (sf)*				4106
Storage Capacity for a single Section 3 Rain Garden (cf)				451
Total Storage Capacity for Section 3 Rain Gardens (cf)				4057

**CONVERSION FACTORS**

conversion factor from cf to gallons	7.48
conversion factor from cfs to MGD:	0.6452
conversion factor from cfs to cf/per time step:	600

**RESULTS SUMMARY**

volume controlled from 10:00 on 11/01/84 to 10:00 on 11/02/84	7,907	(cf per GSI half block)
	59,142	(gal per GSI half block)
<hr/>		
Total volume of runoff removed from 9:30 to 9:50 of the 1984 storm	5,514	(gal per GSI half block)
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Assumed Half blocks to modify with GSI	28.0	
volume controlled during 9:30 to 9:50 on 11/02/84 (gal)	154,385	
volume of rain gardens in subbasin 416 (gal)	849,802	
flow reduction at peak (MGD)	14.7	
volume controlled from 10:00 on 11/01/84 to 10:00 on 11/02/84 (gal)	1,655,965	

**Scenario 2 is the average of 3a and 3b results**

**Rainfall Distribution: 1984 Storm**

**RAIN GARDEN SYSTEM SUMMARY**

Total Infiltration Flow (cfs)	0.0475
Total Swale Storage Capacity (cf)	4057.5

Target flow reduction from subbasin 416 (MGD)	<b>14.6</b>	per John Phillips
Flow reduction from assumed half block at peak flow(MGD)	0.52596127	
Half blocks needed to get total flow reduction out of subbasin 416	27.8	→ 28

**3a/3b Average = 32**

Time (hours)	Time (minutes)	Design Flow Rate from Rain Event (cfs)	Inflow Water Volume (cf)	Inflow Cum. Volume (cf)	Initial Exfiltration to Native Subgrade of Inflow (cfs)	Check if storage infiltrates	Infiltration into Native Subgrade of Stored Water (cfs)	Total Infiltration into Native Subgrade (cfs)	Inflow to Swale After Infiltration into Native Subgrade (cfs)	Swale Storage before Overflow Volume (cf)	Overtop Flow to Pump Station (cfs)	Runoff Stored in Swale Storage Volume (cf)	Volume of Runoff Removed From Pump Station (cf)	Date & Time	Amount Flow Reduced to Pump Station (cfs)	Amount Flow Reduced to Pump Station (MGD)
0	0	0.000	0.00	0.00	0.0000		0.0000	0.0000	0.0000	0.00	0.00	0.00	0			
0.17	10	0.000	0.00	0.00	0.0000		0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:00	0.000	
0.33	20	0.000	0.00	0.00	0.0000		0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:10	0.000	
0.50	30	0.000	0.00	0.00	0.0000		0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:20	0.000	
0.67	40	0.000	0.00	0.00	0.0000		0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:30	0.000	
0.83	50	0.003	1.90	1.90	0.0032		0.0000	0.0032	0.0000	0.00	0.00	0.00	1.900626807	11/1/1984 10:40	0.003	
1.00	60	0.009	5.61	7.51	0.0093		0.0000	0.0093	0.0000	0.00	0.00	0.00	5.605567335	11/1/1984 10:50	0.009	
1.17	70	0.015	9.09	16.59	0.0151		0.0000	0.0151	0.0000	0.00	0.00	0.00	9.085690673	11/1/1984 11:00	0.015	
1.33	80	0.020	12.17	28.77	0.0203		0.0000	0.0203	0.0000	0.00	0.00	0.00	12.17466638	11/1/1984 11:10	0.020	
1.50	90	0.030	17.81	46.58	0.0297		0.0000	0.0297	0.0000	0.00	0.00	0.00	17.8143958	11/1/1984 11:20	0.030	
1.67	100	0.035	21.20	67.78	0.0353		0.0000	0.0353	0.0000	0.00	0.00	0.00	21.19743158	11/1/1984 11:30	0.035	
1.83	110	0.034	20.50	88.28	0.0342		0.0000	0.0342	0.0000	0.00	0.00	0.00	20.50300898	11/1/1984 11:40	0.034	
2.00	120	0.035	21.06	109.35	0.0351		0.0000	0.0351	0.0000	0.00	0.00	0.00	21.06473615	11/1/1984 11:50	0.035	
2.17	130	0.030	18.09	127.43	0.0301		0.0000	0.0301	0.0000	0.00	0.00	0.00	18.08536098	11/1/1984 12:00	0.030	
2.33	140	0.029	17.54	144.97	0.0292		0.0000	0.0292	0.0000	0.00	0.00	0.00	17.53865912	11/1/1984 12:10	0.029	
2.50	150	0.043	25.66	170.63	0.0428		0.0000	0.0428	0.0000	0.00	0.00	0.00	25.6553555	11/1/1984 12:20	0.043	
2.67	160	0.055	33.13	203.76	0.0475		0.0000	0.0475	0.0077	4.62	0.00	4.62	33.13403255	11/1/1984 12:30	0.055	
2.83	170	0.061	36.63	240.39	0.0475		0.0000	0.0475	0.0135	12.73	0.00	12.73	36.63065266	11/1/1984 12:40	0.061	
3.00	180	0.085	50.79	291.18	0.0475		0.0000	0.0475	0.0371	35.01	0.00	35.01	50.79371058	11/1/1984 12:50	0.085	
3.17	190	0.090	53.97	345.16	0.0475		0.0000	0.0475	0.0424	60.47	0.00	60.47	53.97339262	11/1/1984 13:00	0.090	
3.33	200	0.091	54.66	399.82	0.0475		0.0000	0.0475	0.0436	86.62	0.00	86.62	54.66401283	11/1/1984 13:10	0.091	
3.50	210	0.131	78.42	478.24	0.0475		0.0000	0.0475	0.0832	136.52	0.00	136.52	78.41902389	11/1/1984 13:20	0.131	
3.67	220	0.153	91.89	570.13	0.0475		0.0000	0.0475	0.1056	199.90	0.00	199.90	91.89092043	11/1/1984 13:30	0.153	
3.83	230	0.157	94.20	664.33	0.0475		0.0000	0.0475	0.1095	265.58	0.00	265.58	94.19797599	11/1/1984 13:40	0.157	
4.00	240	0.165	99.16	763.49	0.0475		0.0000	0.0475	0.1177	336.22	0.00	336.22	99.15660697	11/1/1984 13:50	0.165	
4.17	250	0.159	95.35	858.83	0.0475		0.0000	0.0475	0.1114	403.05	0.00	403.05	95.34640582	11/1/1984 14:00	0.159	
4.33	260	0.130	78.02	936.85	0.0475		0.0000	0.0475	0.0825	452.56	0.00	452.56	78.02086674	11/1/1984 14:10	0.130	
4.50	270	0.107	64.10	1000.96	0.0475		0.0000	0.0475	0.0593	488.14	0.00	488.14	64.10279216	11/1/1984 14:20	0.107	
4.67	280	0.101	60.31	1061.27	0.0475		0.0000	0.0475	0.0530	519.94	0.00	519.94	60.31251706	11/1/1984 14:30	0.101	
4.83	290	0.134	80.35	1141.62	0.0475		0.0000	0.0475	0.0864	571.77	0.00	571.77	80.34751225	11/1/1984 14:40	0.134	
5.00	300	0.165	98.77	1240.38	0.0475		0.0000	0.0475	0.1171	642.02	0.00	642.02	98.76706303	11/1/1984 14:50	0.165	
5.17	310	0.179	107.50	1347.88	0.0475		0.0000	0.0475	0.1316	721.01	0.00	721.01	107.5018434	11/1/1984 15:00	0.179	
5.33	320	0.206	123.51	1471.40	0.0475		0.0000	0.0475	0.1583	816.01	0.00	816.01	123.5106495	11/1/1984 15:10	0.206	
5.50	330	0.219	131.49	1602.89	0.0475		0.0000	0.0475	0.1716	918.98	0.00	918.98	131.4936174	11/1/1984 15:20	0.219	
5.67	340	0.208	124.79	1727.68	0.0475		0.0000	0.0475	0.1605	1015.25	0.00	1015.25	124.7867403	11/1/1984 15:30	0.208	
5.83	350	0.208	124.63	1852.30	0.0475		0.0000	0.0475	0.1602	1111.37	0.00	1111.37	124.6276671	11/1/1984 15:40	0.208	
6.00	360	0.210	126.06	1978.36	0.0475		0.0000	0.0475	0.1626	1208.91	0.00	1208.91	126.0571051	11/1/1984 15:50	0.210	
6.17	370	0.172	103.41	2081.77	0.0475		0.0000	0.0475	0.1248	1283.80	0.00	1283.80	103.4069694	11/1/1984 16:00	0.172	
6.33	380	0.119	71.70	2153.46	0.0475		0.0000	0.0475	0.0720	1326.98	0.00	1326.98	71.69611608	11/1/1984 16:10	0.119	
6.50	390	0.082	48.91	2202.37	0.0475		0.0000	0.0475	0.0340	1347.37	0.00	1347.37	48.90884629	11/1/1984 16:20	0.082	
6.67	400	0.069	41.44	2243.81	0.0475		0.0000	0.0475	0.0215	1360.30	0.00	1360.30	41.43876698	11/1/1984 16:30	0.069	
6.83	410	0.044	26.41	2270.22	0.0440		0.0035	0.0475	0.0000	1358.19	0.00	1358.19	26.41204143	11/1/1984 16:40	0.044	
7.00	420	0.015	8.80	2279.03	0.0147		0.0329	0.0475	0.0000	1338.48	0.00	1338.48	8.80401381	11/1/1984 16:50	0.015	
7.17	430	0.026	15.60	2294.62	0.0260		0.0215	0.0475	0.0000	1325.56	0.00	1325.56	15.59538824	11/1/1984 17:00	0.026	



7.33	440	0.030	17.86	2312.48	0.0298	0.0178	0.0475	0.0000	1314.90	0.00	1314.90	17.85917971	11/1/1984 17:10	0.030	ROW and Private Parcel
7.50	450	0.010	5.95	2318.43	0.0099	0.0376	0.0475	0.0000	1292.34	0.00	1292.34	5.953059904	11/1/1984 17:20	0.010	
7.67	460	0.003	1.98	2320.42	0.0033	0.0442	0.0475	0.0000	1265.81	0.00	1265.81	1.984353301	11/1/1984 17:30	0.003	
7.83	470	0.001	0.66	2321.08	0.0011	0.0464	0.0475	0.0000	1237.96	0.00	1237.96	0.6614511	11/1/1984 17:40	0.001	
8.00	480	0.043	25.72	2346.80	0.0429	0.0047	0.0475	0.0000	1235.16	0.00	1235.16	25.72349642	11/1/1984 17:50	0.043	
8.17	490	0.100	59.82	2406.62	0.0475	0.0000	0.0475	0.0522	1266.47	0.00	1266.47	59.81741393	11/1/1984 18:00	0.100	
8.33	500	0.119	71.65	2478.27	0.0475	0.0000	0.0475	0.0719	1309.60	0.00	1309.60	71.6497663	11/1/1984 18:10	0.119	
8.50	510	0.127	76.05	2554.32	0.0475	0.0000	0.0475	0.0792	1357.13	0.00	1357.13	76.04967545	11/1/1984 18:20	0.127	
8.67	520	0.152	91.25	2645.57	0.0475	0.0000	0.0475	0.1046	1419.87	0.00	1419.87	91.24862698	11/1/1984 18:30	0.152	
8.83	530	0.184	110.30	2755.87	0.0475	0.0000	0.0475	0.1363	1501.65	0.00	1501.65	110.2975133	11/1/1984 18:40	0.184	
9.00	540	0.196	117.58	2873.45	0.0475	0.0000	0.0475	0.1484	1590.71	0.00	1590.71	117.5802183	11/1/1984 18:50	0.196	
9.17	550	0.202	120.91	2994.35	0.0475	0.0000	0.0475	0.1540	1683.11	0.00	1683.11	120.9069794	11/1/1984 19:00	0.202	
9.33	560	0.228	136.81	3131.16	0.0475	0.0000	0.0475	0.1805	1791.40	0.00	1791.40	136.8091982	11/1/1984 19:10	0.228	
9.50	570	0.168	101.03	3232.20	0.0475	0.0000	0.0475	0.1209	1863.92	0.00	1863.92	101.0324817	11/1/1984 19:20	0.168	
9.67	580	0.103	61.66	3293.86	0.0475	0.0000	0.0475	0.0552	1897.07	0.00	1897.07	61.66489707	11/1/1984 19:30	0.103	
9.83	590	0.104	62.60	3356.46	0.0475	0.0000	0.0475	0.0568	1931.15	0.00	1931.15	62.60238865	11/1/1984 19:40	0.104	
10.00	600	0.082	49.03	3405.49	0.0475	0.0000	0.0475	0.0342	1951.67	0.00	1951.67	49.03102999	11/1/1984 19:50	0.082	
10.17	610	0.051	30.45	3435.94	0.0475	0.0000	0.0475	0.0032	1953.60	0.00	1953.60	30.44722397	11/1/1984 20:00	0.051	
10.33	620	0.040	24.30	3460.24	0.0405	0.0070	0.0475	0.0000	1949.38	0.00	1949.38	24.29564605	11/1/1984 20:10	0.040	
10.50	630	0.108	64.94	3525.18	0.0475	0.0000	0.0475	0.0607	1985.80	0.00	1985.80	64.93806144	11/1/1984 20:20	0.108	
10.67	640	0.155	93.01	3618.18	0.0475	0.0000	0.0475	0.1075	2050.29	0.00	2050.29	93.00716016	11/1/1984 20:30	0.155	
10.83	650	0.123	74.07	3692.25	0.0475	0.0000	0.0475	0.0759	2095.84	0.00	2095.84	74.06515819	11/1/1984 20:40	0.123	
11.00	660	0.065	39.08	3731.33	0.0475	0.0000	0.0475	0.0176	2106.41	0.00	2106.41	39.08295923	11/1/1984 20:50	0.065	
11.17	670	0.046	27.46	3758.79	0.0458	0.0018	0.0475	0.0000	2105.36	0.00	2105.36	27.4619378	11/1/1984 21:00	0.046	
11.33	680	0.039	23.59	3782.38	0.0393	0.0082	0.0475	0.0000	2100.43	0.00	2100.43	23.588264	11/1/1984 21:10	0.039	
11.50	690	0.013	7.86	3790.24	0.0131	0.0344	0.0475	0.0000	2079.78	0.00	2079.78	7.862754665	11/1/1984 21:20	0.013	
11.67	700	0.028	17.09	3807.34	0.0285	0.0190	0.0475	0.0000	2068.36	0.00	2068.36	17.09446975	11/1/1984 21:30	0.028	
11.83	710	0.058	34.68	3842.02	0.0475	0.0000	0.0475	0.0103	2074.52	0.00	2074.52	34.68408837	11/1/1984 21:40	0.058	
12.00	720	0.043	26.07	3868.10	0.0435	0.0041	0.0475	0.0000	2072.08	0.00	2072.08	26.07374306	11/1/1984 21:50	0.043	
12.17	730	0.039	23.24	3891.34	0.0387	0.0088	0.0475	0.0000	2066.81	0.00	2066.81	23.24202522	11/1/1984 22:00	0.039	
12.33	740	0.037	22.30	3913.64	0.0372	0.0104	0.0475	0.0000	2060.59	0.00	2060.59	22.29811927	11/1/1984 22:10	0.037	
12.50	750	0.012	7.43	3921.07	0.0124	0.0351	0.0475	0.0000	2039.51	0.00	2039.51	7.432706422	11/1/1984 22:20	0.012	
12.67	760	0.004	2.48	3923.55	0.0041	0.0434	0.0475	0.0000	2013.47	0.00	2013.47	2.477568807	11/1/1984 22:30	0.004	
12.83	770	0.001	0.83	3924.37	0.0014	0.0461	0.0475	0.0000	1985.78	0.00	1985.78	0.825856269	11/1/1984 22:40	0.001	
13.00	780	0.000	0.28	3924.65	0.0005	0.0471	0.0475	0.0000	1957.54	0.00	1957.54	0.275285423	11/1/1984 22:50	0.000	
13.17	790	0.000	0.09	3924.74	0.0002	0.0474	0.0475	0.0000	1929.12	0.00	1929.12	0.091761808	11/1/1984 23:00	0.000	
13.33	800	0.024	14.62	3939.36	0.0244	0.0232	0.0475	0.0000	1915.22	0.00	1915.22	14.61933703	11/1/1984 23:10	0.024	
13.50	810	0.057	34.09	3973.45	0.0475	0.0000	0.0475	0.0093	1920.79	0.00	1920.79	34.0881654	11/1/1984 23:20	0.057	
13.67	820	0.068	40.65	4014.10	0.0475	0.0000	0.0475	0.0202	1932.93	0.00	1932.93	40.65246943	11/1/1984 23:30	0.068	
13.83	830	0.047	28.21	4042.31	0.0470	0.0005	0.0475	0.0000	1932.63	0.00	1932.63	28.21426748	11/1/1984 23:40	0.047	
14.00	840	0.016	9.40	4051.72	0.0157	0.0319	0.0475	0.0000	1913.52	0.00	1913.52	9.404755826	11/1/1984 23:50	0.016	
14.17	850	0.005	3.13	4054.85	0.0052	0.0423	0.0475	0.0000	1888.14	0.00	1888.14	3.134918609	11/2/1984 0:00	0.005	
14.33	860	0.002	1.04	4055.90	0.0017	0.0458	0.0475	0.0000	1860.67	0.00	1860.67	1.04497287	11/2/1984 0:10	0.002	
14.50	870	0.001	0.35	4056.25	0.0006	0.0469	0.0475	0.0000	1832.50	0.00	1832.50	0.34832429	11/2/1984 0:20	0.001	
14.67	880	0.000	0.12	4056.36	0.0002	0.0473	0.0475	0.0000	1804.10	0.00	1804.10	0.116108097	11/2/1984 0:30	0.000	
14.83	890	0.025	14.74	4071.10	0.0246	0.0230	0.0475	0.0000	1790.32	0.00	1790.32	14.73888167	11/2/1984 0:40	0.025	
15.00	900	0.057	34.35	4105.45	0.0475	0.0000	0.0475	0.0097	1796.16	0.00	1796.16	34.34965272	11/2/1984 0:50	0.057	
15.17	910	0.068	40.96	4146.41	0.0475	0.0000	0.0475	0.0207	1808.60	0.00	1808.60	40.95885028	11/2/1984 1:00	0.068	
15.33	920	0.047	28.43	4174.84	0.0474	0.0002	0.0475	0.0000	1808.51	0.00	1808.51	28.42540294	11/2/1984 1:10	0.047	
15.50	930	0.040	24.28	4199.12	0.0405	0.0071	0.0475	0.0000	1804.28	0.00	1804.28	24.28313802	11/2/1984 1:20	0.040	
15.67	940	0.063	37.75	4236.86	0.0475	0.0000	0.0475	0.0154	1813.51	0.00	1813.51	37.74555447	11/2/1984 1:30	0.063	
15.83	950	0.046	27.43	4264.29	0.0457	0.0018	0.0475	0.0000	1812.42	0.00	1812.42	27.4250229	11/2/1984 1:40	0.046	
16.00	960	0.015	9.14	4273.43	0.0152	0.0323	0.0475	0.0000	1793.04	0.00	1793.04	9.141674302	11/2/1984 1:50	0.015	
16.17	970	0.005	3.05	4276.48	0.0051	0.0424	0.0475	0.0000	1767.57	0.00	1767.57	3.047224767	11/2/1984 2:00	0.005	
16.33	980	0.002	1.02	4277.49	0.0017	0.0458	0.0475	0.0000	1740.08	0.00	1740.08	1.015741589	11/2/1984 2:10	0.002	
16.50	990	0.001	0.34	4277.83	0.0006	0.0470	0.0475	0.0000	1711.90	0.00	1711.90	0.33858053	11/2/1984 2:20	0.001	
16.67	1000	0.025	14.99	4292.82	0.0250	0.0225	0.0475	0.0000	1698.37	0.00	1698.37	14.9908217	11/2/1984 2:30	0.025	
16.83	1010	0.033	19.87	4312.70	0.0331	0.0144	0.0475	0.0000	1689.73	0.00	1689.73	19.87490209	11/2/1984 2:40	0.033	
17.00	1020	0.011	6.62	4319.32	0.0110	0.0365	0.0475	0.0000	1667.84	0.00	1667.84	6.624967362	11/2/1984 2:50	0.011	
17.17	1030	0.078	47.05	4366.37	0.0475	0.0000	0.0475	0.0309	1686.37	0.00	1686.37	47.04725269	11/2/1984 3:00	0.078	
17.33	1040	0.126	75.53	4441.91	0.0475	0.0000	0.0475	0.0784	1733.39	0.00	1733.39	75.53480112	11/2/1984 3:10	0.126	
17.50	1050	0.142	85.43	4527.33	0.0475	0.0000	0.0475	0.0949	1790.31	0.00	1790.31	85.42859048	11/2/1984 3:20	0.142	
17.67	1060	0.199	119.24	4646.57	0.0475	0.0000	0.0475	0.1512	1881.03	0.00	1881.03	119.2375802	11/2/1984 3:30	0.199	
17.83	1070	0.193	115.78	4762.35	0.0475	0.0000	0.0475	0.1454	1968.29	0.00	1968.29	115.7754693	11/2/1984 3:40	0.193	
18.00	1080	0.192	115.08	4877.43	0.0475	0.0000	0.0475	0.1443	2054.85	0.00	2054.85	115.0813695	11/2/1984 3:50	0.192	
18.17	1090	0.192	115.15	4992.58	0.0475	0.0000	0.0475	0.1444	2141.49	0.00	2141.49	115.1488475	11/2/1984 4:00	0.192	
18.33	1100	0.141	84.63	5077.21	0.0475	0.0000	0.0475	0.0935	2197.60	0.00	2197.60	84.63226049	11/2/1984 4:10	0.141	
18.50	1110	0.073	43.66	5120.87	0.0475	0.0000	0.0475								



19.83	1190	0.151	90.46	5565.40	0.0475	0.0000	0.0475	0.1032	2429.15	0.00	2429.15	90.45847505	11/2/1984 5:40	0.151	ROW and Private Parcel
20.00	1200	0.050	30.15	5595.55	0.0475	0.0000	0.0475	0.0027	2430.79	0.00	2430.79	30.15282502	11/2/1984 5:50	0.050	
20.17	1210	0.017	10.05	5605.60	0.0168	0.0308	0.0475	0.0000	2412.32	0.00	2412.32	10.05094167	11/2/1984 6:00	0.017	
20.33	1220	0.058	34.86	5640.47	0.0475	0.0000	0.0475	0.0106	2418.67	0.00	2418.67	34.86452382	11/2/1984 6:10	0.058	
20.50	1230	0.151	90.60	5731.06	0.0475	0.0000	0.0475	0.1035	2480.75	0.00	2480.75	90.59664165	11/2/1984 6:20	0.151	
20.67	1240	0.156	93.53	5824.59	0.0475	0.0000	0.0475	0.1084	2545.77	0.00	2545.77	93.52971004	11/2/1984 6:30	0.156	
20.83	1250	0.078	47.05	5871.64	0.0475	0.0000	0.0475	0.0309	2564.30	0.00	2564.30	47.04647572	11/2/1984 6:40	0.078	
21.00	1260	0.053	31.58	5903.22	0.0475	0.0000	0.0475	0.0051	2567.36	0.00	2567.36	31.57647023	11/2/1984 6:50	0.053	
21.17	1270	0.071	42.34	5945.55	0.0475	0.0000	0.0475	0.0230	2581.18	0.00	2581.18	42.33828806	11/2/1984 7:00	0.071	
21.33	1280	0.157	93.94	6039.50	0.0475	0.0000	0.0475	0.1090	2646.61	0.00	2646.61	93.94241736	11/2/1984 7:10	0.157	
21.50	1290	0.266	159.51	6199.00	0.0475	0.0000	0.0475	0.2183	2777.60	0.00	2777.60	159.5055119	11/2/1984 7:20	0.266	
21.67	1300	0.303	182.08	6381.09	0.0475	0.0000	0.0475	0.2559	2931.17	0.00	2931.17	182.0844789	11/2/1984 7:30	0.303	
21.83	1310	0.263	157.78	6538.86	0.0475	0.0000	0.0475	0.2154	3060.43	0.00	3060.43	157.7777892	11/2/1984 7:40	0.263	
22.00	1320	0.142	85.04	6623.90	0.0475	0.0000	0.0475	0.0942	3116.96	0.00	3116.96	85.03978877	11/2/1984 7:50	0.142	
22.17	1330	0.074	44.60	6668.51	0.0475	0.0000	0.0475	0.0268	3133.04	0.00	3133.04	44.60183741	11/2/1984 8:00	0.074	
22.33	1340	0.052	31.12	6699.63	0.0475	0.0000	0.0475	0.0043	3135.65	0.00	3135.65	31.12252028	11/2/1984 8:10	0.052	
22.50	1350	0.017	10.37	6710.00	0.0173	0.0302	0.0475	0.0000	3117.51	0.00	3117.51	10.37417343	11/2/1984 8:20	0.017	
22.67	1360	0.006	3.46	6713.46	0.0058	0.0418	0.0475	0.0000	3092.45	0.00	3092.45	3.458057809	11/2/1984 8:30	0.006	
22.83	1370	0.002	1.15	6714.61	0.0019	0.0456	0.0475	0.0000	3065.09	0.00	3065.09	1.152685936	11/2/1984 8:40	0.002	
23.00	1380	0.055	32.96	6747.57	0.0475	0.0000	0.0475	0.0074	3069.53	0.00	3069.53	32.95705328	11/2/1984 8:50	0.055	
23.17	1390	0.100	59.88	6807.45	0.0475	0.0000	0.0475	0.0523	3100.89	0.00	3100.89	59.87572031	11/2/1984 9:00	0.100	
23.33	1400	0.060	36.28	6843.72	0.0475	0.0000	0.0475	0.0129	3108.65	0.00	3108.65	36.2757847	11/2/1984 9:10	0.060	
23.50	1410	0.543	325.78	7169.50	0.0475	0.0000	0.0475	0.4954	3405.91	0.00	3405.91	325.777746	11/2/1984 9:20	0.543	0.350298652
23.67	1420	0.815	489.14	7658.64	0.0475	0.0000	0.0475	0.7677	3866.54	0.00	3866.54	489.1439814	11/2/1984 9:30	0.815	0.52596127
23.83	1430	0.579	347.56	8006.21	0.0475	0.0000	0.0475	0.5317	4185.59	0.21	4057.50	219.4720728	11/2/1984 9:40	0.366	0.235991476
24.00	1440	0.417	250.37	8256.58	0.0475	0.0000	0.0475	0.3698	4279.36	0.37	4057.50	28.51557938	11/2/1984 9:50	0.048	
24.17	1450	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	4028.98	0.00	4028.98	0	11/2/1984 10:00	0.000	
24.33	1460	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	4000.46	0.00	4000.46	0	11/2/1984 10:10	0.000	
24.50	1470	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3971.95	0.00	3971.95	0	11/2/1984 10:20	0.000	
24.67	1480	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3943.43	0.00	3943.43	0	11/2/1984 10:30	0.000	
24.83	1490	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3914.92	0.00	3914.92	0	11/2/1984 10:40	0.000	
25.00	1500	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3886.40	0.00	3886.40	0	11/2/1984 10:50	0.000	
25.17	1510	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3857.89	0.00	3857.89	0	11/2/1984 11:00	0.000	
25.33	1520	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3829.37	0.00	3829.37	0	11/2/1984 11:10	0.000	
25.50	1530	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3800.86	0.00	3800.86	0	11/2/1984 11:20	0.000	
25.67	1540	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3772.34	0.00	3772.34	0	11/2/1984 11:30	0.000	
25.83	1550	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3743.82	0.00	3743.82	0	11/2/1984 11:40	0.000	
26.00	1560	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3715.31	0.00	3715.31	0	11/2/1984 11:50	0.000	
26.17	1570	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3686.79	0.00	3686.79	0	11/2/1984 12:00	0.000	
26.33	1580	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3658.28	0.00	3658.28	0	11/2/1984 12:10	0.000	
26.50	1590	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3629.76	0.00	3629.76	0	11/2/1984 12:20	0.000	
26.67	1600	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3601.25	0.00	3601.25	0	11/2/1984 12:30	0.000	
26.83	1610	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3572.73	0.00	3572.73	0	11/2/1984 12:40	0.000	
27.00	1620	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3544.22	0.00	3544.22	0	11/2/1984 12:50	0.000	
27.17	1630	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3515.70	0.00	3515.70	0	11/2/1984 13:00	0.000	
27.33	1640	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3487.18	0.00	3487.18	0	11/2/1984 13:10	0.000	
27.50	1650	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3458.67	0.00	3458.67	0	11/2/1984 13:20	0.000	
27.67	1660	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3430.15	0.00	3430.15	0	11/2/1984 13:30	0.000	
27.83	1670	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3401.64	0.00	3401.64	0	11/2/1984 13:40	0.000	
28.00	1680	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3373.12	0.00	3373.12	0	11/2/1984 13:50	0.000	
28.17	1690	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3344.61	0.00	3344.61	0	11/2/1984 14:00	0.000	
28.33	1700	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3316.09	0.00	3316.09	0	11/2/1984 14:10	0.000	
28.50	1710	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3287.58	0.00	3287.58	0	11/2/1984 14:20	0.000	
28.67	1720	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3259.06	0.00	3259.06	0	11/2/1984 14:30	0.000	
28.83	1730	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3230.54	0.00	3230.54	0	11/2/1984 14:40	0.000	
29.00	1740	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3202.03	0.00	3202.03	0	11/2/1984 14:50	0.000	
29.17	1750	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3173.51	0.00	3173.51	0	11/2/1984 15:00	0.000	
29.33	1760	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3145.00	0.00	3145.00	0	11/2/1984 15:10	0.000	
29.50	1770	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3116.48	0.00	3116.48	0	11/2/1984 15:20	0.000	
29.67	1780	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3087.97	0.00	3087.97	0	11/2/1984 15:30	0.000	
29.83	1790	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3059.45	0.00	3059.45	0	11/2/1984 15:40	0.000	
30.00	1800	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3030.93	0.00	3030.93	0	11/2/1984 15:50	0.000	
30.17	1810	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	3002.42	0.00	3002.42	0	11/2/1984 16:00	0.000	
30.33	1820	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2973.90	0.00	2973.90	0	11/2/1984 16:10	0.000	
30.50	1830	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2945.39	0.00	2945.39	0	11/2/1984 16:20	0.000	
30.67	1840	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2916.87	0.00	2916.87	0	11/2/1984 16:30	0.000	
30.83	1850	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2888.36	0.00	2888.36	0	11/2/1984 16:40	0.000	
31.00	1860	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2859.84	0.00	2859.84	0	11/2/1984 16:50	0.000	
31.17	1870	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2831.33	0.00	2831.33	0	11/2/1984 17:00	0.000	
31.33	1880	0.000	0.00	8256.58	0.0000</										



32.33	1940	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2631.72	0.00	2631.72	0	11/2/1984 18:10	0.000	ROW and Private Parcel
32.50	1950	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2603.20	0.00	2603.20	0	11/2/1984 18:20	0.000	
32.67	1960	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2574.69	0.00	2574.69	0	11/2/1984 18:30	0.000	
32.83	1970	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2546.17	0.00	2546.17	0	11/2/1984 18:40	0.000	
33.00	1980	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2517.65	0.00	2517.65	0	11/2/1984 18:50	0.000	
33.17	1990	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2489.14	0.00	2489.14	0	11/2/1984 19:00	0.000	
33.33	2000	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2460.62	0.00	2460.62	0	11/2/1984 19:10	0.000	
33.50	2010	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2432.11	0.00	2432.11	0	11/2/1984 19:20	0.000	
33.67	2020	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2403.59	0.00	2403.59	0	11/2/1984 19:30	0.000	
33.83	2030	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2375.08	0.00	2375.08	0	11/2/1984 19:40	0.000	
34.00	2040	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2346.56	0.00	2346.56	0	11/2/1984 19:50	0.000	
34.17	2050	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2318.05	0.00	2318.05	0	11/2/1984 20:00	0.000	
34.33	2060	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2289.53	0.00	2289.53	0	11/2/1984 20:10	0.000	
34.50	2070	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2261.01	0.00	2261.01	0	11/2/1984 20:20	0.000	
34.67	2080	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2232.50	0.00	2232.50	0	11/2/1984 20:30	0.000	
34.83	2090	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2203.98	0.00	2203.98	0	11/2/1984 20:40	0.000	
35.00	2100	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2175.47	0.00	2175.47	0	11/2/1984 20:50	0.000	
35.17	2110	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2146.95	0.00	2146.95	0	11/2/1984 21:00	0.000	
35.33	2120	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2118.44	0.00	2118.44	0	11/2/1984 21:10	0.000	
35.50	2130	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2089.92	0.00	2089.92	0	11/2/1984 21:20	0.000	
35.67	2140	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2061.41	0.00	2061.41	0	11/2/1984 21:30	0.000	
35.83	2150	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2032.89	0.00	2032.89	0	11/2/1984 21:40	0.000	
36.00	2160	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	2004.37	0.00	2004.37	0	11/2/1984 21:50	0.000	
36.17	2170	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1975.86	0.00	1975.86	0	11/2/1984 22:00	0.000	
36.33	2180	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1947.34	0.00	1947.34	0	11/2/1984 22:10	0.000	
36.50	2190	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1918.83	0.00	1918.83	0	11/2/1984 22:20	0.000	
36.67	2200	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1890.31	0.00	1890.31	0	11/2/1984 22:30	0.000	
36.83	2210	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1861.80	0.00	1861.80	0	11/2/1984 22:40	0.000	
37.00	2220	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1833.28	0.00	1833.28	0	11/2/1984 22:50	0.000	
37.17	2230	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1804.76	0.00	1804.76	0	11/2/1984 23:00	0.000	
37.33	2240	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1776.25	0.00	1776.25	0	11/2/1984 23:10	0.000	
37.50	2250	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1747.73	0.00	1747.73	0	11/2/1984 23:20	0.000	
37.67	2260	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1719.22	0.00	1719.22	0	11/2/1984 23:30	0.000	
37.83	2270	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1690.70	0.00	1690.70	0	11/2/1984 23:40	0.000	
38.00	2280	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1662.19	0.00	1662.19	0	11/2/1984 23:50	0.000	
38.17	2290	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1633.67	0.00	1633.67	0	1/0/1900 0:00	0.000	
38.33	2300	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1605.16	0.00	1605.16	0	1/0/1900 0:00	0.000	
38.50	2310	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1576.64	0.00	1576.64	0	1/0/1900 0:00	0.000	
38.67	2320	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1548.12	0.00	1548.12	0	1/0/1900 0:00	0.000	
38.83	2330	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1519.61	0.00	1519.61	0	1/0/1900 0:00	0.000	
39.00	2340	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1491.09	0.00	1491.09	0	1/0/1900 0:00	0.000	
39.17	2350	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1462.58	0.00	1462.58	0	1/0/1900 0:00	0.000	
39.33	2360	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1434.06	0.00	1434.06	0	1/0/1900 0:00	0.000	
39.50	2370	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1405.55	0.00	1405.55	0	1/0/1900 0:00	0.000	
39.67	2380	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1377.03	0.00	1377.03	0	1/0/1900 0:00	0.000	
39.83	2390	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1348.52	0.00	1348.52	0	1/0/1900 0:00	0.000	
40.00	2400	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1320.00	0.00	1320.00	0	1/0/1900 0:00	0.000	
40.17	2410	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1291.48	0.00	1291.48	0	1/0/1900 0:00	0.000	
40.33	2420	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1262.97	0.00	1262.97	0	1/0/1900 0:00	0.000	
40.50	2430	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1234.45	0.00	1234.45	0	1/0/1900 0:00	0.000	
40.67	2440	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1205.94	0.00	1205.94	0	1/0/1900 0:00	0.000	
40.83	2450	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1177.42	0.00	1177.42	0	1/0/1900 0:00	0.000	
41.00	2460	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1148.91	0.00	1148.91	0	1/0/1900 0:00	0.000	
41.17	2470	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1120.39	0.00	1120.39	0	1/0/1900 0:00	0.000	
41.33	2480	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1091.88	0.00	1091.88	0	1/0/1900 0:00	0.000	
41.50	2490	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1063.36	0.00	1063.36	0	1/0/1900 0:00	0.000	
41.67	2500	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1034.84	0.00	1034.84	0	1/0/1900 0:00	0.000	
41.83	2510	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	1006.33	0.00	1006.33	0	1/0/1900 0:00	0.000	
42.00	2520	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	977.81	0.00	977.81	0	1/0/1900 0:00	0.000	
42.16	2530	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	949.30	0.00	949.30	0	1/0/1900 0:00	0.000	
42.33	2540	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	920.78	0.00	920.78	0	1/0/1900 0:00	0.000	
42.50	2550	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	892.27	0.00	892.27	0	1/0/1900 0:00	0.000	
42.66	2560	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	863.75	0.00	863.75	0	1/0/1900 0:00	0.000	
42.83	2570	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	835.24	0.00	835.24	0	1/0/1900 0:00	0.000	
43.00	2580	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	806.72	0.00	806.72	0	1/0/1900 0:00	0.000	
43.16	2590	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	778.20	0.00	778.20	0	1/0/1900 0:00	0.000	
43.33	2600	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	749.69	0.00	749.69	0	1/0/1900 0:00	0.000	
43.50	2610	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	721.17	0.00	721.17	0	1/0/1900 0:00	0.000	
43.66	2620	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	692.66	0.00	692.66	0	1/0/1900 0:00	0.000	
43.83	2630	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	664.14	0.00	664.14	0	1/0/1900 0:00	0.000	
44.00	2640	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	635.63	0.00	635.63	0	1/0/1900 0:00	0.000	
44.16	2650	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	607.11	0.					



44.83	2690	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	493.05	0.00	493.05	0	1/0/1900 0:00	0.000	ROW and Private Parcel
45.00	2700	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	464.53	0.00	464.53	0	1/0/1900 0:00	0.000	
45.16	2710	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	436.02	0.00	436.02	0	1/0/1900 0:00	0.000	
45.33	2720	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	407.50	0.00	407.50	0	1/0/1900 0:00	0.000	
45.50	2730	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	378.99	0.00	378.99	0	1/0/1900 0:00	0.000	
45.66	2740	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	350.47	0.00	350.47	0	1/0/1900 0:00	0.000	
45.83	2750	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	321.95	0.00	321.95	0	1/0/1900 0:00	0.000	
46.00	2760	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	293.44	0.00	293.44	0	1/0/1900 0:00	0.000	
46.16	2770	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	264.92	0.00	264.92	0	1/0/1900 0:00	0.000	
46.33	2780	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	236.41	0.00	236.41	0	1/0/1900 0:00	0.000	
46.50	2790	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	207.89	0.00	207.89	0	1/0/1900 0:00	0.000	
46.66	2800	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	179.38	0.00	179.38	0	1/0/1900 0:00	0.000	
46.83	2810	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	150.86	0.00	150.86	0	1/0/1900 0:00	0.000	
47.00	2820	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	122.35	0.00	122.35	0	1/0/1900 0:00	0.000	
47.16	2830	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	93.83	0.00	93.83	0	1/0/1900 0:00	0.000	
47.33	2840	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	65.31	0.00	65.31	0	1/0/1900 0:00	0.000	
47.50	2850	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	36.80	0.00	36.80	0	1/0/1900 0:00	0.000	
47.66	2860	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	8.28	0.00	8.28	0	1/0/1900 0:00	0.000	
47.83	2870	0.000	0.00	8256.58	0.0000	0.0475	0.0475	0.0000	-20.23	0.00	0.00	0	1/0/1900 0:00	0.000	
48.00	2880	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
48.16	2890	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
48.33	2900	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
48.50	2910	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
48.66	2920	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
48.83	2930	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
49.00	2940	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
49.16	2950	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
49.33	2960	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
49.50	2970	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
49.66	2980	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
49.83	2990	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
50.00	3000	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
50.16	3010	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
50.33	3020	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
50.50	3030	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
50.66	3040	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
50.83	3050	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
51.00	3060	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	
51.16	3070	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000	





**King County CSO**  
**Barton Basin Subbasin 416 - GSI Option**  
SvR Project No. 06053  
DATE: 06/15/2010

Combination of (4) 3a cells and (10) 2a cells per half block over 60% of the street length.

RAIN GARDEN SYSTEM COMPONENTS				CONVERSION FACTORS			
	Infiltration Rate into Native Subgrade (in/hr)		<b>0.50</b>	conversion factor from cf to gallons		7.48	
<b>SECTION 01 RG</b>	1.5	25.00	2.00% (biosoil depth/lf/slope)	conversion factor from cfs to MGD:		0.6452	
	Number of Section 1 Rain Gardens for Basin (ea)		<b>0</b>	conversion factor from cfs to cf/per time step:		600	
	Total Infiltration Area for Section 1 Rain Gardens (sf)*		0	<b>RESULTS SUMMARY</b>			
	Storage Capacity for a single Section 1 Rain Garden (cf)		88	volume controlled from 10:00 on 11/01/84 to 10:00 on 11/02/84	4,155	(cf per GSI half block)	
	Total Storage Capacity for Section 1 Rain Gardens (cf)		0		31,080	(gal per GSI half block)	
<b>SECTION 02 RG</b>	1.5	28	3.00% (biosoil depth/lf/slope)	Total volume of runoff removed from 9:30 to 9:50 of the 1984 storm	3,467	(gal per GSI half block)	
	Number of Section 2 Rain Gardens for Basin (ea)		<b>10</b>	Assumed Half blocks to modify with GSI	<b>30.0</b>	(apply to most feasible half blocks: 30 half blocks)	
	Total Infiltration Area for Section 2 Rain Gardens (sf)*		1606	volume controlled during 9:30 to 9:50 on 11/02/84 (gal)	104,018		
	Storage Capacity for a single Section 2 Rain Garden (cf)		155	volume of rain gardens in subbasin 416 (gal)	616,579		Scenario 3 the average
	Total Storage Capacity for Section 2 Rain Gardens (cf)		1545	flow reduction at peak (MGD)	6.7		of the 2a/3a and 2b/3b
<b>SECTION 03 RG</b>	1.5	28	3.00% (biosoil depth/lf/slope)	volume controlled from 10:00 on 11/01/84 to 10:00 on 11/02/84 (gal)	932,405		combination results
	Number of Section 3 Rain Gardens for Basin (ea)		<b>4</b>				
	Total Infiltration Area for Section 3 Rain Gardens (sf)*		1217				
	Storage Capacity for a single Section 3 Rain Garden (cf)		301				
	Total Storage Capacity for Section 3 Rain Gardens (cf)		1202				

Rainfall Distribution: 1984 Storm

**RAIN GARDEN SYSTEM SUMMARY**

Total Infiltration Flow (cfs)	0.0327
Total Swale Storage Capacity (cf)	2747.7

Target flow reduction from subbasin 416 (MGD)	<b>14.6</b>	per John Phillips
Flow reduction from assumed half block at peak flow(MGD)	0.224952925	
Half blocks needed to get total flow reduction out of subbasin 416	64.9	

Time (hours)	Time (minutes)	Design Flow Rate from Rain Event (cfs)	Inflow Water Volume (cf)	Inflow Cumm. Volume (cf)	Check if inflow infiltrates Initial Exfiltration to Native Subgrade of Inflow (cfs)	Check if storage infiltrates Infiltration into Native Subgrade of Stored Water (cfs)	Total Infiltration into Native Subgrade (cfs)	Inflow to Swale After Infiltration into Native Subgrade (cfs)	Swale Storage before Overflow Volume (cf)	Overtop Flow to Pump Station (cfs)	Runoff Stored in Swale Storage Volume (cf)	Volume of Runoff Removed From Pump Station (cf)	Date & Time	Amount Flow Reduced to Pump Station (cfs)	Amount Flow Reduced to Pump Station (MGD)
0	0	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0			
0.17	10	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:00	0.000	
0.33	20	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:10	0.000	
0.50	30	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:20	0.000	
0.67	40	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:30	0.000	
0.83	50	0.003	1.90	1.90	0.0032	0.0000	0.0032	0.0000	0.00	0.00	0.00	1.900626807	11/1/1984 10:40	0.003	
1.00	60	0.009	5.61	7.51	0.0093	0.0000	0.0093	0.0000	0.00	0.00	0.00	5.605567335	11/1/1984 10:50	0.009	
1.17	70	0.015	9.09	16.59	0.0151	0.0000	0.0151	0.0000	0.00	0.00	0.00	9.085690673	11/1/1984 11:00	0.015	
1.33	80	0.020	12.17	28.77	0.0203	0.0000	0.0203	0.0000	0.00	0.00	0.00	12.17466638	11/1/1984 11:10	0.020	
1.50	90	0.030	17.81	46.58	0.0297	0.0000	0.0297	0.0000	0.00	0.00	0.00	17.8143958	11/1/1984 11:20	0.030	
1.67	100	0.035	21.20	67.78	0.0327	0.0000	0.0327	0.0027	1.60	0.00	1.60	21.19743158	11/1/1984 11:30	0.035	
1.83	110	0.034	20.50	88.28	0.0327	0.0000	0.0327	0.0015	2.50	0.00	2.50	20.50300898	11/1/1984 11:40	0.034	
2.00	120	0.035	21.06	109.35	0.0327	0.0000	0.0327	0.0024	3.97	0.00	3.97	21.06473615	11/1/1984 11:50	0.035	
2.17	130	0.030	18.09	127.43	0.0301	0.0025	0.0327	0.0000	2.46	0.00	2.46	18.08536098	11/1/1984 12:00	0.030	
2.33	140	0.029	17.54	144.97	0.0292	0.0034	0.0327	0.0000	0.40	0.00	0.40	17.53865912	11/1/1984 12:10	0.029	
2.50	150	0.043	25.66	170.63	0.0327	0.0000	0.0327	0.0101	6.46	0.00	6.46	25.6553555	11/1/1984 12:20	0.043	
2.67	160	0.055	33.13	203.76	0.0327	0.0000	0.0327	0.0226	19.99	0.00	19.99	33.13403255	11/1/1984 12:30	0.055	
2.83	170	0.061	36.48	240.24	0.0327	0.0000	0.0327	0.0281	36.87	0.00	36.87	36.47754794	11/1/1984 12:40	0.061	
3.00	180	0.080	47.78	288.01	0.0327	0.0000	0.0327	0.0470	65.05	0.00	65.05	47.77688775	11/1/1984 12:50	0.080	
3.17	190	0.080	48.09	336.10	0.0327	0.0000	0.0327	0.0475	93.54	0.00	93.54	48.08714279	11/1/1984 13:00	0.080	
3.33	200	0.075	44.98	381.08	0.0327	0.0000	0.0327	0.0423	118.92	0.00	118.92	44.98314287	11/1/1984 13:10	0.075	
3.50	210	0.100	59.81	440.89	0.0327	0.0000	0.0327	0.0670	159.14	0.00	159.14	59.81060881	11/1/1984 13:20	0.100	
3.67	220	0.110	66.19	507.08	0.0327	0.0000	0.0327	0.0777	205.73	0.00	205.73	66.18986175	11/1/1984 13:30	0.110	
3.83	230	0.107	64.45	571.54	0.0327	0.0000	0.0327	0.0748	250.58	0.00	250.58	64.45468198	11/1/1984 13:40	0.107	
4.00	240	0.108	64.89	636.43	0.0327	0.0000	0.0327	0.0755	295.87	0.00	295.87	64.88628415	11/1/1984 13:50	0.108	
4.17	250	0.101	60.31	696.74	0.0327	0.0000	0.0327	0.0679	336.59	0.00	336.59	60.31248582	11/1/1984 14:00	0.101	
4.33	260	0.080	48.14	744.88	0.0327	0.0000	0.0327	0.0476	365.13	0.00	365.13	48.13781342	11/1/1984 14:10	0.080	
4.50	270	0.065	38.72	783.60	0.0327	0.0000	0.0327	0.0319	384.25	0.00	384.25	38.72385189	11/1/1984 14:20	0.065	
4.67	280	0.060	35.78	819.38	0.0327	0.0000	0.0327	0.0270	400.43	0.00	400.43	35.77643213	11/1/1984 14:30	0.060	
4.83	290	0.078	46.63	866.01	0.0327	0.0000	0.0327	0.0451	427.46	0.00	427.46	46.63284372	11/1/1984 14:40	0.078	
5.00	300	0.094	56.41	922.42	0.0327	0.0000	0.0327	0.0614	464.27	0.00	464.27	56.40882598	11/1/1984 14:50	0.094	
5.17	310	0.100	60.23	982.65	0.0327	0.0000	0.0327	0.0677	504.91	0.00	504.91	60.22934692	11/1/1984 15:00	0.100	
5.33	320	0.113	67.94	1050.59	0.0327	0.0000	0.0327	0.0806	553.25	0.00	553.25	67.94245789	11/1/1984 15:10	0.113	
5.50	330	0.118	71.07	1121.66	0.0327	0.0000	0.0327	0.0858	604.72	0.00	604.72	71.07203902	11/1/1984 15:20	0.118	
5.67	340	0.111	66.46	1188.13	0.0327	0.0000	0.0327	0.0781	651.59	0.00	651.59	66.46357161	11/1/1984 15:30	0.111	
5.83	350	0.109	65.36	1253.48	0.0327	0.0000	0.0327	0.0763	697.35	0.00	697.35	65.35638515	11/1/1984 15:40	0.109	
6.00	360	0.109	65.29	1318.77	0.0327	0.0000	0.0327	0.0762	743.04	0.00	743.04	65.2909189	11/1/1984 15:50	0.109	
6.17	370	0.088	53.05	1371.82	0.0327	0.0000	0.0327	0.0557	776.49	0.00	776.49	53.04664664	11/1/1984 16:00	0.088	
6.33	380	0.061	36.53	1408.35	0.0327	0.0000	0.0327	0.0282	793.42	0.00	793.42	36.53184299	11/1/1984 16:10	0.061	
6.50	390	0.041	24.78	1433.13	0.0327	0.0000	0.0327	0.0086	798.61	0.00	798.61	24.7824167	11/1/1984 16:20	0.041	
6.67	400	0.035	20.89	1454.02	0.0327	0.0000	0.0327	0.0022	799.90	0.00	799.90	20.89120721	11/1/1984 16:30	0.035	
6.83	410	0.022	13.29	1467.31	0.0221	0.0105	0.0327	0.0000	793.59	0.00	793.59	13.28520482	11/1/1984 16:40	0.022	
7.00	420	0.007	4.43	1471.74	0.0074	0.0253	0.0327	0.0000	778.42	0.00	778.42	4.428401606	11/1/1984 16:50	0.007	
7.17	430	0.013	7.81	1479.55	0.0130	0.0196	0.0327	0.0000	766.63	0.00	766.63	7.809950826	11/1/1984 17:00	0.013	



7.33	440	0.015	8.94	1488.49	0.0149	0.0178	0.0327	0.0000	755.97	0.00	755.97	8.9371339	11/1/1984 17:10	0.015
7.50	450	0.005	2.98	1491.46	0.0050	0.0277	0.0327	0.0000	739.35	0.00	739.35	2.979044633	11/1/1984 17:20	0.005
7.67	460	0.002	0.99	1492.46	0.0017	0.0310	0.0327	0.0000	720.74	0.00	720.74	0.993014878	11/1/1984 17:30	0.002
7.83	470	0.001	0.33	1492.79	0.0006	0.0321	0.0327	0.0000	701.48	0.00	701.48	0.331004959	11/1/1984 17:40	0.001
8.00	480	0.021	12.81	1505.60	0.0214	0.0113	0.0327	0.0000	694.69	0.00	694.69	12.81427851	11/1/1984 17:50	0.021
8.17	490	0.050	29.73	1535.33	0.0327	0.0000	0.0327	0.0169	704.82	0.00	704.82	29.72654198	11/1/1984 18:00	0.050
8.33	500	0.059	35.46	1570.79	0.0327	0.0000	0.0327	0.0264	720.68	0.00	720.68	35.45705237	11/1/1984 18:10	0.059
8.50	510	0.062	37.46	1608.24	0.0327	0.0000	0.0327	0.0298	738.54	0.00	738.54	37.45763197	11/1/1984 18:20	0.062
8.67	520	0.074	44.67	1652.91	0.0327	0.0000	0.0327	0.0418	763.61	0.00	763.61	44.67062384	11/1/1984 18:30	0.074
8.83	530	0.089	53.67	1706.58	0.0327	0.0000	0.0327	0.0568	797.68	0.00	797.68	53.66992088	11/1/1984 18:40	0.089
9.00	540	0.095	56.85	1763.44	0.0327	0.0000	0.0327	0.0621	834.94	0.00	834.94	56.85265588	11/1/1984 18:50	0.095
9.17	550	0.097	58.09	1821.53	0.0327	0.0000	0.0327	0.0642	873.43	0.00	873.43	58.08915945	11/1/1984 19:00	0.097
9.33	560	0.109	65.25	1886.78	0.0327	0.0000	0.0327	0.0761	919.08	0.00	919.08	65.25268773	11/1/1984 19:10	0.109
9.50	570	0.080	48.03	1934.81	0.0327	0.0000	0.0327	0.0474	947.51	0.00	947.51	48.0283904	11/1/1984 19:20	0.080
9.67	580	0.049	29.20	1964.01	0.0327	0.0000	0.0327	0.0160	957.11	0.00	957.11	29.20093819	11/1/1984 19:30	0.049
9.83	590	0.049	29.53	1993.54	0.0327	0.0000	0.0327	0.0166	967.05	0.00	967.05	29.53364677	11/1/1984 19:40	0.049
10.00	600	0.038	23.07	2016.61	0.0327	0.0000	0.0327	0.0058	970.52	0.00	970.52	23.06998223	11/1/1984 19:50	0.038
10.17	610	0.024	14.31	2030.92	0.0238	0.0088	0.0327	0.0000	965.23	0.00	965.23	14.3069014	11/1/1984 20:00	0.024
10.33	620	0.019	11.39	2042.31	0.0190	0.0137	0.0327	0.0000	957.03	0.00	957.03	11.3941499	11/1/1984 20:10	0.019
10.50	630	0.051	30.35	2072.66	0.0327	0.0000	0.0327	0.0179	967.78	0.00	967.78	30.34740281	11/1/1984 20:20	0.051
10.67	640	0.072	43.36	2116.02	0.0327	0.0000	0.0327	0.0396	991.54	0.00	991.54	43.36226966	11/1/1984 20:30	0.072
10.83	650	0.057	34.45	2150.47	0.0327	0.0000	0.0327	0.0248	1006.39	0.00	1006.39	34.44910265	11/1/1984 20:40	0.057
11.00	660	0.030	18.16	2168.63	0.0303	0.0024	0.0327	0.0000	1004.95	0.00	1004.95	18.15574833	11/1/1984 20:50	0.030
11.17	670	0.021	12.73	2181.36	0.0212	0.0114	0.0327	0.0000	998.08	0.00	998.08	12.73221472	11/1/1984 21:00	0.021
11.33	680	0.018	10.92	2192.28	0.0182	0.0145	0.0327	0.0000	989.41	0.00	989.41	10.92437018	11/1/1984 21:10	0.018
11.50	690	0.006	3.64	2195.93	0.0061	0.0266	0.0327	0.0000	973.45	0.00	973.45	3.641456727	11/1/1984 21:20	0.006
11.67	700	0.013	7.90	2203.83	0.0132	0.0195	0.0327	0.0000	961.76	0.00	961.76	7.90161	11/1/1984 21:30	0.013
11.83	710	0.027	16.02	2219.84	0.0267	0.0060	0.0327	0.0000	958.17	0.00	958.17	16.01685421	11/1/1984 21:40	0.027
12.00	720	0.020	12.03	2231.88	0.0201	0.0126	0.0327	0.0000	950.61	0.00	950.61	12.03414452	11/1/1984 21:50	0.020
12.17	730	0.018	10.71	2242.59	0.0179	0.0148	0.0327	0.0000	941.73	0.00	941.73	10.71388771	11/1/1984 22:00	0.018
12.33	740	0.017	10.27	2252.87	0.0171	0.0155	0.0327	0.0000	932.40	0.00	932.40	10.27380211	11/1/1984 22:10	0.017
12.50	750	0.006	3.42	2256.29	0.0057	0.0270	0.0327	0.0000	916.23	0.00	916.23	3.424600704	11/1/1984 22:20	0.006
12.67	760	0.002	1.14	2257.43	0.0019	0.0308	0.0327	0.0000	897.77	0.00	897.77	1.141533568	11/1/1984 22:30	0.002
12.83	770	0.001	0.38	2257.81	0.0006	0.0320	0.0327	0.0000	878.55	0.00	878.55	0.380511189	11/1/1984 22:40	0.001
13.00	780	0.000	0.13	2257.94	0.0002	0.0325	0.0327	0.0000	859.08	0.00	859.08	0.126837063	11/1/1984 22:50	0.000
13.17	790	0.000	0.04	2257.98	0.0001	0.0326	0.0327	0.0000	839.53	0.00	839.53	0.042279021	11/1/1984 23:00	0.000
13.33	800	0.011	6.72	2264.71	0.0112	0.0215	0.0327	0.0000	826.65	0.00	826.65	6.723824864	11/1/1984 23:10	0.011
13.50	810	0.026	15.67	2280.37	0.0261	0.0066	0.0327	0.0000	822.72	0.00	822.72	15.66787833	11/1/1984 23:20	0.026
13.67	820	0.031	18.66	2299.04	0.0311	0.0016	0.0327	0.0000	821.79	0.00	821.79	18.66342426	11/1/1984 23:30	0.031
13.83	830	0.022	12.95	2311.98	0.0216	0.0111	0.0327	0.0000	815.13	0.00	815.13	12.94506805	11/1/1984 23:40	0.022
14.00	840	0.007	4.32	2316.30	0.0072	0.0255	0.0327	0.0000	799.85	0.00	799.85	4.315022683	11/1/1984 23:50	0.007
14.17	850	0.002	1.44	2317.74	0.0024	0.0303	0.0327	0.0000	781.69	0.00	781.69	1.438340894	11/2/1984 0:00	0.002
14.33	860	0.001	0.48	2318.21	0.0008	0.0319	0.0327	0.0000	762.57	0.00	762.57	0.479446965	11/2/1984 0:10	0.001
14.50	870	0.000	0.16	2318.37	0.0003	0.0324	0.0327	0.0000	743.13	0.00	743.13	0.159815655	11/2/1984 0:20	0.000
14.67	880	0.000	0.05	2318.43	0.0001	0.0326	0.0327	0.0000	723.59	0.00	723.59	0.053271885	11/2/1984 0:30	0.000
14.83	890	0.011	6.75	2325.18	0.0112	0.0214	0.0327	0.0000	710.74	0.00	710.74	6.748655864	11/2/1984 0:40	0.011
15.00	900	0.026	15.72	2340.89	0.0262	0.0065	0.0327	0.0000	706.86	0.00	706.86	15.71823923	11/2/1984 0:50	0.026
15.17	910	0.031	18.72	2359.62	0.0312	0.0015	0.0327	0.0000	705.98	0.00	705.98	18.72180016	11/2/1984 1:00	0.031
15.33	920	0.022	12.99	2372.60	0.0216	0.0110	0.0327	0.0000	699.37	0.00	699.37	12.98519843	11/2/1984 1:10	0.022
15.50	930	0.018	11.08	2383.68	0.0185	0.0142	0.0327	0.0000	690.85	0.00	690.85	11.07972836	11/2/1984 1:20	0.018
15.67	940	0.029	17.20	2400.88	0.0287	0.0040	0.0327	0.0000	688.45	0.00	688.45	17.20255319	11/2/1984 1:30	0.029
15.83	950	0.021	12.49	2413.38	0.0208	0.0118	0.0327	0.0000	681.35	0.00	681.35	12.49216591	11/2/1984 1:40	0.021
16.00	960	0.007	4.16	2417.54	0.0069	0.0257	0.0327	0.0000	665.91	0.00	665.91	4.164055302	11/2/1984 1:50	0.007
16.17	970	0.002	1.39	2418.93	0.0023	0.0304	0.0327	0.0000	647.70	0.00	647.70	1.388018434	11/2/1984 2:00	0.002
16.33	980	0.001	0.46	2419.39	0.0008	0.0319	0.0327	0.0000	628.57	0.00	628.57	0.462672811	11/2/1984 2:10	0.001
16.50	990	0.000	0.15	2419.55	0.0003	0.0324	0.0327	0.0000	609.12	0.00	609.12	0.15422427	11/2/1984 2:20	0.000
16.67	1000	0.011	6.82	2426.36	0.0114	0.0213	0.0327	0.0000	596.34	0.00	596.34	6.81596559	11/2/1984 2:30	0.011
16.83	1010	0.015	9.04	2435.40	0.0151	0.0176	0.0327	0.0000	585.78	0.00	585.78	9.03654603	11/2/1984 2:40	0.015
17.00	1020	0.005	3.01	2438.41	0.0050	0.0276	0.0327	0.0000	569.19	0.00	569.19	3.01218201	11/2/1984 2:50	0.005
17.17	1030	0.036	21.34	2459.75	0.0327	0.0000	0.0327	0.0029	570.93	0.00	570.93	21.33644097	11/2/1984 3:00	0.036
17.33	1040	0.057	34.23	2493.98	0.0327	0.0000	0.0327	0.0244	585.57	0.00	585.57	34.2346465	11/2/1984 3:10	0.057
17.50	1050	0.064	38.61	2532.59	0.0327	0.0000	0.0327	0.0317	604.58	0.00	604.58	38.60901216	11/2/1984 3:20	0.064
17.67	1060	0.090	53.74	2586.33	0.0327	0.0000	0.0327	0.0569	638.72	0.00	638.72	53.73840931	11/2/1984 3:30	0.090
17.83	1070	0.087	52.04	2638.37	0.0327	0.0000	0.0327	0.0541	671.17	0.00	671.17	52.04427864	11/2/1984 3:40	0.087
18.00	1080	0.086	51.57	2689.94	0.0327	0.0000	0.0327	0.0533	703.13	0.00	703.13	51.56576199	11/2/1984 3:50	0.086
18.17	1090	0.086	51.46	2741.40	0.0327	0.0000	0.0327	0.0531	735.00	0.00	735.00	51.46217019	11/2/1984 4:00	0.086
18.33	1100	0.063	37.75	2779.15	0.0327	0.0000	0.0327	0.0303	753.15	0.00	753.15	37.75115306	11/2/1984 4:10	0.063
18.50	1110	0.032	19.45	2798.61	0.0324	0.0002	0.0327	0.0000	753.01	0.00	753.01	19.4548192	11/2/1984 4:20	0.032
18.67	1120	0.011	6.48	2805.09	0.0108	0.0219	0.0327	0.0000	739.89	0.00	739.89	6.484939734	11/2/1984 4:30	0.011
18.83	1130	0.015	9.04	2814.13	0.0151	0.0176	0.0327	0.0000	729.33	0.00	729.33	9.038074298	11/2/1984 4:40	0.015
19.00	1140	0.016	9.89	2										



19.83	1190	0.067	39.95	2995.34	0.0327	0.0000	0.0327	0.0339	792.96	0.00	792.96	39.95024716	11/2/1984 5:40	0.067	
20.00	1200	0.022	13.32	3008.66	0.0222	0.0105	0.0327	0.0000	786.68	0.00	786.68	13.31674905	11/2/1984 5:50	0.022	
20.17	1210	0.007	4.44	3013.10	0.0074	0.0253	0.0327	0.0000	771.52	0.00	771.52	4.438916352	11/2/1984 6:00	0.007	
20.33	1220	0.026	15.34	3028.44	0.0256	0.0071	0.0327	0.0000	767.26	0.00	767.26	15.33782866	11/2/1984 6:10	0.026	
20.50	1230	0.066	39.79	3068.23	0.0327	0.0000	0.0327	0.0337	787.45	0.00	787.45	39.79322295	11/2/1984 6:20	0.066	
20.67	1240	0.068	41.04	3109.27	0.0327	0.0000	0.0327	0.0357	808.89	0.00	808.89	41.03682138	11/2/1984 6:30	0.068	
20.83	1250	0.034	20.63	3129.90	0.0327	0.0000	0.0327	0.0017	809.92	0.00	809.92	20.62893067	11/2/1984 6:40	0.034	
21.00	1260	0.023	13.83	3143.73	0.0231	0.0096	0.0327	0.0000	804.15	0.00	804.15	13.83081518	11/2/1984 6:50	0.023	
21.17	1270	0.031	18.52	3162.25	0.0309	0.0018	0.0327	0.0000	803.08	0.00	803.08	18.52375145	11/2/1984 7:00	0.031	
21.33	1280	0.068	41.01	3203.26	0.0327	0.0000	0.0327	0.0357	824.50	0.00	824.50	41.01327857	11/2/1984 7:10	0.068	
21.50	1290	0.116	69.50	3272.76	0.0327	0.0000	0.0327	0.0832	874.40	0.00	874.40	69.49861027	11/2/1984 7:20	0.116	
21.67	1300	0.132	79.13	3351.89	0.0327	0.0000	0.0327	0.0992	933.92	0.00	933.92	79.12727626	11/2/1984 7:30	0.132	
21.83	1310	0.114	68.42	3420.31	0.0327	0.0000	0.0327	0.0814	982.75	0.00	982.75	68.41945057	11/2/1984 7:40	0.114	
22.00	1320	0.061	36.84	3457.15	0.0327	0.0000	0.0327	0.0287	999.98	0.00	999.98	36.83689993	11/2/1984 7:50	0.061	
22.17	1330	0.032	19.30	3476.45	0.0322	0.0005	0.0327	0.0000	999.69	0.00	999.69	19.29998862	11/2/1984 8:00	0.032	
22.33	1340	0.022	13.45	3489.90	0.0224	0.0102	0.0327	0.0000	993.54	0.00	993.54	13.45435151	11/2/1984 8:10	0.022	
22.50	1350	0.007	4.48	3494.39	0.0075	0.0252	0.0327	0.0000	978.43	0.00	978.43	4.484783837	11/2/1984 8:20	0.007	
22.67	1360	0.002	1.49	3495.88	0.0025	0.0302	0.0327	0.0000	960.33	0.00	960.33	1.494927946	11/2/1984 8:30	0.002	
22.83	1370	0.001	0.50	3496.38	0.0008	0.0318	0.0327	0.0000	941.23	0.00	941.23	0.498309315	11/2/1984 8:40	0.001	
23.00	1380	0.024	14.22	3510.60	0.0237	0.0090	0.0327	0.0000	935.85	0.00	935.85	14.21959294	11/2/1984 8:50	0.024	0.015289885
23.17	1390	0.043	25.83	3536.42	0.0327	0.0000	0.0327	0.0104	942.07	0.00	942.07	25.82575075	11/2/1984 9:00	0.043	0.027769624
23.33	1400	0.026	15.64	3552.06	0.0261	0.0066	0.0327	0.0000	938.12	0.00	938.12	15.64098018	11/2/1984 9:10	0.026	0.016818258
23.50	1410	0.232	139.50	3691.56	0.0327	0.0000	0.0327	0.1998	1058.02	0.00	1058.02	139.4988459	11/2/1984 9:20	0.232	0.149998759
23.67	1420	0.349	209.21	3900.77	0.0327	0.0000	0.0327	0.3160	1247.63	0.00	1247.63	209.2062202	11/2/1984 9:30	0.349	0.224952925
23.83	1430	0.247	148.01	4048.78	0.0327	0.0000	0.0327	0.2140	1376.04	0.00	1376.04	148.0098299	11/2/1984 9:40	0.247	0.159150355
24.00	1440	0.177	106.32	4155.10	0.0327	0.0000	0.0327	0.1445	1462.76	0.00	1462.76	106.3230673	11/2/1984 9:50	0.177	0.114325879
24.17	1450	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	1443.16	0.00	1443.16	0	11/2/1984 10:00	0.000	
24.33	1460	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	1423.57	0.00	1423.57	0	11/2/1984 10:10	0.000	
24.50	1470	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	1403.97	0.00	1403.97	0	11/2/1984 10:20	0.000	
24.67	1480	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	1384.37	0.00	1384.37	0	11/2/1984 10:30	0.000	
24.83	1490	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	1364.77	0.00	1364.77	0	11/2/1984 10:40	0.000	
25.00	1500	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	1345.17	0.00	1345.17	0	11/2/1984 10:50	0.000	
25.17	1510	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	1325.58	0.00	1325.58	0	11/2/1984 11:00	0.000	
25.33	1520	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	1305.98	0.00	1305.98	0	11/2/1984 11:10	0.000	
25.50	1530	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	1286.38	0.00	1286.38	0	11/2/1984 11:20	0.000	
25.67	1540	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	1266.78	0.00	1266.78	0	11/2/1984 11:30	0.000	
25.83	1550	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	1247.18	0.00	1247.18	0	11/2/1984 11:40	0.000	
26.00	1560	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	1227.58	0.00	1227.58	0	11/2/1984 11:50	0.000	
26.17	1570	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	1207.99	0.00	1207.99	0	11/2/1984 12:00	0.000	
26.33	1580	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	1188.39	0.00	1188.39	0	11/2/1984 12:10	0.000	
26.50	1590	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	1168.79	0.00	1168.79	0	11/2/1984 12:20	0.000	
26.67	1600	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	1149.19	0.00	1149.19	0	11/2/1984 12:30	0.000	
26.83	1610	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	1129.59	0.00	1129.59	0	11/2/1984 12:40	0.000	
27.00	1620	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	1109.99	0.00	1109.99	0	11/2/1984 12:50	0.000	
27.17	1630	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	1090.40	0.00	1090.40	0	11/2/1984 13:00	0.000	
27.33	1640	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	1070.80	0.00	1070.80	0	11/2/1984 13:10	0.000	
27.50	1650	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	1051.20	0.00	1051.20	0	11/2/1984 13:20	0.000	
27.67	1660	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	1031.60	0.00	1031.60	0	11/2/1984 13:30	0.000	
27.83	1670	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	1012.00	0.00	1012.00	0	11/2/1984 13:40	0.000	
28.00	1680	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	992.41	0.00	992.41	0	11/2/1984 13:50	0.000	
28.17	1690	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	972.81	0.00	972.81	0	11/2/1984 14:00	0.000	
28.33	1700	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	953.21	0.00	953.21	0	11/2/1984 14:10	0.000	
28.50	1710	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	933.61	0.00	933.61	0	11/2/1984 14:20	0.000	
28.67	1720	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	914.01	0.00	914.01	0	11/2/1984 14:30	0.000	
28.83	1730	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	894.41	0.00	894.41	0	11/2/1984 14:40	0.000	
29.00	1740	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	874.82	0.00	874.82	0	11/2/1984 14:50	0.000	
29.17	1750	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	855.22	0.00	855.22	0	11/2/1984 15:00	0.000	
29.33	1760	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	835.62	0.00	835.62	0	11/2/1984 15:10	0.000	
29.50	1770	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	816.02	0.00	816.02	0	11/2/1984 15:20	0.000	
29.67	1780	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	796.42	0.00	796.42	0	11/2/1984 15:30	0.000	
29.83	1790	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	776.82	0.00	776.82	0	11/2/1984 15:40	0.000	
30.00	1800	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	757.23	0.00	757.23	0	11/2/1984 15:50	0.000	
30.17	1810	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	737.63	0.00	737.63	0	11/2/1984 16:00	0.000	
30.33	1820	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	718.03	0.00	718.03	0	11/2/1984 16:10	0.000	
30.50	1830	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	698.43	0.00	698.43	0	11/2/1984 16:20	0.000	
30.67	1840	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	678.83	0.00	678.83	0	11/2/1984 16:30	0.000	
30.83	1850	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	659.24	0.00	659.24	0	11/2/1984 16:40	0.000	
31.00	1860	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	639.64	0.00	639.64	0	11/2/1984 16:50	0.000	
31.17	1870	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	620.04	0.00	620.04	0	11/2/1984 17:00	0.000	
31.33	1880	0.000	0.00	4155.10	0.0000	0.0327	0.0327	0.0000	600.44	0.00	600.44	0	11/2/1984 17:10	0.000	













**King County CSO**  
**Barton Basin Subbasin 416 - GSI Option**  
SvR Project No. 06053  
DATE: 06/14/2010

Combination of (4) 3b cells and (6) 2b cells per half block over 60% of the street length.

**RAIN GARDEN SYSTEM COMPONENTS**

	Infiltration Rate into Native Subgrade (in/hr)	0.50	
<b>SECTION 01 RG</b>	1.5	25.00	2.00% (biosoil depth/lf/slope)
	Number of Section 1 Rain Gardens for Basin (ea)	0	
	Total Infiltration Area for Section 1 Rain Gardens (sf)*	0	
	Storage Capacity for a single Section 1 Rain Garden (cf)	88	
	Total Storage Capacity for Section 1 Rain Gardens (cf)	0	
<b>SECTION 02 RG</b>	1.5	42	2.00% (biosoil depth/lf/slope)
	Number of Section 2 Rain Gardens for Basin (ea)	6	
	Total Infiltration Area for Section 2 Rain Gardens (sf)*	1445	
	Storage Capacity for a single Section 2 Rain Garden (cf)	232	
	Total Storage Capacity for Section 2 Rain Gardens (cf)	1391	
<b>SECTION 03 RG</b>	1.5	42	2.00% (biosoil depth/lf/slope)
	Number of Section 3 Rain Gardens for Basin (ea)	4	
	Total Infiltration Area for Section 3 Rain Gardens (sf)*	1825	
	Storage Capacity for a single Section 3 Rain Garden (cf)	451	
	Total Storage Capacity for Section 3 Rain Gardens (cf)	1803	

**CONVERSION FACTORS**

conversion factor from cf to gallons	7.48
conversion factor from cfs to MGD:	0.6452
conversion factor from cfs to cf/per time step:	600

**RESULTS SUMMARY**

volume controlled from 10:00 on 11/01/84 to 10:00 on 11/02/84	4,155	(cf per GSI half block)
	31,080	(gal per GSI half block)
Total volume of runoff removed from 9:30 to 9:50 of the 1984 storm	3,467	(gal per GSI half block)

Assumed Half blocks to modify with GSI **30.0** (apply to most feasible half blocks: 30 half blocks)  
 volume controlled during 9:30 to 9:50 on 11/02/84 (gal) 104,018  
 volume of rain gardens in subbasin 416 (gal) 716,799  
 flow reduction at peak (MGD) 6.7  
 volume controlled from 10:00 on 11/01/84 to 10:00 on 11/02/84 (gal) 932,405  
**Scenario 3 the average of the 2a/3a and 2b/3b combination results**

Rainfall Distribution: 1984 Storm

**RAIN GARDEN SYSTEM SUMMARY**

Total Infiltration Flow (cfs)	0.0378
Total Swale Storage Capacity (cf)	3194.3

Target flow reduction from subbasin 416 (MGD) **14.6** per John Phillips  
 Flow reduction from assumed half block at peak flow(MGD) 0.224952925  
 Half blocks needed to get total flow reduction out of subbasin 416 64.9

Time (hours)	Time (minutes)	Design Flow Rate from Rain Event (cfs)	Inflow Water Volume (cf)	Inflow Cumm. Volume (cf)	Check if inflow infiltrates Initial Exfiltration to Native Subgrade of Inflow (cfs)	Check if storage infiltrates Infiltration into Native Subgrade of Stored Water (cfs)	Total Infiltration into Native Subgrade (cfs)	Inflow to Swale After Infiltration into Native Subgrade (cfs)	Swale Storage before Overflow Volume (cf)	Overtop Flow to Pump Station (cfs)	Runoff Stored in Swale Storage Volume (cf)	Volume of Runoff Removed From Pump Station (cf)	Date & Time	Amount Flow Reduced to Pump Station (cfs)	Amount Flow Reduced to Pump Station (MGD)
0	0	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0			
0.17	10	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:00	0.000	
0.33	20	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:10	0.000	
0.50	30	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:20	0.000	
0.67	40	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:30	0.000	
0.83	50	0.003	1.90	1.90	0.0032	0.0000	0.0032	0.0000	0.00	0.00	0.00	1.900626807	11/1/1984 10:40	0.003	
1.00	60	0.009	5.61	7.51	0.0093	0.0000	0.0093	0.0000	0.00	0.00	0.00	5.605567335	11/1/1984 10:50	0.009	
1.17	70	0.015	9.09	16.59	0.0151	0.0000	0.0151	0.0000	0.00	0.00	0.00	9.085690673	11/1/1984 11:00	0.015	
1.33	80	0.020	12.17	28.77	0.0203	0.0000	0.0203	0.0000	0.00	0.00	0.00	12.17466638	11/1/1984 11:10	0.020	
1.50	90	0.030	17.81	46.58	0.0297	0.0000	0.0297	0.0000	0.00	0.00	0.00	17.8143958	11/1/1984 11:20	0.030	
1.67	100	0.035	21.20	67.78	0.0353	0.0000	0.0353	0.0000	0.00	0.00	0.00	21.19743158	11/1/1984 11:30	0.035	
1.83	110	0.034	20.50	88.28	0.0342	0.0000	0.0342	0.0000	0.00	0.00	0.00	20.50300898	11/1/1984 11:40	0.034	
2.00	120	0.035	21.06	109.35	0.0351	0.0000	0.0351	0.0000	0.00	0.00	0.00	21.06473615	11/1/1984 11:50	0.035	
2.17	130	0.030	18.09	127.43	0.0301	0.0000	0.0301	0.0000	0.00	0.00	0.00	18.08536098	11/1/1984 12:00	0.030	
2.33	140	0.029	17.54	144.97	0.0292	0.0000	0.0292	0.0000	0.00	0.00	0.00	17.53865912	11/1/1984 12:10	0.029	
2.50	150	0.043	25.66	170.63	0.0378	0.0000	0.0378	0.0049	2.95	0.00	2.95	25.6553555	11/1/1984 12:20	0.043	
2.67	160	0.055	33.13	203.76	0.0378	0.0000	0.0378	0.0174	13.37	0.00	13.37	33.13403255	11/1/1984 12:30	0.055	
2.83	170	0.061	36.48	240.24	0.0378	0.0000	0.0378	0.0229	27.14	0.00	27.14	36.47754794	11/1/1984 12:40	0.061	
3.00	180	0.080	47.78	288.01	0.0378	0.0000	0.0378	0.0418	52.21	0.00	52.21	47.77688775	11/1/1984 12:50	0.080	
3.17	190	0.080	48.09	336.10	0.0378	0.0000	0.0378	0.0423	77.59	0.00	77.59	48.08714279	11/1/1984 13:00	0.080	
3.33	200	0.075	44.98	381.08	0.0378	0.0000	0.0378	0.0371	99.86	0.00	99.86	44.98314287	11/1/1984 13:10	0.075	
3.50	210	0.100	59.81	440.89	0.0378	0.0000	0.0378	0.0618	136.97	0.00	136.97	59.81060881	11/1/1984 13:20	0.100	
3.67	220	0.110	66.19	507.08	0.0378	0.0000	0.0378	0.0725	180.45	0.00	180.45	66.18986175	11/1/1984 13:30	0.110	
3.83	230	0.107	64.45	571.54	0.0378	0.0000	0.0378	0.0696	222.19	0.00	222.19	64.45468198	11/1/1984 13:40	0.107	
4.00	240	0.108	64.89	636.43	0.0378	0.0000	0.0378	0.0703	264.37	0.00	264.37	64.88628415	11/1/1984 13:50	0.108	
4.17	250	0.101	60.31	696.74	0.0378	0.0000	0.0378	0.0627	301.98	0.00	301.98	60.31248582	11/1/1984 14:00	0.101	
4.33	260	0.080	48.14	744.88	0.0378	0.0000	0.0378	0.0424	327.41	0.00	327.41	48.13781342	11/1/1984 14:10	0.080	
4.50	270	0.065	38.72	783.60	0.0378	0.0000	0.0378	0.0267	343.42	0.00	343.42	38.72385189	11/1/1984 14:20	0.065	
4.67	280	0.060	35.78	819.38	0.0378	0.0000	0.0378	0.0218	356.49	0.00	356.49	35.77643213	11/1/1984 14:30	0.060	
4.83	290	0.078	46.63	866.01	0.0378	0.0000	0.0378	0.0399	380.41	0.00	380.41	46.63284372	11/1/1984 14:40	0.078	
5.00	300	0.094	56.41	922.42	0.0378	0.0000	0.0378	0.0562	414.11	0.00	414.11	56.40882598	11/1/1984 14:50	0.094	
5.17	310	0.100	60.23	982.65	0.0378	0.0000	0.0378	0.0625	451.64	0.00	451.64	60.22934692	11/1/1984 15:00	0.100	
5.33	320	0.113	67.94	1050.59	0.0378	0.0000	0.0378	0.0754	496.87	0.00	496.87	67.94245789	11/1/1984 15:10	0.113	
5.50	330	0.118	71.07	1121.66	0.0378	0.0000	0.0378	0.0806	545.23	0.00	545.23	71.07203902	11/1/1984 15:20	0.118	
5.67	340	0.111	66.46	1188.13	0.0378	0.0000	0.0378	0.0729	588.99	0.00	588.99	66.46357161	11/1/1984 15:30	0.111	
5.83	350	0.109	65.36	1253.48	0.0378	0.0000	0.0378	0.0711	631.64	0.00	631.64	65.35638515	11/1/1984 15:40	0.109	
6.00	360	0.109	65.29	1318.77	0.0378	0.0000	0.0378	0.0710	674.22	0.00	674.22	65.2909189	11/1/1984 15:50	0.109	
6.17	370	0.088	53.05	1371.82	0.0378	0.0000	0.0378	0.0506	704.56	0.00	704.56	53.04664664	11/1/1984 16:00	0.088	
6.33	380	0.061	36.53	1408.35	0.0378	0.0000	0.0378	0.0230	718.38	0.00	718.38	36.53184299	11/1/1984 16:10	0.061	
6.50	390	0.041	24.78	1433.13	0.0378	0.0000	0.0378	0.0035	720.46	0.00	720.46	24.7824167	11/1/1984 16:20	0.041	
6.67	400	0.035	20.89	1454.02	0.0348	0.0030	0.0378	0.0000	718.64	0.00	718.64	20.89120721	11/1/1984 16:30	0.035	
6.83	410	0.022	13.29	1467.31	0.0221	0.0157	0.0378	0.0000	709.22	0.00	709.22	13.28520482	11/1/1984 16:40	0.022	
7.00	420	0.007	4.43	1471.74	0.0074	0.0305	0.0378	0.0000	690.94	0.00	690.94	4.428401606	11/1/1984 16:50	0.007	
7.17	430	0.013	7.81	1479.55	0.0130	0.0248	0.0378	0.0000	676.04	0.00	676.04	7.809950826	11/1/1984 17:00	0.013	
7.33	440	0.015	8.94	1488.49	0.0149	0.0230	0.0378	0.0000	662.27	0.00	662.27	8.9371339	11/1/1984 17:10	0.015	
7.50	450	0.005	2.98	1491.46	0.0050	0.0329	0.0378	0.0000	642.54	0.00	642.54	2.979044633	11/1/1984 17:20	0.005	
7.67	460	0.002	0.99	1492.46	0.0017	0.0362	0.0378	0.0000	620.82	0.00	620.82	0.993014878	11/1/1984 17:30	0.002	



7.83	470	0.001	0.33	1492.79	0.0006	0.0373	0.0378	0.0000	598.44	0.00	598.44	0.331004959	11/1/1984 17:40	0.001
8.00	480	0.021	12.81	1505.60	0.0214	0.0165	0.0378	0.0000	588.55	0.00	588.55	12.81427851	11/1/1984 17:50	0.021
8.17	490	0.050	29.73	1535.33	0.0378	0.0000	0.0378	0.0117	595.57	0.00	595.57	29.72654198	11/1/1984 18:00	0.050
8.33	500	0.059	35.46	1570.79	0.0378	0.0000	0.0378	0.0212	608.32	0.00	608.32	35.45705237	11/1/1984 18:10	0.059
8.50	510	0.062	37.46	1608.24	0.0378	0.0000	0.0378	0.0246	623.07	0.00	623.07	37.45763197	11/1/1984 18:20	0.062
8.67	520	0.074	44.67	1652.91	0.0378	0.0000	0.0378	0.0366	645.03	0.00	645.03	44.67062384	11/1/1984 18:30	0.074
8.83	530	0.089	53.67	1706.58	0.0378	0.0000	0.0378	0.0516	675.99	0.00	675.99	53.66992088	11/1/1984 18:40	0.089
9.00	540	0.095	56.85	1763.44	0.0378	0.0000	0.0378	0.0569	710.13	0.00	710.13	56.85265588	11/1/1984 18:50	0.095
9.17	550	0.097	58.09	1821.53	0.0378	0.0000	0.0378	0.0590	745.52	0.00	745.52	58.08915945	11/1/1984 19:00	0.097
9.33	560	0.109	65.25	1886.78	0.0378	0.0000	0.0378	0.0709	788.06	0.00	788.06	65.25268773	11/1/1984 19:10	0.109
9.50	570	0.080	48.03	1934.81	0.0378	0.0000	0.0378	0.0422	813.38	0.00	813.38	48.0283904	11/1/1984 19:20	0.080
9.67	580	0.049	29.20	1964.01	0.0378	0.0000	0.0378	0.0108	819.87	0.00	819.87	29.20093819	11/1/1984 19:30	0.049
9.83	590	0.049	29.53	1993.54	0.0378	0.0000	0.0378	0.0114	826.70	0.00	826.70	29.53364677	11/1/1984 19:40	0.049
10.00	600	0.038	23.07	2016.61	0.0378	0.0000	0.0378	0.0006	827.06	0.00	827.06	23.06998223	11/1/1984 19:50	0.038
10.17	610	0.024	14.31	2030.92	0.0238	0.0140	0.0378	0.0000	818.66	0.00	818.66	14.3069014	11/1/1984 20:00	0.024
10.33	620	0.019	11.39	2042.31	0.0190	0.0189	0.0378	0.0000	807.34	0.00	807.34	11.3941499	11/1/1984 20:10	0.019
10.50	630	0.051	30.35	2072.66	0.0378	0.0000	0.0378	0.0127	814.98	0.00	814.98	30.34740281	11/1/1984 20:20	0.051
10.67	640	0.072	43.36	2116.02	0.0378	0.0000	0.0378	0.0344	835.64	0.00	835.64	43.36226966	11/1/1984 20:30	0.072
10.83	650	0.057	34.45	2150.47	0.0378	0.0000	0.0378	0.0196	847.38	0.00	847.38	34.44910265	11/1/1984 20:40	0.057
11.00	660	0.030	18.16	2168.63	0.0303	0.0076	0.0378	0.0000	842.83	0.00	842.83	18.15574833	11/1/1984 20:50	0.030
11.17	670	0.021	12.73	2181.36	0.0212	0.0166	0.0378	0.0000	832.85	0.00	832.85	12.73221472	11/1/1984 21:00	0.021
11.33	680	0.018	10.92	2192.28	0.0182	0.0196	0.0378	0.0000	821.07	0.00	821.07	10.92437018	11/1/1984 21:10	0.018
11.50	690	0.006	3.64	2195.93	0.0061	0.0318	0.0378	0.0000	802.00	0.00	802.00	3.641456727	11/1/1984 21:20	0.006
11.67	700	0.013	7.90	2203.83	0.0132	0.0247	0.0378	0.0000	787.19	0.00	787.19	7.90161	11/1/1984 21:30	0.013
11.83	710	0.027	16.02	2219.84	0.0267	0.0112	0.0378	0.0000	780.50	0.00	780.50	16.01685421	11/1/1984 21:40	0.027
12.00	720	0.020	12.03	2231.88	0.0201	0.0178	0.0378	0.0000	769.83	0.00	769.83	12.03414452	11/1/1984 21:50	0.020
12.17	730	0.018	10.71	2242.59	0.0179	0.0200	0.0378	0.0000	757.83	0.00	757.83	10.71388771	11/1/1984 22:00	0.018
12.33	740	0.017	10.27	2252.87	0.0171	0.0207	0.0378	0.0000	745.40	0.00	745.40	10.27380211	11/1/1984 22:10	0.017
12.50	750	0.006	3.42	2256.29	0.0057	0.0321	0.0378	0.0000	726.11	0.00	726.11	3.424600704	11/1/1984 22:20	0.006
12.67	760	0.002	1.14	2257.43	0.0019	0.0359	0.0378	0.0000	704.55	0.00	704.55	1.141533568	11/1/1984 22:30	0.002
12.83	770	0.001	0.38	2257.81	0.0006	0.0372	0.0378	0.0000	682.22	0.00	682.22	0.380511189	11/1/1984 22:40	0.001
13.00	780	0.000	0.13	2257.94	0.0002	0.0376	0.0378	0.0000	659.64	0.00	659.64	0.126837063	11/1/1984 22:50	0.000
13.17	790	0.000	0.04	2257.98	0.0001	0.0378	0.0378	0.0000	636.97	0.00	636.97	0.042279021	11/1/1984 23:00	0.000
13.33	800	0.011	6.72	2264.71	0.0112	0.0266	0.0378	0.0000	620.99	0.00	620.99	6.723824864	11/1/1984 23:10	0.011
13.50	810	0.026	15.67	2280.37	0.0261	0.0117	0.0378	0.0000	613.95	0.00	613.95	15.66787833	11/1/1984 23:20	0.026
13.67	820	0.031	18.66	2299.04	0.0311	0.0067	0.0378	0.0000	609.90	0.00	609.90	18.66342426	11/1/1984 23:30	0.031
13.83	830	0.022	12.95	2311.98	0.0216	0.0163	0.0378	0.0000	600.14	0.00	600.14	12.94506805	11/1/1984 23:40	0.022
14.00	840	0.007	4.32	2316.30	0.0072	0.0307	0.0378	0.0000	581.74	0.00	581.74	4.315022683	11/1/1984 23:50	0.007
14.17	850	0.002	1.44	2317.74	0.0024	0.0354	0.0378	0.0000	560.47	0.00	560.47	1.438340894	11/2/1984 0:00	0.002
14.33	860	0.001	0.48	2318.21	0.0008	0.0370	0.0378	0.0000	538.25	0.00	538.25	0.479446965	11/2/1984 0:10	0.001
14.50	870	0.000	0.16	2318.37	0.0003	0.0376	0.0378	0.0000	515.70	0.00	515.70	0.159815655	11/2/1984 0:20	0.000
14.67	880	0.000	0.05	2318.43	0.0001	0.0378	0.0378	0.0000	493.04	0.00	493.04	0.053271885	11/2/1984 0:30	0.000
14.83	890	0.011	6.75	2325.18	0.0112	0.0266	0.0378	0.0000	477.08	0.00	477.08	6.748655864	11/2/1984 0:40	0.011
15.00	900	0.026	15.72	2340.89	0.0262	0.0117	0.0378	0.0000	470.09	0.00	470.09	15.71823923	11/2/1984 0:50	0.026
15.17	910	0.031	18.72	2359.62	0.0312	0.0066	0.0378	0.0000	466.11	0.00	466.11	18.72180016	11/2/1984 1:00	0.031
15.33	920	0.022	12.99	2372.60	0.0216	0.0162	0.0378	0.0000	456.38	0.00	456.38	12.98519843	11/2/1984 1:10	0.022
15.50	930	0.018	11.08	2383.68	0.0185	0.0194	0.0378	0.0000	444.75	0.00	444.75	11.07972836	11/2/1984 1:20	0.018
15.67	940	0.029	17.20	2400.88	0.0287	0.0092	0.0378	0.0000	439.25	0.00	439.25	17.20255319	11/2/1984 1:30	0.029
15.83	950	0.021	12.49	2413.38	0.0208	0.0170	0.0378	0.0000	429.03	0.00	429.03	12.49216591	11/2/1984 1:40	0.021
16.00	960	0.007	4.16	2417.54	0.0069	0.0309	0.0378	0.0000	410.49	0.00	410.49	4.164055302	11/2/1984 1:50	0.007
16.17	970	0.002	1.39	2418.93	0.0023	0.0355	0.0378	0.0000	389.17	0.00	389.17	1.388018434	11/2/1984 2:00	0.002
16.33	980	0.001	0.46	2419.39	0.0008	0.0371	0.0378	0.0000	366.92	0.00	366.92	0.462672811	11/2/1984 2:10	0.001
16.50	990	0.000	0.15	2419.55	0.0003	0.0376	0.0378	0.0000	344.37	0.00	344.37	0.15422427	11/2/1984 2:20	0.000
16.67	1000	0.011	6.82	2426.36	0.0114	0.0265	0.0378	0.0000	328.48	0.00	328.48	6.81596559	11/2/1984 2:30	0.011
16.83	1010	0.015	9.04	2435.40	0.0151	0.0228	0.0378	0.0000	314.80	0.00	314.80	9.03654603	11/2/1984 2:40	0.015
17.00	1020	0.005	3.01	2438.41	0.0050	0.0328	0.0378	0.0000	295.11	0.00	295.11	3.01218201	11/2/1984 2:50	0.005
17.17	1030	0.036	21.34	2459.75	0.0366	0.0023	0.0378	0.0000	293.74	0.00	293.74	21.33644097	11/2/1984 3:00	0.036
17.33	1040	0.057	34.23	2493.98	0.0378	0.0000	0.0378	0.0192	305.26	0.00	305.26	34.2346465	11/2/1984 3:10	0.057
17.50	1050	0.064	38.61	2532.59	0.0378	0.0000	0.0378	0.0265	321.16	0.00	321.16	38.60901216	11/2/1984 3:20	0.064
17.67	1060	0.090	53.74	2586.33	0.0378	0.0000	0.0378	0.0517	352.19	0.00	352.19	53.73840931	11/2/1984 3:30	0.090
17.83	1070	0.087	52.04	2638.37	0.0378	0.0000	0.0378	0.0489	381.53	0.00	381.53	52.04427864	11/2/1984 3:40	0.087
18.00	1080	0.086	51.57	2689.94	0.0378	0.0000	0.0378	0.0481	410.39	0.00	410.39	51.56576199	11/2/1984 3:50	0.086
18.17	1090	0.086	51.46	2741.40	0.0378	0.0000	0.0378	0.0479	439.14	0.00	439.14	51.46217019	11/2/1984 4:00	0.086
18.33	1100	0.063	37.75	2779.15	0.0378	0.0000	0.0378	0.0251	454.18	0.00	454.18	37.75115306	11/2/1984 4:10	0.063
18.50	1110	0.032	19.45	2798.61	0.0324	0.0054	0.0378	0.0000	450.93	0.00	450.93	19.4548192	11/2/1984 4:20	0.032
18.67	1120	0.011	6.48	2805.09	0.0108	0.0270	0.0378	0.0000	434.71	0.00	434.71	6.484939734	11/2/1984 4:30	0.011
18.83	1130	0.015	9.04	2814.13	0.0151	0.0228	0.0378	0.0000	421.04	0.00	421.04	9.038074298	11/2/1984 4:40	0.015
19.00	1140	0.016	9.89	2824.02	0.0165	0.0214	0.0378	0.0000	408.22	0.00	408.22	9.889119152	11/2/1984 4:50	0.016
19.17	1150	0.005	3.30	2827.32	0.0055	0.0324	0.0378	0.0000	388.81	0.00	388.81	3.296373051	11/2/1984 5:00	0.005
19.33	1160	0.002	1.10	2828.41	0.0018	0.0360	0.0378	0.0000	367.20	0.00	367.20	1.098791017	11/2/1984 5:10	0.002
19.50	1170	0.081	48.65											



20.83	1250	0.034	20.63	3129.90	0.0344	0.0035	0.0378	0.0000	464.30	0.00	464.30	20.62893067	11/2/1984 6:40	0.034	
21.00	1260	0.023	13.83	3143.73	0.0231	0.0148	0.0378	0.0000	455.43	0.00	455.43	13.83081518	11/2/1984 6:50	0.023	
21.17	1270	0.031	18.52	3162.25	0.0309	0.0070	0.0378	0.0000	451.24	0.00	451.24	18.52375145	11/2/1984 7:00	0.031	
21.33	1280	0.068	41.01	3203.26	0.0378	0.0000	0.0378	0.0305	469.55	0.00	469.55	41.01327857	11/2/1984 7:10	0.068	
21.50	1290	0.116	69.50	3272.76	0.0378	0.0000	0.0378	0.0780	516.34	0.00	516.34	69.49861027	11/2/1984 7:20	0.116	
21.67	1300	0.132	79.13	3351.89	0.0378	0.0000	0.0378	0.0940	572.76	0.00	572.76	79.12727626	11/2/1984 7:30	0.132	
21.83	1310	0.114	68.42	3420.31	0.0378	0.0000	0.0378	0.0762	618.47	0.00	618.47	68.41945057	11/2/1984 7:40	0.114	
22.00	1320	0.061	36.84	3457.15	0.0378	0.0000	0.0378	0.0235	632.60	0.00	632.60	36.83689993	11/2/1984 7:50	0.061	
22.17	1330	0.032	19.30	3476.45	0.0322	0.0057	0.0378	0.0000	629.19	0.00	629.19	19.29998862	11/2/1984 8:00	0.032	
22.33	1340	0.022	13.45	3489.90	0.0224	0.0154	0.0378	0.0000	619.93	0.00	619.93	13.45435151	11/2/1984 8:10	0.022	
22.50	1350	0.007	4.48	3494.39	0.0075	0.0304	0.0378	0.0000	601.71	0.00	601.71	4.484783837	11/2/1984 8:20	0.007	
22.67	1360	0.002	1.49	3495.88	0.0025	0.0354	0.0378	0.0000	580.50	0.00	580.50	1.494927946	11/2/1984 8:30	0.002	
22.83	1370	0.001	0.50	3496.38	0.0008	0.0370	0.0378	0.0000	558.29	0.00	558.29	0.498309315	11/2/1984 8:40	0.001	
23.00	1380	0.024	14.22	3510.60	0.0237	0.0141	0.0378	0.0000	549.80	0.00	549.80	14.21959294	11/2/1984 8:50	0.024	0.015289885
23.17	1390	0.043	25.83	3536.42	0.0378	0.0000	0.0378	0.0052	552.91	0.00	552.91	25.82575075	11/2/1984 9:00	0.043	0.027769624
23.33	1400	0.026	15.64	3552.06	0.0261	0.0118	0.0378	0.0000	545.85	0.00	545.85	15.64098018	11/2/1984 9:10	0.026	0.016818258
23.50	1410	0.232	139.50	3691.56	0.0378	0.0000	0.0378	0.1947	662.64	0.00	662.64	139.4988459	11/2/1984 9:20	0.232	0.149998759
23.67	1420	0.349	209.21	3900.77	0.0378	0.0000	0.0378	0.3108	849.14	0.00	849.14	209.2062202	11/2/1984 9:30	0.349	0.224952925
23.83	1430	0.247	148.01	4048.78	0.0378	0.0000	0.0378	0.2088	974.44	0.00	974.44	148.0098299	11/2/1984 9:40	0.247	0.159150355
24.00	1440	0.177	106.32	4155.10	0.0378	0.0000	0.0378	0.1394	1058.05	0.00	1058.05	106.3230673	11/2/1984 9:50	0.177	0.114325879
24.17	1450	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	1035.34	0.00	1035.34	0	11/2/1984 10:00	0.000	
24.33	1460	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	1012.64	0.00	1012.64	0	11/2/1984 10:10	0.000	
24.50	1470	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	989.93	0.00	989.93	0	11/2/1984 10:20	0.000	
24.67	1480	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	967.22	0.00	967.22	0	11/2/1984 10:30	0.000	
24.83	1490	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	944.51	0.00	944.51	0	11/2/1984 10:40	0.000	
25.00	1500	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	921.80	0.00	921.80	0	11/2/1984 10:50	0.000	
25.17	1510	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	899.09	0.00	899.09	0	11/2/1984 11:00	0.000	
25.33	1520	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	876.39	0.00	876.39	0	11/2/1984 11:10	0.000	
25.50	1530	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	853.68	0.00	853.68	0	11/2/1984 11:20	0.000	
25.67	1540	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	830.97	0.00	830.97	0	11/2/1984 11:30	0.000	
25.83	1550	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	808.26	0.00	808.26	0	11/2/1984 11:40	0.000	
26.00	1560	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	785.55	0.00	785.55	0	11/2/1984 11:50	0.000	
26.17	1570	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	762.84	0.00	762.84	0	11/2/1984 12:00	0.000	
26.33	1580	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	740.14	0.00	740.14	0	11/2/1984 12:10	0.000	
26.50	1590	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	717.43	0.00	717.43	0	11/2/1984 12:20	0.000	
26.67	1600	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	694.72	0.00	694.72	0	11/2/1984 12:30	0.000	
26.83	1610	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	672.01	0.00	672.01	0	11/2/1984 12:40	0.000	
27.00	1620	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	649.30	0.00	649.30	0	11/2/1984 12:50	0.000	
27.17	1630	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	626.59	0.00	626.59	0	11/2/1984 13:00	0.000	
27.33	1640	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	603.89	0.00	603.89	0	11/2/1984 13:10	0.000	
27.50	1650	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	581.18	0.00	581.18	0	11/2/1984 13:20	0.000	
27.67	1660	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	558.47	0.00	558.47	0	11/2/1984 13:30	0.000	
27.83	1670	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	535.76	0.00	535.76	0	11/2/1984 13:40	0.000	
28.00	1680	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	513.05	0.00	513.05	0	11/2/1984 13:50	0.000	
28.17	1690	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	490.34	0.00	490.34	0	11/2/1984 14:00	0.000	
28.33	1700	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	467.64	0.00	467.64	0	11/2/1984 14:10	0.000	
28.50	1710	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	444.93	0.00	444.93	0	11/2/1984 14:20	0.000	
28.67	1720	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	422.22	0.00	422.22	0	11/2/1984 14:30	0.000	
28.83	1730	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	399.51	0.00	399.51	0	11/2/1984 14:40	0.000	
29.00	1740	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	376.80	0.00	376.80	0	11/2/1984 14:50	0.000	
29.17	1750	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	354.09	0.00	354.09	0	11/2/1984 15:00	0.000	
29.33	1760	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	331.39	0.00	331.39	0	11/2/1984 15:10	0.000	
29.50	1770	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	308.68	0.00	308.68	0	11/2/1984 15:20	0.000	
29.67	1780	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	285.97	0.00	285.97	0	11/2/1984 15:30	0.000	
29.83	1790	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	263.26	0.00	263.26	0	11/2/1984 15:40	0.000	
30.00	1800	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	240.55	0.00	240.55	0	11/2/1984 15:50	0.000	
30.17	1810	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	217.84	0.00	217.84	0	11/2/1984 16:00	0.000	
30.33	1820	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	195.14	0.00	195.14	0	11/2/1984 16:10	0.000	
30.50	1830	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	172.43	0.00	172.43	0	11/2/1984 16:20	0.000	
30.67	1840	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	149.72	0.00	149.72	0	11/2/1984 16:30	0.000	
30.83	1850	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	127.01	0.00	127.01	0	11/2/1984 16:40	0.000	
31.00	1860	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	104.30	0.00	104.30	0	11/2/1984 16:50	0.000	
31.17	1870	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	81.59	0.00	81.59	0	11/2/1984 17:00	0.000	
31.33	1880	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	58.89	0.00	58.89	0	11/2/1984 17:10	0.000	
31.50	1890	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	36.18	0.00	36.18	0	11/2/1984 17:20	0.000	
31.67	1900	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	13.47	0.00	13.47	0	11/2/1984 17:30	0.000	
31.83	1910	0.000	0.00	4155.10	0.0000	0.0378	0.0378	0.0000	-9.24	0.00	0.00	0	11/2/1984 17:40	0.000	
32.00	1920	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 17:50	0.000	
32.17	1930	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 18:00	0.000	
32.33	1940	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/2/1984 18:10	0.000	
32.50	1950	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00				







46.83	2810	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
47.00	2820	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
47.16	2830	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
47.33	2840	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
47.50	2850	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
47.66	2860	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
47.83	2870	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.00	2880	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.16	2890	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.33	2900	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.50	2910	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.66	2920	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.83	2930	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.00	2940	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.16	2950	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.33	2960	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.50	2970	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.66	2980	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.83	2990	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.00	3000	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.16	3010	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.33	3020	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.50	3030	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.66	3040	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.83	3050	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
51.00	3060	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
51.16	3070	0.000	0.00	4155.10	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000





**King County CSO  
Barton Basin Subbasin 416 - GSI Option**

SvR Project No. 06053  
DATE: 06/14/2010

Combination of (4) 3a cells and (10) 2a cells per half block over 60% of the street length.

**RAIN GARDEN SYSTEM COMPONENTS**

Infiltration Rate into Native Subgrade (in/hr)	0.50
<b>SECTION 01 RG</b>	1.5 25.00 2.00% (biosoil depth/lf/slope)
Number of Section 1 Rain Gardens for Basin (ea)	0
Total Infiltration Area for Section 1 Rain Gardens (sf)*	0
Storage Capacity for a single Section 1 Rain Garden (cf)	88
Total Storage Capacity for Section 1 Rain Gardens (cf)	0
<b>SECTION 02 RG</b>	1.5 28 3.00% (biosoil depth/lf/slope)
Number of Section 2 Rain Gardens for Basin (ea)	10
Total Infiltration Area for Section 2 Rain Gardens (sf)*	1606
Storage Capacity for a single Section 2 Rain Garden (cf)	155
Total Storage Capacity for Section 2 Rain Gardens (cf)	1545
<b>SECTION 03 RG</b>	1.5 28 3.00% (biosoil depth/lf/slope)
Number of Section 3 Rain Gardens for Basin (ea)	4
Total Infiltration Area for Section 3 Rain Gardens (sf)*	1217
Storage Capacity for a single Section 3 Rain Garden (cf)	301
Total Storage Capacity for Section 3 Rain Gardens (cf)	1202

**CONVERSION FACTORS**

conversion factor from cf to gallons	7.48
conversion factor from cfs to MGD:	0.6452
conversion factor from cfs to cf/per time step:	600

**RESULTS SUMMARY**

volume controlled from 10:00 on 11/01/84 to 10:00 on 11/02/84	5,440	(cf per GSI half block)
	40,691	(gal per GSI half block)
Total volume of runoff removed from 9:30 to 9:50 of the 1984 storm	440	(gal per GSI half block)

Assumed Half blocks to modify with GSI **30.0 (apply to most feasible half blocks: 30 half blocks)**

volume controlled during 9:30 to 9:50 on 11/02/84 (gal)	13,194
volume of rain gardens in subbasin 416 (gal)	616,579
flow reduction at peak (MGD)	0.6
volume controlled from 10:00 on 11/01/84 to 10:00 on 11/02/84 (gal)	1,220,740

**Scenario 3 the average  
of the 2a/3a and 2b/3b  
combination results**

**Rainfall Distribution: 1984 Storm**

**RAIN GARDEN SYSTEM SUMMARY**

Total Infiltration Flow (cfs)	0.0327
Total Swale Storage Capacity (cf)	2747.7

Target flow reduction from subbasin 416 (MGD)	<b>14.6</b>	per John Phillips
Flow reduction from assumed half block at peak flow(MGD)	0.021073351	
Half blocks needed to get total flow reduction out of subbasin 416	692.8	

Time (hours)	Time (minutes)	Design Flow Rate from Rain Event (cfs)	Inflow Water Volume (cf)	Inflow Cum. Volume (cf)	Initial Exfiltration to Native Subgrade of Inflow (cfs)	Infiltration into Native Subgrade of Stored Water (cfs)	Total Infiltration into Native Subgrade (cfs)	Inflow to Swale After Infiltration into Native Subgrade (cfs)	Swale Storage before Overflow Volume (cf)	Overtop Flow to Pump Station (cfs)	Runoff Stored in Swale Storage Volume (cf)	Volume of Runoff Removed From Pump Station (cf)	Date & Time	Amount Flow Reduced to Pump Station (cfs)	Amount Flow Reduced to Pump Station (MGD)
0	0	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0			
0.17	10	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:00	0.000	
0.33	20	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:10	0.000	
0.50	30	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:20	0.000	
0.67	40	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:30	0.000	
0.83	50	0.003	1.90	1.90	0.0032	0.0000	0.0032	0.0000	0.00	0.00	0.00	1.900626807	11/1/1984 10:40	0.003	
1.00	60	0.009	5.61	7.51	0.0093	0.0000	0.0093	0.0000	0.00	0.00	0.00	5.605567335	11/1/1984 10:50	0.009	
1.17	70	0.015	9.09	16.59	0.0151	0.0000	0.0151	0.0000	0.00	0.00	0.00	9.085690673	11/1/1984 11:00	0.015	
1.33	80	0.020	12.17	28.77	0.0203	0.0000	0.0203	0.0000	0.00	0.00	0.00	12.17466638	11/1/1984 11:10	0.020	
1.50	90	0.030	17.81	46.58	0.0297	0.0000	0.0297	0.0000	0.00	0.00	0.00	17.8143958	11/1/1984 11:20	0.030	
1.67	100	0.035	21.20	67.78	0.0327	0.0000	0.0327	0.0027	1.60	0.00	1.60	21.19743158	11/1/1984 11:30	0.035	
1.83	110	0.034	20.50	88.28	0.0327	0.0000	0.0327	0.0015	2.50	0.00	2.50	20.50300898	11/1/1984 11:40	0.034	
2.00	120	0.035	21.06	109.35	0.0327	0.0000	0.0327	0.0024	3.97	0.00	3.97	21.06473615	11/1/1984 11:50	0.035	
2.17	130	0.030	18.09	127.43	0.0301	0.0025	0.0327	0.0000	2.46	0.00	2.46	18.08536098	11/1/1984 12:00	0.030	
2.33	140	0.029	17.54	144.97	0.0292	0.0034	0.0327	0.0000	0.40	0.00	0.40	17.53865912	11/1/1984 12:10	0.029	
2.50	150	0.043	25.66	170.63	0.0327	0.0000	0.0327	0.0101	6.46	0.00	6.46	25.6553555	11/1/1984 12:20	0.043	
2.67	160	0.055	33.13	203.76	0.0327	0.0000	0.0327	0.0226	19.99	0.00	19.99	33.13403255	11/1/1984 12:30	0.055	
2.83	170	0.061	36.63	240.39	0.0327	0.0000	0.0327	0.0284	37.02	0.00	37.02	36.63065266	11/1/1984 12:40	0.061	
3.00	180	0.085	50.79	291.18	0.0327	0.0000	0.0327	0.0520	68.22	0.00	68.22	50.79371058	11/1/1984 12:50	0.085	
3.17	190	0.090	53.97	345.16	0.0327	0.0000	0.0327	0.0573	102.59	0.00	102.59	53.97339262	11/1/1984 13:00	0.090	
3.33	200	0.091	54.66	399.82	0.0327	0.0000	0.0327	0.0584	137.66	0.00	137.66	54.66401283	11/1/1984 13:10	0.091	
3.50	210	0.131	78.42	478.24	0.0327	0.0000	0.0327	0.0980	196.48	0.00	196.48	78.41902389	11/1/1984 13:20	0.131	
3.67	220	0.153	91.89	570.13	0.0327	0.0000	0.0327	0.1205	268.77	0.00	268.77	91.89092043	11/1/1984 13:30	0.153	
3.83	230	0.157	94.20	664.33	0.0327	0.0000	0.0327	0.1243	343.37	0.00	343.37	94.19797599	11/1/1984 13:40	0.157	
4.00	240	0.165	99.16	763.49	0.0327	0.0000	0.0327	0.1326	422.93	0.00	422.93	99.15660697	11/1/1984 13:50	0.165	
4.17	250	0.159	95.35	858.83	0.0327	0.0000	0.0327	0.1262	498.68	0.00	498.68	95.34640582	11/1/1984 14:00	0.159	
4.33	260	0.130	78.02	936.85	0.0327	0.0000	0.0327	0.0974	557.10	0.00	557.10	78.02086674	11/1/1984 14:10	0.130	
4.50	270	0.107	64.10	1000.96	0.0327	0.0000	0.0327	0.0742	601.61	0.00	601.61	64.10279216	11/1/1984 14:20	0.107	
4.67	280	0.101	60.31	1061.27	0.0327	0.0000	0.0327	0.0679	642.32	0.00	642.32	60.31251706	11/1/1984 14:30	0.101	
4.83	290	0.134	80.35	1141.62	0.0327	0.0000	0.0327	0.1012	703.07	0.00	703.07	80.34751225	11/1/1984 14:40	0.134	
5.00	300	0.165	98.77	1240.38	0.0327	0.0000	0.0327	0.1319	782.24	0.00	782.24	98.76706303	11/1/1984 14:50	0.165	
5.17	310	0.179	107.50	1347.88	0.0327	0.0000	0.0327	0.1465	870.14	0.00	870.14	107.5018434	11/1/1984 15:00	0.179	
5.33	320	0.206	123.51	1471.40	0.0327	0.0000	0.0327	0.1732	974.06	0.00	974.06	123.5106495	11/1/1984 15:10	0.206	
5.50	330	0.219	131.49	1602.89	0.0327	0.0000	0.0327	0.1865	1085.95	0.00	1085.95	131.4936174	11/1/1984 15:20	0.219	
5.67	340	0.208	124.79	1727.68	0.0327	0.0000	0.0327	0.1753	1191.14	0.00	1191.14	124.7867403	11/1/1984 15:30	0.208	
5.83	350	0.208	124.63	1852.30	0.0327	0.0000	0.0327	0.1750	1296.17	0.00	1296.17	124.6276671	11/1/1984 15:40	0.208	
6.00	360	0.210	126.06	1978.36	0.0327	0.0000	0.0327	0.1774	1402.63	0.00	1402.63	126.0571051	11/1/1984 15:50	0.210	
6.17	370	0.172	103.41	2081.77	0.0327	0.0000	0.0327	0.1397	1486.44	0.00	1486.44	103.4069694	11/1/1984 16:00	0.172	
6.33	380	0.119	71.70	2153.46	0.0327	0.0000	0.0327	0.0868	1538.53	0.00	1538.53	71.69611608	11/1/1984 16:10	0.119	
6.50	390	0.082	48.91	2202.37	0.0327	0.0000	0.0327	0.0489	1567.85	0.00	1567.85	48.90884629	11/1/1984 16:20	0.082	
6.67	400	0.069	41.44	2243.81	0.0327	0.0000	0.0327	0.0364	1589.69	0.00	1589.69	41.43876698	11/1/1984 16:30	0.069	
6.83	410	0.044	26.41	2270.22	0.0327	0.0000	0.0327	0.0114	1596.50	0.00	1596.50	26.41204143	11/1/1984 16:40	0.044	
7.00	420	0.015	8.80	2279.03	0.0147	0.0180	0.0327	0.0000	1585.71	0.00	1585.71	8.80401381	11/1/1984 16:50	0.015	
7.17	430	0.026	15.60	2294.62	0.0260	0.0067	0.0327	0.0000	1581.70	0.00	1581.70	15.59538824	11/1/1984 17:00	0.026	
7.33	440	0.030	17.86	2312.48	0.0298	0.0029	0.0327	0.0000	1579.96	0.00	1579.96	17.85917971	11/1/1984 17:10	0.030	



7.50	450	0.010	5.95	2318.43	0.0099	0.0227	0.0327	0.0000	1566.32	0.00	1566.32	5.953059904	11/1/1984 17:20	0.010	ROW and Private Parcel
7.67	460	0.003	1.98	2320.42	0.0033	0.0294	0.0327	0.0000	1548.70	0.00	1548.70	1.984353301	11/1/1984 17:30	0.003	
7.83	470	0.001	0.66	2321.08	0.0011	0.0316	0.0327	0.0000	1529.77	0.00	1529.77	0.6614511	11/1/1984 17:40	0.001	
8.00	480	0.043	25.72	2346.80	0.0327	0.0000	0.0327	0.0102	1535.89	0.00	1535.89	25.72349642	11/1/1984 17:50	0.043	
8.17	490	0.100	59.82	2406.62	0.0327	0.0000	0.0327	0.0670	1576.11	0.00	1576.11	59.81741393	11/1/1984 18:00	0.100	
8.33	500	0.119	71.65	2478.27	0.0327	0.0000	0.0327	0.0868	1628.16	0.00	1628.16	71.6497663	11/1/1984 18:10	0.119	
8.50	510	0.127	76.05	2554.32	0.0327	0.0000	0.0327	0.0941	1684.62	0.00	1684.62	76.04967545	11/1/1984 18:20	0.127	
8.67	520	0.152	91.25	2645.57	0.0327	0.0000	0.0327	0.1194	1756.27	0.00	1756.27	91.24862698	11/1/1984 18:30	0.152	
8.83	530	0.184	110.30	2755.87	0.0327	0.0000	0.0327	0.1512	1846.96	0.00	1846.96	110.2975133	11/1/1984 18:40	0.184	
9.00	540	0.196	117.58	2873.45	0.0327	0.0000	0.0327	0.1633	1944.95	0.00	1944.95	117.5802183	11/1/1984 18:50	0.196	
9.17	550	0.202	120.91	2994.35	0.0327	0.0000	0.0327	0.1688	2046.26	0.00	2046.26	120.9069794	11/1/1984 19:00	0.202	
9.33	560	0.228	136.81	3131.16	0.0327	0.0000	0.0327	0.1954	2163.47	0.00	2163.47	136.8091982	11/1/1984 19:10	0.228	
9.50	570	0.168	101.03	3232.20	0.0327	0.0000	0.0327	0.1357	2244.90	0.00	2244.90	101.0324817	11/1/1984 19:20	0.168	
9.67	580	0.103	61.66	3293.86	0.0327	0.0000	0.0327	0.0701	2286.97	0.00	2286.97	61.66489707	11/1/1984 19:30	0.103	
9.83	590	0.104	62.60	3356.46	0.0327	0.0000	0.0327	0.0717	2329.97	0.00	2329.97	62.60238865	11/1/1984 19:40	0.104	
10.00	600	0.082	49.03	3405.49	0.0327	0.0000	0.0327	0.0491	2359.40	0.00	2359.40	49.03102999	11/1/1984 19:50	0.082	
10.17	610	0.051	30.45	3435.94	0.0327	0.0000	0.0327	0.0181	2370.25	0.00	2370.25	30.44722397	11/1/1984 20:00	0.051	
10.33	620	0.040	24.30	3460.24	0.0327	0.0000	0.0327	0.0078	2374.95	0.00	2374.95	24.29564605	11/1/1984 20:10	0.040	
10.50	630	0.108	64.94	3525.18	0.0327	0.0000	0.0327	0.0756	2420.29	0.00	2420.29	64.93806144	11/1/1984 20:20	0.108	
10.67	640	0.155	93.01	3618.18	0.0327	0.0000	0.0327	0.1223	2493.70	0.00	2493.70	93.00716016	11/1/1984 20:30	0.155	
10.83	650	0.123	74.07	3692.25	0.0327	0.0000	0.0327	0.0908	2548.17	0.00	2548.17	74.06515819	11/1/1984 20:40	0.123	
11.00	660	0.065	39.08	3731.33	0.0327	0.0000	0.0327	0.0325	2567.65	0.00	2567.65	39.08295923	11/1/1984 20:50	0.065	
11.17	670	0.046	27.46	3758.79	0.0327	0.0000	0.0327	0.0131	2575.52	0.00	2575.52	27.4619378	11/1/1984 21:00	0.046	
11.33	680	0.039	23.59	3782.38	0.0327	0.0000	0.0327	0.0067	2579.51	0.00	2579.51	23.588264	11/1/1984 21:10	0.039	
11.50	690	0.013	7.86	3790.24	0.0131	0.0196	0.0327	0.0000	2567.77	0.00	2567.77	7.862754665	11/1/1984 21:20	0.013	
11.67	700	0.028	17.09	3807.34	0.0285	0.0042	0.0327	0.0000	2565.27	0.00	2565.27	17.09446975	11/1/1984 21:30	0.028	
11.83	710	0.058	34.68	3842.02	0.0327	0.0000	0.0327	0.0251	2580.35	0.00	2580.35	34.68408837	11/1/1984 21:40	0.058	
12.00	720	0.043	26.07	3868.10	0.0327	0.0000	0.0327	0.0108	2586.83	0.00	2586.83	26.07374306	11/1/1984 21:50	0.043	
12.17	730	0.039	23.24	3891.34	0.0327	0.0000	0.0327	0.0061	2590.47	0.00	2590.47	23.24202522	11/1/1984 22:00	0.039	
12.33	740	0.037	22.30	3913.64	0.0327	0.0000	0.0327	0.0045	2593.17	0.00	2593.17	22.29811927	11/1/1984 22:10	0.037	
12.50	750	0.012	7.43	3921.07	0.0124	0.0203	0.0327	0.0000	2581.01	0.00	2581.01	7.432706422	11/1/1984 22:20	0.012	
12.67	760	0.004	2.48	3923.55	0.0041	0.0285	0.0327	0.0000	2563.88	0.00	2563.88	2.477568807	11/1/1984 22:30	0.004	
12.83	770	0.001	0.83	3924.37	0.0014	0.0313	0.0327	0.0000	2545.11	0.00	2545.11	0.825856269	11/1/1984 22:40	0.001	
13.00	780	0.000	0.28	3924.65	0.0005	0.0322	0.0327	0.0000	2525.79	0.00	2525.79	0.275285423	11/1/1984 22:50	0.000	
13.17	790	0.000	0.09	3924.74	0.0002	0.0325	0.0327	0.0000	2506.28	0.00	2506.28	0.091761808	11/1/1984 23:00	0.000	
13.33	800	0.024	14.62	3939.36	0.0244	0.0083	0.0327	0.0000	2501.30	0.00	2501.30	14.61933703	11/1/1984 23:10	0.024	
13.50	810	0.057	34.09	3973.45	0.0327	0.0000	0.0327	0.0241	2515.79	0.00	2515.79	34.0881654	11/1/1984 23:20	0.057	
13.67	820	0.068	40.65	4014.10	0.0327	0.0000	0.0327	0.0351	2536.85	0.00	2536.85	40.65246943	11/1/1984 23:30	0.068	
13.83	830	0.047	28.21	4042.31	0.0327	0.0000	0.0327	0.0144	2545.46	0.00	2545.46	28.21426748	11/1/1984 23:40	0.047	
14.00	840	0.016	9.40	4051.72	0.0157	0.0170	0.0327	0.0000	2535.27	0.00	2535.27	9.404755826	11/1/1984 23:50	0.016	
14.17	850	0.005	3.13	4054.85	0.0052	0.0274	0.0327	0.0000	2518.81	0.00	2518.81	3.134918609	11/2/1984 0:00	0.005	
14.33	860	0.002	1.04	4055.90	0.0017	0.0309	0.0327	0.0000	2500.25	0.00	2500.25	1.04497287	11/2/1984 0:10	0.002	
14.50	870	0.001	0.35	4056.25	0.0006	0.0321	0.0327	0.0000	2481.00	0.00	2481.00	0.34832429	11/2/1984 0:20	0.001	
14.67	880	0.000	0.12	4056.36	0.0002	0.0325	0.0327	0.0000	2461.52	0.00	2461.52	0.116108097	11/2/1984 0:30	0.000	
14.83	890	0.025	14.74	4071.10	0.0246	0.0081	0.0327	0.0000	2456.66	0.00	2456.66	14.73888167	11/2/1984 0:40	0.025	
15.00	900	0.057	34.35	4105.45	0.0327	0.0000	0.0327	0.0246	2471.41	0.00	2471.41	34.34965272	11/2/1984 0:50	0.057	
15.17	910	0.068	40.96	4146.41	0.0327	0.0000	0.0327	0.0356	2492.78	0.00	2492.78	40.95885028	11/2/1984 1:00	0.068	
15.33	920	0.047	28.43	4174.84	0.0327	0.0000	0.0327	0.0147	2501.60	0.00	2501.60	28.42540294	11/2/1984 1:10	0.047	
15.50	930	0.040	24.28	4199.12	0.0327	0.0000	0.0327	0.0078	2506.29	0.00	2506.29	24.28313802	11/2/1984 1:20	0.040	
15.67	940	0.063	37.75	4236.86	0.0327	0.0000	0.0327	0.0302	2524.43	0.00	2524.43	37.74555447	11/2/1984 1:30	0.063	
15.83	950	0.046	27.43	4264.29	0.0327	0.0000	0.0327	0.0130	2532.26	0.00	2532.26	27.4250229	11/2/1984 1:40	0.046	
16.00	960	0.015	9.14	4273.43	0.0152	0.0174	0.0327	0.0000	2521.80	0.00	2521.80	9.141674302	11/2/1984 1:50	0.015	
16.17	970	0.005	3.05	4276.48	0.0051	0.0276	0.0327	0.0000	2505.25	0.00	2505.25	3.047224767	11/2/1984 2:00	0.005	
16.33	980	0.002	1.02	4277.49	0.0017	0.0310	0.0327	0.0000	2486.67	0.00	2486.67	1.015741589	11/2/1984 2:10	0.002	
16.50	990	0.001	0.34	4277.83	0.0006	0.0321	0.0327	0.0000	2467.41	0.00	2467.41	0.33858053	11/2/1984 2:20	0.001	
16.67	1000	0.025	14.99	4292.82	0.0250	0.0077	0.0327	0.0000	2462.80	0.00	2462.80	14.9908217	11/2/1984 2:30	0.025	
16.83	1010	0.033	19.87	4312.70	0.0327	0.0000	0.0327	0.0005	2463.08	0.00	2463.08	19.87490209	11/2/1984 2:40	0.033	
17.00	1020	0.011	6.62	4319.32	0.0110	0.0216	0.0327	0.0000	2450.11	0.00	2450.11	6.624967362	11/2/1984 2:50	0.011	
17.17	1030	0.078	47.05	4366.37	0.0327	0.0000	0.0327	0.0457	2477.56	0.00	2477.56	47.04725269	11/2/1984 3:00	0.078	
17.33	1040	0.126	75.53	4441.91	0.0327	0.0000	0.0327	0.0932	2533.49	0.00	2533.49	75.53480112	11/2/1984 3:10	0.126	
17.50	1050	0.142	85.43	4527.33	0.0327	0.0000	0.0327	0.1097	2599.32	0.00	2599.32	85.42859048	11/2/1984 3:20	0.142	
17.67	1060	0.199	119.24	4646.57	0.0327	0.0000	0.0327	0.1661	2698.96	0.00	2698.96	119.2375802	11/2/1984 3:30	0.199	
17.83	1070	0.193	115.78	4762.35	0.0327	0.0000	0.0327	0.1603	2795.14	0.08	2747.68	68.31334841	11/2/1984 3:40	0.114	
18.00	1080	0.192	115.08	4877.43	0.0327	0.0000	0.0327	0.1591	2843.16	0.16	2747.68	19.59821667	11/2/1984 3:50	0.033	
18.17	1090	0.192	115.15	4992.58	0.0327	0.0000	0.0327	0.1593	2843.23	0.16	2747.68	19.59821667	11/2/1984 4:00	0.033	
18.33	1100	0.141	84.63	5077.21	0.0327	0.0000	0.0327	0.1084	2812.71	0.11	2747.68	19.59821667	11/2/1984 4:10	0.033	
18.50	1110	0.073	43.66	5120.87	0.0327	0.0000	0.0327	0.0401	2771.74	0.04	2747.68	19.59821667	11/2/1984 4:20	0.033	
18.67	1120	0.024	14.55	5135.42	0.0243	0.0084	0.0327								



20.00	1200	0.050	30.15	5595.55	0.0327	0.0000	0.0327	0.0176	2758.23	0.02	2747.68	19.59821667	11/2/1984 5:50	0.033	ROW and Private Parcel
20.17	1210	0.017	10.05	5605.60	0.0168	0.0159	0.0327	0.0000	2738.13	0.00	2738.13	10.05094167	11/2/1984 6:00	0.017	
20.33	1220	0.058	34.86	5640.47	0.0327	0.0000	0.0327	0.0254	2753.40	0.01	2747.68	29.14549166	11/2/1984 6:10	0.049	
20.50	1230	0.151	90.60	5731.06	0.0327	0.0000	0.0327	0.1183	2818.68	0.12	2747.68	19.59821667	11/2/1984 6:20	0.033	
20.67	1240	0.156	93.53	5824.59	0.0327	0.0000	0.0327	0.1232	2821.61	0.12	2747.68	19.59821667	11/2/1984 6:30	0.033	
20.83	1250	0.078	47.05	5871.64	0.0327	0.0000	0.0327	0.0457	2775.13	0.05	2747.68	19.59821667	11/2/1984 6:40	0.033	
21.00	1260	0.053	31.58	5903.22	0.0327	0.0000	0.0327	0.0200	2759.66	0.02	2747.68	19.59821667	11/2/1984 6:50	0.033	
21.17	1270	0.071	42.34	5945.55	0.0327	0.0000	0.0327	0.0379	2770.42	0.04	2747.68	19.59821667	11/2/1984 7:00	0.033	
21.33	1280	0.157	93.94	6039.50	0.0327	0.0000	0.0327	0.1239	2822.02	0.12	2747.68	19.59821667	11/2/1984 7:10	0.033	
21.50	1290	0.266	159.51	6199.00	0.0327	0.0000	0.0327	0.2332	2887.59	0.23	2747.68	19.59821667	11/2/1984 7:20	0.033	
21.67	1300	0.303	182.08	6381.09	0.0327	0.0000	0.0327	0.2708	2910.16	0.27	2747.68	19.59821667	11/2/1984 7:30	0.033	
21.83	1310	0.263	157.78	6538.86	0.0327	0.0000	0.0327	0.2303	2885.86	0.23	2747.68	19.59821667	11/2/1984 7:40	0.033	
22.00	1320	0.142	85.04	6623.90	0.0327	0.0000	0.0327	0.1091	2813.12	0.11	2747.68	19.59821667	11/2/1984 7:50	0.033	
22.17	1330	0.074	44.60	6668.51	0.0327	0.0000	0.0327	0.0417	2772.68	0.04	2747.68	19.59821667	11/2/1984 8:00	0.033	
22.33	1340	0.052	31.12	6699.63	0.0327	0.0000	0.0327	0.0192	2759.20	0.02	2747.68	19.59821667	11/2/1984 8:10	0.033	
22.50	1350	0.017	10.37	6710.00	0.0173	0.0154	0.0327	0.0000	2738.45	0.00	2738.45	10.37417343	11/2/1984 8:20	0.017	
22.67	1360	0.006	3.46	6713.46	0.0058	0.0269	0.0327	0.0000	2722.31	0.00	2722.31	3.458057809	11/2/1984 8:30	0.006	
22.83	1370	0.002	1.15	6714.61	0.0019	0.0307	0.0327	0.0000	2703.87	0.00	2703.87	1.152685936	11/2/1984 8:40	0.002	
23.00	1380	0.055	32.96	6747.57	0.0327	0.0000	0.0327	0.0223	2717.23	0.00	2717.23	32.95705328	11/2/1984 8:50	0.055	0.035437692
23.17	1390	0.100	59.88	6807.45	0.0327	0.0000	0.0327	0.0671	2757.51	0.02	2747.68	50.04911288	11/2/1984 9:00	0.083	0.05381625
23.33	1400	0.060	36.28	6843.72	0.0327	0.0000	0.0327	0.0278	2764.36	0.03	2747.68	19.59821667	11/2/1984 9:10	0.033	0.021073351
23.50	1410	0.543	325.78	7169.50	0.0327	0.0000	0.0327	0.5103	3053.86	0.51	2747.68	19.59821667	11/2/1984 9:20	0.033	0.021073351
23.67	1420	0.815	489.14	7658.64	0.0327	0.0000	0.0327	0.7826	3217.22	0.78	2747.68	19.59821667	11/2/1984 9:30	0.033	0.021073351
23.83	1430	0.579	347.56	8006.21	0.0327	0.0000	0.0327	0.5466	3075.64	0.55	2747.68	19.59821667	11/2/1984 9:40	0.033	0.021073351
24.00	1440	0.417	250.37	8256.58	0.0327	0.0000	0.0327	0.3846	2978.46	0.38	2747.68	19.59821667	11/2/1984 9:50	0.033	0.021073351
24.17	1450	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2728.08	0.00	2728.08	0	11/2/1984 10:00	0.000	
24.33	1460	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2708.48	0.00	2708.48	0	11/2/1984 10:10	0.000	
24.50	1470	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2688.88	0.00	2688.88	0	11/2/1984 10:20	0.000	
24.67	1480	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2669.29	0.00	2669.29	0	11/2/1984 10:30	0.000	
24.83	1490	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2649.69	0.00	2649.69	0	11/2/1984 10:40	0.000	
25.00	1500	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2630.09	0.00	2630.09	0	11/2/1984 10:50	0.000	
25.17	1510	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2610.49	0.00	2610.49	0	11/2/1984 11:00	0.000	
25.33	1520	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2590.89	0.00	2590.89	0	11/2/1984 11:10	0.000	
25.50	1530	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2571.29	0.00	2571.29	0	11/2/1984 11:20	0.000	
25.67	1540	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2551.70	0.00	2551.70	0	11/2/1984 11:30	0.000	
25.83	1550	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2532.10	0.00	2532.10	0	11/2/1984 11:40	0.000	
26.00	1560	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2512.50	0.00	2512.50	0	11/2/1984 11:50	0.000	
26.17	1570	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2492.90	0.00	2492.90	0	11/2/1984 12:00	0.000	
26.33	1580	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2473.30	0.00	2473.30	0	11/2/1984 12:10	0.000	
26.50	1590	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2453.71	0.00	2453.71	0	11/2/1984 12:20	0.000	
26.67	1600	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2434.11	0.00	2434.11	0	11/2/1984 12:30	0.000	
26.83	1610	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2414.51	0.00	2414.51	0	11/2/1984 12:40	0.000	
27.00	1620	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2394.91	0.00	2394.91	0	11/2/1984 12:50	0.000	
27.17	1630	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2375.31	0.00	2375.31	0	11/2/1984 13:00	0.000	
27.33	1640	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2355.71	0.00	2355.71	0	11/2/1984 13:10	0.000	
27.50	1650	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2336.12	0.00	2336.12	0	11/2/1984 13:20	0.000	
27.67	1660	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2316.52	0.00	2316.52	0	11/2/1984 13:30	0.000	
27.83	1670	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2296.92	0.00	2296.92	0	11/2/1984 13:40	0.000	
28.00	1680	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2277.32	0.00	2277.32	0	11/2/1984 13:50	0.000	
28.17	1690	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2257.72	0.00	2257.72	0	11/2/1984 14:00	0.000	
28.33	1700	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2238.12	0.00	2238.12	0	11/2/1984 14:10	0.000	
28.50	1710	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2218.53	0.00	2218.53	0	11/2/1984 14:20	0.000	
28.67	1720	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2198.93	0.00	2198.93	0	11/2/1984 14:30	0.000	
28.83	1730	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2179.33	0.00	2179.33	0	11/2/1984 14:40	0.000	
29.00	1740	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2159.73	0.00	2159.73	0	11/2/1984 14:50	0.000	
29.17	1750	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2140.13	0.00	2140.13	0	11/2/1984 15:00	0.000	
29.33	1760	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2120.54	0.00	2120.54	0	11/2/1984 15:10	0.000	
29.50	1770	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2100.94	0.00	2100.94	0	11/2/1984 15:20	0.000	
29.67	1780	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2081.34	0.00	2081.34	0	11/2/1984 15:30	0.000	
29.83	1790	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2061.74	0.00	2061.74	0	11/2/1984 15:40	0.000	
30.00	1800	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2042.14	0.00	2042.14	0	11/2/1984 15:50	0.000	
30.17	1810	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2022.54	0.00	2022.54	0	11/2/1984 16:00	0.000	
30.33	1820	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	2002.95	0.00	2002.95	0	11/2/1984 16:10	0.000	
30.50	1830	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1983.35	0.00	1983.35	0	11/2/1984 16:20	0.000	
30.67	1840	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1963.75	0.00	1963.75	0	11/2/1984 16:30	0.000	
30.83	1850	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1944.15	0.00	1944.15	0	11/2/1984 16:40	0.000	
31.00	1860	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1924.55	0.00	1924.55	0	11/2/1984 16:50	0.000	
31.17	1870	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1904.96	0.00	1904.96	0	11/2/1984 17:00	0.000	
31.33	1880	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1885.36	0.00	1885.36	0	11/2/1984 17:10	0.000	
31.50	189														



32.50	1950	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1748.17	0.00	1748.17	0	11/2/1984 18:20	0.000	ROW and Private Parcel	
32.67	1960	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1728.57	0.00	1728.57	0	11/2/1984 18:30	0.000		
32.83	1970	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1708.97	0.00	1708.97	0	11/2/1984 18:40	0.000		
33.00	1980	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1689.37	0.00	1689.37	0	11/2/1984 18:50	0.000		
33.17	1990	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1669.78	0.00	1669.78	0	11/2/1984 19:00	0.000		
33.33	2000	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1650.18	0.00	1650.18	0	11/2/1984 19:10	0.000		
33.50	2010	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1630.58	0.00	1630.58	0	11/2/1984 19:20	0.000		
33.67	2020	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1610.98	0.00	1610.98	0	11/2/1984 19:30	0.000		
33.83	2030	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1591.38	0.00	1591.38	0	11/2/1984 19:40	0.000		
34.00	2040	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1571.79	0.00	1571.79	0	11/2/1984 19:50	0.000		
34.17	2050	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1552.19	0.00	1552.19	0	11/2/1984 20:00	0.000		
34.33	2060	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1532.59	0.00	1532.59	0	11/2/1984 20:10	0.000		
34.50	2070	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1512.99	0.00	1512.99	0	11/2/1984 20:20	0.000		
34.67	2080	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1493.39	0.00	1493.39	0	11/2/1984 20:30	0.000		
34.83	2090	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1473.79	0.00	1473.79	0	11/2/1984 20:40	0.000		
35.00	2100	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1454.20	0.00	1454.20	0	11/2/1984 20:50	0.000		
35.17	2110	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1434.60	0.00	1434.60	0	11/2/1984 21:00	0.000		
35.33	2120	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1415.00	0.00	1415.00	0	11/2/1984 21:10	0.000		0
35.50	2130	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1395.40	0.00	1395.40	0	11/2/1984 21:20	0.000		0
35.67	2140	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1375.80	0.00	1375.80	0	11/2/1984 21:30	0.000		0
35.83	2150	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1356.21	0.00	1356.21	0	11/2/1984 21:40	0.000		0
36.00	2160	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1336.61	0.00	1336.61	0	11/2/1984 21:50	0.000		0
36.17	2170	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1317.01	0.00	1317.01	0	11/2/1984 22:00	0.000		0
36.33	2180	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1297.41	0.00	1297.41	0	11/2/1984 22:10	0.000		
36.50	2190	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1277.81	0.00	1277.81	0	11/2/1984 22:20	0.000		
36.67	2200	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1258.21	0.00	1258.21	0	11/2/1984 22:30	0.000		
36.83	2210	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1238.62	0.00	1238.62	0	11/2/1984 22:40	0.000		
37.00	2220	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1219.02	0.00	1219.02	0	11/2/1984 22:50	0.000		
37.17	2230	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1199.42	0.00	1199.42	0	11/2/1984 23:00	0.000		
37.33	2240	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1179.82	0.00	1179.82	0	11/2/1984 23:10	0.000		
37.50	2250	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1160.22	0.00	1160.22	0	11/2/1984 23:20	0.000		
37.67	2260	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1140.62	0.00	1140.62	0	11/2/1984 23:30	0.000		
37.83	2270	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1121.03	0.00	1121.03	0	11/2/1984 23:40	0.000		
38.00	2280	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1101.43	0.00	1101.43	0	11/2/1984 23:50	0.000		
38.17	2290	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1081.83	0.00	1081.83	0	1/0/1900 0:00	0.000		
38.33	2300	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1062.23	0.00	1062.23	0	1/0/1900 0:00	0.000		
38.50	2310	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1042.63	0.00	1042.63	0	1/0/1900 0:00	0.000		
38.67	2320	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1023.04	0.00	1023.04	0	1/0/1900 0:00	0.000		
38.83	2330	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	1003.44	0.00	1003.44	0	1/0/1900 0:00	0.000		
39.00	2340	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	983.84	0.00	983.84	0	1/0/1900 0:00	0.000		
39.17	2350	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	964.24	0.00	964.24	0	1/0/1900 0:00	0.000		
39.33	2360	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	944.64	0.00	944.64	0	1/0/1900 0:00	0.000		
39.50	2370	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	925.04	0.00	925.04	0	1/0/1900 0:00	0.000		
39.67	2380	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	905.45	0.00	905.45	0	1/0/1900 0:00	0.000		
39.83	2390	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	885.85	0.00	885.85	0	1/0/1900 0:00	0.000		
40.00	2400	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	866.25	0.00	866.25	0	1/0/1900 0:00	0.000		
40.17	2410	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	846.65	0.00	846.65	0	1/0/1900 0:00	0.000		
40.33	2420	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	827.05	0.00	827.05	0	1/0/1900 0:00	0.000		
40.50	2430	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	807.45	0.00	807.45	0	1/0/1900 0:00	0.000		
40.67	2440	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	787.86	0.00	787.86	0	1/0/1900 0:00	0.000		
40.83	2450	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	768.26	0.00	768.26	0	1/0/1900 0:00	0.000		
41.00	2460	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	748.66	0.00	748.66	0	1/0/1900 0:00	0.000		
41.17	2470	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	729.06	0.00	729.06	0	1/0/1900 0:00	0.000		
41.33	2480	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	709.46	0.00	709.46	0	1/0/1900 0:00	0.000		
41.50	2490	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	689.87	0.00	689.87	0	1/0/1900 0:00	0.000		
41.67	2500	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	670.27	0.00	670.27	0	1/0/1900 0:00	0.000		
41.83	2510	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	650.67	0.00	650.67	0	1/0/1900 0:00	0.000		
42.00	2520	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	631.07	0.00	631.07	0	1/0/1900 0:00	0.000		
42.16	2530	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	611.47	0.00	611.47	0	1/0/1900 0:00	0.000		
42.33	2540	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	591.87	0.00	591.87	0	1/0/1900 0:00	0.000		
42.50	2550	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	572.28	0.00	572.28	0	1/0/1900 0:00	0.000		
42.66	2560	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	552.68	0.00	552.68	0	1/0/1900 0:00	0.000		
42.83	2570	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	533.08	0.00	533.08	0	1/0/1900 0:00	0.000		
43.00	2580	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	513.48	0.00	513.48	0	1/0/1900 0:00	0.000		
43.16	2590	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	493.88	0.00	493.88	0	1/0/1900 0:00	0.000		
43.33	2600	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	474.29	0.00	474.29	0	1/0/1900 0:00	0.000		
43.50	2610	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	454.69	0.00	454.69	0	1/0/1900 0:00	0.000		
43.66	2620	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	435.09	0.00	435.09	0	1/0/1900 0:00	0.000		
43.83	2630	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	415.49	0.00	415.49	0	1/0/1900 0:00	0.000		
44.00	2640	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	395.89	0.00	395.89	0	1/0/1900 0:00	0.000		
44.16	2650	0														



45.00	2700	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	278.30	0.00	278.30	0	1/0/1900 0:00	0.000
45.16	2710	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	258.70	0.00	258.70	0	1/0/1900 0:00	0.000
45.33	2720	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	239.11	0.00	239.11	0	1/0/1900 0:00	0.000
45.50	2730	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	219.51	0.00	219.51	0	1/0/1900 0:00	0.000
45.66	2740	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	199.91	0.00	199.91	0	1/0/1900 0:00	0.000
45.83	2750	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	180.31	0.00	180.31	0	1/0/1900 0:00	0.000
46.00	2760	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	160.71	0.00	160.71	0	1/0/1900 0:00	0.000
46.16	2770	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	141.12	0.00	141.12	0	1/0/1900 0:00	0.000
46.33	2780	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	121.52	0.00	121.52	0	1/0/1900 0:00	0.000
46.50	2790	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	101.92	0.00	101.92	0	1/0/1900 0:00	0.000
46.66	2800	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	82.32	0.00	82.32	0	1/0/1900 0:00	0.000
46.83	2810	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	62.72	0.00	62.72	0	1/0/1900 0:00	0.000
47.00	2820	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	43.12	0.00	43.12	0	1/0/1900 0:00	0.000
47.16	2830	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	23.53	0.00	23.53	0	1/0/1900 0:00	0.000
47.33	2840	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	3.93	0.00	3.93	0	1/0/1900 0:00	0.000
47.50	2850	0.000	0.00	8256.58	0.0000	0.0327	0.0327	0.0000	-15.67	0.00	0.00	0	1/0/1900 0:00	0.000
47.66	2860	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
47.83	2870	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.00	2880	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.16	2890	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.33	2900	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.50	2910	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.66	2920	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.83	2930	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.00	2940	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.16	2950	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.33	2960	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.50	2970	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.66	2980	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.83	2990	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.00	3000	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.16	3010	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.33	3020	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.50	3030	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.66	3040	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.83	3050	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
51.00	3060	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
51.16	3070	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000





**King County CSO**  
**Barton Basin Subbasin 416 - GSI Option**  
SvR Project No. 06053  
DATE: 06/15/2010

**Combination of (4) 3b cells and (6) 2b cells per half block over 60% of the street length.**

**RAIN GARDEN SYSTEM COMPONENTS**

	Infiltration Rate into Native Subgrade (in/hr)	<b>0.50</b>	
<b>SECTION 01 RG</b>	1.5	25.00	2.00% (biosoil depth/lf/slope)
	Number of Section 1 Rain Gardens for Basin (ea)	<b>0</b>	
	Total Infiltration Area for Section 1 Rain Gardens (sf)*	0	
	Storage Capacity for a single Section 1 Rain Garden (cf)	88	
	Total Storage Capacity for Section 1 Rain Gardens (cf)	0	
<b>SECTION 02 RG</b>	1.5	42	2.00% (biosoil depth/lf/slope)
	Number of Section 2 Rain Gardens for Basin (ea)	<b>6</b>	
	Total Infiltration Area for Section 2 Rain Gardens (sf)*	1445	
	Storage Capacity for a single Section 2 Rain Garden (cf)	232	
	Total Storage Capacity for Section 2 Rain Gardens (cf)	1391	
<b>SECTION 03 RG</b>	1.5	42	2.00% (biosoil depth/lf/slope)
	Number of Section 3 Rain Gardens for Basin (ea)	<b>4</b>	
	Total Infiltration Area for Section 3 Rain Gardens (sf)*	1825	
	Storage Capacity for a single Section 3 Rain Garden (cf)	451	
	Total Storage Capacity for Section 3 Rain Gardens (cf)	1803	

**CONVERSION FACTORS**

conversion factor from cf to gallons	7.48
conversion factor from cfs to MGD:	0.6452
conversion factor from cfs to cf/per time step:	600

**RESULTS SUMMARY**

volume controlled from 10:00 on 11/01/84 to 10:00 on 11/02/84	6,291	(cf per GSI half block)
	47,059	(gal per GSI half block)
Total volume of runoff removed from 9:30 to 9:50 of the 1984 storm	510	(gal per GSI half block)

Assumed Half blocks to modify with GSI	<b>30.0</b>	(apply to most feasible half blocks: 30 half blocks)
volume controlled during 9:30 to 9:50 on 11/02/84 (gal)	15,287	
volume of rain gardens in subbasin 416 (gal)	716,799	
flow reduction at peak (MGD)	0.7	
volume controlled from 10:00 on 11/01/84 to 10:00 on 11/02/84 (gal)	1,411,777	

**Scenario 3 the average of the 2a/3a and 2b/3b combination results**

Rainfall Distribution: 1984 Storm

**RAIN GARDEN SYSTEM SUMMARY**

Total Infiltration Flow (cfs)	0.0378
Total Swale Storage Capacity (cf)	3194.3

Target flow reduction from subbasin 416 (MGD)	<b>14.6</b>	per John Phillips
Flow reduction from assumed half block at peak flow(MGD)	0.024417541	
Half blocks needed to get total flow reduction out of subbasin 416	597.9	

Time (hours)	Time (minutes)	Design Flow Rate from Rain Event (cfs)	Inflow Water Volume (cf)	Inflow Cumm. Volume (cf)	Check if inflow infiltrates Initial Exfiltration to Native Subgrade of Inflow (cfs)	Check if storage infiltrates Infiltration into Native Subgrade of Stored Water (cfs)	Total Infiltration into Native Subgrade (cfs)	Inflow to Swale After Infiltration into Native Subgrade (cfs)	Swale Storage before Overflow Volume (cf)	Overtop Flow to Pump Station (cfs)	Runoff Stored in Swale Storage Volume (cf)	Volume of Runoff Removed From Pump Station (cf)	Date & Time	Amount Flow Reduced to Pump Station (cfs)	Amount Flow Reduced to Pump Station (MGD)
0	0	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0			
0.17	10	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:00	0.000	
0.33	20	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:10	0.000	
0.50	30	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:20	0.000	
0.67	40	0.000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	11/1/1984 10:30	0.000	
0.83	50	0.003	1.90	1.90	0.0032	0.0000	0.0032	0.0000	0.00	0.00	0.00	1.900626807	11/1/1984 10:40	0.003	
1.00	60	0.009	5.61	7.51	0.0093	0.0000	0.0093	0.0000	0.00	0.00	0.00	5.605567335	11/1/1984 10:50	0.009	
1.17	70	0.015	9.09	16.59	0.0151	0.0000	0.0151	0.0000	0.00	0.00	0.00	9.085690673	11/1/1984 11:00	0.015	
1.33	80	0.020	12.17	28.77	0.0203	0.0000	0.0203	0.0000	0.00	0.00	0.00	12.17466638	11/1/1984 11:10	0.020	
1.50	90	0.030	17.81	46.58	0.0297	0.0000	0.0297	0.0000	0.00	0.00	0.00	17.8143958	11/1/1984 11:20	0.030	
1.67	100	0.035	21.20	67.78	0.0353	0.0000	0.0353	0.0000	0.00	0.00	0.00	21.19743158	11/1/1984 11:30	0.035	
1.83	110	0.034	20.50	88.28	0.0342	0.0000	0.0342	0.0000	0.00	0.00	0.00	20.50300898	11/1/1984 11:40	0.034	
2.00	120	0.035	21.06	109.35	0.0351	0.0000	0.0351	0.0000	0.00	0.00	0.00	21.06473615	11/1/1984 11:50	0.035	
2.17	130	0.030	18.09	127.43	0.0301	0.0000	0.0301	0.0000	0.00	0.00	0.00	18.08536098	11/1/1984 12:00	0.030	
2.33	140	0.029	17.54	144.97	0.0292	0.0000	0.0292	0.0000	0.00	0.00	0.00	17.53865912	11/1/1984 12:10	0.029	
2.50	150	0.043	25.66	170.63	0.0378	0.0000	0.0378	0.0049	2.95	0.00	2.95	25.6553555	11/1/1984 12:20	0.043	
2.67	160	0.055	33.13	203.76	0.0378	0.0000	0.0378	0.0174	13.37	0.00	13.37	33.13403255	11/1/1984 12:30	0.055	
2.83	170	0.061	36.63	240.39	0.0378	0.0000	0.0378	0.0232	27.30	0.00	27.30	36.63065266	11/1/1984 12:40	0.061	
3.00	180	0.085	50.79	291.18	0.0378	0.0000	0.0378	0.0468	55.38	0.00	55.38	50.79371058	11/1/1984 12:50	0.085	
3.17	190	0.090	53.97	345.16	0.0378	0.0000	0.0378	0.0521	86.65	0.00	86.65	53.97339262	11/1/1984 13:00	0.090	
3.33	200	0.091	54.66	399.82	0.0378	0.0000	0.0378	0.0533	118.60	0.00	118.60	54.66401283	11/1/1984 13:10	0.091	
3.50	210	0.131	78.42	478.24	0.0378	0.0000	0.0378	0.0929	174.31	0.00	174.31	78.41902389	11/1/1984 13:20	0.131	
3.67	220	0.153	91.89	570.13	0.0378	0.0000	0.0378	0.1153	243.49	0.00	243.49	91.89092043	11/1/1984 13:30	0.153	
3.83	230	0.157	94.20	664.33	0.0378	0.0000	0.0378	0.1191	314.98	0.00	314.98	94.19797599	11/1/1984 13:40	0.157	
4.00	240	0.165	99.16	763.49	0.0378	0.0000	0.0378	0.1274	391.43	0.00	391.43	99.15660697	11/1/1984 13:50	0.165	
4.17	250	0.159	95.35	858.83	0.0378	0.0000	0.0378	0.1211	464.07	0.00	464.07	95.34640582	11/1/1984 14:00	0.159	
4.33	260	0.130	78.02	936.85	0.0378	0.0000	0.0378	0.0922	519.38	0.00	519.38	78.02086674	11/1/1984 14:10	0.130	
4.50	270	0.107	64.10	1000.96	0.0378	0.0000	0.0378	0.0690	560.78	0.00	560.78	64.10279216	11/1/1984 14:20	0.107	
4.67	280	0.101	60.31	1061.27	0.0378	0.0000	0.0378	0.0627	598.38	0.00	598.38	60.31251706	11/1/1984 14:30	0.101	
4.83	290	0.134	80.35	1141.62	0.0378	0.0000	0.0378	0.0961	656.02	0.00	656.02	80.34751225	11/1/1984 14:40	0.134	
5.00	300	0.165	98.77	1240.38	0.0378	0.0000	0.0378	0.1268	732.08	0.00	732.08	98.76706303	11/1/1984 14:50	0.165	
5.17	310	0.179	107.50	1347.88	0.0378	0.0000	0.0378	0.1413	816.87	0.00	816.87	107.5018434	11/1/1984 15:00	0.179	
5.33	320	0.206	123.51	1471.40	0.0378	0.0000	0.0378	0.1680	917.68	0.00	917.68	123.5106495	11/1/1984 15:10	0.206	
5.50	330	0.219	131.49	1602.89	0.0378	0.0000	0.0378	0.1813	1026.46	0.00	1026.46	131.4936174	11/1/1984 15:20	0.219	
5.67	340	0.208	124.79	1727.68	0.0378	0.0000	0.0378	0.1701	1128.54	0.00	1128.54	124.7867403	11/1/1984 15:30	0.208	
5.83	350	0.208	124.63	1852.30	0.0378	0.0000	0.0378	0.1699	1230.46	0.00	1230.46	124.6276671	11/1/1984 15:40	0.208	
6.00	360	0.210	126.06	1978.36	0.0378	0.0000	0.0378	0.1722	1333.81	0.00	1333.81	126.0571051	11/1/1984 15:50	0.210	
6.17	370	0.172	103.41	2081.77	0.0378	0.0000	0.0378	0.1345	1414.51	0.00	1414.51	103.4069694	11/1/1984 16:00	0.172	
6.33	380	0.119	71.70	2153.46	0.0378	0.0000	0.0378	0.0816	1463.49	0.00	1463.49	71.69611608	11/1/1984 16:10	0.119	
6.50	390	0.082	48.91	2202.37	0.0378	0.0000	0.0378	0.0437	1489.69	0.00	1489.69	48.90884629	11/1/1984 16:20	0.082	
6.67	400	0.069	41.44	2243.81	0.0378	0.0000	0.0378	0.0312	1508.43	0.00	1508.43	41.43876698	11/1/1984 16:30	0.069	
6.83	410	0.044	26.41	2270.22	0.0378	0.0000	0.0378	0.0062	1512.13	0.00	1512.13	26.41204143	11/1/1984 16:40	0.044	
7.00	420	0.015	8.80	2279.03	0.0147	0.0232	0.0378	0.0000	1498.22	0.00	1498.22	8.80401381	11/1/1984 16:50	0.015	
7.17	430	0.026	15.60	2294.62	0.0260	0.0119	0.0378	0.0000	1491.11	0.00	1491.11	15.59538824	11/1/1984 17:00	0.026	
7.33	440	0.030	17.86	2312.48	0.0298	0.0081	0.0378	0.0000	1486.26	0.00	1486.26	17.85917971	11/1/1984 17:10	0.030	
7.50	450	0.010	5.95	2318.43	0.0099	0.0279	0.0378	0.0000	1469.51	0.00	1469.51	5.953059904	11/1/1984 17:20	0.010	
7.67	460	0.003	1.98	2320.42	0.0033	0.0345	0.0378	0.0000	1448.78	0.00	1448.78	1.984353301	11/1/1984 17:30	0.003	
7.83	470	0.001	0.66	2321.08	0.0011	0.0367	0.0378	0.0000	1426.74	0.00	1426.74	0.6614511	11/1/1984 17:40	0.001	



8.00	480	0.043	25.72	2346.80	0.0378	0.0000	0.0378	0.0050	1429.75	0.00	1429.75	25.72349642	11/1/1984 17:50	0.043
8.17	490	0.100	59.82	2406.62	0.0378	0.0000	0.0378	0.0618	1466.86	0.00	1466.86	59.81741393	11/1/1984 18:00	0.100
8.33	500	0.119	71.65	2478.27	0.0378	0.0000	0.0378	0.0816	1515.80	0.00	1515.80	71.6497663	11/1/1984 18:10	0.119
8.50	510	0.127	76.05	2554.32	0.0378	0.0000	0.0378	0.0889	1569.14	0.00	1569.14	76.04967545	11/1/1984 18:20	0.127
8.67	520	0.152	91.25	2645.57	0.0378	0.0000	0.0378	0.1142	1637.68	0.00	1637.68	91.24862698	11/1/1984 18:30	0.152
8.83	530	0.184	110.30	2755.87	0.0378	0.0000	0.0378	0.1460	1725.27	0.00	1725.27	110.2975133	11/1/1984 18:40	0.184
9.00	540	0.196	117.58	2873.45	0.0378	0.0000	0.0378	0.1581	1820.14	0.00	1820.14	117.5802183	11/1/1984 18:50	0.196
9.17	550	0.202	120.91	2994.35	0.0378	0.0000	0.0378	0.1637	1918.34	0.00	1918.34	120.9069794	11/1/1984 19:00	0.202
9.33	560	0.228	136.81	3131.16	0.0378	0.0000	0.0378	0.1902	2032.44	0.00	2032.44	136.8091982	11/1/1984 19:10	0.228
9.50	570	0.168	101.03	3232.20	0.0378	0.0000	0.0378	0.1305	2110.77	0.00	2110.77	101.0324817	11/1/1984 19:20	0.168
9.67	580	0.103	61.66	3293.86	0.0378	0.0000	0.0378	0.0649	2149.73	0.00	2149.73	61.66489707	11/1/1984 19:30	0.103
9.83	590	0.104	62.60	3356.46	0.0378	0.0000	0.0378	0.0665	2189.62	0.00	2189.62	62.60238865	11/1/1984 19:40	0.104
10.00	600	0.082	49.03	3405.49	0.0378	0.0000	0.0378	0.0439	2215.94	0.00	2215.94	49.03102999	11/1/1984 19:50	0.082
10.17	610	0.051	30.45	3435.94	0.0378	0.0000	0.0378	0.0129	2223.68	0.00	2223.68	30.44722397	11/1/1984 20:00	0.051
10.33	620	0.040	24.30	3460.24	0.0378	0.0000	0.0378	0.0026	2225.27	0.00	2225.27	24.29564605	11/1/1984 20:10	0.040
10.50	630	0.108	64.94	3525.18	0.0378	0.0000	0.0378	0.0704	2267.50	0.00	2267.50	64.93806144	11/1/1984 20:20	0.108
10.67	640	0.155	93.01	3618.18	0.0378	0.0000	0.0378	0.1172	2337.80	0.00	2337.80	93.00716016	11/1/1984 20:30	0.155
10.83	650	0.123	74.07	3692.25	0.0378	0.0000	0.0378	0.0856	2389.15	0.00	2389.15	74.06515819	11/1/1984 20:40	0.123
11.00	660	0.065	39.08	3731.33	0.0378	0.0000	0.0378	0.0273	2405.53	0.00	2405.53	39.08295923	11/1/1984 20:50	0.065
11.17	670	0.046	27.46	3758.79	0.0378	0.0000	0.0378	0.0079	2410.28	0.00	2410.28	27.4619378	11/1/1984 21:00	0.046
11.33	680	0.039	23.59	3782.38	0.0378	0.0000	0.0378	0.0015	2411.16	0.00	2411.16	23.588264	11/1/1984 21:10	0.039
11.50	690	0.013	7.86	3790.24	0.0131	0.0247	0.0378	0.0000	2396.32	0.00	2396.32	7.862754665	11/1/1984 21:20	0.013
11.67	700	0.028	17.09	3807.34	0.0285	0.0094	0.0378	0.0000	2390.70	0.00	2390.70	17.09446975	11/1/1984 21:30	0.028
11.83	710	0.058	34.68	3842.02	0.0378	0.0000	0.0378	0.0200	2402.68	0.00	2402.68	34.68408837	11/1/1984 21:40	0.058
12.00	720	0.043	26.07	3868.10	0.0378	0.0000	0.0378	0.0056	2406.04	0.00	2406.04	26.07374306	11/1/1984 21:50	0.043
12.17	730	0.039	23.24	3891.34	0.0378	0.0000	0.0378	0.0009	2406.58	0.00	2406.58	23.24202522	11/1/1984 22:00	0.039
12.33	740	0.037	22.30	3913.64	0.0372	0.0007	0.0378	0.0000	2406.17	0.00	2406.17	22.29811927	11/1/1984 22:10	0.037
12.50	750	0.012	7.43	3921.07	0.0124	0.0255	0.0378	0.0000	2390.89	0.00	2390.89	7.432706422	11/1/1984 22:20	0.012
12.67	760	0.004	2.48	3923.55	0.0041	0.0337	0.0378	0.0000	2370.66	0.00	2370.66	2.477568807	11/1/1984 22:30	0.004
12.83	770	0.001	0.83	3924.37	0.0014	0.0365	0.0378	0.0000	2348.78	0.00	2348.78	0.825856269	11/1/1984 22:40	0.001
13.00	780	0.000	0.28	3924.65	0.0005	0.0374	0.0378	0.0000	2326.35	0.00	2326.35	0.275285423	11/1/1984 22:50	0.000
13.17	790	0.000	0.09	3924.74	0.0002	0.0377	0.0378	0.0000	2303.73	0.00	2303.73	0.091761808	11/1/1984 23:00	0.000
13.33	800	0.024	14.62	3939.36	0.0244	0.0135	0.0378	0.0000	2295.64	0.00	2295.64	14.61933703	11/1/1984 23:10	0.024
13.50	810	0.057	34.09	3973.45	0.0378	0.0000	0.0378	0.0190	2307.02	0.00	2307.02	34.0881654	11/1/1984 23:20	0.057
13.67	820	0.068	40.65	4014.10	0.0378	0.0000	0.0378	0.0299	2324.96	0.00	2324.96	40.65246943	11/1/1984 23:30	0.068
13.83	830	0.047	28.21	4042.31	0.0378	0.0000	0.0378	0.0092	2330.47	0.00	2330.47	28.21426748	11/1/1984 23:40	0.047
14.00	840	0.016	9.40	4051.72	0.0157	0.0222	0.0378	0.0000	2317.17	0.00	2317.17	9.404755826	11/1/1984 23:50	0.016
14.17	850	0.005	3.13	4054.85	0.0052	0.0326	0.0378	0.0000	2297.59	0.00	2297.59	3.134918609	11/2/1984 0:00	0.005
14.33	860	0.002	1.04	4055.90	0.0017	0.0361	0.0378	0.0000	2275.93	0.00	2275.93	1.04497287	11/2/1984 0:10	0.002
14.50	870	0.001	0.35	4056.25	0.0006	0.0373	0.0378	0.0000	2253.57	0.00	2253.57	0.34832429	11/2/1984 0:20	0.001
14.67	880	0.000	0.12	4056.36	0.0002	0.0377	0.0378	0.0000	2230.98	0.00	2230.98	0.116108097	11/2/1984 0:30	0.000
14.83	890	0.025	14.74	4071.10	0.0246	0.0133	0.0378	0.0000	2223.01	0.00	2223.01	14.73888167	11/2/1984 0:40	0.025
15.00	900	0.057	34.35	4105.45	0.0378	0.0000	0.0378	0.0194	2234.65	0.00	2234.65	34.34965272	11/2/1984 0:50	0.057
15.17	910	0.068	40.96	4146.41	0.0378	0.0000	0.0378	0.0304	2252.90	0.00	2252.90	40.95885028	11/2/1984 1:00	0.068
15.33	920	0.047	28.43	4174.84	0.0378	0.0000	0.0378	0.0095	2258.62	0.00	2258.62	28.42540294	11/2/1984 1:10	0.047
15.50	930	0.040	24.28	4199.12	0.0378	0.0000	0.0378	0.0026	2260.19	0.00	2260.19	24.28313802	11/2/1984 1:20	0.040
15.67	940	0.063	37.75	4236.86	0.0378	0.0000	0.0378	0.0251	2275.23	0.00	2275.23	37.74555447	11/2/1984 1:30	0.063
15.83	950	0.046	27.43	4264.29	0.0378	0.0000	0.0378	0.0079	2279.95	0.00	2279.95	27.4250229	11/2/1984 1:40	0.046
16.00	960	0.015	9.14	4273.43	0.0152	0.0226	0.0378	0.0000	2266.38	0.00	2266.38	9.141674302	11/2/1984 1:50	0.015
16.17	970	0.005	3.05	4276.48	0.0051	0.0328	0.0378	0.0000	2246.72	0.00	2246.72	3.047224767	11/2/1984 2:00	0.005
16.33	980	0.002	1.02	4277.49	0.0017	0.0362	0.0378	0.0000	2225.03	0.00	2225.03	1.015741589	11/2/1984 2:10	0.002
16.50	990	0.001	0.34	4277.83	0.0006	0.0373	0.0378	0.0000	2202.66	0.00	2202.66	0.33858053	11/2/1984 2:20	0.001
16.67	1000	0.025	14.99	4292.82	0.0250	0.0129	0.0378	0.0000	2194.94	0.00	2194.94	14.9908217	11/2/1984 2:30	0.025
16.83	1010	0.033	19.87	4312.70	0.0331	0.0047	0.0378	0.0000	2192.10	0.00	2192.10	19.87490209	11/2/1984 2:40	0.033
17.00	1020	0.011	6.62	4319.32	0.0110	0.0268	0.0378	0.0000	2176.02	0.00	2176.02	6.624967362	11/2/1984 2:50	0.011
17.17	1030	0.078	47.05	4366.37	0.0378	0.0000	0.0378	0.0406	2200.36	0.00	2200.36	47.04725269	11/2/1984 3:00	0.078
17.33	1040	0.126	75.53	4441.91	0.0378	0.0000	0.0378	0.0880	2253.19	0.00	2253.19	75.53480112	11/2/1984 3:10	0.126
17.50	1050	0.142	85.43	4527.33	0.0378	0.0000	0.0378	0.1045	2315.91	0.00	2315.91	85.42859048	11/2/1984 3:20	0.142
17.67	1060	0.199	119.24	4646.57	0.0378	0.0000	0.0378	0.1609	2412.44	0.00	2412.44	119.2375802	11/2/1984 3:30	0.199
17.83	1070	0.193	115.78	4762.35	0.0378	0.0000	0.0378	0.1551	2505.50	0.00	2505.50	115.7754693	11/2/1984 3:40	0.193
18.00	1080	0.192	115.08	4877.43	0.0378	0.0000	0.0378	0.1540	2597.88	0.00	2597.88	115.0813695	11/2/1984 3:50	0.192
18.17	1090	0.192	115.15	4992.58	0.0378	0.0000	0.0378	0.1541	2690.32	0.00	2690.32	115.1488475	11/2/1984 4:00	0.192
18.33	1100	0.141	84.63	5077.21	0.0378	0.0000	0.0378	0.1032	2752.24	0.00	2752.24	84.63226049	11/2/1984 4:10	0.141
18.50	1110	0.073	43.66	5120.87	0.0378	0.0000	0.0378	0.0349	2773.19	0.00	2773.19	43.65612424	11/2/1984 4:20	0.073
18.67	1120	0.024	14.55	5135.42	0.0243	0.0136	0.0378	0.0000	2765.03	0.00	2765.03	14.55204141	11/2/1984 4:30	0.024
18.83	1130	0.034	20.32	5155.74	0.0339	0.0040	0.0378	0.0000	2762.65	0.00	2762.65	20.32459792	11/2/1984 4:40	0.034
19.00	1140	0.037	22.25	5177.99	0.0371	0.0008	0.0378	0.0000	2762.19	0.00	2762.19	22.24878343	11/2/1984 4:50	0.037
19.17	1150	0.012	7.42	5185.41	0.0124	0.0255	0.0378	0.0000	2746.90	0.00	2746.90	7.416261142	11/2/1984 5:00	0.012
19.33	1160	0.004	2.47	5187.88	0.0041	0.0337	0.0378	0.0000	2726.66	0.00	2726.66	2.472087047	11/2/1984 5:10	0.004
19.50	1170	0.183	109.92	5297.80										



21.00	1260	0.053	31.58	5903.22	0.0378	0.0000	0.0378	0.0148	3203.16	0.01	3194.29	22.70831289	11/2/1984 6:50	0.038	
21.17	1270	0.071	42.34	5945.55	0.0378	0.0000	0.0378	0.0327	3213.92	0.03	3194.29	22.70831289	11/2/1984 7:00	0.038	
21.33	1280	0.157	93.94	6039.50	0.0378	0.0000	0.0378	0.1187	3265.52	0.12	3194.29	22.7083129	11/2/1984 7:10	0.038	
21.50	1290	0.266	159.51	6199.00	0.0378	0.0000	0.0378	0.2280	3331.09	0.23	3194.29	22.7083129	11/2/1984 7:20	0.038	
21.67	1300	0.303	182.08	6381.09	0.0378	0.0000	0.0378	0.2656	3353.67	0.27	3194.29	22.70831289	11/2/1984 7:30	0.038	
21.83	1310	0.263	157.78	6538.86	0.0378	0.0000	0.0378	0.2251	3329.36	0.23	3194.29	22.70831289	11/2/1984 7:40	0.038	
22.00	1320	0.142	85.04	6623.90	0.0378	0.0000	0.0378	0.1039	3256.62	0.10	3194.29	22.70831289	11/2/1984 7:50	0.038	
22.17	1330	0.074	44.60	6668.51	0.0378	0.0000	0.0378	0.0365	3216.18	0.04	3194.29	22.7083129	11/2/1984 8:00	0.038	
22.33	1340	0.052	31.12	6699.63	0.0378	0.0000	0.0378	0.0140	3202.70	0.01	3194.29	22.7083129	11/2/1984 8:10	0.038	
22.50	1350	0.017	10.37	6710.00	0.0173	0.0206	0.0378	0.0000	3181.96	0.00	3181.96	10.37417343	11/2/1984 8:20	0.017	
22.67	1360	0.006	3.46	6713.46	0.0058	0.0321	0.0378	0.0000	3162.71	0.00	3162.71	3.458057809	11/2/1984 8:30	0.006	
22.83	1370	0.002	1.15	6714.61	0.0019	0.0359	0.0378	0.0000	3141.15	0.00	3141.15	1.152685936	11/2/1984 8:40	0.002	
23.00	1380	0.055	32.96	6747.57	0.0378	0.0000	0.0378	0.0171	3151.40	0.00	3151.40	32.95705328	11/2/1984 8:50	0.055	0.035437692
23.17	1390	0.100	59.88	6807.45	0.0378	0.0000	0.0378	0.0619	3188.57	0.00	3188.57	59.87572031	11/2/1984 9:00	0.100	0.064382495
23.33	1400	0.060	36.28	6843.72	0.0378	0.0000	0.0378	0.0226	3202.13	0.01	3194.29	28.43218661	11/2/1984 9:10	0.047	0.030572244
23.50	1410	0.543	325.78	7169.50	0.0378	0.0000	0.0378	0.5051	3497.36	0.51	3194.29	22.7083129	11/2/1984 9:20	0.038	0.024417541
23.67	1420	0.815	489.14	7658.64	0.0378	0.0000	0.0378	0.7774	3660.73	0.78	3194.29	22.70831289	11/2/1984 9:30	0.038	0.024417541
23.83	1430	0.579	347.56	8006.21	0.0378	0.0000	0.0378	0.5414	3519.14	0.54	3194.29	22.7083129	11/2/1984 9:40	0.038	0.024417541
24.00	1440	0.417	250.37	8256.58	0.0378	0.0000	0.0378	0.3794	3421.96	0.38	3194.29	22.70831289	11/2/1984 9:50	0.038	0.024417541
24.17	1450	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	3171.58	0.00	3171.58	0	11/2/1984 10:00	0.000	
24.33	1460	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	3148.87	0.00	3148.87	0	11/2/1984 10:10	0.000	
24.50	1470	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	3126.16	0.00	3126.16	0	11/2/1984 10:20	0.000	
24.67	1480	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	3103.46	0.00	3103.46	0	11/2/1984 10:30	0.000	
24.83	1490	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	3080.75	0.00	3080.75	0	11/2/1984 10:40	0.000	
25.00	1500	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	3058.04	0.00	3058.04	0	11/2/1984 10:50	0.000	
25.17	1510	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	3035.33	0.00	3035.33	0	11/2/1984 11:00	0.000	
25.33	1520	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	3012.62	0.00	3012.62	0	11/2/1984 11:10	0.000	
25.50	1530	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2989.91	0.00	2989.91	0	11/2/1984 11:20	0.000	
25.67	1540	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2967.21	0.00	2967.21	0	11/2/1984 11:30	0.000	
25.83	1550	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2944.50	0.00	2944.50	0	11/2/1984 11:40	0.000	
26.00	1560	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2921.79	0.00	2921.79	0	11/2/1984 11:50	0.000	
26.17	1570	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2899.08	0.00	2899.08	0	11/2/1984 12:00	0.000	
26.33	1580	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2876.37	0.00	2876.37	0	11/2/1984 12:10	0.000	
26.50	1590	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2853.67	0.00	2853.67	0	11/2/1984 12:20	0.000	
26.67	1600	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2830.96	0.00	2830.96	0	11/2/1984 12:30	0.000	
26.83	1610	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2808.25	0.00	2808.25	0	11/2/1984 12:40	0.000	
27.00	1620	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2785.54	0.00	2785.54	0	11/2/1984 12:50	0.000	
27.17	1630	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2762.83	0.00	2762.83	0	11/2/1984 13:00	0.000	
27.33	1640	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2740.12	0.00	2740.12	0	11/2/1984 13:10	0.000	
27.50	1650	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2717.42	0.00	2717.42	0	11/2/1984 13:20	0.000	
27.67	1660	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2694.71	0.00	2694.71	0	11/2/1984 13:30	0.000	
27.83	1670	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2672.00	0.00	2672.00	0	11/2/1984 13:40	0.000	
28.00	1680	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2649.29	0.00	2649.29	0	11/2/1984 13:50	0.000	
28.17	1690	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2626.58	0.00	2626.58	0	11/2/1984 14:00	0.000	
28.33	1700	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2603.87	0.00	2603.87	0	11/2/1984 14:10	0.000	
28.50	1710	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2581.17	0.00	2581.17	0	11/2/1984 14:20	0.000	
28.67	1720	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2558.46	0.00	2558.46	0	11/2/1984 14:30	0.000	
28.83	1730	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2535.75	0.00	2535.75	0	11/2/1984 14:40	0.000	
29.00	1740	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2513.04	0.00	2513.04	0	11/2/1984 14:50	0.000	
29.17	1750	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2490.33	0.00	2490.33	0	11/2/1984 15:00	0.000	
29.33	1760	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2467.62	0.00	2467.62	0	11/2/1984 15:10	0.000	
29.50	1770	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2444.92	0.00	2444.92	0	11/2/1984 15:20	0.000	
29.67	1780	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2422.21	0.00	2422.21	0	11/2/1984 15:30	0.000	
29.83	1790	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2399.50	0.00	2399.50	0	11/2/1984 15:40	0.000	
30.00	1800	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2376.79	0.00	2376.79	0	11/2/1984 15:50	0.000	
30.17	1810	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2354.08	0.00	2354.08	0	11/2/1984 16:00	0.000	
30.33	1820	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2331.37	0.00	2331.37	0	11/2/1984 16:10	0.000	
30.50	1830	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2308.67	0.00	2308.67	0	11/2/1984 16:20	0.000	
30.67	1840	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2285.96	0.00	2285.96	0	11/2/1984 16:30	0.000	
30.83	1850	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2263.25	0.00	2263.25	0	11/2/1984 16:40	0.000	
31.00	1860	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2240.54	0.00	2240.54	0	11/2/1984 16:50	0.000	
31.17	1870	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2217.83	0.00	2217.83	0	11/2/1984 17:00	0.000	
31.33	1880	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2195.12	0.00	2195.12	0	11/2/1984 17:10	0.000	
31.50	1890	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2172.42	0.00	2172.42	0	11/2/1984 17:20	0.000	
31.67	1900	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2149.71	0.00	2149.71	0	11/2/1984 17:30	0.000	
31.83	1910	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2127.00	0.00	2127.00	0	11/2/1984 17:40	0.000	
32.00	1920	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2104.29	0.00	2104.29	0	11/2/1984 17:50	0.000	
32.17	1930	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2081.58	0.00	2081.58	0	11/2/1984 18:00	0.000	
32.33	1940	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2058.87	0.00	2058.87	0	11/2/1984 18:10	0.000	
32.50	1950	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	2036.17	0.00	2036.17	0	11/2/1984 1		



34.00	2040	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1831.79	0.00	1831.79	0	11/2/1984 19:50	0.000
34.17	2050	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1809.08	0.00	1809.08	0	11/2/1984 20:00	0.000
34.33	2060	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1786.37	0.00	1786.37	0	11/2/1984 20:10	0.000
34.50	2070	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1763.67	0.00	1763.67	0	11/2/1984 20:20	0.000
34.67	2080	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1740.96	0.00	1740.96	0	11/2/1984 20:30	0.000
34.83	2090	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1718.25	0.00	1718.25	0	11/2/1984 20:40	0.000
35.00	2100	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1695.54	0.00	1695.54	0	11/2/1984 20:50	0.000
35.17	2110	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1672.83	0.00	1672.83	0	11/2/1984 21:00	0.000
35.33	2120	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1650.12	0.00	1650.12	0	11/2/1984 21:10	0.000
35.50	2130	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1627.42	0.00	1627.42	0	11/2/1984 21:20	0.000
35.67	2140	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1604.71	0.00	1604.71	0	11/2/1984 21:30	0.000
35.83	2150	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1582.00	0.00	1582.00	0	11/2/1984 21:40	0.000
36.00	2160	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1559.29	0.00	1559.29	0	11/2/1984 21:50	0.000
36.17	2170	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1536.58	0.00	1536.58	0	11/2/1984 22:00	0.000
36.33	2180	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1513.87	0.00	1513.87	0	11/2/1984 22:10	0.000
36.50	2190	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1491.17	0.00	1491.17	0	11/2/1984 22:20	0.000
36.67	2200	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1468.46	0.00	1468.46	0	11/2/1984 22:30	0.000
36.83	2210	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1445.75	0.00	1445.75	0	11/2/1984 22:40	0.000
37.00	2220	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1423.04	0.00	1423.04	0	11/2/1984 22:50	0.000
37.17	2230	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1400.33	0.00	1400.33	0	11/2/1984 23:00	0.000
37.33	2240	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1377.62	0.00	1377.62	0	11/2/1984 23:10	0.000
37.50	2250	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1354.92	0.00	1354.92	0	11/2/1984 23:20	0.000
37.67	2260	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1332.21	0.00	1332.21	0	11/2/1984 23:30	0.000
37.83	2270	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1309.50	0.00	1309.50	0	11/2/1984 23:40	0.000
38.00	2280	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1286.79	0.00	1286.79	0	11/2/1984 23:50	0.000
38.17	2290	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1264.08	0.00	1264.08	0	1/0/1900 0:00	0.000
38.33	2300	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1241.37	0.00	1241.37	0	1/0/1900 0:00	0.000
38.50	2310	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1218.67	0.00	1218.67	0	1/0/1900 0:00	0.000
38.67	2320	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1195.96	0.00	1195.96	0	1/0/1900 0:00	0.000
38.83	2330	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1173.25	0.00	1173.25	0	1/0/1900 0:00	0.000
39.00	2340	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1150.54	0.00	1150.54	0	1/0/1900 0:00	0.000
39.17	2350	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1127.83	0.00	1127.83	0	1/0/1900 0:00	0.000
39.33	2360	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1105.12	0.00	1105.12	0	1/0/1900 0:00	0.000
39.50	2370	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1082.42	0.00	1082.42	0	1/0/1900 0:00	0.000
39.67	2380	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1059.71	0.00	1059.71	0	1/0/1900 0:00	0.000
39.83	2390	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1037.00	0.00	1037.00	0	1/0/1900 0:00	0.000
40.00	2400	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	1014.29	0.00	1014.29	0	1/0/1900 0:00	0.000
40.17	2410	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	991.58	0.00	991.58	0	1/0/1900 0:00	0.000
40.33	2420	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	968.88	0.00	968.88	0	1/0/1900 0:00	0.000
40.50	2430	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	946.17	0.00	946.17	0	1/0/1900 0:00	0.000
40.67	2440	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	923.46	0.00	923.46	0	1/0/1900 0:00	0.000
40.83	2450	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	900.75	0.00	900.75	0	1/0/1900 0:00	0.000
41.00	2460	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	878.04	0.00	878.04	0	1/0/1900 0:00	0.000
41.17	2470	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	855.33	0.00	855.33	0	1/0/1900 0:00	0.000
41.33	2480	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	832.63	0.00	832.63	0	1/0/1900 0:00	0.000
41.50	2490	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	809.92	0.00	809.92	0	1/0/1900 0:00	0.000
41.67	2500	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	787.21	0.00	787.21	0	1/0/1900 0:00	0.000
41.83	2510	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	764.50	0.00	764.50	0	1/0/1900 0:00	0.000
42.00	2520	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	741.79	0.00	741.79	0	1/0/1900 0:00	0.000
42.16	2530	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	719.08	0.00	719.08	0	1/0/1900 0:00	0.000
42.33	2540	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	696.38	0.00	696.38	0	1/0/1900 0:00	0.000
42.50	2550	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	673.67	0.00	673.67	0	1/0/1900 0:00	0.000
42.66	2560	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	650.96	0.00	650.96	0	1/0/1900 0:00	0.000
42.83	2570	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	628.25	0.00	628.25	0	1/0/1900 0:00	0.000
43.00	2580	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	605.54	0.00	605.54	0	1/0/1900 0:00	0.000
43.16	2590	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	582.83	0.00	582.83	0	1/0/1900 0:00	0.000
43.33	2600	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	560.13	0.00	560.13	0	1/0/1900 0:00	0.000
43.50	2610	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	537.42	0.00	537.42	0	1/0/1900 0:00	0.000
43.66	2620	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	514.71	0.00	514.71	0	1/0/1900 0:00	0.000
43.83	2630	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	492.00	0.00	492.00	0	1/0/1900 0:00	0.000
44.00	2640	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	469.29	0.00	469.29	0	1/0/1900 0:00	0.000
44.16	2650	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	446.58	0.00	446.58	0	1/0/1900 0:00	0.000
44.33	2660	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	423.88	0.00	423.88	0	1/0/1900 0:00	0.000
44.50	2670	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	401.17	0.00	401.17	0	1/0/1900 0:00	0.000
44.66	2680	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	378.46	0.00	378.46	0	1/0/1900 0:00	0.000
44.83	2690	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	355.75	0.00	355.75	0	1/0/1900 0:00	0.000
45.00	2700	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	333.04	0.00	333.04	0	1/0/1900 0:00	0.000
45.16	2710	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	310.33	0.00	310.33	0	1/0/1900 0:00	0.000
45.33	2720	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	287.63	0.00	287.63	0	1/0/1900 0:00	0.000
45.50	2730	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	264.92	0.00	264.92	0	1/0/1900 0:00	0.000
45.66	2740	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	242.21	0.00	242.21	0	1/0/1900 0:00	0.000
45.83	2750	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	219.50	0.00	219.50	0	1/0/1900 0:00	0.000
46.00	2760	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	196.79	0.00	196.79	0	1/0/1900 0:00	0.000
46.16	2770	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	174.08	0.00	174.08	0	1/0/1900 0:00	0.000



47.00	2820	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	60.54	0.00	60.54	0	1/0/1900 0:00	0.000
47.16	2830	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	37.83	0.00	37.83	0	1/0/1900 0:00	0.000
47.33	2840	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	15.13	0.00	15.13	0	1/0/1900 0:00	0.000
47.50	2850	0.000	0.00	8256.58	0.0000	0.0378	0.0378	0.0000	-7.58	0.00	0.00	0	1/0/1900 0:00	0.000
47.66	2860	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
47.83	2870	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.00	2880	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.16	2890	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.33	2900	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.50	2910	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.66	2920	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
48.83	2930	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.00	2940	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.16	2950	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.33	2960	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.50	2970	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.66	2980	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
49.83	2990	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.00	3000	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.16	3010	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.33	3020	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.50	3030	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.66	3040	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
50.83	3050	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
51.00	3060	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000
51.16	3070	0.000	0.00	8256.58	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0	1/0/1900 0:00	0.000

