# APPENDIX E

# SWMM MODEL CALIBRATION

## 1. CALIBRATION STORM SELECTION

As discussed in the main body of the report, rainfall and stream depth data were available for various periods in 2005 and 2006 to calibrate the flow portion of the models. The rainfall record and water level data availability were analyzed to determine potential target storms for calibration and verification. In order for the model to function properly over a wide range of storm conditions, calibration and verification storms were selected that featured both long duration - moderate intensity rainfall and short duration - high intensity rainfall. Storms of longer duration and lower intensity are considered pervious-dominated storms. The relatively slow and steady rainfall allows for significant infiltration, thus the model parameters related to pervious areas and infiltration like soils and initial moisture deficit have a significant influence on the model results. Conversely, storms of short duration and high intensity (e.g. thunderstorms) are considered impervious-dominated as the runoff flows quickly over the basin surfaces allowing less infiltration. Thus, the model parameters related to impervious surfaces such as percent impervious, watershed width and slope are more important.

Storm characteristics were reviewed for a number of storms for which the data loggers were functioning The nature of the rainfall and the flow response were evaluated. After this analysis, the June 27, 2005 storm was selected for calibration of the watershed. Two validation storms were selected July 13, 2005 and June 3, 2005. For the Black Creek sub-watershed, equipment malfunctions limited data from this period. For this sub-watershed, the May 11, 2006 storm was selected for calibration and the July 2, 2006 was selected for verification. Table E-1 provides details on the rainfall and intensity for the selected storms.

**Table E-1: Details of Selected Storms**

| | Model Process | Date | Rainfall/Duration | Average Intensity | Storm Type |
|---|---|---|---|---|---|
| Hydrology - (except Blk Crk) | Calibration | 6/27/2005 | 1.27 in., 18 hrs | 0.07 in/hr | Pervious dominated |
| | Validation | 7/13/2005 | 0.42 ins, 1 hr | 0.42 in/hr | Impervious dominated |
| | Validation | 6/3/2005 | 1.2 ins, 26 hrs | 0.05 in/hr | Pervious dominated |
| Hydrology - Blk Crk Sub-Basin | Calibration | 5/11/2006 | 1.11 ins, 6 hrs | 0.19 in/hr | Pervious dominated |
| | Validation | 7/2/2006 | 0.99 ins, 1 hr | 0.99 in/hr | Impervious dominated |
| Water Quality | Calibration | 10/17/2006 | 1.08 ins, 11.8 hrs | 0.09 in/hr | Pervious dominated |

## 2. FLOW CALIBRATION

For each storm event, rainfall data was input into the SWMM Runoff Module to generate flow and quality from each sub-watershed. The runoff results were then routed through the various streams and ponds of the watershed, using the Transport Module. For flow, calibration was an iterative process in which the flow hydrograph (a graph of flow vs. time) in which the modeled results were compared with observed flows. If necessary, the model parameters were modified and the model was re-run until the model output adequately matches the field data.

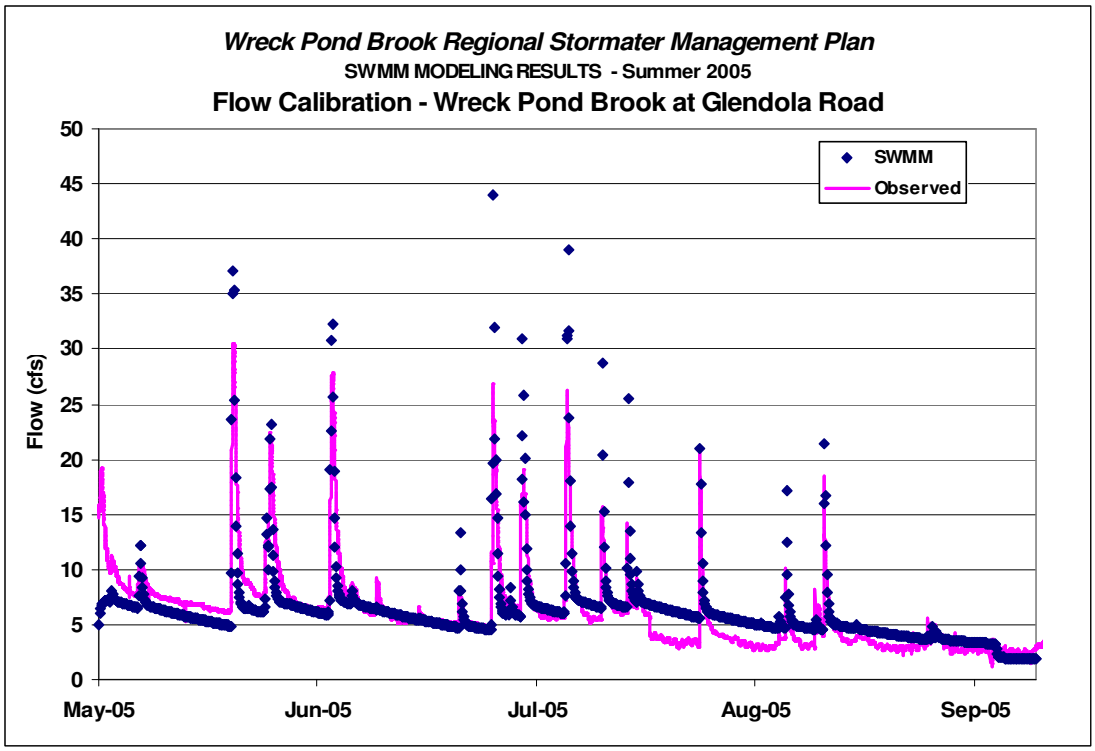
During calibration process, only a limited number of parameters were considered important for any particular sub-watershed. Overall, these parameters were: sub-basin width, connected impervious percentage, watershed slope, groundwater flow coefficient, initial upper zone moisture and stream Manning's roughness coefficient.

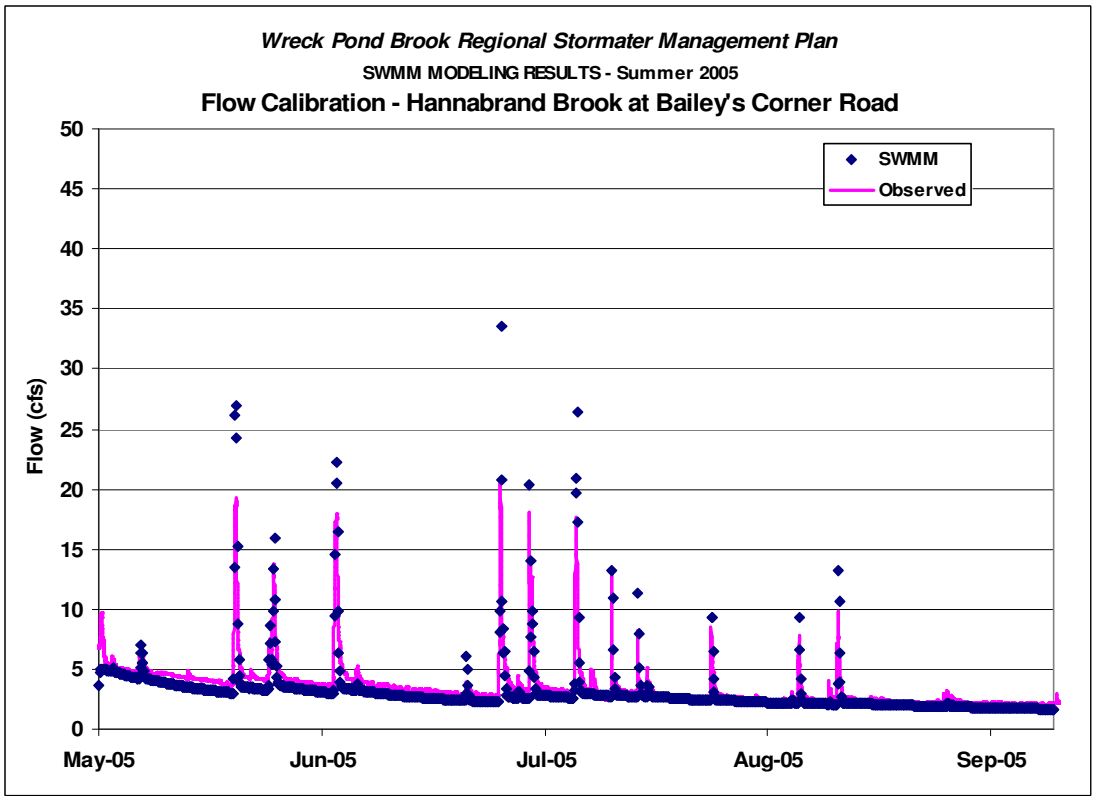
The calibration process was performed one sub-watershed at a time, for the six sub-watersheds for which flow data was deemed suitable for calibration. Calibration was complete when the flow data acceptably matched the field data flow hydrograph and volume.

Once the hydraulic and hydrologic portion of the model was calibrated, validation of the model was performed using both a pervious dominated and impervious dominated storm event. Adjustments based on both model validation runs were then made to the original calibration run, and tolerances between modeled results and in-field data for all three (3) events were checked. Overall, parameter adjustments were simultaneously made to all three (3) model simulations until acceptable tolerances for the objective functions were met for the three (3) storm events. This process was conducted for all six (6) calibrated sub-basins.

As previously stated, the calibration and verification period was the summer of 2005. The Figures below provide graphs of flow over time for that period for two calibration stations, demonstrating that the model fits the data within expected range. A similar process was followed for the Black Creek sub-watershed. However, due to the lack of flow data in 2005, two storms in 2006 were used. Flow data were not available for the other stations for 2006. The model was adapted to all sub-watersheds so that the generated flow output simulates the expected flows at the most downstream stations.

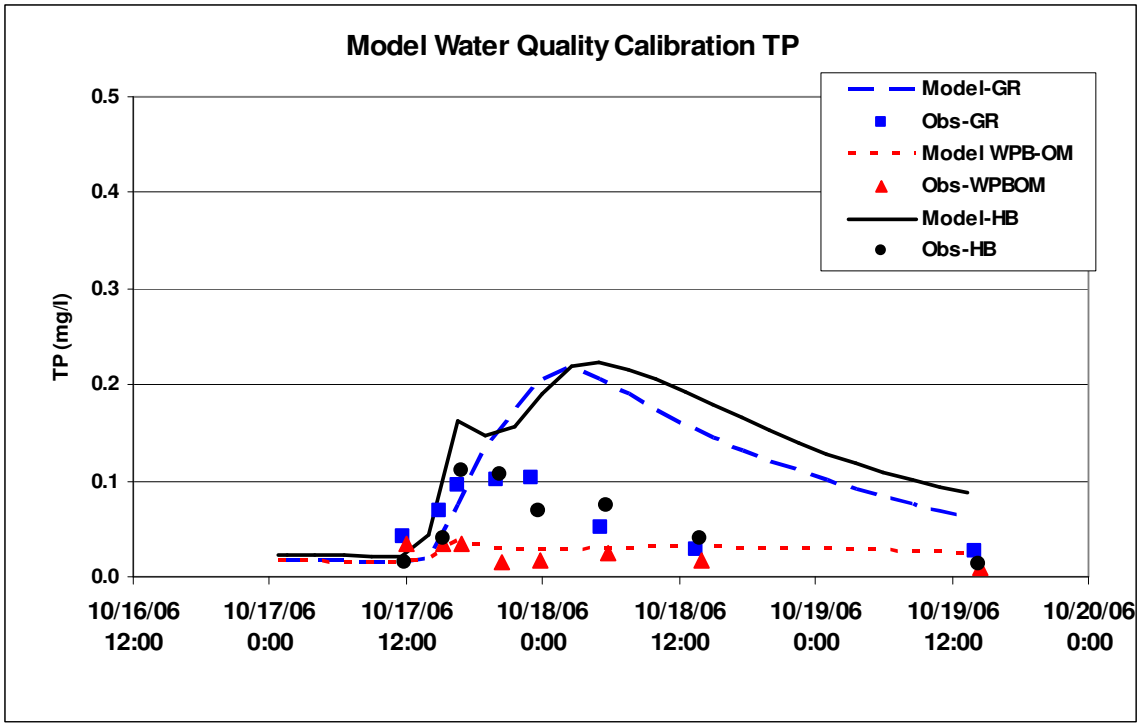
As limited data was available for the numerous ponds within the watershed, a number of assumptions were required during model development. Assumptions were made concerning: the dam discharge characteristics, general pond geometry and average pond depth. Also due to limited groundwater information throughout the watershed, some assumptions were required with regard to aquifer depth, water table elevations and stream stage elevations. It is suggested that future studies gather information regarding both of these topics.

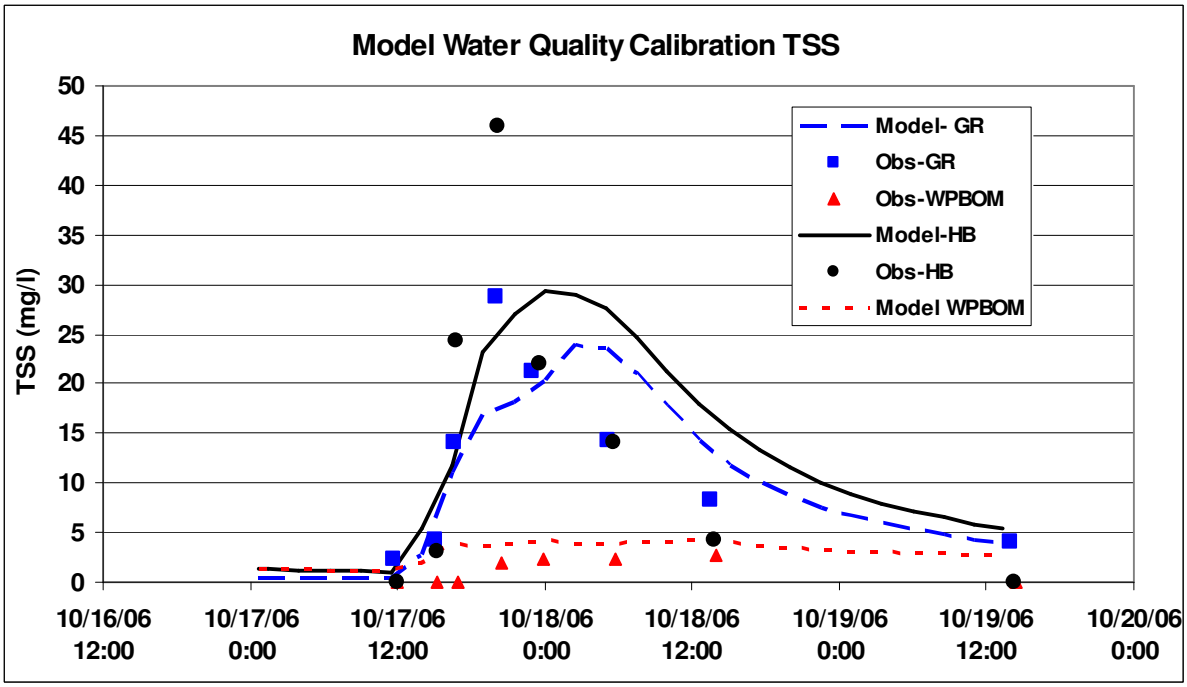

Wreck Pond Brook Regional Stormater Management Plan
SWMM MODELING RESULTS - Summer 2005
Flow Calibration - Wreck Pond Brook at Glendola Road
SWMM
Observed
Flow (cfs)
50
45
40
35
30
25
20
15
10
5
0
May-05
Jun-05
Jul-05
Aug-05
Sep-05

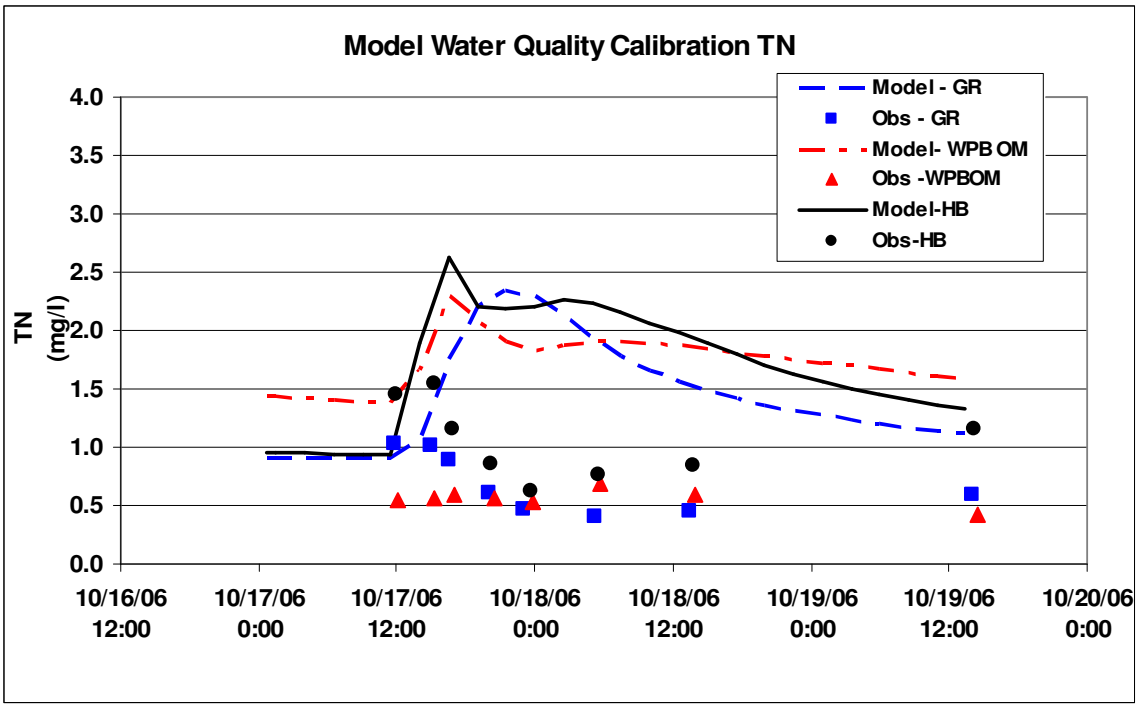

Wreck Pond Brook Regional Stormater Management Plan
SWMM MODELING RESULTS - Summer 2005
Flow Calibration - Hannabrand Brook at Bailey's Corner Road
SWMM
Observed
Flow (cfs)
50
45
40
35
30
25
20
15
10
5
0
May-05
Jun-05
Jul-05
Aug-05
Sep-05

## 3. WATER QUALITY CALIBRATION

The water quality calibration process was conducted for the October 16-19 2006 storm as discussed in the main body of this report. Calibration plots are as shown.




Model Water Quality Calibration TN
Model - GR
Obs - GR
Model- WPB OM
Obs -WPBOM
Model-HB
Obs-HB
TN (mg/l)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
10/16/06 12:00
10/17/06 0:00
10/17/06 12:00
10/18/06 0:00
10/18/06 12:00
10/19/06 0:00
10/19/06 12:00
10/20/06 0:00